ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

ECO-CITY PLANNING AND DESIGN CRITERIA – ASSESSMENT OF KOCAKIR, ESKİŞEHİR PROJECT

M.Sc. THESIS

Nigar ALIYEVA

Department of Urban and Regional Planning

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DECEMBER 2019

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Nigar ALIYEVA
(502161816)

Department of Urban and Regional Planning

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Thesis Advisor: Prof. Dr. Handan TÜRKOĞLU

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EKO-KENT PLANLAMA VE TASARIM KRİTERLERİ – KOCAKIR, ESKİŞEHİR PROJE DEĞERLENDİRMESİ

YÜKSEK LİSANS TEZİ

Nigar ALİYEVA
(502161816)

Şehir ve Bölge Planlama Anabilim Dalı

Şehir Planlama Programı

Tez Danışmanı: Prof. Dr. Handan TÜRKOĞLU

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Nigar Aliyeva, a M.Sc. student of ITU Graduate School of Science Engineering and Technology student ID 502161816, successfully defended the thesis/dissertation entitled "ECO-CITY PLANNING AND DESIGN CRITERIA – ASSESSMENT OF KOCAKIR, ESKİŞEHİR PROJECT", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor :	**Prof. Dr. Handan TÜRKOĞLU** Istanbul Technical University	.....
Jury Members :	**Prof. Dr. Fatih TERZİ** Istanbul Technical University	.....
	Lecturer. Dr. Gökçer OKUMUŞ Istanbul Commerce University	.....

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To my family,

FOREWORD

First of all, I would like to thank my supervisor Prof. Dr. Handan TÜRKOĞLU for sharing her knowledge and experience with me during the thesis study process.

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December 2019

Nigar ALIYEVA
(Architect)

TABLE OF CONTENTS

Page

ABBREVIATIONS

EB	**:** Ecocity Builders
EC	**:** European Commission
EIA	**:** Environmental Impact Assessment
IEC	**:** International Electrotechnical Commission
IEFS	**:** International Ecocity Framework and Standards
IES	**:** International Ecocity Standards
IPCC	**:** Intergovernmental Panel on Climate Change
IPHA	**:** The International Passive House Association
ISO	**:** International Organization for Standardization
UN	**:** United Nations
UNCED	**:** United Nations Conference on Environment and Development
S.U.S.I.	**:** Self-organised Independent Settlement Initiative
OECD	**:** Organisation for Economic Co-operation and Development
WCED	**:** World Comission on Environment and Development
WHO	**:** World Health Organization

LIST OF TABLES

Page

LIST OF FIGURES

Page

ECO-CITY PLANNING AND DESIGN CRITERIA – ASSESSMENT OF KOCAKIR, ESKİŞEHİR PROJECT

SUMMARY

According to scientists, irreversible environmental damage to the planet is the result of human activities. The world population is growing rapidly, and according to scientific estimates, by the end of the first half of the 21st century, more than two-thirds of the total world population will be living in urban areas. Although cities have advantages such as social life, work and education opportunities, they also require the widespread use of natural raw materials and fossil fuels, create environmental and noise pollution, and cannot meet the expectations of the population due to socio-economic problems. In recent years, it has become increasingly common to analyze the negative effects of nature and environment on living organisms and to find solutions to these problems. In this respect, the concept of sustainability, which came up with the Brundtland report in 1987, emerged as a theoretical way of securing the livable future of cities in the world.

Reducing environmental problems as a result of human activities in cities is possible by ensuring the sustainability of that city. However, it is known that only the environmental aspects are no longer sufficient and a more balanced relationship between the environmental, social and economic dimensions of sustainability should be established. For this reason, various sustainable city concepts have been developed and although they have different goals and strategies, their purpose is to ensure urban sustainability by creating a healthier, safer and more livable city. In this study which main subject is eco-cities, firstly the history and development of the concept of sustainability, the place and importance of urban sustainability in this concept are explained, then the concepts of compact city, slow city and smart city which are sustainable city concepts will be analyzed and how sustainability is reflected in these cities will be explained. Smart cities provide sustainability by using technology, compact cities preserving farmland and preventing urban expansion, and slow cities preserving cultural values. Apart from these urban approaches, eco-cities have a wider scope and thus achieve sustainability by using technology, achieving compact development and preserving natural values.

The concept of eco-city, which has been proposed as a model both in the planning of new settlements and in the transformation of cities, has emerged as a response to the ever-changing environmental, social and economic problems that characterize them. It is seen that eco-city criteria are uncertain and change according to performance indicators developed by various countries and institutions such as Eco-City Framework and Standards, European Green City Index, Eco-City Project, Reference Framework for Sustainable Cities, Urban Sustainability Indicators. Within the scope of the study, eco-city planning and design criteria were determined as ecological, spatial and socio-economic and the objectives and contribution of each to the eco-cities will be explained based on the indicators of these institutions and literature review.

In this direction, the objectives and indicators such as renewable energy and its contribution to environment, its contribution to the ecosystem by preserving and increasing biodiversity, reuse of urban wastes and obtaining energy, increasing the quality and preservation of air, water and soil management are determined within the scope of ecological criteria. In the context of spatial criteria, the importance of choosing the right area for eco-cities was emphasized at first, to reduce vehicle dependence by providing compact urban form and to shorten the walking distances, to provide sustainable transportation system, to obtain energy by designing sustainable green buildings and structures, to increase urban open spaces and green spaces. It is explained that it has an important place not only in spatial but also in ecological, economic and social development of eco-cities. Eco-city planning should not be limited to ecological and spatial criteria but should be planned with a focus on people and society. As social-economic criteria, social justice, equality, adequate education and health institutions, improvement of air quality, increasing the quality of urban life by creating safe living spaces, ensuring the participation of the right and developing strategies that will contribute to the economy of the city should be developed. For a successful eco-city project, it should be planned by providing public participation in the planning and design process and by providing environmental education to the public. Within the framework of these criteria, an evaluation table has been established with parameters, targets and indicators.

The eco-city project was first planned in China, and spread throughout the world. Although not all of them implemented, more than 150 eco-city projects which most of them in Asia and Europe have been planned so far. In this study, 4 eco-city projects - Dongtan, Vauban, Bo01 and Eco-Viikki projects were examined, 3 of which were implemented. These samples were evaluated within the scope of the table created based on the literature review and common and different characteristics were determined. Although it is understood from the examples of the world that eco-cities are the main planning criteria, it varies according to the socio-economic situation, climate conditions, legal infrastructure and technological progress of the country and it is seen that a local ecological city is planned for each country.

In the fourth part of this study was to examine how the concept of sustainability in Turkey is developed on a national scale and how eco-cities are handled legally. Despite the increasing number of eco-cities in Europe but this situation doesn't seem as same in Turkey. Although various projects have been carried out on the subject, none of them have been implemented yet, only projects on a building scale have been implemented. For this reason, in the study, the ecological settlement project planned for Kocakır Reserve Building Area in Eskişehir was selected as the sample area according to the agreement signed between the Ministry of Environment and Urbanization and Istanbul Technical University. By examining the plan reports of the project, the eco-city planning and design criteria determined within the scope of the thesis are explained under separate headings and it is analyzed whether these criteria are met or not. In addition, taking into consideration of Turkey legal framework the conformity assessment of the project will be done in this context.

According to the evaluation results, although some criteria are not met or lacking in Kocakır project, it is seen that it meets most criteria in terms of ecological and spatial in general, but lags behind as socio-economic criteria. In compliance with legal framework conformity assessment some of the strategies which are not in Turkey legislation, but are required for the eco-city planning considered in the projects.

EKO-KENT PLANLAMA VE TASARIM KRİTERLERİ: KOCAKIR, ESKİŞEHİR PROJE DEĞERLENDİRMESİ

ÖZET

Bilim insanlarına göre gezegene yapılan ve geri dönüşü olmayan çevresel zarar insan faaliyetlerinin sonucudur. Dünya nüfusu hızla büyüyor ve bilimsel tahminlere göre 21. yüzyılın ilk yarısının sonuna kadar, toplam dünya nüfusunun üçte ikisinden fazlası kentsel alanlarda yaşıyor olacak. Kentlerin sosyal yaşam, iş ve eğitim olanakları gibi avantajları olsa da diğer yandan hem doğal hammadde ve fosil yakıtların yaygın olarak kullanılmasını gerektirmekte, çevre ve gürültü kirliliği yaratmakta, hem de yaranan sosyo-ekonomik sorunlar nedeniyle nüfusun beklentilerini karşılayamamaktadır. Son yıllarda doğa ve çevrenin canlılara olan olumsuz etkilerini araştırmak ve bu araştırmalar doğrultusunda sorunlara çözüm üretmek giderek yaygınlaşmıştır. Bu doğrultuda 1987 yılında Brundtland raporuyla gündeme gelen sürdürülebilirlik kavramı dünyadaki şehirlerin yaşanabilir geleceğini güvence altına almanın teorik bir yolu olarak ortaya çıkmıştır.

Ortak yaşam alanı olan kentlerde insan faaliyetlerinin sonucu olan çevresel sorunları azaltmak o kentin sürdürülebilirliğini sağlamakla mümkündür. Ama sadece çevresel yönün artık yeterli olmadığı, sürdürülebilirliğin çevresel, sosyal ve ekonomik boyutları arasında daha dengeli bir ilişki kurulması gerektiği bilinmektedir. Bu nedenle çeşitli sürdürülebilir kent kavramları geliştirilmiş, farklı hedef ve stratejileri olmasına rağmen hepsinin tek amacı daha sağlıklı, daha güvenli ve daha yaşanabilir bir kent oluşturarak kentsel sürdürülebilirliği sağlamaktır. Ana konusu eko-kentler olan bu çalışmada ilk olarak sürdürülebilirlik kavramının tarihi ve gelişimi, kentsel sürdürülebilirliğin bu kavramdaki yeri ve önemi açıklandıktan sonra sürdürülebilir kent konseptleri olan kompakt kent, yavaş kent ve akıllı kent kavramları incelenerek bu kentlerde sürdürülebilirliğin mekana nasıl yansıtıldığı aktarılacaktır. Akıllı şehirler teknolojiyi kullanarak, kompakt şehirler tarım alanlarını koruyarak ve kentsel yayılmayı önleyerek, yavaş şehirler ise kültürel değerleri koruyarak sürdürülebilirliği sağlamaktadır. Bu kent yaklaşımlarından faklı olarak eko-kentler daha geniş bir kapsama sahip olmakla hem teknolojiyi kullanarak, hem kompakt gelişmeyi sağlayarak, hem de doğal değerleri koruyarak sürdürülebilirliğe erişmektedir.

Hem yeni yerleşim alanlarının planlanmasında hem de şehirlerin dönüşümünde bir model olarak önerilen eko-kent kavramı, aslında kendilerini karakterize eden ve sürekli değişen çevresel, sosyal ve ekonomik sorunlara bir cevap olarak ortaya çıkmıştır. Eko-kent genel olarak, ekolojik olarak sağlıklı kentlerin meydana gelmesi olarak tanımlanabilir. Eko-kent modelinde yapı tasarımında yerel malzemenin kullanılması, ekolojik kentsel tasarımın ön planda tutulması, meyve sebze bahçeciliğinin desteklenmesi, ulaşımda yürüyüş, bisiklet ve toplu taşıma araçlarının tercih edilmesi, gelecek nesilleri düşünen bir kent modeli olması bakımından önem taşıyan uygulamalardır. Geniş anlamıyla eko-kentler yalnızca çevresel bir zorunluluk değil, aynı zamanda gelecekteki ekonomik gelişme ve hızlı kentleşmenin anahtarı olarak bilinmektedir. Bunun arkasında şehirlerin sera gazı emisyonları üretmedeki rolünün ve iklim değişikliği etkilerinin potansiyel olarak adapte edilmesine yönelik bir

alan olarak kabul edilmesi, kentsel nüfusun hızla artması, yeşil ekonominin ortaya çıkışı yatmaktadır. Bu faktörlere yanıt olarak geliştirilen eko-kent kavramının 3 ana formu: mevcut kentsel alanın dönüştülerek güçlendirilmesi, tamamen sıfırdan inşa edilerek ve çevre dostu özelliklere ve uygulamalara sahip olan mevcut kentin genişlemesi şeklinde planlaması mümkündür.

Eko-Kent Çerçevesi ve Standartları, Avrupa Yeşil Şehir Endeksi, Eko-Kent Projesi, Sürdürülebilir Kentler İçin Referans Çerçeve, Kensel Sürdürülebilirlik Göstergeleri gibi çeşitli ülkeler ve kurumlar tarafından geliştirilen performans göstergelerine göre eko-kent kriterlerinin belirsiz olduğu ve değiştiği görülmektedir. Çalışma kapsamında bu kurumların belirlediği göstergelerden ve literatür taramasından yola çıkarak eko-kent planlama ve tasarım kriterleri ekolojik, mekansal ve sosyo-ekonomik olarak belirlenmiş, her birinin hedefleri ve eko-kentlere olan katkısı açıklanmıştır.

Ekolojik kent kavramını ilk kez kullanan Register'a göre o zamana kadar eko-kentlere rastlanmamıştır. Eko-kent kavramının kullanıldığı günden beri akademide büyük ilgi görmeye başlamış, kentlerin politikalarını olumlu yönde etkilemiştir. Bir eko-kentin temel özellikleri: doğal kent olarak planlanması, iklime uygun hale getirilmesi, çevre kirliliğinin önlenmesi, doğal varlıkların ve biyoçeşitliliğin korunması, yağmur sularının tekrardan kullanılması, ısıtma, soğutma ve ulaşımda yenilenebilir enerji kaynaklarının kullanılması, katı atıkların geri dönüşümünün sağlanması, ekolojik mimarinin ve ileri teknolojinin kullanımı, yerel halkın ekolojik eğitimlerle bilinçlendirilmesi olarak bilinmektedir.

Eko-kentlerin en temel özelliği çevre koruma politikalarının mekansal planlamasıyla entegre edilmesidir. Karbon atıklarından kurtulmak, enerjiyi tamamen yenilenebilir kaynaklardan sağlamak ve doğayı kentle bütünleştirerek yeşil bir kent olarak yeniden yaratmak eko-kent planlamak demektir. Bu doğrultuda ekolojik kriterler kapsamında yenilenebilir enerji ve çevreye olan katkısı, biyolojik çeşitlilik korunarak ve artırılarak ekosisteme olan katkısı, kentsel atıkların yeniden değerlendirilerek kullanımının sağlanması ve enerji elde edilmesi, hava, su ve toprak yönetimi sağlanarak kalitesinin artırılması ve korunması gibi hedef ve göstergeler belirlenmiştir.

Mekansal kriterler bağlamında ilk başta eko-kentler için doğru alan seçiminin önemi vurgulanmış, kompakt kentsel form sağlanarak araç bağımlığını azaltmak ve yürüme mesafelerinin kısaltılması, sürdürülebilir ulaşım sisteminin sağlanması, sürdürülebilir yeşil bina ve yapıların tasarlanarak enerji elde edilmesi, kentsel açık alanların ve yeşil alanların artırılması hedefleri sadece mekansal değil hem ekolojik, hem ekonomik, hem de sosyal olarak eko-kentlerin gelişmesinde önemli yere sahip olduğu açıklanmıştır. Eko-kent planlaması sadece ekolojik ve mekansal kriterlerle sınırlı kalmayıp, insan ve toplum odaklı planlanmalıdır.

Sosyo-ekonomik kriter olarak sosyal adalet, eşitlik, yeterli eğitim ve sağlık kuruluşları, hava kalitesinin iyileştirilmesi, güvenli yaşam alanları oluşturarak kentsel yaşam kalitesinin artırılması, haklın katılımının sağlanması ve kentin ekonomisine katkı sağlayacak stratejilerin geliştirilmiş olması gerkmektedir. Başarılı bir eko-kent projesi için planlama ve tasarım sürecine halkın katılımı sağlanarak ve halka çevre ile ilgili eğitim verilerek planlanmalıdır. Araştırılan bu kriterler çerçevesinde parametreler, hedefler ve göstergeler olmakla değerlendirme tablosu oluşturulmuştur.

Eko-kent projesi ilk olarak Çinde tasarlanmış, giderek tüm dünyaya yayılmıştır. Şimdiye kadar çoğunluğu Asya ve Avrupada olmak üzere tamamı uygulanmamış olsa da 150'den fazla eko-kent projesi yapılmıştır. Bu çalışmada 3'ü uygulanmış olmakla 4 eko-kent projesi – Dongtan, Vauban, Bo01 ve Eko-Viikki projeleri incelenmiştir. İncelenen bu örneklerin litaratür taramasından yola çıkarak oluşturulan tablo kapsamında değerlendirilmesi yapılmış, ortak ve farklı özellikleri belirlenmiştir.

Dünya örneklerinden de anlaşıldığı üzere eko-kentlerin başlıca planlama kriterleri olsa da ülkenin sosyo-ekonomik durumuna, iklim koşullarına, yasal altyapısına ve teknolojik ilerlemelerine göre değişiklik göstermekte, her bir ülke için yerele özel ekolojik kent planlandığı görülmektedir.
5 bölümden oluşan tezin 4. bölümünde sürdürülebilirlik kavramının Türkiye'de ulusal ölçekte nasıl geliştiği ve eko-kentlerin yasal olarak nasıl ele alındığı incelenmiştir. Bugün Avrupa'da eko-kentlerin sayısı giderek artsa da Türkiye'de bu durumun aynı olmadığı görülmektedir. Konuyla ilgili Türkiye'de çeşitli projeler yapılsa da henüz hiçbirisi uygulama aşamasına geçmemiş, sadece bina ölçeğinde projeler uygulanmıştır. Bu nedenle çalışmada Çevre ve Şehircilik Bakanlığı ve İstanbul Teknik Üniversitesi arasında imzalanan sözleşmeye göre Eskişehir'de yer alan Kocakır Reserv Yapı Alanı için planlanmış olan ekolojik yerleşke projesi örnek alan olarak seçilmiştir. Projenin plan raporları incelenerek tez kapsamında belirlenmiş olan eko-kent planlama ve tasarım kriterleri ayrı başlıklarda açıklanarak bu kriterleri sağlayıp sağlamadığı araştırılmış ve bu doğrultuda değerlendirilmesi yapılmıştır. Buna ek olarak Türkiye yasal çerçevesi göz önünde bulundurularak projenin bu çerçevede de uygunluk değerlendirilmesi yapılmıştır.
Proje kapsamında optimum düzeyde enerji verimli yapılardan oluşan uygun karma kullanım ile yapıların ürettiği ısıyı değerlendiren, kendi enerjisini yenilebilir kaynaklarla üretebilen, depolayan, kullanan, evsel ve yağmur sularını ayrık sistemde toplayan, evsel atık suyu arıtan, atık suyu ve yağmur suyunu geri kazanan ve yeniden kullanan, yeşil alan ve kentsel tarım alanı temin eden, donatılara, ticaret ve iş yerlerine yaya ve bisiklet yolları ve toplu taşıma ile erişilebilen, fosil yakıtlı bireysel araç kullanımını sınırlayan ve dönüşümden kaynaklı inşaat atıklarını ve diğer atıkları değerlendiren uygulamaların teşvik edilmesiyle eko-kent planlamasının ekolojik ve mekansal kriterlerinin bir çoğunu karşılamaktadır
Değerlendirme sonucuna göre Kocakır projesinde bazı kriterler karşılanmamış veya eksik olsa da genel olarak ekolojik ve mekansal olarak çoğu kriteri sağladığı fakat sosyo-ekonomik kriterler olarak geri planda kaldığı görülmektedir. Türkiye'nin yasal altyapısına uygunluk değerlendirmesine göre ise Kocakır projesinde düşünülen bazı stratejilerin Türkiye mevzuatında bulunmadığı ama eko-kent için gerekli olan hedefler alınmıştır.

1. INTRODUCTION

In recent years, the increasing number of people in urban areas, economy-oriented growth, increasing use of automobiles have led to a significant change in the built environment, urban sprawl, destruction of natural resources, insufficient urban infrastructure and an increase in the amount of energy used. These reasons have led to the development of new planning approaches that will provide environmental, social and economic benefits to cities, including urban design and architecture. The concept of sustainability, which is one of the main approaches, has an important role in the creation of self-sufficient, environmentally friendly cities with low carbon emissions. One of the sustainable urban models emerging in this context is eco-cities.

On the recommendation of Richard Register, eco-cities included in the urban planning area are a technological city model that takes into account the ecological carrying capacity of the urban environment and at the same time directs the innovations and developments of the era. The most important features are the use of green technologies by including renewable energy, solid waste management systems, water treatment systems and zero energy structures in the planning. The development of these cities is not only about the environment but also about demographic, sociological, economic and cultural change. Unlike the existing planning approach, ecological planning aims to produce holistic and long-term solutions. It is a holistic planning approach that is planned according to resources rather than resource usage, which keeps production and consumption in balance, protects natural resources, is considered not only for human beings but for all other living beings, it is not dependent on outside sources, ensures the public participation and gives importance to environmental consciousness.

1.1 Purpose of Thesis

Indicators have been prepared by various institutions and organizations internationally on the conditions under which a city can be accepted as an eco-city. The aim of this thesis is to determine and examine the ecological, spatial and socio-economic criteria of eco-city planning and design in detail based on these indicators and to reveal the

effects of these criteria in the context of sustainable city. Later, Turkey eco-city planning to examine the legal and technical criteria and in the context of the Kocakır project will be determined in terms of the applicability issues and aimed to analyze their potential.

In this context, the following research questions have been developed in order to elaborate the above mentioned scope and cover each sub-heading:

- How the eco-cities are linked with the sustainable urban development?
- What are the main planning and design criteria of eco-cities?
- To what extend eco-city concept is applicable in terms of practical, technical and legal approaches in Turkey?
- To what extent does the Kocakır–Eskişehir project meet the eco-city planning and design criteria?

1.2 Research Method

In the first part of the study, the aim, scope and methodology of the thesis are explained. In the second chapter, the conceptual framework of the thesis has been established by analyzing the literature. In this section, starting from the history of sustainability, the concept of sustainable city and four sustainable city models are analyzed and compared ecologically, economically and socially. Then, the concepts related to eco-city planning are explained and the historical development process and characteristics of eco-city planning are examined and their relation with sustainable cities is explained.

In this section, which constitutes the main structure of the thesis, planning and design criteria of eco-cities are summarized under 3 headings - ecological, spatial and socio-economic, and a list of criteria, objectives and indicators has been created. Under the title of ecological criteria, the use of renewable energy in eco-cities, biodiversity, waste management, air, water and soil quality were examined. In the context of spatial criteria, the importance of eco-cities in the context of eco-cities is explained by choosing the appropriate location, urban form and land use, transportation system, the characteristics of buildings and structures, and the importance of public spaces. In the context of socio-economic criteria, the concept of urban quality of life is addressed,

and the practices necessary to increase the life quality of the urban dwellers, the most powerful dynamics shaping the city, to ensure social justice and social cohesion in the city, to provide sufficient employment for all and to provide the housing types that everyone can pay. As a result of this section, the objectives and indicators included in these 3 criteria are summarized and an evaluation table is prepared.

In the third part of the thesis, applied or project based eco-cities in different countries are examined in order to compile ecological design principles. Within the framework of the criteria developed within the scope of the thesis, Dongtan - China, Vauban - Germany, Bo01 - Sweden and Eko-Viikki - Finland samples were examined and design approaches were introduced. In section 3.6, evaluation of these eco-cities, common and different aspects are analyzed.

The 4th section of the thesis Turkey sustainable urbanization and eco-city planning history, development plans and legal and administrative foundation that will enable the development of eco-city approach are analyzed. Then, the master plan, implementation zoning and design reports of the Kocakır - Eskişehir project were examined and their compatibility with plan decisions, project targets and upper scale plans were mentioned. Evaluation of this project within the scope of ecological urban criteria developed in the second part of thesis, positive and negative aspects in terms of applicability and compliance with the Turkey's legal framework has been analyzed.

In the conclusion part, the inferences obtained from the whole study are summarized and basic ecological urban planning and legal problems and solution proposals are mentioned.

2. CONCEPTUAL FRAMEWORK

2.1 The Evolution of Sustainability

Excessive increase in fossil fuel use after the 18th century industrial revolution, increasing population in cities and changing consumption patterns caused environmental problems on a global scale. The most logical way to minimize environmental issues is to ensure sustainability. Sustainability is defined as ensuring the continuity of diversity and productivity of a system in order to sustain itself, as well as maintaining its ability to be permanent. In a broader sense, sustainability is the ability of something to protect or conserve itself and to maintain its existence. That is, it may be possible to reuse, repeat or recycle product or anything.

Holmberg and Sandbrook (1992) indicated that it is available more than 100 definitions of sustainability in the literature. The meaning of sustainability from the Latin word "sustinere" was explained in the online version of Oxford Dictionary in 1980 as "*Able to be maintained at a certain rate or level*" (Newton and Freyfogle, 2005).

Today, scarcity, poverty, the environment, global pollution, dramatic migration movements, pollution of the land, diminishing of potable water resources, and marginal population groups are concerned with all societies and the dimensions that local societies and nations can solve at their own pace. These problems, solely through global operations and strategies, have been solved only by global approaches and national priorities.

The concept of sustainability firstly emerged in 1972 at the "United Nations Conference on the Human Environment" in Stockholm, which was attended by 113 countries (Newman and Kenworthy, 1999). The main topic of the conference was the environment should not be ignored for the development and the whole world should have a common position about the environment. Thereby it was acknowledged the universality environmental problems and "we have a single world" slogan was memorized. After the Stockholm conference "The World Commission on Environment and Development" published the report known as "Our Common Future"

or “Brundtland” in 1987. With this report, the concept of sustainability defined and since then it has been used in all areas of the life (Yigitcanlar and Kamruzzaman, 2015). Based on the report sustainable development defined as *“development that meets the needs of the present without compromising the ability of future generations to meet their own needs”* (UN, 1987).

According to the Brundtland report, sustainability concept which has three dimensions as environment, economy and socio-cultural, is a set of principles aimed at making use of environmental, historical and cultural values not only today but also in the future. Sustainable development has shown the new approach to planning and management at different scales. It has basic objectives such as ensuring intergenerational equality, poverty reduction, careful use of natural resources, population control, development of environmentally friendly technology, and the use of renewable energy (WCED, 1987). After published Brundtland report sustainability term was defined in so many different ways. The reason for that sustainability is not only a concept related to the environment, but also it could be used in every area of life from urban planning to architecture, from health to culture, from transportation to economy, from biology to agriculture, from industry to energy and so on.

The work on environmental and development problems that started with the Stockholm conference continued with the 1987 Brundtland report on the concept of sustainability came on the agenda and in 1992 the “United Nations Conference on Environment and Development” was held in Rio de Janeiro, known as the Earth Summit. The Rio Declaration with its 27 principles set goals for environmental sustainability and social equity. At the Rio Conference, 5 issues were mainly raised: Rio Declaration on Environment and Development, Agenda 21, Climate Change Convention, The Convention of Biological Diversity and Forest Principles (Basiago, 1995: 110).

The Rio conference has significantly changed the agenda of the world and the concept of sustainability has developed as the most important issue in the conferences held after it. In the “Habitat II United Nations Conference on Human Settlements” conference held in Istanbul in 1996, the concept of sustainability was discussed together with the urban, and notions such as social participation and democracy became the main subject. The major aim of Habitat II is to provide adequate and sustainable human settlements for all. The principles to achieve this aims are

determined as gender equality, sustainable human settlements, eradication of poverty, participation and quality of life (UN, 1996).

The “UN World Summit on Sustainable Development” was held a conference in Johannesburg which is known as Rio+10 for evaluation purposes. The main objective of the conference is to implement sustainable development more extensively. The elements of the implementation plan are: poverty eradication, conservation of natural resources, health and sustainable development, reduction of biological diversity, health, education, agriculture and access to clean water.

The next sustainable development conference was held in 2012 in Rio de Janeiro. The conference, which coincides with the 40th anniversary of the UN Stockholm Conference in 1972 and the twentieth anniversary of the UN Rio Conference on Environment and Development in 1992, is defined as Rio + 20 (Yıldız, 2016). After the Rio 2012 evaluation it was clear that most of the problems still continued. In other words, lack of cooperation between developed and underdeveloped countries, failure to solve ecological problems of underdeveloped countries, and inadequacies in global development were observed. Rio 2012 has developed new sustainable development policies and green growth strategies to solve these and similar problems.

The implementation of the concept of sustainable development presents a long-term program to achieve economic development, social well-being, and ecological integration. In this context, it is possible to collect approaches related to sustainable development in 4 main objectives (Wood and Bruff, 2000):

- to provide a high-level economic development and workforce
- social development in line with the everyone's requirement
- protection of the environment
- attentive use of natural resources

For the purpose of access successful sustainable development, the components of economic, ecological and social development should always be in balanced. Economic sustainability focuses on improve living conditions by taking into consideration the present and future generations. The main principles of sustainable economic improvement are to reduce poverty and hunger as much as possible, to prevent imbalances that harm agricultural production without paying attention to the

development level of the countries, and to be careful consumption habits. Ensuring sustainability means creating a balance between nature and economical costs. In order to maintain this balance, it is important to conserve and use natural resources in the consumption and production stages and to benefit from renewable energy sources (Vivien, 2008).

Another component of sustainable development is ecological sustainability. All living things, including human beings, need a clean and reliable environment in order to live healthier. And the most important way to ensure this environment is to achieve sustainability, that is to create a balance between human being and environment. According to Sutton (2004) ecological sustainability could be defined as protecting the valuables in the physical environment. As everyone knows, human life depends on natural resources which do not have eternity. Maintaining and preserving these natural resources, using them in a right way, increasing their resistance to external factors, reducing non-renewable resource amount and wastes, protecting biodiversity, converting environmental wastes to the renewable energy are the main issues of ecological sustainability (Morelli, 2011).

Social sustainability, which is another element of sustainable development, although it is not at the forefront as the other two dimensions of sustainability, it is at least as important as them. Social sustainability came up with the Brundtland Report in 1987, focuses primarily on humanity's initial needs such as food, security, education, and subsistence. According to McKenzie (2004), in order for a society to be sustainable, 5 basic principles are required. These principles are ensuring equality among all members of society, diversity, improving quality of life, ensuring democratic governance and commitment at formal, informal and institutional levels. Figure 2.1 illustrates the characteristics of sustainable development in terms of economic, community and ecological development (Pinfield, 1997).

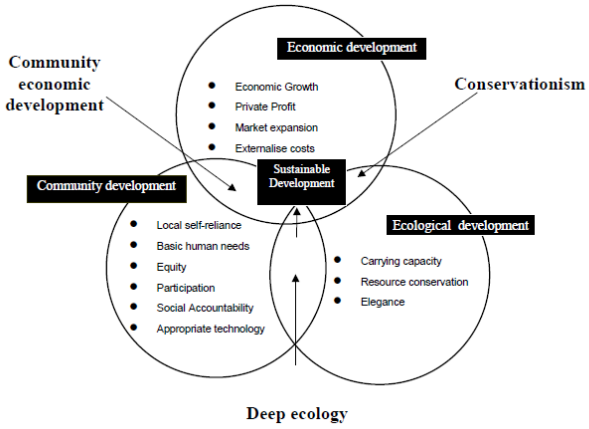

Figure 2.1 : Sustainable development components (Pinfield, 1997).

As it can be seen from the dimensions of sustainability concept, it is approached with human action and human thought. The purpose of all three dimensions is to achieve the best and the highest quality of life possible for human beings. Ensuring sustainability within the framework social, economic and environment development has also direct interaction with the sustainable urban development concept. In this sense, the basic condition for the implementation of sustainable development policies is that these policies should be reflected to the space.

2.2 Sustainable Urban Development

Cities which are the living systems are defined as settlements in constant development and more densely populated than the rural areas where the needs of the society are met, such as settlement, sheltering, departure, working, resting or having fun. Rural to urban migration, which started with the industrial revolution, is still continuing and causes the human density in urban areas. It is known that today more than half of the world's population lives in cities. It means half of the total energy, three-quarters of water, and nine-tenths of food are consumed by the urban population. According to UNFPA data, the total world population will exceed 8 billion by the year 2035 and 6 billion of this population will live in cities. According to the United Nations (UN) report, by 2050, two out of three people will live in cities. As such, urban areas are the main users of natural resources and the main producer of environmental losses.

The relationship between the city and the environment increases as the number of population increases. Environmental problems caused by industrialization and urbanization are seen also in developed countries. Developing countries cause more

environmental problems in consequence of the efforts to reach the economic level of developed countries, leads to increase in slum areas and unplanned urbanization, unplanned consumption of natural resources, increase of natural disaster risks and formation of unhealthy cities. In developed countries, although more environmental regulations and environmental policies are available, the environmental damage caused by the industrial facilities of these countries is not minimal. It brings about to an increase in natural land use and consumption, an increase towards urban peripheries and an increase in environmental pollutants.

When these problems are considered as spatial development, they reveal the situation such as urban sprawl, transportation based growth, and decentralization in urban functions in developed and developing countries and coincide with the policies envisaged by the sustainable development that solve these problems. Considering this features of the cities, urban sustainability has an important function in sustainable development.

Sustainable city means is designed to minimize the water, food, energy costs, to preserve the people from the negative effects of air pollution in the environment they live. The objective of the development this urban system is to ensure the restructuring and to enhance the life quality in common areas, to protect the ecosystem, to develop the city to supply the demands of future generations, and to strengthen its ability to maintain its existence as a residential area.

Within the framework of the Rio Declaration, “Sustainable Human Settlements” takes place as a section which addresses 8 principles (UNCED, 1992):

- Providing sustainable public transportation and bicycle
- Use of sustainable construction materials
- Upgrading of slum areas
- Improving of urban administrations
- Planning and management of disaster areas
- Developing of the agricultural areas
- Ensuring adequate housing

These problems, have been solved through global operations and strategies, only by global approaches and international priorities. International institutions and organizations such as UN, WHO, OECD, EU and World Bank have started to develop environmental policies. The concept of sustainable urbanization has been brought to the agenda with the 1996 Istanbul Declaration of Habitat II Summit. The declaration includes:

- Re-evaluation of the concept of sustainable development in the urban scale has became a current issue.
- Should be determined urban democracy.
- The importance of public and private sector cooperation was underlined.
- Cities and the discussions on the role of citizens have been started.

Sustainable cities are the cities in which socio-economic interests are integrated with environmental and energy concerns in order to ensure changing in continuity. Just because the city is environmentally sustainable does not mean that it is sustainable. Table 2.1 shows the main indicators of sustainable city.

Table 2.1 : Sustainable urban indicators.

Sector	Description
Environment	Minimizing the consumption of and natural resources Providing energy needs of cities by using renewable energy sources Increasing the per capita green areas and restoration of natural systems should be ensured Preventing biodiversity and integration with physical planning and economic and sectoral policies Determining policies to decrease the greenhouse gases and preventing of air, water and soil pollution Ensuring access to safe drinking water, adequate infrastructure and transport facilities Developing eco-friendly agricultural systems
Economy	To reduce the low-income group and the unemployment rate in the city

Table 2.1 : (continued). Sustainable urban indicators.

Sector	Description
Social	Keeping population density in balance It should be decreased the private car ownership and encourage people to use public transport, bicycle, and pedestrian Providing mixed-use urban development To ensure the population accessibility to health care and educational services Green architecture and eco-technologies should be used Providing public participation in the planning process To ensure equality, safety and adequacy from strategies that address community issues

2.3 The Types of Main Sustainable City Concepts

To find solutions to ecological, economic and social problems in cities alternative urban models have emerged. The alternative urban models that have been created start from Ebenezer Howard's Garden City model and still continue. The main targets of the sustainable city concepts that emerge from the concept of sustainability are the pollution of the environment to the minimum level, the use of vertical land use instead of horizontal, the conservation of natural resources and historical values, the decline of the number of vehicles per person, increasing the life welfare and strategies that will contribute to many other urban forms. In this direction, various urban models such as new urbanism, compact city, slow city, eco-city, green city, low carbon city, smart city and digital city have emerged since 1990. Although all models were developed by different people in different countries at different times, the aim of all of them is to provide sustainability with small differences in meaning and to create a model that is compatible with the environment and a livable model for future generations.

In this section, different models of sustainable city models such as compact city, slow city, smart city and finally eco-city model will be examined, their features, contribution to sustainability and main objectives will be explained. Table 2.2 is grouped according to the ecological, economic and social sustainability planning and design principles of these four concepts. As can be seen from the table the reflection of sustainability to spatial is different in each model. Smart cities achieve sustainability by using technology, compact cities achieve preserving of agricultural areas and

avoiding urban sprawl, slow cities achieve by preserving cultural values. At the same time, each model has different priority sustainability dimensions.

Table 2.2 : Sustainable city models and planning principles.

Type	Ecological	Economic	Social
Compact cities	Compact settlements Mixed-use development Low energy consumption Sustainable transportation systems Protecting of agricultural areas	Economic urban infrastructure	Social equity
Slow Cities	Promoting alternative energy sources Energy efficiency and waste management Prevention of noise, electromagnetic, visual pollution Encouraging pedestrian, bicycle and alternative public transportation	Supporting the local economy	Protection and promotion of local, historical cultural values Establishment of studies on family life and local social life
Smart Cities	Conservation of natural recourse, efficient waste management Supporting cities with renewable energy technologies Dissemination of zero energy building applications Reducing urban pollution Water and solid waste management	Flexibility of the labor market Adaptation of developing technology to the city	Promoting social and ethnic diversity, To promote participation in decision-making processes, Education and health, cultural events, strengthening individual security opportunities
Eco-cities	Using renewable energy sources Water and waste management Mixed-use and compact development Accessibility of green areas Development of efficient transport systems Use of sustainable materials and buildings Protecting and increasing of biodiversity	Healthy economy	To promote public participation in decision-making and planning process Social diversity and integration

2.3.1 Compact cities

The concept of compact city, first coined in 1973, but was considered a sustainable urban model in 1990 (Arbury, 2005). In order to contribute to the sustainable urban form, this concept proposes the development of residential areas in a concentrated instead of spreading to the dispersed and structured environment. Williams (2000), who describes the compact cities as a reflection of sustainability principles of the city, classifies compact city features under the four headings:

- Compact cities should have a sustainable transport system. Since these cities have high density and mixed use, people should have easy access to their daily destinations on foot or by public transport.
- It is possible to take advantage of urban sprawl in order to re-use the urban lands and to protect the rural areas.
- Compact and mixed settlement, together with socio-cultural development, forms an accessible urban form for all.
- Due to the compact settlements with high density, the provision of quality of life has an economic quality.

With these features, compact city causes factors such as efficient use of resources, minimization of environmental pollution and urban mobility, access to social reinforcements and protection of rural areas. In this context, compact cities can be considered as a type of sustainable urban systems.

When a non-compact city is compared with a compact city, it is seen that these cities have many negative aspects. According to Neuman (2005), urban sprawl is the cause of large, dirty and crime-ridden cities starting from the 19th century. Urban sprawl leads to a decrease in rural areas, an increase in the use of automobiles to reach the city center, social inequality and economic problems.

Neuman, using Burchell et al. (1998), categorized the problems of urban sprawl under 10 headings: low density settlements, external urban expansion, spatial isolation of various land-use types, leapfrog development, diverse small local governments, increasing of private care ownership, decentralized ownership of land, inequality of the fiscal capacity, extensive commercial development along the highways, to provide accommodation for low-income families. In contrast to these disadvantages, compact

urban features are described under 14 headings, which include economic, social, physical and environmental values: high density settlements, mixed-use land, closeness of varied uses, grow of social and economic interactions, adjacent development, separated legible limits of urban development, water and sewage system, different modes of transportation, accessibility, street network connectivity, control of land development, adequate fiscal capacity.

In addition to all these benefits, compact cities also have some drawbacks: economically, compact residential areas can cause rising land prices due to housing shortage and intensive land use. Apart from this, it may cause problems such as the increase in crime rates, noise pollution, crowded urban life, the inability to catch the sun of the houses due to congested settlements, the decrease of urban green and public spaces. However, it is a fact that these problems are not great and can be solved by legal and administrative arrangements (Burton, 2000).

As a result, the compact urban model is closely linked to sustainable urbanization and achieves its objectives both economically, socially and environmentally.

2.3.2 Slow cities

The slow food movement, which started in 1986 for the first time, was founded by the Italian gastronomy writer Carlo Petrini, which advocated a clean and healthy diet and aimed at preserving local flavors. This organization, which has become increasingly international, has begun to be developed in more than 100 countries. In 1999 Carlo Petrini laid the foundations of the Slow City concept in Italian city of Orvieto in order to apply this concept in all areas of life (Mayer and Knox, 2007). The first cities of the slow city model were Greve, Bra, Orvieto and Positano. The reason for the slow city movement was to prevent the increase in fast food restaurants, noise and visual pollution and traffic problems in these cities. This organization aims to better the quality of city-dwellers, and to strengthen the conservation of cultural and natural values of the city.

The word slow does not mean that people live in a slow rhythm or that cities develop slowly. According to Radstrom (2011) “The slow in Cittaslow concerns the idea of taking the time for quality”. The main objectives of these cities are determined as the preservation of historical and touristic cultural values, the preservation of traditions, the preservation of the city's characteristic structure, and the protection of energy

resources. Although the concept of slow city initially thought that people living in that city would experience better quality, it gradually started to gain value in terms of tourism.

The slow urban movement offers an alternative approach to sustainable urban development. Some of the policies that support the components of sustainability:

- Strategies for the recycling of wastes
- Using the renewable energy sources
- Restriction of the use of genetically modified products in agriculture
- Projects for the prevention of electromagnetic pollution
- Plans for establishment bicycle path
- Encourage use of public transportation
- Protecting of water, soil and air
- Creation of green areas
- Recycling of industrial and domestic waste into fertilizer
- Providing accessibility for everyone
- Protection and promotion of local, historical cultural values

If these criteria are to be expanded a little more, slow city movement will protect the city's people, craftsman, encourage the use of bicycles to prevent air pollution, create recreation areas, increase the sale of organic products, determine routes for tourists in historical places, make planning by considering elderly and disabled people, education level and the number of employment. In summary, it is seen that the slow city concept exists in every aspect of life, from eating to drinking, from tourism to commerce, from economy to transportation to ecology.

2.3.3 Smart cities

Technological advances that have entered our lives consciously or unconsciously in the last two decades have changed our lives significantly. These changes are also manifested in spatial and urban planning. The availability of technology as a solution to the problems that arise in cities, the widespread use of geographic information system and getting easy of information exchange have given rise to the concept of

smart city (Terzi and Ocakçı, 2017). The concept of smart growth, first introduced in the 1990s, is actually a form of integrating sustainability into spatial planning and everyday life. Briefly, smart cities are applying to cities using technology to ensure a sustainable life.

The concept of smart city has an important role to make the cities more sustainable and livable due to the increase in population, unplanned urbanization, economic and social problems. Smart cities come to the forefront in international policies with the use of information and communication technologies, mobility management, new forms of participation, minimizing the use of resources, combating environmental problems and disasters, improving the life quality, transportation and communication infrastructure (Türkoğlu, 2019). According to the ISO new technologies such as Ubiquitous Computing, Networking, Open Data, Big Data, E-Government, GIS and Cloud Computing are used for smart city planning and implementation (ISO and IEC, 2015).

The smart city wheel, created by Cohen (2012) for a holistic approach, combines 6 criteria: smart transportation, smart living, smart governance, smart environment, smart economy and smart people:

Smart transportation. This combination of information and communication technology-supported transport includes tramway, bicycle, subway, bus and pedestrian groups, which are sustainable transport systems. Charging according to the length of the road, informing the passengers, drivers about the traffic density or general condition and electronic fare payment system are the main subjects of this component. Increasing the number of vehicles, limited road capacity, pedestrian and vehicle traffic necessitate for this transportation system. In particular, it offers solutions to the disadvantaged groups, the elderly people, children and people with disabilities. This transportation system not only provides energy conservation, but also reduces travel times and consequently reduces fuel consumption.

Smart governance. Thanks to this component, public participation and transparency principles in management processes such as analysis, synthesis and implementation are provided by using technology. It is significant for the economic development and the consolidation of local democracy data is clearly shared among the relevant institutions, which ensures that the state, local governments and the public sector work

together. E-government applications have the advantages of using information and communication technologies such as establishing a connection between the state and the citizen, increasing the quality of service and providing democracy.

Smart environment. Information and technology supported energy networks, renewable energy resource usage, smart wastewater usage, solid waste collection systems, green ecological buildings, air and water pollution monitoring systems, radiation rate measurement applications are the most important applications used in the smart city concept. For example, it could be determined waste containers collected in cities by homes or workplaces are filled or empty with the help of smart sensors. This makes it possible to simplify the day of arrival of the garbage truck, its route and at the same time to prevent the garbage cans from overfilling. By using smart street lamps, it is possible to save energy and prevent environmental pollution thanks to the illumination of the night streets of the energy obtained from the sun during the day, street lamp poles that can measure air pollution, and lighting systems that automatically shut down when no one is present.

Smart economy. Smart economy is evaluated within the scope of e-commerce, smart production and consumption by using technology, economic input-output systems and other applications. In this way, efficient usage rate increases against increasing consumption sources.

Smart life. Smart life means healthy, safe and happy life. Advanced technology leads to changes in lifestyles and behaviors. It includes smart home systems, smart education and health systems, fire brigade, emergency response technological applications where there is less crime rate with the surveillance of smart life security cameras. All of these are the main factors for a better, healthier and safer life.

Smart people. People are the main point in the creation of intelligent technologies and cities. They should have the ability to use information technology to benefit to the city, to produce information, to carry out operations that could better the life quality and to make advantages of it. According to Giffinger (2007), there are seven basic factors and 15 indicators that smart cities should possess for these components. The presence of advanced universities and research centers, knowledge of foreign languages and participation in foreign language courses, high level of eagerness to learn, high level

of creativity, participation in voluntary jobs and city and municipal election are some of these determinants.

2.3.4 Eco-cities

Eco-city is a concept formed by the unification of ecology and city. As the name implies, eco-cities envisage a relationship between human beings, nature and the city. According to Caprotti (2014) eco cities like sustainable cities are not only about the environment but also about demographic, economic, technological and most importantly cultural transformation. The eco-city is based on the balance between environmental factors, economic resources and human as the spatial expression of sustainability. Therefore, the city model that encourages sustainable use of resources is called eco-city.

The concept of eco-city prioritizes ecological qualities and aims to maintain important environmental resources. Eco-cities are defined as regular urban environments that protect the environment, do not pollute, do not harm the natural cultural and historical values, and can balance between the ecology, economy and technology.

Eco-cities are divided into 3 categories according to the development type: new development such as Masdar–UAE, Dongtan–China, Arcosanti–USA, urban expansion – Eko-Viikki-Finland, Tübingen–Germany and retrofit – Freiburg–Germany, Hamburg–Germany, Malmö–Sweden, Vancouver–Canada and so on. (Joss, 2011). Out of a total of approximately 180 eco-city projects, 24 were established on newly developed – unstructured green areas. Especially after 2000, new developed eco-city projects became more widespread in Asian countries (Joss et al, 2013).

2.4 Eco-Cities as a Sustainable Urban Structure

The global adoption of capitalism after the industrial revolution has led to scattered and unhealthy urban environments, the growth of slum areas and the rapid depletion of natural resources. As a solution to these problems, states, planners, architects and environmentalists focused on making cities healthier and more planned, and the new ecological concept eco-city was emerged (Roseland, 1997). The main aim of eco-cities is to get rid of carbon residue, to provide energy completely from the renewable energy sources and to create nature as a green city by integrating nature with the city.

The concept of the eco-city was developed by urban planners or architects such as Peter Newman, Jeffrey Kenworthy, Richard Register and Isabelle Jennings after the 1970s (Jong et al., 2013). But in 1975, urban theorist Register founded Urban Ecology group and organized various conferences for the conversion of the city of Berkeley into an ecological city. He published his book in 1987 “Eco city Berkeley: Buildings Cities for a Healthy Future” which is known as eco-city term was used in a first time. In this book human settlements should be ecologically healthy and livable were determined as the main condition. Register defined 7 characteristics of eco-cities: planning should be started from scratch, should be addressed to the all of the living creatures, should be decreased the energy consumption, should be provide equality, should be preferential pedestrian and bicycle, should be contribute to the urban economy, should be improved the biosphere.

Urban Ecology group has determined 10 principles for the eco-city goals (Premalatha, 2013):

- To provide mix-used development around public transportation facilities
- To encourage people using the public transportation
- Restoring and repairing damaged urban environments, especially streams, coastlines, peaks and wetlands
- To create residential areas affordable to everyone
- To provide social equality, priorities for women, children and people with disabilities excluded from society
- To develop agricultural areas, green city concept and community gardening
- To encourage recycling, innovative appropriate technology and resource protection
- To support ecologically strong economic activity by local or private sectors
- To dissuade from excessive use of materials
- To increase public awareness

In this context, it is seen that the concept of eco-city is not a new concept, it is related to the Garden City model developed by Howard in 1892 (Saad et al., 2017). Howard's goal was to reduce the gap between the rural and urban, to design an integrated urban

model with low density, fresh air, recreational areas, within walking distance of workplaces and residential areas, surrounded by green space around the settlement.

Register and Urban Ecology group coordinated the first international eco-city conference in Berkeley, California in 1990. The conference, which lasted for 3 days and had more than 500 participants, focused on urban sustainability issues and proposed eco-city projects for the future (Altenberg, 1990). In 1992, after the "United Nations Earth Summit", Register established the first non-profit educational organization "Ecocity Builders" (EB) which aims to provide sustainability in cities (EB, 2011). This organization developed policies, methods on ecosystems, transportation, and urban design with the contribution of more than 800 people from 13 countries. Towards these methods, "The Ecocity Framework and Standards" (IEFS) enterprise was established in Vancouver, Canada in 2010 to provide guidance and assessment within the eco-city perspective.

Eco-city standards are categorized under 4 headings by Ecocity Builders: Urban design feature – easy access; biogeophysical conditions – air, energy, food, soil and water; socio-cultural characteristics – public participation, culture, welfare, economy, education; and ecological – biodiversity, capacity and environmental integrity.

Cities are classified as unhealthy cities, greener cities, eco-cities and Gaia-level cities by IEFS and each level of cities has various characteristics. Gaia or whole earth cities is the highest level in this classification. The term Gaia, which describes the world and all living things living there, is a city that is socially and physically connected with the world. According to IEFS, the lowest level is unhealthy cities and the minimum targeted level is eco cities. Green cities, on the other hand, are the way to eco cities, which means they provide less indicators than eco cities (EB, 2011). Although there is no significant difference between these two concepts, in fact the result of both concepts is based on sustainability. A city can be defined as sustainable if it can remain green or eco city for a long time until it reaches its next goal (Figure 2.2).

Figure 2.2 : IEFS urbanization categories (EB, 2011).

Although there is no single explanation of the eco-city definition, it is known that there is a network of relations with sustainable development. The main feature that distinguishes eco-cities from other approaches is the provision of ecological, spatial, economic, social and cultural sustainability.

The integration of environmental policies with spatial planning is the main feature of eco-city planning. Creating an ecological city model means providing a healthy and natural living space that is strengthened by the city's renewable energy resources and creating a self-sufficient city that is not ecologically dependent on the outside. In addition, eco-cities ensure the resources are used in the most effective and the cleanest way, with the least amount of waste produced, recycling and reusing of waste.

The main marks of eco-cities:

- Sustainable use of natural resources
- Prevention of air, soil, water pollution
- Development of biological diversity
- Reduction of fossil energy use
- Energy efficiency
- Application of ecological architecture
- People-oriented planning, not transport-oriented
- Mixed-use city or neighborhood formation
- Recycling of waste
- Reduction of consumption
- Providing safety, health, welfare and education
- Harmony with technology and nature
- Ensuring public participation

2.5 Eco-City Planning and Design Criteria

Planning an eco-city is not only about the ability to envision and create new cities of the future. Existing cities and their legacies of building form, urban infrastructures and social practices are the foundations for creating eco-cities.

Starting from the studies on sustainable cities, it has led to the definition of different sets of international assessment criteria in the world. It is available various eco-city performance indicators under 3 headings – ecological, socio-cultural and economical for use to measure level of the city (Table 2.3).

Table 2.3 : Performance indicators for eco-cities and sustainable cities.

Indicators	Organization	Ecological	Socio-cultural	Economical
Ecocity Framework and Standards	Ecocity Builders	Clean air Healthy soil Clean and safe water Responsible materials Clean and renewable energy Healthy food Healthy biodiversity Earth's carrying capacity Ecological integrity	Healthy culture Community capacity building Education Healthy and equitable economy Well-being – quality of life	
European Green City Index	Siemens	CO2 emissions Energy Buildings Transport Water Air Waste and land use Environmental governance		
Urban Sustainability Indicators	European Foundation	Global climate Air quality Acidification Ecosystem toxification Clean transport Waste management Energy consumption Water consumption Green, public space and heritage Nuisance	Social justice Housing quality Safety Citizen participation Unique sustainability	Economic urban sustainability

Table 2.3 : (continued). Performance indicators for eco-cities and sustainable cities.

Indicators	Organization	Ecological	Socio-cultural	Economical
ECOCITY project	European Union	CO2 emissions Less land demand Energy consumption Air and noise pollution Open and green spaces Mixed use development Renewable and recycled materials Water Waste Sustainable transport	Diversity of population group Accessible social infrastructure Cultural identity and social diversity Public participation	Labor force Strong local economy
Global City Indicators Program	Global City Indicators Facility	Recreation Transportation Wastewater Energy Solid waste Water	Education Governance Safety Health Civic Engagement Social Equity Culture Shelter	Finance

Ecocity Framework and Standards – As mentioned above, Ecocity Builders indicators, which are collected under 4 main headings - 10 of them are environmental and 5 of them social indicators. In terms of percentage, it consists of indicators aiming at 67% environmental sustainability and 33% social sustainability (EB, 2011).

European Green City Index – It is a method created by Siemens and Economist Intelligence Unit for both measure existing sustainability performance and future environmental impacts thought its goals. The method firstly applied in 30 European cities was divided into a total of 8 ecological categories and 16 qualitative and 14 quantitative indicators are considered. According to 2019 data, Copenhagen ranks the highest point in the European ranking (Economist Intelligence Unit, 2012).

Urban Sustainability Indicators – The Aalborg Charter, published after the "1st European Conference on Sustainable Cities and Towns" in Aalborg, Denmark in 1994, mentions Urban Sustainability Indicators for measuring sustainability performance (Mega and Pedersen, 1998). These indicators, unlike the aforementioned indicators, focuses on the three dimensions of urban sustainability. 9 of them are ecological, 6 social and 1 economical index.

ECOCITY project – The eco-city approach has been put forward within the scope of the "Urban Developments Towards Appropriate Structures for Sustainable Transp2ort" project carried out by the EU between 2002-2005. This project was developed based on the fact that 80% of the European population lives in cities, especially in large and medium-sized cities. In this eco-city approach, four main topics are addressed: urban structure, transportation infrastructure, energy and socio-economic index (Ecocity final report, 2001).

Reference Framework for Sustainable Cities – It is an initiative under the leadership of the "French Ministry of Housing and Sustainable Homes", "The Council of European Municipalities and Regions" and other organizations to achieve the Leipzig Charter and UN Sustainable Development policies. The criteria categories developed within this scope consist of 30 criteria under 5 categories (EC, 2018).

As can be seen, eco-city performance indicators have different characteristics depending on the country in which they are developed. While all of them addresses different levels of environmental, social and economic issues, the majority are more focused on environmental factors. Based on the above mentioned planning indicators, the eco-city planning and design criteria will be examined under three headings: ecological, spatial and social.

2.5.1 Ecological criteria

2.5.1.1 Energy

The fast-growing population, improvement of living standards, economic growth and industrialization bring about an increase in energy demand. The majority of carbon emissions are due to the use of fossil resources in energy sector, and carbon emission increase as energy consumption increases. Fossil fuels used as energy sources cause some solid and gaseous residues after firing. These residues cannot be reuse in any way and bring about environmental pollution, climate change, and global warming. To reduce global warming, it is significant to mitigate emissions and increase the absorption of carbon dioxide (Kamata, 2010).

Considering its economic, social and environmental dimensions, the most prominent element of sustainable development and eco-city development is undoubtedly

renewable energy. In this context, the use of renewable energy resources should be increased as much as possible (Yuana, et al, 2011).

Both the problems of sustainable development and climate change are the main problems of energy resources and their use. There are two primary types of sources: fossil fuels and renewable energies. For example, in the US and other industrialized countries, almost all of the energy is derived from fossil fuels such as coal, oil and natural gas. During their usage, the damage to environment is not considered so much (Geller, 2003). Renewable energy sources have great importance because they are sustainable and also can be found and used all over the world. Sources - solar, wind, geothermal, biomass, biogas, hydroelectric energies are known as the renewable energy sources. Advantages of this energy use are in terms of sustainable energy:

- They don't cause environmental problems, especially air pollution. As well as, they contribute to the decline of pollution caused by the use of fossil fuels, in particular, greenhouse gas emissions.
- Because of being a domestic source, it decreases dependence on foreign sources in terms of energy supply.
- Provide diversity in energy resources.
- Contribute to the socio-economic development through the job and infrastructure opportunities in rural areas (Bostan, 2014).

Today, with the development of technology, the production and use of various energy sources are increasing. Nearly all of the renewable energy sources used are of solar origin. It is one of the most widely used energy sources and generally used by converting it into electrical energy or heat energy. Electricity is produced in two different ways from solar energy. They are photovoltaic batteries that convert sunlight directly into energy and thermal solar energy systems help to convert this steam into electrical energy by obtaining steam from solar heat. For this reason, solar energy does not generate greenhouse gases for energy production (Raj and Agarwal, 2014).

Wind power is a kind of energy that takes its origin from the sun. Due to the difference in temperature and pressure caused by the heating of the surface of the sun, air flow occurs. The rise of the heated air mass and the replacement of the cold air mass causes the creation of wind. Wind energy is obtained through wind turbines. This renewable energy is source that not external dependency, not harmful to human health, not has

carbon emission and radioactive effect. One of the greatest advantages of wind energy can reduce the use of fossil resources and can also contribute to the savings in greenhouse gas emissions that may occur in the consumption of fossil resources. Although renewable energies lots of advantages, they also have some disadvantages. Since the wind turbines are very noisy, they could be very uncomfortable to the residents if they are located close to the settlements (Bloom, 2018).

Biomass energy is an inexhaustible resource and can be found everywhere and is a source of economic energy, especially for rural areas. Biomass sources in general are corn, wheat, algae, herbs, fertilizer and industrial waste, animal feces, all organic waste (fruit and vegetable residues) thrown from home and other places. Biomass energy is obtained in the form of electricity or heat by burning the aforementioned wastes or by various processes. CO_2 produced by burning biomass from plants is energy that is released during photosynthesis and does not cause an extra carbon dioxide release.

2.5.1.2 Biodiversity

The term biological diversity, which means the diversity of species of living organisms, was first used by the US National Research Council in 1986 and then abbreviated to biodiversity. Conservation of biodiversity is important for both economic development and ecological development in the context of creating a sustainable ecosystem. However, ecosystem stability cannot be retained unless biodiversity is protected. Although it has been proven that ecosystems can still function, even with a limited number of keystone species, a high level of biodiversity is still of paramount importance since the higher the number of species available in an ecosystem, the more resilient the ecosystem can be in withstanding human and natural disturbances (Athina, 2015).

There are also considerable psychological benefits from preserving biodiversity and natural habitats. In fact, a substantial body of evidence shows that the need to interact with other species is positively associated with human wellbeing. Knowledge that rare species and landscapes exist is also an important factor that enhances aesthetic values (Athina, 2015).

2.5.1.3 Waste management

Increasing waste generated during production or consumption leads to environmental problems. In developing countries, these wastes generally consist of domestic wastes, wastes which can remain insoluble for many years such as glass, metal, organic wastes, animal and vegetable wastes, increased carbon emission as a result of industry and transportation. As a result of this, waste reach to the extent that they may cause air, water, soil, visual and noise pollution and also harmful for human health (Awomeso et al., 2010).

Waste can be classified as solid, liquid, gas and packaging wastes in terms of consumption, production, chemical, physical. Solid wastes contain solids that are no longer useful or are no longer desired by the user. These wastes are divided into 6 sections according to their place of use: domestic wastes, medical wastes, industrial wastes, hazardous wastes, agricultural wastes and construction waste. Domestic wastes are waste that occur in homes, offices, markets and do not contain harmful substances and can be recycled by separation. These are food waste, kitchen waste, plastic water bottles, paper, glass shards and other waste. Medical wastes include waste from used medicine after medical intervention, operations in hospitals, clinics or laboratories. Industrial wastes are generated during and after industrial processes in industrial and production facilities. Hazardous wastes are explosive, flammable, disease-infectious wastes that can cause significant harm to human health or the environment in industrial or other production facilities. Agricultural wastes are waste produced during plant and animal production. Since these wastes are used as fertilizer, straw or feed, they do not constitute a serious environmental problem. Construction wastes are composed of wastes such as stone, wood, soil, paint during any construction or repair at home. The formation of these wastes varies according to socio-economic status, geographical characteristics, feeding habits and climate conditions of developed and developing countries (Skenderovic et al., 2015).

To prevent such wastes increase, to minimize the damage to the environment and people, to avoid pollution is to create waste management in a systematic way. Waste management is a type of management that consists of on-site separation, collection, transportation, storage and recovery of wastes according to their characteristics and taking environmental and human health into consideration during these processes. It

makes harmless by performing different processes for each of the above mentioned waste types.

Integrated waste management, developed by the U.S. Environmental Protection Agency provides a holistic management of waste. This is a step towards achieving both economic and environmental sustainability. Integrated waste management consists of a total of 6 strategies, regardless of the type of waste: prevention, minimization, reuse, recycling, energy recovery and disposal.

At the first stage, targets for waste reduction should be developed. People should be encouraged not to buy products that they will not use, and to buy products that have less packaging. If this is not the case, waste should be minimized. Reuse and recycling steps are the most important steps in this process. Recycling of used wastes such as paper, glass, plastic, organic products for reuse is economically advantageous as it will be sold at an affordable price and minimizes environmental damage. The next step is to convert wastes that cannot be reused and recycled into renewable energy. The energy that can be reached by burning or other methods can be used in power plants and industrial areas. Finally, it is the disposal of products where no method can be applied.

2.5.1.4 Air, water and soil

The protection of the natural environment and its delivery to future generations without any problem depends entirely on the activities of human beings. The most important task of the human being is to ensure the sustainable use of the environment, especially the protection of ecosystems such as air, water and soil in a balanced way. According to the UN Sustainable Development Goals №3.9 emphasis on the protection of ecosystems, such as: "*the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination*" by 2030 (UN, 2015).

Industrialization, urbanization, globalization and rapid population growth are the main causes of environmental pollution, and after the 1970s it has become a global problem. Air pollution is one of the most controversial environmental problems and its impact will be seen in a very short time. The factors causing air pollution are divided into two groups as pollution caused by natural causes and human activities. Harmful substances such as sulfur and chlorine after natural causes, volcanic eruptions, heat, chemical gases and solid particles after forest fires, harmful dusts or gases caused by some plant

species and animals have great contribution to air pollution. Pollution caused by various activities of people is more than natural causes. In particular, toxic gases and dust emitted from factories, quarries, harmful gases emitted from vehicles, ships and vehicles, nuclear weapons, methane gas generated in garbage depots, chemicals and fossil fuels adversely affect human, animal and plant health (Choudhary and Garg, 2013).

The most common air polluting gases are gases, dusts and fumes from heating, industry and traffic. Disposal of the poor quality fuels burned in the chimneys for heating purposes especially in winter areas causes carbon monoxide (CO), nitrogen dioxide (NOx) and sulfur dioxide (SO2) emissions and the spread of respiratory tract infectious diseases as a result of this gas being easily transmitted to the blood. Traffic pollutants account for about half of air pollution. CO, NO_2, particulate matter, hydrocarbons are pollutant sources due to increased use of vehicles and unconscious use. Preventing these problems is possible by avoiding public transportation or cycling as much as possible, through regular car maintenance and correct fuel selection.

Another environmental problem is the pollution of water resources. Physical, chemical and biological pollution of water means water pollution. Water, which is the living source of living things, is polluted more rapidly than other environmental managers and this pollution causes global problems, climate change, economic downturn and diseases that harm human health. In general, water use can be grouped under 5 headings as domestic and drinking water, industry, energy, agriculture and water needs of ecosystems. Agricultural water use is used more than other sources, and according to the World Bank report, it accounts for approximately 71% of total use worldwide. 18% was used for industry and 11% for domestic use. These uses vary according to the socio-economic status of the settlements, feeding habits and technological developments.

According to Carpenter et al (1998), the sources causing water pollution are divided into two groups as point sources and non-point sources. Point sources are generally controllable sources and affect the immediate environment. Sewage wastewater, construction, industrial and oil fields flow from the water sources point pollution. Non-point sources constitute wastewater whose source is not known, discharged from different places and difficult to control. for example, agricultural land, pastures, water flowing from abandoned mines are these sources.

To ensure integrated water management in an ecological city, it is necessary to use technologies to reduce waste, collect rainwater, reuse wastewater, and improve retention of rainwater without further use of water resources in that city. This water management is based on reducing water consumption in buildings by 40% compared to traditional buildings, recovering waste water and using it only where necessary (Amabile and Ferrari, 2018).

2.5.2 Spatial criteria

2.5.2.1 Location

This parameter focuses on the choice of area to be developed for the eco-city or eco-neighborhood. The random and inhomogeneous growth of urbanized areas above all peripheral is the main cause of the typical problems related to the destruction of local ecosystems, natural habitats, wetlands and to the increase of greenhouse gases, as well as to the increase in the use of private means of transport for access services. Therefore, the right choice of site during planning makes a significant difference in terms of both environmental benefits and human health.

The main objective in site selection is to position it close to the highly urbanized areas and the city center. This causes the expansion of the urban area and the prevention of social and economic problems. Another important factor is ensuring adequate access to public transport to counteract unstable growth and create a more livable space. Being close to public transportation such as buses, rail systems and railroads makes it possible for people who will live in the region to go to the city center and to ensure the ecological sustainability of the area.

2.5.2.2 Urban form

Compact development and mixed land use be in the first place among the spatial criteria of creating an eco-city or sustainable city. Compact development, which aims not to consume much land and not to occupy a place, also enables people to meet their daily needs without spending much time and money. Mixed land use aims to promote transport to different areas and to ensure that the starting and ending points are close to each other. This strategy enables interconnected journeys, that is, it is possible to carry out several activities on a single journey.

For a proper eco-city or eco-neighborhood design, the distance to the service areas and public transport stops in the area should be no more than 400 meters from each residential area. In order to ensure a quality of life, a mixture of both day and night activities should be provided to diversify the lands that provide services not only to this but also to all residential areas and to ensure that the neighborhood lives at any time of the day. Compacting the size of the city will make the city more comprehensible and will increase accessibility and eliminate automobile-centered transport. This will significantly reduce emissions from fossil fuel consumption in parallel with a reduction in automobile use. The streets and sidewalks are open and the stores on the first floor of each building will make the pedestrian path safer and more enjoyable.

2.5.2.3 Transportation

Transportation is the most damaging sector to the environment and covers approximately 23% of the generated CO2 emissions (IPCC, 2014). Unsustainable transportation affects negatively with the pollution of atmospheric air, urban economy as well as human health. Therefore, the approaches in the field of transportation in eco-cities and the strategies of sustainable transportation systems are of capital importance.

Urban transportation is the most significant feature of the urban areas when it is taken into consideration in terms of sustainability. On the one hand, the desire to reduce environmental impacts, on the other hand, to ensure a high level of accessibility emphasizes the importance of coordinating the move in a coordinated manner. The most basic need for the continuation of activities in cities is the need for movement and access. Planning of sustainable transportation includes consideration for transit, automobiles, pedestrians, cyclists, and people for all abilities (Urban Strategies inc, 2008).

The criteria for environmentally friendly sustainable transport are mentioned in each of the aforementioned eco-city performance indicators. To provide the distance between residential areas and social service areas on foot, to use technological transportation models operating with renewable energy sources and to develop non-motorized transportation systems are the major features of eco-city planning.

Sustainable transportation could be explained as to provide mobility by protecting and improving ecosystem, economy and social system for today and future. For the

socially, it provides justice, accessibility, healthy life, responsibility, for the ecology to provide environmental pollution, using of sources and the latest one for economy it supports full cost accounting (OECD, 1996).

The most reasonable way to reduce urban vehicle use is primarily to create compact and mixed-use settlements. The fact that work, school, shopping or recreation areas are close to the place where people live, increases pedestrian access and bicycle use, reduces the ownership of private vehicles and traffic congestion. To creation the compact urban structures will also reduce greenhouse gas emissions up to 40% (Aytıs et al, 2010).

The continuity level of the streets indicates the linearity and connection frequency of the main roads and streets in the network. A road network with a high level of continuity has a large number of short links and junctions, while the number of dead-end streets is minimal. As the level of continuity increases, travel distances are shortened and route options are increased, leading to a more direct and more accessible journey. There should be also continuity of pedestrian paths in the city, vehicle roads, bicycle paths, and disabled routes. Sidewalks and pedestrian crossings should provide continuous, clear paths to the user. Even a small part of the road is irregular, full of obstacles, which is a deterrent for pedestrians, creating a serious obstacle for wheelchair users. Designs that prioritize pedestrians and prioritize access are important in terms of walkability and in a more general context the quality of life.

Access and arrangement of bus stops in the urban public transport is an important component of the bus routes, thus the availability and comfort of bus lanes. A properly designed public transport network is a key part of safe urban roads. The high-quality public transport system is the safest form of urban mobility and carries more passengers safer than other types of transport. Bus stops should be selected at a distance of at least 100 m from the intersections; vehicles waiting at the intersection should be prevented from hanging on the road section at the stop (Walker, 2010). According to standards the distance between the two stops should be at least 400 meter in order not to decrease the operating speed of other traffic.

One of the most important means of transportation to ensure the sustainability in eco-cities is bicycle. Bicycles, which have been dominant since the first half of the 20th century, offer effects such as cheap transportation and reducing the congestion

problem. Nevertheless, it has the advantages of being more durable, causing less air pollution and reducing the impression of climate change. In this context, bicycle use has been classified as one of the primary urban transportation vehicles in eco-cities. Today, cycling has become one of the most important means of protecting human health, economy and atmosphere in most developed countries. There are more than 2 billion bicycles around the world. 23 million of this figure is in the share of Holland, which is the most cycling country in the world. In Holland, there are 3 bikes per family (Harms and Kansen, 2016).

To sum up it is clear that sustainable transportation system is mandatory for the creating eco-city:

- By creating high density and mixed-use urban settlements, distances should be cut down and walkability should be increased
- Access to daily activities of people should be within a maximum 10-minute walk, pedestrian access and bicycle use should be encouraged
- Should take priority of pedestrian, bicycle and public transport respectively on the streets
- Providing different public transportation options - rapid bus transportation, tram and train lines should be developed in accordance with the topography and the frequency of headway should be increased
- Use of electric vehicles should be increased and renewable energy system should be used
- Provide adequate parking spaces for bicycles
- Measures should be taken to reduce traffic accidents
- To reduce the parking areas by using car-sharing systems
- To provide public transport means for the disabled people

2.5.2.4 Buildings and structures

Buildings use energy, water, and raw materials during their construction, generate waste, and potentially emit harmful atmospheric emissions. The negative impact of buildings on the atmosphere is about one third of the total gases causing the greenhouse effect. According to IPCC report (2007) greenhouse gas emissions which contributed

by the building sector will increase 26% by 2030. In addition, approximately 35% of carbon emissions are due to construction and expected to increase faster than other sectors in the next 25 years (Mardiana and Riffat, 2015). For this reason, sustainable buildings play an important role in reducing the environmental impact on the new built areas or for the recovery of the existing settlements. Energy efficiency in buildings and structures, storm water management, disposal of household wastes and the use of non-traditional construction materials that are not harmful to the environment are the basic elements to be applied in eco-city buildings. The major objective of these strategies is to reduce greenhouse gas emissions and prevent pollution. One of the most important design elements is to increase energy efficiency, in particular, and the availability of solar power steering and district heating and cooling systems that enable the use of locally produced renewable resources. Water use in buildings can be significantly reduced by the use of technologies that save water and allow water to be reused. The green roofs ensure that the rain water is collected and reused for flushing and also help to reduce the heat island effect.

Building types used in eco-city projects to comply with these strategies are known as green and passive buildings:

Green Buildings. The basic principles of these buildings are to minimize energy demand by increasing energy efficiency, to provide this energy from renewable sources, to reduce water use and waste and to preserve biodiversity. In green building construction, local and recyclable materials are used as much as possible to reduce project costs and minimize environmental damage (Howe, 2011).

In the green buildings, the electric energy to be obtained from the solar panels can be used for lighting and the wind energy can be used for the building's electricity needs. Electric energy produced by using solar and wind energy is used for heating in winter and cooling in summer. Lighting systems using daylight placed on the roof of the building provide lighting without electricity in the building, especially in winter. The most important feature of the green building is that the greenhouse gas emission to the environment is about 80% lower than an equivalent building (Iskender, 2010).

Passive Houses. These buildings not only improve the living comfort of the residents but also minimize the energy demand of buildings in accordance with the global sustainability principle. By saving high energy, it is possible to save 80% of CO2

emissions in passive houses compared to conventional buildings. Passive houses are designed to be cool in the summer and warm in the winter without heating or ventilation. These houses are characterized by a well-insulated exterior, a smart ventilation system and a structure that maintains the temperature (IPHA, 2014, p.39).

In passive houses, solar energy is used instead of using electric energy network. With the photovoltaic system applied to the exterior facades or windows of the buildings, these structures are converted into equipment that uses solar energy directly, and electricity is produced from the panels on the roofs. Passive house design principles are not just to be applied in the residential sector. It is also possible to implement the principles for commercial, industrial, community centers, apartments, schools and public buildings (IPHA, 2014).

2.5.2.5 Open public spaces and green areas

Cities are places where individuals and societies come together and socialize, and take on the role of a meeting place for the people of all social and cultural classes, different age groups and people with very different characteristics come together. Especially open public spaces play a significant role in the formation of ecological, economic, physical, aesthetic functions and quality living environments in cities. Individuals continue their socio-cultural life with the experiences and activities in these places. Open and green space systems contribute to urbanization by creating more livable environments (Erdönmez, 2005).

The public places could be characterized as a common ground that connects the society, where people perform functional and ceremonial activities in their normal daily routines or periodic festivals. The creation of social life connecting people is understood as place and space. From a distance, the city looks like as a silhouette with the shapes of long and sharp buildings rising to the sky; but when we enter the city, what we want to see the most and what gives us the information about the nature of the region is public spaces. The open space extends from the streets to the squares and the parks and the surrounding buildings and forms the most important parts of the cities (Madanipour, 1996).

The most prominent function of open urban places is to create a social life between buildings. This social life enables people to communicate and socialize with each other in a public space and create a common identity. This social life includes playing

children, celebrations, conversations, collective actions, and passive communication (Erdönmez, 2005).

Jacobs (1961) defines public open spaces as places that people can access for free. Parks and green spaces help to improve the quality of life and create a natural environment. The gathering areas formed by squares and streets came together as a result of settling around a space surrounding buildings. In the vicinity of the squares and smaller-scale collection areas, there are commercial functions as well as cultural activities. These different activities provide the active use of the open urban space 24 hours in a day.

While evaluating the public place with all physical and social environmental conditions, the following features of public space should be taken into consideration (Karayılmazlar, 2018):

- To be open in terms of accessibility or to be a commonplace in terms of usage and meaning
- To play a major role to define the environment
- Gather people who don't know each other
- Be permanent
- Variability in use
- Creating an adventure environment

The factors such as age, education, gender, expectations, preferences, and demands of the people have a notable impact on the usage of green space. For this reason, the characteristics of the social structure (age, gender, occupation, culture, etc.), needs, tendencies and expectations of urban people should be taken into consideration in green space plan and design. Sociological research has shown that social class and subcultures affect public space regulations in cities (Onder, 2012). For example, the upper and middle social classes demand more arrangements for activities such as libraries, congresses, and theaters, while the lower social class demands areas such as entertainment, games and sports. The best way to learn these demands is to ensure that people living in that area are involved in planning stage (Karayılmazlar, 2018).

Public spaces of an ecological city could be designed according to certain criteria (Tunçer and İlçan, 1994):

- Efficient use of microclimatic parameters such as energy saving and waste recovery
- Existing natural areas should be evaluated and developed
- Construction works without changing the topography of the land
- Low cost, reusable, recyclable materials
- Provide enough green space
- Should be accessible to all social groups
- Pedestrian priority transportation system should be provided

Green systems are the most important criterion of eco-city planning and should be established not only by creating new green spaces on their own, but also by integrating them into the existing green system of the city. If green spaces are present, they should not affect their maintenance in any way while preserving their natural habitat and local natural features. The design of the new green areas contributes significantly to the conservation of biodiversity and the development of air pollution and carbon emissions by the development of new plant species depending on their geographical location. New areas to be designed will need to be introduced to streets or tree-lined squares to protect roads from sunlight and to shade at least 40% of the length of the blocks.

2.5.3 Socio-economic criteria

2.5.3.1 Quality of life

For the first time in America, quality of life surveys began in order to detect the social, economic or spatial problems of a country or city and then spread to Canada, England and other European countries. Quality of life means that people can live in a healthy environment, feel safe, find opportunities for their development, and meet nutritional and protection needs. Related United Nations, OECD, WHO and other institutions have established quality of life indicators. A city with a high quality of urban life means a sustainable and healthy city.

The quality of urban life consists of subjective components such as health, security and peace, while concrete values such as built environment, natural environment and economy constitute objective components. The quality of urban life combines physical, social and economic indicators. physical environment can be defined by the

presence of open and green areas, improved transportation facilities, infrastructure services, preservation of historical values. The economic environment is defined by the cost of living and labor characteristics, while the social environment is defined by education, health and safety. It should be taken into consideration these indicators may vary according to different space, different time, different climate zones and different components that may affect the quality may emerge.

According to the OECD Better Life Index, urban quality of life consists of 11 indicators - housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance and 24 components in this context.

2.5.3.2 Public participation

Participation in the planning process is one of the important tools used by decision-makers, planners, designers and architects in shaping contemporary cities due to the positive results it brings. On the one hand, participation in the protection of democratic resources in the sharing of public resources, on the other hand, by adopting the problems of the environment in where the inhabitants live, brings about efforts to enhance the life quality (Esengil, 2009). It is a process in which people involve decisions affecting their personal living conditions, individually or as a group (Meyer, 2011). Especially planning the urban open space, it is necessary to include people who will use it. This involvement will help control that recreational areas, parks, and public places truly meet citizen's diverse demands (Enger, 2005).

The methods of participation in the planning process vary in relation to local managers, planners, and architects as decision-makers' objectives. The participation of citizens in planning and development activities in decision-making processes in various countries is supported by laws. There are a lot of methods to include public to planning development and adoption process (Enger, 2005).

Methods of obtaining information about the user - it is the method used to learn the thoughts and behaviors of the public. The survey which is a statistical data collection method, referendum to learn the general idea of the people, observations that examine the interaction of the people with the physical space and each other are among the methods used to obtain information about the user.

Methods of informing the user - It is very important for the public to be informed by the local authorities to actively participate in the planning process. Because individuals tend to participate at the level, they are aware of exhibitions, public consultation meetings, press releases and announcements via the internet are in this group. The local press is the fastest and most effective way for the local authority to communicate its message to the public.

Methods of planning with mediators – It is the duties of this group to determine the demands by establishing relations with the people in the organization and renewal activities of the physical environment, to provide technical assistance to the people of the region, to inform the official institutions and to obtain information from the official institutions. Based on the principle of volunteering, these groups carry out social responsibility projects and work to protect the interests of people in decisions taken by the authority (Esengil, 2009).

As mentioned above in the eco-city socio-cultural indicators public participation is the main criteria according to all of the organizations. To ensure sustainability in eco-cities without ensuring the rights of urban citizens is impossible. Sustainable development is also a form of participatory development (Newman and Kenworthy, 1999). Meeting the social and spatial needs, having an equal opportunity and a sustainable life for the different ethnic groups, women, children and disabled persons are mandatory for the social sustainability of eco-city planning. In brief, in order to develop where people live they should be a part of planning process and could be perceive the city and environment.

2.5.3.3 Healthy economy

The most important determinant of the society's better prosperity is the economic dimension integrated with the environmental and social dimension. There have always been efforts to eliminate the effects of economic activities on the environment in order to prevent people from being affected by social, cultural and political changes. The most important way to achieve economic sustainability in an eco-city is to increase job opportunities for everyone in the city.

These job opportunities can be in the newly established trade areas in the city, in the tourism areas or in the new construction sites. All these employment opportunities

should be created between the citizens in a fair manner without discrimination between men and women and equal pay for equal work should be provided.

Another method of providing a sustainable economy in eco-cities is the existence of dwellings that can be purchased or accessed by everyone in the area. The presence of both low-priced and high-priced housing in the city or neighborhood will facilitate the social integration of the people living in that area and ensure compliance with different economic classes.

The compact layout of the ecosystem positively affects the spread of job opportunities in the city. The short distance between the housing and the workplace will allow people to reach their destination without wasting much time and at the same time, as the use of vehicles will be reduced, the damage to the environment will also be reduced. For this reason, the distance between workplace and home should be established more closely during planning. The diversity of public transport systems also contributes to the economy of the city.

2.6 Section result

The first criteria to be considered in eco-city planning is the ecological criteria. In this direction, indicators such as the use of renewable energy sources to reduce the environmental impact of fossil fuels, waste management to reduce the harm caused by human wastes, prevention of water, air and soil pollution and protection of natural ecosystem examined. The second one is the spatial which constitute of location of eco-city, urban form, transportation systems, building and structures and open public spaces and green areas parameters. And the last one which is important as the ecological and spatial criteria is socio-economic. In this criteria it will be explained the importance of the life quality, providing public participation and healthy economy objectives and indicators (Table 2.4).

Table 2.4 : Eco-city planning and design criteria.

Criteria	Parameters	Objective	Indicators
Ecological	Energy	Providing energy production from renewable energy sources	Use of solar energy
			Use of wind energy
			Use of geothermal energy
			Use of biomass energy
	Biodiversity	Protecting biodiversity and ecologically important areas	Use different types of plants to protect the biodiversity
			Revitalization of local vegetation
			Evaluation of forest
	Waste management	Ensuring effective recycling	Separate waste collection
			Recycling of wastes
			Generating biogas energy from wastes
			Composting systems for organic waste
			Wastewater recovery and reuse systems
	Water	Protecting water sources and consumption	Rainwater recovery and reuse systems
			Reuse the water for irrigation, washing, fire-fighting or non-domestic use
			Reducing water consumption in buildings
	Air	Ensuring air quality	Reducing greenhouse gases and carbon emission
	Soil	Ensuring soil quality	Preserve pollution of soil
			Reuse of contaminated land
Spatial	Location	Correct field selection	Close to the city center
			Close to main transportation networks
			To be compatible with climate conditions
			The presence of existing settlements around

Table 2.4 : (continued). Eco-city planning and design criteria.

Criteria	Parameters	Objective	Indicators
Spatial	Urban form and land use	Providing mixed-use and compact development	At least 20 services within 400 meters of the residences
			Accessibity to urban facilities
			Different housing typologies
	Transportation	Providing sustainable transportation system	Increasing pedestrian access
			Increasing access by bicycle
			Minimizing vehicle priority in transportation
			Priority giving to public transportation
			Decrease parking areas
			Car sharing or bike sharing near public transport stops
			Transport demand management
			Accessible transportation for disabled people
	Buildings and structures	Reduction of energy need	Design of low energy consuming structures
			Taking into account the distance between buildings and buildings height
			Orientation of the buildings to the south
			Energy saving material usage
		Design of structures in harmony with climate	Establishment of green roofs for reducing heat island
			Increased green facades
			Use of materials that do not harm the nature
		Providing efficient water management	Optimization of water use in buildings
			Establishment of green roofs for water accumulation

Table 2.4 : (continued). Eco-city planning and design criteria.

Criteria	Parameters	Objective	Indicators
Spatial	Open public and green spaces	Providing open and green areas	Increasing green surfaces and areas
			Accessible open spaces for disabled people
			Afforested and shaded streets
			Integration with the existing green system
Socio-Economic	Public participation	Ensuring social sustainability	Involvement of the residents during the planning, accepting advice, organizing workshops and integrative initiatives
			Providing public education on ecology and environment
	Quality of life	Increasing life satisfaction	Providing social justice, better and safety life, health, education opportunities
	Healthy economy	Ensuring economic sustainability	Creating the right amount of job opportunities
			Affordable houses for everyone
			Proximity home and work distance

3. EVALUATION OF WORLD CASES WITHIN THE FRAMEWORK OF ECO-CITY PLANNING AND DESIGN CRITERIA

In this section, four eco-city samples which have been implemented or on project basis in different countries have been selected and their implementation and project objectives have been analyzed within the scope of eco-city criteria.

3.1 Dongtan – Shanghai, China

The Dongtan project, known as the first eco-city plan, is located on the Chongming Island of Shanghai, China. The project was planned by ARUP company in 2010 and it is thought that 500.000 people will live in an area of 3,000 hectares. The main objective of the project was to reduce carbon emissions to zero, to generate enough energy to meet the needs of the buildings, to be self-sufficient in water and energy, and to create a city that provides transportation and infrastructure requirements from renewable energies (Storer and Yang, 2009), (Figure 3.1).

Figure 3.1 : Dongtan project (New Town Institute, 2017).

The Dongtan eco-city has urban planning and environmental design based on sustainable principles. China's energy problems have led to the need to build 400 cities by 2020 to prevent migration from rural areas to cities. This leads to a significant increase in energy consumption and therefore leads to the design of strategies,

planning, projects and technologies related to sustainable development (Cheng and Hu, 2009).

Although the planned objectives of the Dongtan Project could not be achieved, the project is important both as a partnership project of local companies, foreign companies and as an incentive for the implementation of many eco-city projects. In China, there are more than one hundred eco-city or eco-village projects based on the Dongtan Project.

The principles of the Dongtan project to achieve sustainability (Chang and Sheppard, 2013):

- Use of renewable energies: wind, solar, biomass
- Organic farming
- Local resources for construction
- Fuel cells for vehicles, public transport, electric scooters and bicycles
- Green plants cover roofs for building insulation and water recycling
- Maximum eight floors for buildings
- For pedestrians, a space six times bigger than in Copenhagen

According to the master plan, Dongtan eco-city will have a 60% smaller ecological footprint (2.6 global hectares per person) than conventional Chinese cities, a 66% reduction in energy demand, 40% energy from bio-energy, 100% renewable energy in buildings and on-site transportation, reduction of waste to landfills by 83%, and almost no CO_2 emissions (Cheng and Hu, 2009).

Energy. The most important strategy for the Dongtan project to reduce CO_2 emissions is the use of fully renewable energy sources in the use of electricity, heat and fuel. Biomass energy from shells of rice fields, electricity from wind turbine fields, biogas energy by converting solid wastes, photovoltaic panels installed on the roofs of structures and the wind turbines will meet the electricity and heat needs of the area. It will be possible to recycle most of the wastes to obtain biomass energy, as well as to use it for fertilization from domestic organic wastes (Head, 2008).

Biodiversity. Chongming Island is one of the rare preserved natural areas of the region. It is known as a natural park protected by wildlife and bird breeding area in the south.

Although it is a legally protected area, the government cleared some areas for the construction of cities, and one of them was chosen for Dongtan construction.

Waste management. For waste management, it is planned to collect all types of waste in the area and to recycle about 90%. Therefore, no waste collection area is planned in the city and biomass energy will be generated from the majority of the collected waste (Cheng and Hu, 2009).

Air, water and soil. The main objective of the project was to create a city with zero carbon emissions. The strategies to be implemented for this purpose have been primarily set for the use of renewable energy sources, the design of sustainable transport system and sustainable buildings, and the improvement of air quality through organic farming practices. It is foreseen that the project area will be supplied with drinking water with the new water system, and 43% savings in water consumption will be achieved by using rain roofs with the help of green roofs and using them as siphon water or on farms (Cheng and Hu, 2009).

Location. The Dongtan project was designed to be implemented on an island called Chongming, which is part of the city, 60 km from Shanghai city center. This region was a nature reserve with some planting areas and some urban agglomerations and its access was quite precarious. However, in 2009, the construction of a 20 km-long tunnel connecting the region to the land was completed and planned to be of great economic interest. Before the construction of this tunnel, this area was mostly covered with wetlands and natural vegetation (Head, 2006).

Urban form. Urban compactness is designed to provide incentives for the interaction of inhabitants in addition to lower energy requirements and less pollution. Determining the maximum and minimum number of floors for buildings will ensure that the area has a controlled density. The density is planned to be 75 people per hectare. The project area has scattered service areas and various buildings such as tourism, entertainment and cultural buildings. Schools and kindergartens are located within easy reach of vehicles, however universities and hospitals are located at two different corners of the area within easy reach of public transportation (Chang and Sheppard, 2013). The majority of the buildings to be included in the project are considered to be mixed-use and will have functions that will involve mostly commercial and office activities. The urban structure of the Dongtan project is divided into 55% residential area, 24%

commercial and light industrial area, 16% culture, tourism and entertainment and 5% social infrastructure. Most residential buildings in the central area also have mixed use. Different activities are distributed to the urban area and distances are minimized. Some blocks are residence only and the central area is more commercial and serviceable. Big part of the city's design is mixed-use and compact (Barbosa, 2013).

Transportation. In Dongtan, transportation is planned to reduce the impact to the environment and reduce the energy used as much as possible. For vehicles only non-polluting clean fuels such as electric batteries and hydrogen cells are intended to be used. The whole area is focused on bicycles and pedestrians, there are different public transport facilities, parking lots are not within the area but at the entrance of the city, compact development of the land is among the policies of reducing the use of vehicles and sustainable transportation. The public transport network has been sized to ensure walking time of at most ten minutes, in every point of the city, so as to minimize the need for private transport. It envisages an urban network with public transport stations every 550 meters (Head, 2006).

Located on the island with a large wetland, this project aims to use for mobility and better interaction with the natural environment. The roads and channels with the entire transportation system are designed to be connected to each other. At the same time, the road hierarchy has been successfully designed in the project and is divided into main road, second degree, third degree, local roads, bicycle paths and pedestrian roads. This road differentiation both increases urban mobility and pedestrian mobility and provides easy access.

Buildings and structures. Planning of the buildings that make up 40% of the total area different from the general structures reduces the energy to be used up to 70%. It is thought to be a maximum of 8 floors unlike most of the Chinese buildings for the purpose of reducing the energy caused by the use of elevators in the buildings. The green roofs to be installed in the building roofs can be used both for storing rain water and then transforming it. One of the main strategies of Dongtan project is the use of environmentally friendly materials such as wood, and the design of the building heights and the distance between them so that they can benefit from the sun's rays (Cheng and Hu, 2009).

Open public spaces and green areas. Open and green areas developed within the scope of the project have a significant impact. Taking into consideration the height of the buildings, the space was left provided that it is not less than 3 meters. These spaces are covered with green areas, bicycles and pedestrian paths. In addition, public parks are designed for green spaces and entertainment options per person. The existence of open spaces is very important in the Dongtan project, and most of these areas are full of natural elements. In addition, almost all open areas are free access to the public. In addition, the sides of the canals are covered with vegetation to protect local biodiversity.

Quality of life. The main objectives of the project are to provide a healthy and safe life, to create equal service capacity for everyone, to provide job opportunities for all regardless of age and gender, to take measures to reduce crime rates lead to improve the quality of life in the area. It is planned to create a sustainable city by creating management systems where all citizens can communicate with and be represented by the administration.

Public participation. Since the planning mechanism of the Dongtan project is the state, no demographic involvement of any civil organizations and no public participation has been considered in the planning process.

Health economy. In addition to the ecological strategies, Dongtan is examined from the socio-economic point of view and the project is in compliance with the sustainability principles. It is envisaged that the whole population will be employed in schools, hospitals which will be established, agricultural areas and most importantly in tourism sector where the population living in Dongtan. Tourism facilities that provide employment for approximately 50,000 people have been planned (Barbosa, 2013).

3.2 Vauban – Freiburg, Germany

Freiburg im Breisgau, known as the European capital of environmentalism is located at the foothills of the Black Forest (*German: Schwarzwald*) in the south-west part of Germany - Baden-Württemberg province (Fraker, 2013). Placed 25 km from the French and 60 km from the Swiss border, Freiburg is a district in its own right and the center of the town of Breisgau-Hochschwarzwald. Today, the city with a population

of about 255.623 is famous for its mild climate and is one of the warmest parts of Germany (Talmage et al., 2018). Freiburg is acknowledged as an eco-city with its mix urban functions, public transport systems, advanced energy and ecological systems and attractive open spaces. Its economic structure is consisting of research or academic sector and eco-tourism which is focused on green urbanism (Preller, 2018).

Freiburg is well known with its planned sustainable urban district - Vauban. Forum Vauban, which was a social organization established in 1994, and Vauban City Council which took urban planning decisions, worked together to form a zoning plan, urban design concept and also to change the land use plan for Vauban. For this reason, in 1994 a competition for urban planning ideas was organized in Freiburg. Kohloff&Kohloff team from Stuttgart won the design idea concept competition among 70 architecture and urban planning offices. The area was built in three construction phases. The main object of Vauban project which continued until 1998, was to design sustainable urban area and environment where socio-cultural and economic requirements meet (Saraiva, 2010).

The first phase involved the renovation of old military building stock by self-organized building cooperatives, such as S.U.S.I. and Genova, as well as the construction of the Solar Settlement, which included 210 low, zero and plus energy houses. By 2000, the first phase had been completed and 2000 residents had moved in. The City of Freiburg started selling the plots to Baugruppen in the summer of 1999 and the second development phase which involved the construction of another 645 housing units, was initiated in the summer of 2000. During the second building phase, the tram connection was also established, providing easy access to the city center of Freiburg. The last implementation phase started in 2003, but due to financial difficulties stemming from the recession, it was not finalized until 2010. The recession and the difficult market conditions also forced the municipality to deviate from the Baugruppen concept and attract private investors, whose conservative ideas resulted in a conventional parking provision for the remainder of the site (Athina, 2015).

The main goal of the Vauban project was to ensure that this district is ecologically, socio-cultural and economically sustainable. From the conversion of old buildings to new residential buildings, Vauban is not just a neighborhood, it is a living laboratory with buildings that include cooperative, private or commercial functions (Saraiva, 2010).

The goals set by the city of Freiburg and the Forum Vauban are mainly based on six heading of housing, urban planning form, population and social relations, transport and mobility, environment and finally public participation in the project. The major objectives of the project in the context of ecological, economical and socio-cultural dimension:

- To bring down the use of private vehicles, the construction of the tram line to Vauban from Freiburg city center
- Developing car-free concept
- Construction of the low energy buildings for the protection environment
- Construction of roofs with solar panels placed
- Soil water infiltration and use of ecological sanitary systems
- Use of sustainable ecologic building materials
- Protection of existing green areas and plant new ones
- To mix the housing and working areas
- To develop a district center with shops for daily necessities
- To develop a social and cultural infrastructure
- To adjust educational structures such as kindergartens and primary schools within walking distance of the residential areas
- Ensuring a social balance within the region
- Construction of small scale cultural buildings for the cultural activities like concert, theater events can be held

Energy. Already during the competition, Forum Vauban aimed for the Vauban project to reduce environmental pollution through low-energy construction and efficient use of its energy.

Vauban had the advantage that the project area had a heating system left from military use. But due to the fact that this system was at the regional level, residents' control over energy resources could not meet the percentage of fossil and renewable fuels in particular. The solution to this problem in 2002, local defense groups established a combined heat and power system that could use forest wastes as the main fuel at the

neighborhood level after a long study. The “Freiburg Low-Energy Standard” meets the local energy efficiency code for all buildings in the neighborhood.

According to the energy policy of this project:

- The average annual energy usage of all buildings in the area should not exceed 65 kWh/m².
- The energy requirement of the area should be provided by high efficiency wood chips and gas-fired cogeneration plant.
- Photovoltaics were placed on an area of 450 m^2 - most of the buildings until 2000, in order to access heating and hot water supported by construction cooperatives.
- Low-energy houses, passive houses and plus energy houses were gathered under 3 different standards (Fraker, 2013), (Figure 3.2).

Solar energy is used on a large scale in Vauban. The photovoltaic solar panels used for heating the area and water were voluntarily carried out by the building owners, including dormitories, schools and garages. In particular, the Vauban “Expo 2000 Solar Settlement” project consists of 60 plus energy residential buildings and the commercial “Sun Ship” building on an area of 11,000 m2. This site generates approximately 420,000 kWh of energy per year with photovoltaic power (URL-1).

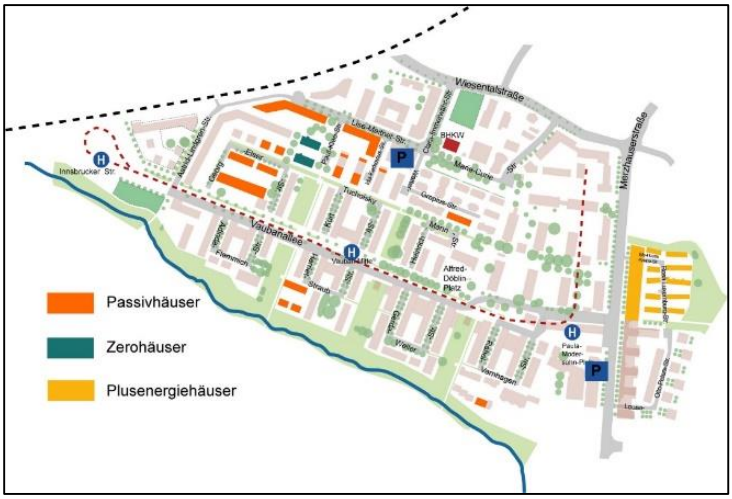

Figure 3.2 : Housing typologies in Vauban (URL-1).

Since 1991, the 5-storey Solar Garage, with its entire roof covered with solar panels, has been producing 81 MWh of energy annually. It does not only meet the energy needs of the car park, it also meets the daily energy needs of the grocery store on the

ground floor. Until 2013, 89 photovoltaic solar panels were installed on a total area of 1200 m^2. In conclusion, Vauban saves 28 GJ energy per year, 2100 tons/year CO_2, 4 tons/year SO_2 and 1600 ton/year mineral recourses (Fraker, 2013).

Biodiversity. Vauban is known for its pleasant view of its green and open spaces. Trees that existed for more than 60 years were a natural advantage for Vauban. Although some trees were damaged during the construction, the tree species were examined and started to be object against unnecessary cuts before starting the project. The presence of around 70 planes, limes, poplars, maples and chestnuts creates leafy surroundings and a healthies atmosphere, bringing the cool of their shade and moisture to the dry summer air. To the south the district borders on the protected "regenerated biotope" area beside the Sankt Georgen Stream. In addition to the trees that have existed for centuries, there are also trees carefully planted by the inhabitants of Vauban and its surroundings (Müller, D. G. 2002), (Figure 3.3).

Figure 3.3 : Regenerated biotope area in Vauban (photos by author, 2018).

Waste management. Vauban has a specially designed drainage system to facilitate the absorption of rainwater. Open water channels collecting rain water on the streets were built parallel to the main street. These channels are connected to the central collector channel located in the west. At the same time, waste water from the kitchens or bathrooms of the residences flows into the central canal. Most of the wastes are mixed with the natural structure of the soil through a biological treatment made on the bottom surface of the pipes along the transportation channel.

Air, Water and Soil. In Vauban, rainwater recovery is provided by green roofs with a 10-degree slope. These green roofs retain a part of rainwater and release it to the infiltration trenches at a later stage. 70-100% of the collected rain water is either used by plants or directly evaporated. In addition, some buildings are equipped with rainwater tanks for flushing for toilets or washing machines (Fraker, 2013).

Location. Vauban district is located about 3 km south from the center of Freiburg, 15 minutes away from the Freiburg main station by train. This area, which was barracks until 1990, was occupied by a group of students and citizens after 6.000 French troops left. In 1992, the city of Freiburg received 34 hectares of a total of 38 hectares of area from the federal government for 20.45 million consideration euros and decided to develop here with sustainable urbanism principles. The remaining 4 hectares were taken in 1993 by S.U.S.I and Stundentenwerk (Athina, 2015).

Urban form. The urban planning concept for Vauban is reserved for compact residential space in the southern and central regions, while the northern part is reserved for commercial use. In the transition to the entrance to Merzhauser street for commercial and residential use, limited areas were identified as a mixed area in the development plan.

The settlement area is divided into small and medium parcels to support the architectural diversity of the buildings. These areas vary from 162 m^2 to 5400 m^2 for individual owners, construction groups or commercial investors. The service areas are distributed along with the residential buildings throughout the neighborhood.

Transportation. When designing the Vauban project, the first goal was to create a neighborhood where people could walk or cycle to perform their daily activities. Forum Vauban described the transportation idea for project *"We did not want to be fanatical about the car free concept. We wanted to reduce individual car use and offer people the option of car free living"* (Melia, 2006). Based on this objective, the layout plan of the area is designed in such a way that small offices, commercial buildings and businesses are distributed around the central axis. Houses and open green spaces are scattered around this axis, and the design of the roads and paths is adjusted to the main center with the U-shaped grid system. The structure of the district focuses on discontinuity in order to create closed residential areas, which leads to a reduction in traffic areas and speed of travel (Figure 3.4).

Figure 3.4 : Street views in Vauban (photos by author, 2018).

Basic transportation policies developed in Vauban:

- Reducing car using within the area
- Parking prohibition at the residential areas
- Short distance access to schools, shopping areas or recreation areas
- Car sharing availability
- Public transport access
- Speed limit policy

The policy of reducing car use was not foreign to the inhabitants of the city of Freiburg. Interesting and new was that the concept of reducing the number of cars combined with the concept of parking restriction. According to the car-free concept, it is forbidden to park cars in residential areas, especially at the entrances of buildings, and is only permitted in cases of loading, unloading, taking or leaving. For parking, a total of 470 4-storey Solar garage and Glasgarage which costs 40,000$, open parking areas or approximately 400 underground parking lots can be used at the periphery of the residential area. In addition, residents who do not drive are obliged to sign a document annually to indicate and commit. More than 40% of the 1000 families in Vauban prefer car-free living and there are 183 cars per 1000 people (Coates, 2013).

As in Freiburg's city transport policy, the entire Vauban area is 300 meters from a house and store for short trips, or 300 meters from school and services, and 700 meters from one end of the neighborhood to the other. The speed limit is set at 50 km/h on

Merzhauser Street, the main transportation axis in the Vauban region for traffic calming purposes, 30 km/h on the roads within the islands and 10 km/h on the 4 m wide side roads (Schroepfer and Hee, 2006). The speed limit is advantageous for children playing in the neighborhood. The development of the car free concept has made it easy to reach public transport stops and social facilities in Vauban. All stops within the neighborhood are about 300 meters from the house and are within walking distance.

The tram line connects Freiburg center and Vauban completed in 2006. Vauban is located 3 km from the center of Freiburg and can be reached in 15 minutes by this tram line. There is also a suburban train line and 3 bus lines to reach Vauban. Apart from these the "Freiburger Auto Gemeinschaft" company provides car and minibus vehicles for everyone to facilitate their arrival in the city center. There are 12 of these vehicles and 5 of them are located in Solar garage. Residents can use these vehicles for 350 euros per person per year or 600 euros per family.

Buildings and Structures. The buildings built in Vauban have three types as low energy, passive houses and plus energy houses. Approximately 300 of the total housing units are passive houses and plus energy houses for low energy saving.

Passive Houses. Buildings with a heat consumption of less than 15 kWh per square meter per year or 1.5 liters of heating oil per m^2 per year. In 1999, for the first time in Germany, passive house standards were applied in Vauban in multi-family housing. According to 2013 data, there are approximately 200 passive housing units in Vauban. Some of these buildings generate the thermal energy they need in cogeneration plants, while others use the district's general heating network. Since the front facades of passive houses had to look south for heat and electric production, they had to be revised according to the east-west level of the buildings in Vauban's land use plan.

Plus Energy Houses. Although at first glance it may seem like a normal house, plus energy houses, like passive houses, are structures with a heat consumption of less than 15 kWh per square meter per year, producing all the electrical energy it needs, and even surplus energy. Vauban has about 100 housing units so far. Key features of the plus energy house developed by German architect Rolf Disch:

- the living and bedrooms of the buildings are to the south, and the areas such as bathrooms, kitchens are on the north side,

- covering the entire roof with solar photovoltaic panels (3 to 10 kWh),
- the use of recycled materials in building construction,
- high thermal insulation windows
- indoor wood coating
- the south-facing portion of the roofs is longer than the other side to increase the number of solar panels.

Open public spaces and green areas. The natural landscape was widely preserved and enhanced. There was an effort to retain the old trees on site wherever possible, while the masterplan established five green corridors that connected the neighborhood with the surrounding countryside. Open spaces were carefully designed and were either public or semi-public in nature. Five large common green areas were applied between the north-south roads throughout the Vauban neighborhood. Since each one was planned with the participation of the residents in the workshops, these green spaces allowed the differentiation of the character and the use of the residents. Green and open spaces within the district provide areas for children's sport and play, young people can engage in social activities and adults can come together in that areas. Buildings are separated by 30 m wide green strips, where the buildings are oriented north-south.

The contribution to Vauban's sustainability is not limited to green spaces, but the other important contribution is the green roofing and green facades that are widely used in both residential and other buildings. The environmental and ecological contribution of green roofs to the management of storm water, and the aesthetic and ecological contribution of vertical green facades are the main factors in the Vauban project (Figure 3.5).

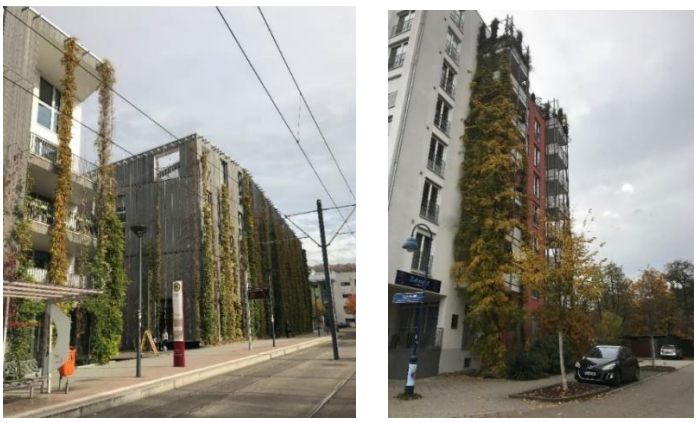

Figure 3.5 : Buildings with green facade in Vauban (photos by author, 2018).

Public participation. Providing public participation, which is one of the main social goals of the Vauban project, has undoubtedly brought various advantages to the neighborhood. In early 1994, Forum Vauban applied to coordinate the participation process, and a year later it was officially assigned by Freiburg as a participatory planning organization. Baugruppens (building cooperatives) were also recognized by the participants as vital for the maximum inclusion in the public participation process. Building cooperatives started being formed by families who were interested in moving to Vauban, for the collective acquiring of the plot and the construction of the residential unit (Athina, 2015). The first participation process started with an activity of 80 people and forming five working groups. Since Forum Vauban did not use any role models, it was constantly receiving new requests and had to respond to them. From 1995 to 2000 a total of 5 participation stages can be defined:

1995 – Idea and Vision

1996 – Technical support and publicity campaign

1996-1999 – Realization and project construction

1998 – Special participation procedures on individual aspect

From 2000 – Operating and implementation support

The main purpose of the Forum Vauban was to create a sustainable model urban district. For this reason, it also participated in the development plan and significantly changed the Vauban neighborhood with the traffic and energy concepts developed. Forum Vauban also ensured the participation of citizens interested in the design process of the streets, streets, common areas and children's playgrounds.

Healthy Economy. The economic performance of the project in Vauban was, to a large extent, satisfactory with regards to eco-city design criteria. From an employment planning perspective, the opening of commercial spaces and leisure facilities in the area facilitated the acquiring of jobs for the residents within the district. The information and other invaluable resources provided by Forum Vauban raised awareness around environmental issues, a fact that promoted the formulation of green businesses. In addition to that mixed-used land use, the walking distance of areas such as work places, schools or kindergartens affect the neighborhood economy positively for those living in Vauban.

3.3 Bo01– Malmö, Sweden

Malmö city which is the connected to Copenhagen with bridge is located at the edge of southern Sweden - Oresund Strait. Malmö, which is the third biggest city of the country with a population of 280.000, has set targets for sustainable development since 1970 and completed the first sustainable development phase until 2001. In 2001, Bo01 (Bo means - housing, 01 means -2001) was presented as ecological with the "City of Tomorrow" concept for the European Housing Exhibition. The construction of the project started in 1998 and covers an area of approximately 22 hectares (Figure 3.6).

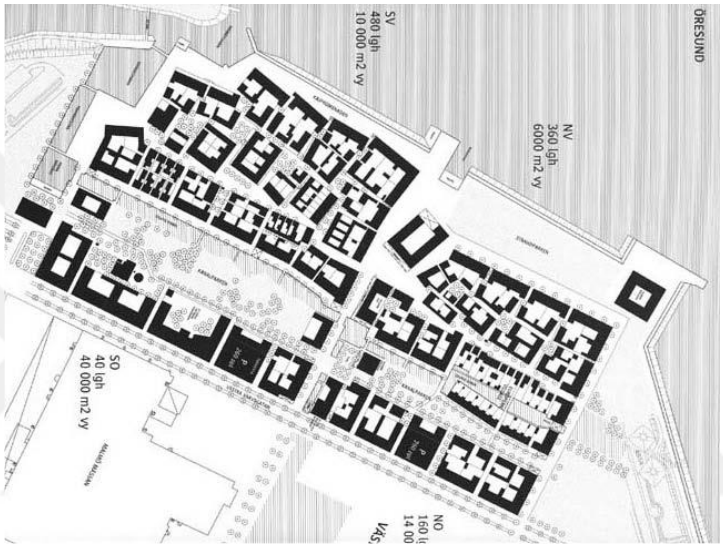

Figure 3.6 : Bo01 master plan (Austin, 2013).

The major objectives of the project in the context of ecological, economical and socio-cultural dimension:

- Ensuring 100% renewable energy use
- Ensuring biodiversity
- Ensuring the use of rain water through systems such as green roofs
- Establishing an effective waste management
- Pedestrian and bicycle priority, ecological and sustainable transportation system forming
- Urban identity, diversity, compactness, human scale, meeting points ensuring aesthetic quality through parameters such as safety
- Ensuring social cohesion

- Supply of green architectural designs
- Energy by constructing the morphological structure of the city according to the climate saving
- Ensure the active use of information and communication technologies

Energy. The main objectives of the Bo01 project are the use of renewable energy sources. The solar panels installed on the roofs of the buildings, the wind power station at the northern port and the conversion of organic wastes into biogas total energy are used from 100% renewable energy sources. Almost all of the electrical energy is supplied by wind energy. The area, which has the strongest 2 MW wind turbines in Sweden, is located 3 km from the port area. Its annual output is 6.3 million kWh, which meets the energy demand of the neighborhood. 85% of heat production is met by geothermal energy. The heat stored in summer is distributed for heating in winter and the cold water collected in winter is distributed for the supply of air conditioning systems in summer. In addition, heating is provided by solar panels covering an area of 1400 m^2 and a central district heating system which operates with a thermal power plant which uses the heat difference between 200 m^2 solar collectors and heat pumps (URL-2).

Biodiversity. During the implementation of the project, the strategy of increasing green areas and biodiversity was developed in order to increase the amount of rainwater infiltration in the area. Therefore, a total of 35 environmental measures have been established in the neighborhood, including the cultivation of rare endemic plants, the creation of different habitats for small animals, birds, bats and insects. At least 10 of these measures have been implemented in each residential courtyard. This approach allowed the city to continue to concentrate while preserving an urban environment rich in flora and fauna. In the neighborhood nearly 300m^2 are reserved for green spaces per 1000 m^2 and the circulation of water while 200 m^2 are occupied by semi-waterproof surfaces covered with gravel (Anderberg, 2015), (Figure 3.7).

Figure 3.7 : Green points in Bo01 (Anderberg, 2015).

Waste management. The waste management system in the region is being used effectively and is divided into two types – organic and non-organic. Organic wastes are collected in underground tanks and converted into biogas energy in the newly built biogas plant. This energy is used both for heating in the area and as fuel in vehicles.

Air, water and soil. Rain water collection system is well designed. The basic concept for rainwater management is a sustainable and open drainage system. The main purpose of such a selection is to integrate environmental values into the region and to direct such a system in a very dense residential area with limited green spaces. Rain water management system includes green roofs, vertical green facades, permeable surfaces, open trenches, ponds in private courtyards, canals, and a large rainwater basin. This drainage system is completely integrated into the neighborhood design, from general squares, canals and green areas to fine drainage. Rainwater from roofs is often left on the surface, rather than buried in subsurface pipes and drains. Most of the collected rain water is reused and some of it is used in the streets or in the pools in the parks.

Even if the project area was not an old industrial zone, it was one of the basic strategies to clear the soil to be used. In some places there was a high concentration of toxic material and about 10,000 tons of rubble were transported. Almost 75% of the excavated soil was reused after lots of tests. The rest was sent to sanitation for chemical and biological management. In areas with low concentrations of pollutants, it has been made useful by covering new clean soil on old soil.

Location. The project area was built 3 km north-west of Malmö city center. The area chosen for the settlement of the area, which covers an area of about 22 hectares and has a population of approximately 3,600 people, is located to the west of Västra Hamnen, a former port and shipbuilding area. Västra Hamnen is an artificial peninsula of 160 hectares built towards the end of the 19th century, thanks to the original seashore reclamation of the Kockums shipyards. In 1996, the municipality of Malmö purchased the entire artificial peninsula to transform it into a new residential area that takes care of ecological issues. The entire urban transformation project of Västra Hamnen is expected to be completed by approximately 2030. Although the area where the Bo01 project is implemented is the old industrial area of Västra Hamnen Malmö, it has advantages in the direction of creating an ecological city because of its proximity to the seashore, the city center and low air pollution.

Urban form. The architects who designed the general master plan for the western port area have prepared an irregular grid, taking into account the bioclimatic requirements. Since this part of the port area is exposed to strong wind breeze, the polygons of the buildings are designed to direct the air currents. This, together with the green space and water space designs, creates different landscapes that characterize the neighborhood. In Bo01, approximately two thirds of the urban area are for residential use, the rest for commercial activities, offices and services. The heights of the building vary from one to six floors, with an average of three floors. The buildings on the dock are five and stories to protect the rest of the neighborhood from strong western wind. Aesthetic quality has been achieved by considering the compactness and human scale in the mixed-use area.

Transportation. Creating an ecological city with a sustainable transportation system in the area was another objective of the project. All streets provide the best service for pedestrians, bicycle users and public transport. Public transport serves every node in the neighborhood and all bus stops are approximately 300 meters from the residential areas. At the same time, public transport is electrically powered, helping to reduce carbon emissions.

The most important factor that makes the neighborhood environmentally sustainable is the presence of pedestrian and bicycle paths designed to minimize vehicle traffic. 30 km/h speed limit has been applied on main roads to make the spaces more livable

and safer, and the parking area per family (0.7) has been minimized to reduce vehicle use.

Buildings and structures. In the Bo01 project area, attention has been paid to the initialization of the buildings, high-rise buildings are located in the coastal zone and low-rise buildings are located in the inner parts to prevent the wind from passing into the inner regions (Figure 3.8). This arrangement eliminates venture effects in the streets and alleys, while enjoying the benefits of the coastline. The rented or private apartments in the area are divided according to the social level of the inhabitants or arrivals: private property promotions provide more luxurious, canal and sea views and beautiful panoramic views. In addition, ecologically non-hazardous materials were used in all of the buildings constructed and received several certification awards for the environment (Farr, 2018).

Figure 3.8 : Low-rise buildings in the inner part in Bo01 (Anderberg, 2015).

Open public spaces and green areas. Open public and green spaces are essential for the project. Three main parks are planned to ensure mobility and livability of the spaces. Areas equipped for sports, skateboarding along the canal, public gardens, docks designed along the sea and the canal have made the area more socially attractive.

Quality of Life. The quality of life in the area is generally satisfactory, but according to the survey results some problems are known. The lack of schools and kindergartens and the fact that cafes and restaurants are closed in winter are among the complaints of the residents. For the outdoor level residents requests are the playground where children can play, and for the transportation, buses should be more frequent.

Public Participation. During project planning public participation was not considered.

3.4 Eco-Viikki – Helsinki, Finland

Viikki region, which is located 8 km from the Finland capital Helsinki city center, started to be built in 1999 and was completed in 2004. In the 1990s, studies were initiated to create sustainable settlements that are thought to be the solution to the ecological problems in Finland and the Viikki project which has cultural and historical value, was selected as the project area. The project, which consists of 5 stages, covers an area of approximately 1200 hectares. 25% of this area is reserved for housing and the rest for recreation and wetlands. This region is located near a large agricultural area that forms a green belt around a large nature reserve. In addition to residential buildings, there are commercial spaces with all the necessary services such as hospitals, schools, shops, biotechnology is mainly used in R & D centers, winter garden, and livestock farms (Siiskonen, 2008).

The Eco-Vikki region was located in the southern part of the area and was built in the second phase of the Viikki project. The project is spread over a total area of 23 hectares on a greenfield site, bounded by the historical natural conservation area and university (Figure 3.9).

The main goals of the project are collected on 5 headings:

- Reducing the pollution
- Use of natural resources
- Improving the quality of life
- Ensuring biodiversity
- Organic agriculture

Figure 3.9 : Eco-Viikki ecologic settlement (Heikki, 2009).

Developed to achieve these purposes ecological design principles of the project are:

- Including green areas between built areas as “green-fingers”
- Characterizing the green area between the built and open areas as a wind protection zone
- Orientation of the buildings to the south
- High-rise structures (3-5 storey) on the inner part of the area and low-rise (2-3 storey) structures on the external part
- Using eco-friendly materials (timber)
- To protect the historical and natural values
- To reduce CO_2 emission using renewable energy sources
- To apply systems that will save 40-50 liters of water per person
- To provide 20% less waste
- Preserving agricultural areas outside of the project area
- Public spaces for the children and youth
- Active participation of users and citizens in decision-making processes (Viikki, 2010).

The project examines the realization of sustainability change at three different levels: 1. Technological potential in practice: change in energy and water consumption, 2. Policy controls: change in building and design standards, 3. Housing and environmental potential: values of inhabitants and green structure.

Energy. When the Eco-Viikki project is examined within the framework of eco-city design criteria, it is seen that the utilization of renewable energy is among the main objectives of the project. Eco-Viikki has the first and only solar apartment buildings in Finland. 9 building blocks and 412 residential units are equipped with solar heating to heat hot water in the area. With regard to solar energy, Eco-Viikki applies passive techniques involving building orientation, green houses and glazed balconies, while active techniques involve solar-generated heating and electricity systems (Droege, 2009). Thanks to the energy obtained from the photovoltaic panels used in buildings, it meets 20% of the electricity requirement of an apartment. Apart from that, in order

to increase the efficiency of natural ventilation from wind power, negative pressure fans are installed in the chimneys of the houses (Hakaste et al., 2005).

Biodiversity. The strong wind in the area is a feature that is taken into consideration in the design of green space and vegetation. The main wind direction in the Viikki region is southwest and the nearby coastal areas do not serve as natural barriers. In order to reduce the wind in the area, increase the comfort of life and reduce the energy consumption of buildings, a dense vegetation of various species was planted along the southern edge of the settlement to form a natural barrier against the wind. To maintain the effectiveness of wind protection in winter, deciduous trees and shrubs are surrounded by other evergreen trees of the conifer family. One characteristic of the urban plan for this experimental eco-settlement is that natural areas are intertwined with residential areas.

Air, Water and Soil. "Green fingers" system applied in Eco-Viikki project has been very successful both in horticulture and storm water collection. Due to the its nature, the land of Viikki is unable to retain all of the rain water and absorb some of it. This is prevented by the "Green fingers" system and is directed to the channel near the escaping water area by means of opened grooves. The system includes rain water wells and this rain water is used in garden irrigation (Figure 3.10). There are hydraulic pipe systems for water saving in buildings and systems for reusing rain water in condominium use. Daily water consumption is less than the average of the Helsinki municipality, but varies between approximately 100-125 liters. This depends on whether the laundry and sauna are common or private.

Figure 3.10 : Green Fingers and surface water run-off system in Eko-Viikki (Heikki, 2009).

Location. Located on the 8 km north-east of Helsinki center, 20 minutes from Helsinki-Vantaa airport, close to a large agricultural area Eco-Viikki acts as a green belt around

an important nature reserve. The site is located in an advantageous location in terms of its geographical location or accessibility.

Urban form. In the Viikki project, housing, recreation and business areas are interrelated. The 850 km long bike path links these functions to each other and creates a compact residential area. In addition, metro and train line to reach the center of Helsinki reduces the use of cars.

When the Eco-Viikki master plan is examined, it is seen that housing and working areas are associated with universities and techno parks. The working areas are located close to the main traffic arteries and the recreation areas are located close to the residential areas. The proximity of residential, working, service and recreation areas is within walking distance with is a compact settlement. It is planned to preserve natural protected areas and agricultural areas for the region, which has a wide valley character and is bordered by forest and rocky areas in the north. The morphological structure, location and climate of Eco-Viikki are shaped in accordance with the densely structured parts of the highway, the large recreation areas are connected with the Helsinki Central Park in the northeast of the city.

Transportation. The most important feature of the Eco-Viikki is that private car use is not necessary and has an efficient public transport network, such as a bus and train line, which provides adequate connections to the city. The area is equipped with traffic calming techniques, vehicles and pedestrian roads are kept separate to ensure maximum safety. Parking space is minimized: 1 for every $16m^2$ residential area for terraced houses and 1 for every $80m^2$ for condominium.

Buildings and Structures. In the Eco-Viikki project, it is aimed to use the materials used unlike the traditional structures in a way that they are not harmful to the environment ecologically. The walls and windows are intended to be fitted with thicker and higher quality insulating material to prevent escaping hot air. Even during the winter all buildings aimed at utilizing solar energy were directed to the south. The solar collectors on the roofs of the building have been installed with an inclination of 45-60 degrees to make better use of the sun. These collectors cover a total area of 1250 m^2 (Figure 3.11).

Figure 3.11 : Buildings with solar systems in Eko-Viikki (Hakaste et al., 2005).

Open public space and green areas. In the Eco-Viikki area, the green areas are mainly designed to be located in the area which is called “Green fingers”. The buildings are grouped around the residential areas and connected directly to the green area by the green fingers inside the built environment. In this section, there are public open spaces among the trees, 500-1000 m^2 gardens where the citizens can do agriculture, areas where storm water collection and humus compost for urban wastes will take place. The region has been enriched with public spaces by creating local shopping centers, shops and restaurants.

Quality of Life. Great importance has been given to improving the quality of life of the citizens with spatial and social practices in the area. Whether sustainable transport system and active green spaces or social cohesion are the main actions developed in this direction. Mixed social structures were created by not being placed separately as the property owners, social dwellers and tenants of the population, and spaces were created for all social sectors.

Public Participation. In addition to actors such as city management, technology agencies, architects and planners, the participation of the citizens in the design process of the project was ensured. Ensuring the active participation of the citizens is an indication that Eco-Viikki attaches importance to social sustainability.

Healthy Economy. The economy of the Viikki region is based on high-tech ecological agriculture and have been provided a sufficient number of jobs.

3.5 Assessement

In this section, the examples of the world cases will be compared according to the eco-city planning and design criteria developed within the scope of the thesis. These

criteria are ecological, spatial and socio-economic and "✓" is used when the indicators meet the specified indicators, "✗" is used when it does not meet and "n/a" is used when it is not available (Table 3.1).

Table 3.1: Assessment of world cases in terms of eco-city planning and design criteria.

	Parameters	Indicators	Dongtan	Vauban	Bo01	Eco-Viikki
Ecological	Energy	Use of solar energy	✓	✓	✓	✓
		Use of wind energy	✓	n/a	✓	✓
		Use of geothermal energy	n/a	n/a	✓	n/a
		Use of biomass energy	✓	✓	✓	n/a
	Biodiversity	Use different types of plants to protect the biodiversity	✓	✓	✓	✓
		Revitalization of local vegetation	✓	✓	✓	✓
		Evaluation of forest	n/a	✓	n/a	n/a
	Waste management	Separate waste collection	✓	✓	✓	✓
		Recycling of wastes	✓	✓	✓	✓
		Generating biogas energy from wastes	✓	n/a	✓	n/a
		Composting systems for organic waste	✓	n/a	✓	✓
		Wastewater recovery and reuse systems	✓	n/a	✓	✓
	Water	Rainwater recovery and reuse systems	✓	✓	✓	✓
		Reuse the water for irrigation, washing, fire-fighting or non-domestic use	✓	✓	✓	✓
		Reducing water consumption in buildings	✓	✓	✓	✓

Table 3.1: (continued). Assessment of world cases in terms of eco-city planning and design criteria.

	Parameters	Indicators	Dongtan	Vauban	Bo01	Eco-Viikki
Ecological	Air	Reducing greenhouse gases and carbon emission	✓	✓	✓	✓
	Soil	Preserve pollution of soil	✗	✗	✓	✓
		Reuse of contaminated land	n/a	n/a	✓	n/a
Spatial	Location	Close to the city center	✗	✓	✓	✓
		Close to main transportation networks	✗	✓	✓	✓
		To be compatible with climate conditions	✓	✓	✓	✓
		The presence of existing settlements around	✗	✓	✓	✓
	Urban form	At least 20 services within 400 meters of the residences	✓	✓	✗	✗
		Accessibility to urban facilities	✓	✓	✗	✓
		Different housing typologies	✓	✓	✓	✓
	Transportation	Increasing pedestrian access	✓	✓	✓	✓
		Increasing access by bicycle	✓	✓	✓	✓
		Minimizing vehicle priority in transportation	✓	✓	✓	✓
		Priority giving to public transportation	✓	✓	✗	✓
		Decrease parking areas	✓	✓	✓	✓
		Car sharing or bike sharing near public transport stops	✗	✓	✓	✗
		Transport demand management	✓	✓	✗	✗
		Accessible transportation for disabled people	✗	✓	✗	✗

Table 3.1: (continued). Assessment of world cases in terms of eco-city planning and design criteria.

	Parameters	Indicators	Dongtan	Vauban	Bo01	Eco-Viikki
Spatial	Buildings and structures	Design of low energy consuming structures	✓	✓	✓	✓
		Taking into account the distance between buildings and buildings height	✓	✓	✓	✓
		Orientation of the buildings to the south	✗	✓	✗	✓
		Energy saving material usage	✓	✓	✓	✓
		Establishment of green roofs for reducing heat island	✓	✓	✓	✓
		Increased green facades	✗	✓	✗	✗
		Optimization of water use in buildings	✓	✓	✓	✓
		Establishment of green roofs for water accumulation	✓	✓	✓	✗
	Open public and green spaces	Increasing green surfaces and areas	✓	✓	✓	✓
		Accessible open spaces for disabled people	✗	✓	✗	✗
		Afforested and shaded streets	✓	✓	✗	✗
		Integration with the existing green system	✓	✓	n/a	✓
Socio-economic	Public participation	Involvement of the residents during the planning, accepting advice, organizing workshops and integrative initiatives	✗	✓	✗	✓
		Providing public education on ecology and environment	✗	✓	✗	✗

Table 3.1: (continued). Assessment of world cases in terms of eco-city planning and design criteria.

	Parameters	Indicators	Dongtan	Vauban	Bo01	Eco-Viikki
Socio-economic	Quality of life	Providing social justice, better and safety life, health, education opportunities	✓	✓	✓	✓
	Healthy economy	Creating the right amount of job opportunities	✓	✓	✗	✓
		Affordable houses for everyone	✗	✓	✗	✗
		Proximity home and work distance	✗	✓	✗	✓

All of the samples studied were built for different reasons requiring the transformation of functions in the existing area or a new urban expansion was planned to be suitable for the planned area. These settlements have been designed in accordance with the principle of compact urban design with high population density and produced as a result of solutions developed against existing problems in order to ensure the ecological, spatial and social sustainability of existing urban areas. The differences in eco-city design criteria in the world examples examined vary not only with respect to geomorphology and spatial characteristics, but also with the architectural or urban planning traditions, legal infrastructure, planning and technical solutions of the city or country.

In this study, four world samples which differ according to the type of development were analyzed: Dongtan project with new planning and not implemented for now, retrofit - Vauban and Bo01 projects, urban expansion - Eco-Viikki ecological settlement. The main differences and similarities that emerge in the comparison of the eco-cities studied are as follows: The planning and implementation objectives of each cities were developed for different themes. The aim of the Dongtan project is to create a modern ecological living space with zero carbon emissions while preserving China's traditional social and cultural life, the aim of the Vauban project is to build an urban area where ecological, social, economic and cultural needs can be provided through participation in a former military barracks, Bo01 project to utilize 100% renewable energy resources by re-evaluating an old port area, the aim of the Eco-Viikki project

was to create an ecological area by preserving the green areas of historical and cultural value.

As can be seen from the table 3.1, all the examples in the context of environmental criteria foresee to generate energy by utilizing renewable energy sources. Especially the city of Bo01 has achieved a 100% by using all renewable energy sources. All of the samples focused more on obtaining energy from solar energy, while wind energy was used by all other eco-city examples except Vauban. Eco-Viikki and Bo01 samples are aimed to reach the principles of eco-city based on more technology. Strategies have been developed to improve the air quality in all settlements, the highest CO_2 emission reduction is seen in Bo01 by 100%. This is followed by Vauban (60%) and Eco-Viikki (13%). Only in the Eko-Viikki has been designed for noise curtain due to its proximity to the ring road. The proximity of Dongtan and Eco-Vikki to the existing green and agricultural areas, and the presence of the Vauban in the proximity of the existing biotope, helped to ensure biodiversity in the cities. In the vicinity of Bo01, biodiversity was successfully achieved with the green system that was created afterwards, although there were no existing green and agricultural areas.

In all cases, a waste management system was established and focused on the generation of energy from the collected wastes. The Dongtan project aims to recycle and reuse 90% of wastes. The waste management system was successfully established in each of the Eco-Viikki and Bo01 projects and positive results were achieved in biogas energy production. In the Vauban project, no information is given about waste management and it is integrated to Freiburg city waste system. Unlike solid waste management, rain water management is successfully implemented in all cases using green technologies. Whether with the help of green roofs and facades, or with rainwater collection systems, Vauban re-uses about 70-100% of the collected rain water.

In the context of spatial criteria, all samples are designed to be compact and mixed, utilizing renewable energy sources, taking into account bioclimatic data, in accordance with the current environment. Vauban and Bo01 are 3 km away from the city center and Eco-Viikki is 8 km away, each surrounded by existing settlements. Dongtan project area is designed in an empty area 60 km away from the city center. Mixed use and high density of the areas reduced walking distance and helped to reduce vehicle dependence.

In all cases, it is important to increase pedestrian and bicycle use, and strategies were developed to reduce vehicle use. As a deterrent practice for the use of automobiles, the number of car parks in all settlements has been reduced or the car parks should be located outside the settlement area. In particular, the use of the car-free concept and the shared vehicle method, which has been implemented in Vauban, has helped to reduce the number of vehicle use. Electric cars, green buses and light rail systems, intended for use in Dongtan and Bo01, are intended to create ecological transport systems and reduce carbon emissions.

In terms of energy saving, importance has been attached to the construction of sustainable structures that consume less energy in all settlements. In particular, only in Vauban the design of plus energy houses helped to provide significant energy. In all the examples, the height of the building and the distance between the buildings were taken into consideration in order to make more use of solar energy. Green roofs have been designed in all settlements for the purpose of obtaining more oxygen, reducing the heat effect, providing visual beauty and collecting rain water.

When socio-economic indicators are analyzed, it is seen that Vauban is more advanced than other samples. The high level of participation of urban residents in project design and implementation procedures distinguishes Vauban from other examples. Sufficient number of jobs have been created in each settlement and each has an ecologically sustainable economic structure. Although no specific employment sector was identified in the Vauban case, Bo01 provided employment opportunities in the service and trade sector and Eco-Viikki in the ecological agriculture sector due to its location. In all settlements, social equality was provided to improve the quality of urban life. Apart from the Eco-Viikki and Vauban projects, the participation of actors in the social sustainability of eco-cities was not considered in other projects.

4. CASE STUDY - KOCAKIR, ESKİŞEHİR PROJECT

In this chapter Turkey's eco-city planning history, legal and administrative arrangements within in the framework of eco-city planning and design criteria are examined. After that, the eco-city planning and design criteria developed within the scope of the thesis are evaluated within the framework of compliance with the objectives of Kocakır project, which has not been implemented yet, and the positive and negative aspects of the project are analyzed.

4.1 Eco-city Planning Development in Turkey

The reasons leading to urbanization vary according to the level of development, socio-economic status, and geography of the countries. This process has begun in Turkey since the 1950s and is continue today. The most important reason lead to urbanization is disrupted start shrinking agricultural land by inheritance and mechanization process in agriculture and it has also been the decline in the economy in Turkey. Firstly, migration to cities such as Istanbul, Izmir, Ankara where more industries were available, then spread to different provinces for different reasons. Factors causing the urbanization in Turkey are grouped under three main headings driving, transporter and attractive factors.

The driving factors are mainly seen as the use of new technologies in agriculture and the decrease in the demand for human labor. It increased the willingness of people to live in the city because of the reduction of negative problems in rural areas, inadequate land, low productivity, and changing jobs according to the season. However, migration from rural to urban areas has started and the trend of urbanization has increased. Attractive factors are positive reasons such as high job and education opportunities in urban areas, high living standards, increasing the attractiveness of the city more dynamic social life, higher income compared to rural areas, safety living, and transportation opportunities. Especially, cities such as Istanbul, Kocaeli, Izmir, Bursa, Ankara, Antalya, and Mersin have become centers of attraction due to employment opportunities. The transmission forces are related to the development of

communication and transportation facilities. Especially after 1950, the developments in transportation, the expansion of the road network, the cheaper means of transportation, the existence of alternative transportation models, telephone, technology and the development of the internet have made easier communication between rural and urban areas, the collection of goods and services production and distribution in certain centers and increased the desire of people to migrate to the city. In addition, since the region transportation facilities are developed is the region where industrial enterprises are preferred it contributes greatly to the urban economy (Tosun, nd).

The urbanization process in Turkey has grown very quickly in the city center and a few more increased than any other city. This is because urbanization is disproportionate to industrialization and does not meet the needs of industrialization. The urban population, which was 18.5% in 1950, reached 56.3% in 1990, 65% in 2000, and 76.2% in 2010 (TUKSTAT, 2011). This caused the sudden and unbalanced growth of the cities, economic, environmental problems such as unemployment, housing problems, inadequacy of services, deterioration of social balance, inequality in income distribution, settlement, social and physical problems.

With the city's internal migration occurred in Turkey in the face of increasing population, especially the problem of inadequate housing that has brought the slum problem. Having no necessary infrastructure, Turkey-specific ones that matter the economic, social and cultural issues are collected in itself. The people living in these buildings are generally the group of people who cannot find work in the villages and find the solution to migrate to the city. Unemployment is increasing due to the fact that the urban industry cannot provide all of this population with jobs and people living here are trying to earn money in illegitimate ways. Another problem caused by the slums is the damage suffered in terms of economy as a result of their collapse. These types of buildings, which were built unplanned, also disrupt the aesthetic structure of the city, causing noise pollution, increasing urban crime and social differentiation (Es and Ateş, 2004).

Another important problem caused by urbanization is environmental problems from soil pollution to water pollution. The most important damages caused by migration are the rapid increase in the use of water resources and water pollution. This problem is especially observed in Istanbul between 1985-1990, whose population increased by

1 million people through migration. Discharging the used water into lakes, dams and seas without purification has caused serious pollution of water resources. In addition, 65% of the population in western Turkey realized that discharge into the sea because of industrial concentration, is discharged to 20% of rivers and 15% of urban sewage (Yiğitbaşoğlu, 1998). The damage caused by the industrial areas to the environment is another problem caused by urbanization.

In this direction in 1972 after the Stockholm conference in Turkey as in other countries it is also determined policies in a systematic way to ensure sustainable development. Although many environmental protection policies have been developed so far, they have not been productive since they are all independent (Baykal, 2010). With the establishment of the "*Prime Ministry Undersecretariat of Environment"* in 1978, national and international activities were initiated. Since the beginning of the 1980s, there have been many developments related to environmental management, in 1983, the Environmental Law No. 2872 entered into force through policies such as preventing water, soil and air pollution throughout the country, as well as the protection and development of natural resources (Terzi, 2017).

In total to ensure its sustainability and ecological city planning implementation for the State Planning Organization (SPO) by 10 development plans have been developed in Turkey. These development plans are the main leader for the policies to be implemented. The first plan is the third five-year development plan in parallel with the change experienced in the Stockholm conference covering 1973-1977. This plan focuses on environmental issues such as air, water and coast, and emphasizes the need to examine them as a whole within the planning system (Keleş and Hamamcı, 1997). The fourth five-year development plan of 1979-1983 focuses on the protection of natural and historical environment in the process of industrialization and urbanization, reduction of unemployment, healthy nutrition, public entrepreneurship and ecological balance (URL-3). Since the fifth five-year development plan, which was covered in 1985-1989, coincided with the period in which the Brundtland report was published, environmental approach policies were developed under its influence. The main objective is not only to eliminate existing pollution, but also to make the best use and development of resources for future generations. In this plan, it is mentioned that the use of renewable energy sources and the, Environmental Impact Assessment report will be prepared (URL-4).

During the sixth five-year development plan period covering 1990-1994, many international developments have been experienced. Biological Diversity Agreements were signed in line with the sustainability objectives addressed at the Rio conference in 1992, and implementation of the Agenda 21 action plan was initiated. In 1992, the UNCED and special environmental protection directorates were established. In this plan, it is aimed to develop research-development technologies for environmental protection, to increase environmental awareness and to maintain sustainability by preserving the natural balance for human health.

The next seventh development plan includes basic policies such as ensuring environmental sustainability through economic, political and social policies, reducing interregional development disparities, increasing education level, integration of agriculture and industrialization with the world, and environmental protection. In addition, the National Environmental Strategy and Action Plan was established which initiated in 1995 and completed in 1998. According to this plan aims for long-term environmental problems in Turkey should be directed to the EU environmental standards (Altunbaş, 2004). Improving the quality of life, preventing pollution, ensuring the sustainability of resources, accessing infrastructure services, improving environmental awareness and management, and providing economic, social and cultural development in the context of sustainability are the basic principles of the National Environmental Strategy and Action Plan.

The main objective of the eighth five-year development plan for 2001-2005, especially in the economic and social sectors in Turkey - agriculture, manufacturing, energy, development of the transport sector and to take a greater share of world output, the society's quality of life, improving social welfare and human resources. In this plan, environment and economy are associated for the first time and it is determined that the measures to be taken in line with the environment will contribute to the economy (URL-5).

The ninth development plan covering the years 2007-2013 was prepared within the framework constant and balanced growth and competitiveness on a global scale vision. This plan includes policies in areas such as environmental protection and development of urban infrastructure, activation of agricultural structure, transition to high value-added production structure in industry and services, increasing employment and improving quality in public services (URL-6). The last development plan is the tenth

five-year plan and the new growth model that will contribute to eco-city planning has gained importance in this report for 2014-2018. This concept is aimed at environmental protection with clean production and eco-efficiency. The plan emphasized the importance of effective use of food, water and natural resources, the evaluation of renewable energy resources for sustainable development, clean technology will be supported, design of cities resistant to disasters, increasing prosperity level, preventing image and noise pollution and reducing carbon emissions.

Although development plans started in the 1970s, strategies focusing on sustainable development started with the Seventh Development Plan. While the initial plans focus only on the environmental problems, towards the end these plans are based on fundamental principles such as sustainable socio-economic development, sustainable energy, sustainable rural development, integration of the environment and the economy.

In addition to these development plans in order to implement the goals of the Rio conference has established Local Agenda 21 action plan in 1997. The Local Agenda 21 action plan is seen as a high-level action plan that aims to achieve a balance between environment and development, enabling the concept of sustainable development to be implemented (Aksu, 2011).

One of the most important elements of the planning process of an ecological city is the Environmental Impact Assessment (EIA), a process to determine the positive and negative aspects of the projects to be planned, to measure the impact on the environment and to minimize the damage. The EIA was put into legal status in 1983 with the 10th article of the Environmental Law and in 2014 it was put into practice as a regulation. The EIA, which is a monitoring and evaluation process, consists of 3 stages: *Screening* - selection of the projects to be prepared according to the environmental impact, *scoping* - the process of setting the campus of the report to be prepared and *monitoring* - the process to measure whether the responsibilities in the prepared report are fulfilled (Serter, 2006). The projects subject to EIA regulation are grouped under 7 sectors as industry, chemical, pharmaceutical and waste, agriculture and forestry, transportation, energy, tourism and mining (URL-7).

The main tasks of the EIA are:

- To carry out environmental impact assessment studies

- Checking the quality of the environment, taking measures to prevent pollution
- To identify, control and stop the activities that cause air, water, soil and noise pollution
- To measure the compliance of the exhaust emissions of the transportation vehicles with the specified standards
- Establishing laboratories for all kinds of environmental measurements, monitoring, analysis and controls
- To prepare environmental situation reports and to follow international studies

4.2 Legal Framework for Eco-city in Turkey

According to TURKSTAT with a population of 82.3 million in 2018, Turkey's population in 2023 will be 84.2 million, and by 2050 will reach approximately 94.6 million. Moreover, it is predicted that 90% of this population will live in cities (TURKSTAT, 2018). Because of this population increase, it is inevitable that urban development will be sustainable and natural resources will be preserved and use in a right way. Although there are not the criteria of national ecological city set in Turkey, it is obvious that in the context of eco-city design criteria described above the studies on a national and local scale are available.

The concept of ecological urban development in recent years has begun in Turkey. Since the 1980s, environmental priority development policies have been included in national legislation. Legal and administrative arrangements created for the protection of natural resources and prevention of environmental pollution have led to the development of eco-city planning. Development plans prepared on a national scale are one of the positive examples of a well-developed process. There have been many developments based on environment protection, sustainable urban approaches, green growth economy and people-oriented planning, especially starting with the 10th development plan.

The main legal basis of the eco-city planning in Turkey, as the Environmental Law, the Forest Law, the Law on Protection of Cultural and Natural Heritage, the Energy Efficiency Law, Soil Conservation and Land Use Law, Housing Law, Law on Transformation of Areas at Disaster Risk has been identified. The competent

institutions that will provide these laws are divided into central and local government. Responsibilities of the central governmental organizations Ministry of Environment and Urban Planning, Ministry of Culture and Tourism, Ministry of Energy and Natural Resources, Ministry of Forestry and Water Affairs, Ministry of European Union, and local administrations Metropolitan Municipality, Municipalities, Special Provincial Administrations and Local Administrative Units in eco-city implementation and tasks. Especially the Ministry of Environment and Urban Planning is one of the main institutions that will ensure the implementation of eco-city design features (Table 4.1).

Protection of the environment, balanced development and integration of environmental policy and economic policy has become a common vision in Turkey management institutions. However, it is known that environmental protection policies are limited within the framework of the legislation and there are deficiencies in its application to urban area (Yıldız, 2016).

Energy. The number of population increases, energy consumption is growing in Turkey as well as all over the world. In Turkey, an efficient use of energy resources and have the lowest impact on the environment are undertaken by the "Ministry of Energy and Natural Resources". The main task of *"General Directorate of Renewable Energy"* are:

- Evaluation of renewable energy sources such as wind, solar, biomass, geothermal,
- Efficient use of energy in industry and buildings,
- Setting goals and strategies in line with the needs of the country,
- Developing recommendations for increasing energy efficiency (URL-8).

Ensuring energy efficiency helps to ensure sustainability in the national economy on the one hand and to improve the quality of life in buildings. Turkey production levels, although a good geographical point in terms of the use of renewable energy is lower. The reason for the large difference between the potential and the current situation lies in the costs and the lack of legal regulations. About 32 percent of the total energy supply is met from renewable energy sources in Turkey (Karagöl and Kavaz, 2017).

Despite having a total of 2,737 hours of annual sunshine duration by Turkey to benefit from the sun it is behind other European countries. Turkey's potential of generating

electricity from the sun is known to be 500 thousand MW. However, this figure is equal to 79 thousand MW according to 2016 calculations (Karagöl and Kavaz, 2017). The installed capacity of the plant was 0 MW in 2012 and it was 830 MW in 2016 and 2060 MW in 2017. Despite the value of Turkey has increased in recent years, more of these figures has the potential to be high. Especially Southeast Anatolia Region and Mediterranean Region are known as solar energy potential regions (URL-9).

Wind energy is another renewable energy source has good potential due to its location as Turkey has. Wind energy potential in Aegean, Eastern Mediterranean, Black Sea, Central Anatolia and Marmara regions has the highest rate compared to OECD countries. Having only 59 MW of wind power in 2006, Turkey was 6872.10 MW as of 2017 increased 116 times. However, this figure has the potential to be 88 thousand MW. The main reason for this situation is due to technological deficiencies and economic constraints (Karagöl and Kavaz, 2017).

Biodiversity. In order to protect the biological and ecological habitats of cities, it is essential to develop the urban ecosystem. This can be achieved by planning new green areas and natural parks that will increase biodiversity in the city. "*Environmental Impact Assessment"* legislation be regarded as the protection of biological and ecological habitats in Turkey.

Waste Management. As in all over the world the amount of waste as a result of industrialization and urbanization also increase in Turkey and measures are needed for the protection of the environment. With the establishment of the Ministry of Environment in 1991, solid waste management was included in the duties of this ministry. Waste management is managed under the *"Regulation on Control of Solid Waste"* in Turkey. The main purpose of this directive is "*to prohibit directly or indirectly transfer all kinds of wastes to the receiving environment, storage, transportation, removal and similar activities, and to control the consumption of materials that may adversely affect the environment. The aim of this course is to prevent pollutants which have permanent effects on water and soil from disturbing animal and plant generations, natural riches and ecological balance and to determine, implement and develop principles, policies and programs for this purpose*".

In addition to solid waste control, the control of Packaging Wastes, Control of Hazardous Wastes, Control of Medical Wastes, Control of Construction and

Demolition Wastes, and municipalities are responsible for the collection, transportation and storage of wastes by the *Law on 5393 Municipalities* and *5216 Metropolitan Municipality Law* (Gören and Özdemir, 2011).

Turkey has two major legislations on solid waste management: *"Regulation on the Landfill of Waste and Regulation on Waste Management"* published in the Official Gazette.

Purpose of Waste Management Regulation (URL-10):

- Ensuring the management of waste from formation to disposal without harming the environment and human health.
- Reduction of waste generation, reuse, recycling, recovery of waste by reducing natural resource use and ensuring waste management.
- Production and market surveillance of products covered by this regulation which have certain criteria, basic conditions and characteristics in terms of environment and human health.

The other project, which was initiated in 2017 to achieve sustainable growth, is the Zero Waste project. During the actions implemented by this project, the use of different colored containers and trash cans for the collection system, the installation of piggy banks for glass waste on the streets and streets, the installation of different facilities according to the type, the placement of storage equipment in at least one set every 400-600 meters, practices such as providing awareness-raising trainings (URL-11).

Air, Water and Soil. "Soil pollution and Control Regulation" regarding soil pollution to the protection was repealed by the year 2010, and Soil Pollution prepared by the Ministry of Environment and Forestry Control and Point Source was established in the *"Regulation on Contaminated Sites"*. The main purpose of this directive is not only to prevent pollution and to identify areas where it exists, but also to clean these areas in line with sustainable development goals. The principles regarding the prevention and elimination of soil pollution are as follows (URL-12):

- Prevention of soil pollution at source.
- Prohibition of direct or indirect disposal of wastes that will damage the soil.
- Do not mix clean and dirty soil.

- Taking measures to prevent soil contamination in facilities where hazardous wastes may occur and where recovery is made.

Other environmental problems that cause water pollution and water demand factor is an increasing problem in Turkey. Many organizations and institutions are responsible for water management in Turkey. Ministry of Forestry and Water Affairs for management of water resources, policy formulation and coordination, Ministry of Environment and Urbanization for drinking and potable water, Ministry of Health for monitoring of drinking water and bathing water quality, Ministry of Food, Agriculture and Livestock for providing efficient use of water in agriculture, rain water and the planning of wastewater systems is managed by metropolitan municipalities and other municipalities. In this case, lead to a confusion of authority in Turkey, makes it difficult to ensure participation, leads to an increase in the cost of services.

Within the scope of *"Legislation of the Ministry of Environment and Urbanization"*, *"Regulations on Water Pollution Control"*, *"Urban Wastewater Treatment"*, *"Swimming Water Quality"*, *"Control of Pollution Caused by Hazardous Substances in Water and Environment"*, *"Surface Water Quality Obtained or Planned to be Produced Drinking Water"* have been established. According to the legislation on water pollution control, the main objective is "*to determine the legal and technical principles necessary to achieve the prevention of water pollution with the sustainable development objectives in order to protect and ensure the best use of the groundwater and surface water potential of the country*" (URL-13).

Since 1986, directives have been set up for the monitoring of air quality based on the 1982 environmental law. According to the first *"Air Quality Control Regulation",* the aim is to define and establish air quality targets to prevent or reduce the harmful effects of air pollution on the environment and human health, to evaluate air quality on the basis of defined methods and criteria, to maintain the current situation where air quality is good and to improve in other cases, to gather sufficient information about air quality and to inform the public through warning thresholds.

Air pollution is caused by fuels used for heating purposes and transportation in Turkey. On the other hand, harmful gases emitted from industrial chimneys based on urbanization and industrialization after 1960 negatively affected air quality. Turkey is in a critical condition by the current air quality (URL-14).

Urban form and land use. Eco-city's most important components that are having a compact and mixed-use development which published on Official Gazette *№ 29030 "Spatial Plans Construction Regulation"* and *№ 3194 "Reconstruction Law"* and related legislations can be considered in Turkey (URL-15).

According to the *"Spatial Plans Construction Regulation",* it is obligatory to specify the housing use rates in mixed use areas in the development plans and to separate the social and technical infrastructure areas required by the housing use.

It is recommended that a maximum of 30% housing can be used in mixed use areas, in cases where the rate of housing use is not specified in mixed-use areas. In the zoning plans, the access range of the population in the service impact area of education, health and green areas should be planned considering the topography, construction, density, existing texture, natural and artificial thresholds. Children's playground, outdoor sports area, kindergarten, and elementary school functions can be planned in the service impact area which should be reached on foot by approximately 500 meters, secondary schools approximately 1,000 meters, and high schools approximately 2,500 meters. In addition, design principles should be developed in order to take measures to facilitate access and use of urban infrastructure, social infrastructure areas for people who have difficulty in using public common spaces such as disabled people, children and the elderly (URL-15).

Transportation. In recent years increasing in private car ownership in Turkey has caused high population density traffic congestion, environmental problems and sustainability of urban transport systems. According to TURKSTAT data, the number of transportation vehicles has increased by 107% in the last 15 years. While the number of vehicles per 1000 people was 135 in 2003, it reached 279 in 2018. This data shows that Turkey's ranked last when compared with other European countries. In this context, when the carbon footprint of transportation is examined, the total emission share is 15%.

In Turkey 5216 "*Metropolitan Municipality Law"* and the 5993 "*Law on Municipalities"* are responsible for urban transportation. In addition, the Ministry of Environment and Urban Planning published the Official Gazette on the *"Design and Construction of Bicycle Roads, Bicycle Stations and Parking Areas on Urban Roads"* and *"The Integrated Urban Development Strategy and Action Plan"* was prepared in

2007 by the Ministry of Public Works and Settlement (Cirit, 2014). According to *№5216 Metropolitan Municipality Law* Article 7: *"Draw up or cause to draw up and implement the metropolitan transport master plan; plan and coordinate transport and public transport services; designate the numbers, fares and schedules, timing and routes of any type of service and public transport vehicles that are operated on land, sea, water and rail ways, together with taxis; designate and operate or cause to operate or lease the stops and vehicle parking spots on motorways, roads, avenues, streets, squares and similar places; carry out all works of traffic arrangement as assigned to the municipalities by laws"* should be considered (URL-16).

According to the "*Spatial Plans Construction Regulation"*, it is essential to reduce vehicle traffic and to design a public transportation and pedestrian priority transportation system. In order to promote the use of public transport, decisions should be made in the development plans regarding the expansion of the park and continue system and the separation and integration of parking areas in the area of influence where the public transport stops are located.

Transportation strategies start with the 7th Development Plan and are particularly emphasized in the 8th Development Plan. Policies on increasing traffic safety, expanding the use of pedestrians, bicycles and public transport, parking management and maritime transport have been developed.

Buildings and structures. After the 1950s, uncontrolled and rapid urbanization led to the increasing of buildings that did not meet the need for sustainability. The share of total energy consumption in Turkey has experienced growth in recent years, more than about 30%, which is related to the building industry. Since 80% of the energy used in buildings is consumed for heating purposes, insulation should be used more to prevent heat loss. In this context, the 2002 European Parliament and Council Directive and *"The Law of the Energy Performance and Energy Efficiency"* has been announced the reduce energy consumption without reducing the quality of life and service quality in buildings and without reducing production quality and quantity in industrial enterprises (Karaca and Çetintaş, 2015).

The basic legal regulations in Turkey in developing sustainable building scale are listed below:

- 1998 - TSE 825 Thermal Insulation Rules in Buildings

- 2008 - Regulation on Thermal Insulation in Buildings
- 2008 - Energy Performance Regulation in Buildings
- 2013 - Construction Materials Regulation
- 2014 - Regulation on Certification of Sustainable Green Buildings and Sustainable Settlements

"TSE 825 Thermal Insulation Rules in Buildings" entered into force in 1998 and since 2000, it has established standards that must be applied in all buildings to be built. The purpose of these standards is to save the energy used for the heating of buildings, to determine the standard account value to be used at the same time, and to construct high-comfort buildings (URL-17).

"The Regulation on Thermal Insulation in Buildings" entered into force in 2008 and laws on reducing heat losses in buildings, energy saving and implementation were determined. Energy Performance Regulation in Buildings, which came into force in the same year, aimed to obtain energy by using renewable energy sources, to use energy efficiently, to keep the heating, cooling, natural ventilation and lighting requirements to a minimum level in the architectural design of buildings, to ensure that the annual heating energy requirement of the building is smaller than the limit value specified in TS 825 standard (URL-18).

"The Regulation on Certification of Sustainable Green Buildings and Sustainable Settlements" aimed at creating a system of sustainable green buildings and settlements in order to reduce the environmental impact of buildings. In this respect, it takes into consideration the preparation of an evaluation guide for the criteria and performance indicators for the certification of the buildings and settlements, ensuring the environmental, social and economic sustainability of the existing buildings and the new buildings to be constructed (URL-19).

Open public spaces and green areas. In Turkey open and green spaces are divided into 3 groups according to their usage: Public open spaces - neighborhood parks, forests, botanical gardens, boulevards and sports fields for everyone; semi-private open green areas - areas specific to specific institutions or administrations, such as school gardens, military areas; private open green spaces - are private property areas that can only be used by the owners.

Regulations on public and green spaces are in accordance with the *"Regulation on the Construction of Spatial Plans"* and open and green spaces and other social and technical infrastructure areas should be planned together with the centers as a whole.

In the settlements up to 75.000 people, in the planning of the areas that belong to the category of social open green areas, a minimum of 10 m^2 green area should be established per person. The minimum scale of green areas per person should be taken into consideration in the planning of the neighborhood scale and more green areas should be created if possible (URL-15).

Public Participation. In order to strengthen and develop local democracy, attempts are made to ensure the participation of the public in the decision-making and planning processes of local governments in Turkey. Local policies for participation were first described in the 8th and 9th Development Plan. The 8th development plan includes the principle of engaging with participation and the principle of establishing a management approach towards the public. According to this plan, public participation in environmental decisions should be ensured, participation processes should be realized and mechanisms should be established to ensure the accountability of local administrators at the same time. In the 9th development plan, the importance of concepts such as strengthening social dialogue and participation, social contribution, flexibility, transparency, accountability and predictability are mentioned (Esengil, 2009).

Ensuring public participation is addressed in the *5393 "Municipality Law"*, which came into force in 2005 within the legal framework. According to this law, the most important legal regulation to ensure participation is the creation of Citizens-Assembly, which is the product of Local Agenda 21. Another law aimed at ensuring the participation of the public is the *2872 "Environmental Law"*, which were created in 1983 and amended in 2006. Public participation developed with participation meetings in the context of EIA in Turkey. In these meetings, public participation is provided by informing the public about the project before the preparation of the EIA report and by taking into consideration the problems, opinions and suggestions of the public during the project implementation process (OECD, 2008).

Quality of Life. Taking account of the quality of urban life began on a national scale during the urbanization process in Turkey after 1960. In 1960, the State Planning

Organization was established for the economic, social and cultural development of the country. Data were collected for the first time in 1965 and for the second time in 1996 to measure the development level of the provinces. In the 1996 survey, demographic, health, education, agriculture, construction, financial, industry, employment, infrastructure and other welfare indicators were identified, and Istanbul, Ankara, Izmir, Kocaeli and Bursa ranked first.

Especially after the Habitat II conference, improvement of the quality of urban living environment and quality of life concept was at the agenda with the principle in Turkey. In the 7th development plan in order to get a higher share from the world welfare, policies are developed to increase the level of education and to provide education to all individuals of the society in accordance with their abilities and to ensure cultural development. 8th development plan emphasizes the importance of improving the quality of life of the society in order to ensure the long-term development strategy, balanced and sustainable development, and to ensure that individuals are in good social, physical and spiritual well-being. In the 9th development plan, it is stated that the achievement of EU norms and standards in many areas such as democracy, rule of law, human rights, health, food security, consumer rights, competition rules, institutional improvement and environmental protection plays an important role in improving the quality of life of the country.

4.3 Kocakır – Eskişehir Project

In this section, because of the absence of an implemented ecological settlements in Turkey, the project commissioned by the Ministry of Environment and Urbanization to the Istanbul Technical University team for the Kocakır – Eskişehir project was evaluated as a case study within the framework of the method developed within the scope of the thesis.

4.3.1 General information

In order to establish an ecological settlement in Eskişehir – Kocakır settlement the protocol was signed by the Ministry of Environment and Urban Planning and Istanbul Technical University in 2013 within the scope of *"The Law of Transformation of Areas under the Disaster Risks"* (Terzi and et.al, 2016).

Within the scope of this protocol, 1/5000 and 1/1000 scale analysis and synthesis, 1/5000 scale Master Plan, 1/1000 scale Implementation Plan, 1/1000 scale Urban Design Project and Reconstruction Program were prepared.

According to the Law № 6306 on the *"Transformation of Disaster Risk Areas"*, it is aimed to establish healthier and safer settlements by means of urban transformation of the settlements at risk of disasters. Initiating the process of urban regeneration is of great importance both for the creation of healthy environmental conditions and for the sustainability of social interaction. Kocakır is declared as Reserve Building Area within the scope of Law № 6306.

The creation of alternative reserve areas for residential and trade centers is important both for the transformation of disaster-risk areas and for the reduction of the congestion in the city center (Kocakır Reserve Building Area Component 4.2 Report, 2015).

Eskişehir has a key position in terms of transportation. Ankara-Eskişehir highway extending in the east-west direction and the highway divided into Bursa and Istanbul pass through the center of Eskişehir. It is located in the northwest of the Central Anatolia Region and has borders with the Black Sea in the north, Marmara in the northwest, and Aegean regions in the west and southwest. Eskişehir has a population of 871.187. Odunpazarı is the most populous district with 404.267 people and Tepebaşı is the second with 359.303 people (TURKSTAT, 2018).

Existing high speed train connections to Eskişehir-Ankara-Konya, Eskişehir-Bilecik-Istanbul has caused the city to become a center of attraction by investors. In addition, the population migrating from rural areas to cities has been increasing in recent years and this causes the congestion of the city center.

Today, due to the agricultural areas located in the north of Eskişehir city center, urban development is oriented towards south-west. For this reason, Kocakır which was declared as a reserve building area by the Ministry of Environment and Urbanization in 2013 is located 10 km to the city center, 5 km to the city connection road, 10 km to the high speed train station, 10 km to the city bus station and 6 km to the Osmangazi University, is located in the south-west of the city macroform (Figure 4.1). This area, which is not adjacent to the city center and has a total area of 838.3 hectares, has been deemed suitable as a reservoir area in terms of its suitability for its geological structure

or its utilization of solar energy. The fact that the planning area is open to development, the proximity of the tourism zone and the university development area are known as the reasons for choosing the reserve and sustainable settlement area (Kocakır Reserve Building Area Component 4.2 Report).

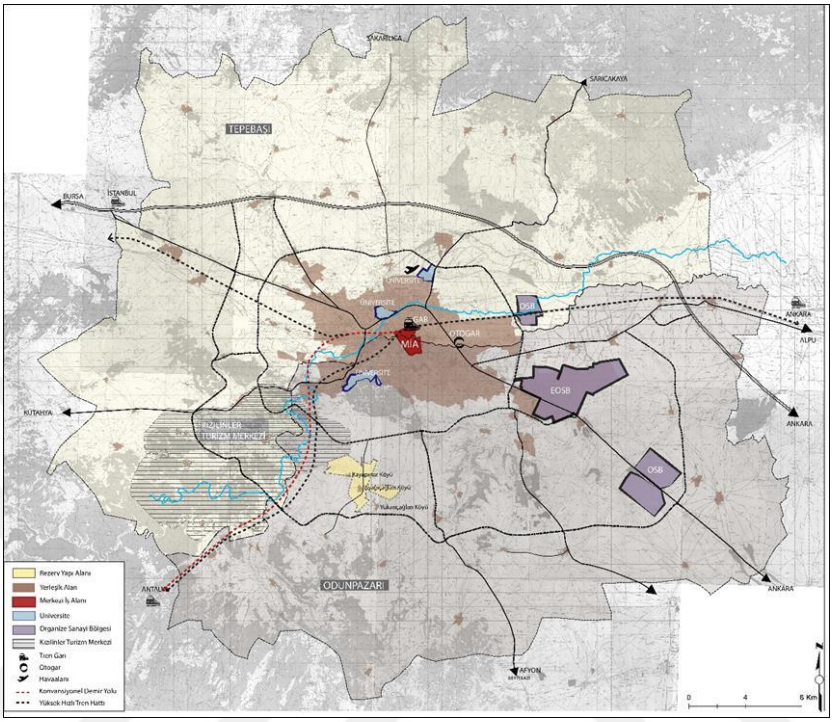

Figure 4.1 : Location of the Kocakır project area (Kocakır Reserve Building Area Component 4.3 Report, 2015).

The planning area consists of 3 districts (Kayapınar, Yukarıçağlan and Aşağı Çağlan) with the total population is 211 people. Lack of infrastructure, job opportunities, insufficiency of social amenities, transportation problems are defined as the most important problems of the planning area. Especially lack of electricity, sewage, and natural gas system, problems of not collecting garbage on a daily basis affect the daily life of the inhabitants at a certain level and cause environmental problems. Although the economy of all three neighborhoods is based on agriculture, it is known that there are social and economic problems such as unconscious fertilization, insufficient organization of the environment, lack of agriculture based industry, lack of pasture, livestock and agriculture sector (Kocakır Reserve Building Area Component 4.2 Report, 2015).

In line with these problems, according to the Kocakır Reserve Building Area Development Plan, the main purpose is to reduce the negative effects of urbanization in the area, to reduce carbon emissions as much as possible, to benefit from renewable

energy sources, to develop independently without external dependence, and to create a living space that is resistant to disasters.

4.3.2 The main objectives of Kocakır project

The Kocakır project is planned in line with the upper scale plan decisions. According to the principles of Eskişehir 1/100.000 Environmental Plan, irrigated agricultural areas and special crop areas should be protected. Attention should be paid to the protection of agricultural areas which are prioritized in site selection and the absence of agricultural lands in development areas and decisions should be taken to evaluate the tourism potential of Eskişehir. It has developed strategies for preserving ecological values and providing sustainable living, promoting the use of renewable energy, ensuring social integrity through social justice and social cohesion, and reducing environmental risks (Terzi and et.al, 2016).

The main objective of the Kocakır reserve area project, which was developed within the framework of these plan decisions, is to protect the environment by preventing urban sprawl, to create an eco-city that is low in carbon emissions, can use energy efficiently, is not externally dependent and resistant to disaster risks. Reducing carbon wastes, supplying the energy needed by the planning area from renewable energy sources, establishing strong relations between the urban and its environs, developing social and economic and cultural life, creating accessible living spaces and a healthy environment for all. In this context, strategies and targets related to these objectives have been determined in six headings in the Master Plan Planning Report (2015).

1. Land Use: *Sustainability and Site Selection*. According to this strategy, planning a residential area by preserving ecological and cultural values in line with sustainability principles is explained under a total of 29 objectives:

- The provide close connectivity to the transportation facilities
- To prevent the spread of the city
- To plan bus stops within 400-meter walking distance for residential and non-residential areas
- To provide the proximity of residential areas and different type units
- Rainwater management

- Protecting of existing agricultural areas
- Protecting and increasing of biodiversity
- To avoid construction in the flooding areas
- To prevent construction in the steep slopes
- To prevent construction in the topographic risk area
- Easy access to hydrates and ponds against fire hazard
- To provide built-up area cover minimize
- Use of green roofs and use of solar energy in the buildings and structures
- Prevention of construction pollution
- Proximity of social facilities and residential areas
- Create different size housing units for the different social groups
- Connectivity of building entrance and pedestrian walkway to ensure pedestrian priority streets
- Consider of building height and length for the pedestrian priority streets
- Afforestation of the streets by considering climatic conditions
- To protecting urban natural areas and provide integrate with the planned green system
- To provide accessibility to the public spaces bye everyone including disabled persons
- Establishment of neighborhood farms and gardens

2. Energy Production and Efficiency: A total of 10 targets were determined under the energy use strategy developed to create a sustainable environment:

- Design of new energy efficient systems, infrastructures and buildings
- Promotion of green building designs
- Use of renewable energy sources such as solar and biomass
- The use of heating and cooling systems in the neighborhood scale

- Eliminating light pollution and its negative effects by reducing unconscious energy consumption
- Reduction of environmental impacts caused by energy consumed
- Designing a settlement where fossil resources are never used
- Reduce heat island effects
- Use of effective sunlight, paying attention to the placement of buildings
- Designing energy efficient buildings to reduce air, water and soil pollution and adverse environmental impacts (Kocakır Reserve Building Area Component 4.3 Report, 2015).

Water Supply, Use and Management: The main goal of this strategy is minimizing the water consumption as much as possible and make provision for this purpose. Under this strategy 6 goals were determined:

- Reduce water consumption by limiting water consumption of buildings
- Control of water consumption, especially in green areas
- At least 40% less water consumption of new buildings compared to traditional buildings
- Rainwater management to provide sustainable usage
- Reuse of wastewater
- Meeting all water requirements in the area with the closed loop – collecting rainwater, treatment of wastewater

Transportation system: A total of 7 targets have been determined in order to reach sustainable transportation system in the project area.

- The compact and mixed-use design of the site will allow pedestrian access everywhere.
- The distance to public transportation stops is within walking distance
- Develop methods of reducing car use
- Reduce parking spaces
- Promoting the use of bicycles

- Providing high-efficiency access to pedestrians, cyclists and drivers
- Ensuring the coordination of sufficient stops and service points provided

***3. Materials, Resource Use and Management*:** The sustainability of the materials to be used during or after construction and the management of the wastes to be generated within the site are explained under a title and a total of 5 objectives are focused on.

- To increase the environmental sensitivity of construction materials and to use sustainable materials
- Reduce the need for waste materials and new materials for construction activities
- Preserving the existing resources and ensuring that the infrastructure materials to be used are recyclable
- To reduce the amount of solid waste that can be generated by developing a recycling system
- Minimizing the negative impact of the settlement on the environment

4. Social and Economic Sustainability: In order to sustain the economic developments in the planning area, a strategy has been determined in order to ensure social connections, justice and equality and 7 targets have been established for this strategy:

- Ensuring effective public participation in decision-making processes
- Establishing a social study program in order not to affect the lives of people living in existing settlements in the area
- Establishment of project collective management organizations and preparation of necessary legal and administrative infrastructure
- To get the ideas of the current property, land, housing, business owners and the people who will live here about the project
- Performing economic impact analysis in order to measure the economic impacts of the planning area on the immediate environment and the city as a whole
- Life cycle cost calculation of projects

- To create an organization of employment structuring in order to increase employment opportunities in the field

In line with the aims and objectives described above, it is envisaged that 75,000 people will live in 838.3 hectares of the area and will be implemented in 4 stages. The gross density in the planning area will be 90 per/ha.

4.4 Planning and Design Criteria of Kocakır Project

In this section objectives and strategies foreseen to be implemented in Kocakır project area are explained in detail within the framework of eco-city planning and design criteria which is developed within the scope of the thesis under 3 headings – ecological, spatial and socio-economic. In addition to that the objectives of this project, which has yet to pass the implementation phase are evaluated in the framework of compliance with the relevant regulations and legislation within the scope of the legal framework of Turkey.

4.4.1 Ecological criteria

4.4.1.1 Energy

One of the most important ways to obtain electric energy in ecological settlements is to utilize renewable energy as much as possible. Utilization of renewable energy sources is possible with many methods and it is possible to design low energy buildings, to establish solar fields, to benefit from wind and geothermal energy, to establish a cogeneration plant, and to obtain biogas energy from organic wastes.

For this purpose, energy generation, distribution and storage areas connected to renewable energy sources have been proposed in Kocakır project. Natural gas based cogeneration system for electric power generation in the region is planned to be installed and photovoltaic systems will be installed to utilize solar energy. Electricity, heating and hot water needs of the region will be provided from cogeneration center (combined heat and power). This system will meet the electricity needs of all buildings in the area of electricity planning to be produced. In addition to the cogeneration center, it is planned to establish an organic waste recovery facility, an agricultural waste processing facility (a facility intended to generate energy from agricultural wastes) and a waste water treatment plant, and the aim is to convert the gas to be

generated from these facilities into energy in the combined heat and power system (Kocakır Reserve Building Area Component 4.4 Report, 2015).

Eskişehir region, including Kocakır, has the potential to benefit from solar energy. It is planned to produce enough energy to meet the electricity and heat needs of the building directly by using the integrated systems of the building, not only from the solar plants to be installed from the sun rays. Photovoltaic panels have been proposed as solar fields in some areas on the roofs of the buildings and on the other part of the land where the land will benefit more from solar farms. Areas where wind turbines can be installed in the project area for the purpose of utilizing wind energy have been determined. Small scale tribunes within the integrated wind energy systems or settlement units are not foreseen to be installed in the planning area as they have the potential both in terms of cost and to generate noise pollution. Another generation of renewable energy sources in the project area is biogas energy consisting of wastewater and agricultural wastes (Kocakır Reserve Building Area Component 4.6 Report, 2015).

To sum up, with the solar panels it has planned to meet 66% and with the cogeneration system 34% (3.1% from wastewater and 1.8% from solid waste) of the annual electricity demand. The electricity produced in the cogeneration system will meet the electricity needs of all buildings and lighting in the planning area. Considering the renewable energy potential of the region for the ecological settlement unit planned in the Kocakır project, providing the settlement's energy needs from renewable sources as much as possible is one of the most important steps in ensuring ecological settlement principles.

In this context, providing the total electricity demand from the cogeneration plant and renewable energy source in the project area, encouraging the generation of its own energy, will both help to reduce the significant amount of air pollution and carbon emission in the planning area and contribute to the economy.

4.4.1.2 Biodiversity

Measures should be taken to improve urban ecosystems in the area to protect biodiversity, which is another important issue for ecological settlements. According to Kocakır project analysis and synthesis report, there is no natural conservation area in the planning area. Only Çağlan stream and seam, separated from the branches of

Porsuk stream, passes through the project area. Within the scope of *"Environmental Impact Assessment Regulation"* these areas constitute a natural habitat in terms of vegetation and water resources in the region and carry the characteristics of an ecologically valuable corridor. Along this corridor which is 8.5 km, it is covered by the plants of common species. This flora, consisting mostly of leafy trees and perennial and herbaceous plants, is integrated into the creek starting from Aşağı Çağlan Village to Kayapınar Village and then extending continuously to northwest and west directions. In the urban design project, this region has been defined as the Habitat and Ecology corridor, and it has been proposed to be used both for recreation and agricultural purposes. Among the residential areas aimed at reducing the ecological footprint in the project area other than natural areas, the planting and afforestation specific to the area in urban open spaces are among the project objectives (Kocakır Reserve Building Area Component 4.6 Report, 2015).

As explained in the conceptual framework, it is not possible to maintain ecosystem balance unless biodiversity and ecological habitat are preserved. In this context, the project concept shows that the measures taken to protect and improve agricultural lands and ecologically sensitive regions meet this principle.

4.4.1.3 Waste management

The increasing amount of waste in urban areas together with the human population causes significant environmental problems. Providing recycling of wastes instead of eliminating them both reduces the negative impacts of the wastes on the environment and contributes to the economy. Recycling of wastes is carried out in ecological settlements with a sustainable waste management system. In this context, the amount of solids that may occur on the basis of the stage and the proportional distribution of the components in the solid waste were calculated for the Kocakır project. According to the waste characterization calculated on the basis of Eskişehir province, most of the wastes generated in the region are composed of kitchen wastes. As a result, 83 ton/day waste generation is expected in the project area, of which 55.6 tons/day is composed of kitchen wastes (Kocakır Reserve Building Area Component 4.6 Report, 2015).

As stated in the conceptual framework waste management sub-heading of the thesis, according to the integrated waste management system, the waste should be separated at source. Within this context in order to create sustainable solid waste management in

Kocakır project area, firstly, it is planned to apply separate collection method at source. With this method, kitchen wastes and organic wastes will be recovered effectively and the amount of waste sent to storage facilities will be reduced. Regarding the conversion of organic wastes to energy compost or biomethanization method will be used in Kocakır project area (Kocakır Reserve Building Area Component 4.6 Report, 2015).

The separation of urban wastes and their recycling, reuse and recycling of these materials have an important place in integrated solid waste management. Although recycling of packaging wastes is considered among the project targets, no information has been given about the total amount of waste to be recovered.

Waste collection centers are waste stations that serve more population. The size of the waste collection centers in the Kocakır Reserve Area should be approximately 5000 m^2. The total amount of packaging waste that can be recovered in the project area is calculated as approximately 3101 tons/year. 68.9% of this is paper-cardboard and the total amount is 2135 tons/year (Kocakır Reserve Building Area Component 4.6 Report, 2015).

Biogas is produced by unventilated treatment of domestic organic solid wastes in biomethanization plants. Separation of wastes at source plays an important role in the efficiency of the produced biogas. According to the calculations for the project area, biogas yield is calculated as approximately 150 m^3/ton treated waste. The biogas amount to be 11.928 tons of waste to be treated in the biomethanization plant is equal to 1,789,200 m^3 biogas/year. The resulting biogas is used for heating and onsite needs (Kocakır Reserve Building Area Component 4.6 Report, 2015).

All these decisions are taken into consideration in accordance with the "Waste Management Regulation and the Regulation on the Landfill of Waste".

Criteria for separation of wastes generated at the project area, reducing the amount of solid wastes, establishing effective recycling systems and ensuring the proper storage and control of hazardous wastes are inclusive of the criteria within the framework of waste management criteria of eco-cities.

4.4.1.4 Air, water and soil

Among the main indicators that should be applied in water management of eco-cities are the recycling of rain water, reuse of this water in irrigation, domestic use and taking

measures to reduce water consumption in buildings and preparing designs with this approach. In this context, waste water usage, rainwater harvesting, waste water treatment and zero discharge targets were taken for Kocakır project.

One of the strategies developed to ensure the reuse of waste water in the project area is to design water pipes from sinks and showers in separate and different colors from other pipes and collect them in gray water recovery system. With this it is possible to collect, treat the wastewater from the shower, bath and basin of the project area separately from other wastewater. It is suggested to use the wastewater such as shower and sink collected daily in the buildings as the flushing water after being treated with the treatment system located on the ground floor of the building.

Rainwater harvesting will be carried out not only on the basis of the area, but also on the basis of the building in the planning area. The technique is considered on the basis of area is to collect rainwater in ponds with the help of various channels and to use these ponds for recreation or irrigation purposes. Another method is to create rainwater accumulation system on the roofs of buildings. The collected rainwater harvest will be used for irrigation of agricultural and landscape areas and for building needs. This will result in a significant reduction in water consumption in the regional scale (Kocakır Reserve Building Area Component 4.6 Report, 2015).

Reducing water consumption and taking measures for this consumption is one of the most current issues in the world today. Reducing consumption in the understanding of sustainable water use should be primarily within the scope of the country's policy, and even more specifically at the regional and even basin scale. Providing conscious, controlled and re-use of daily drinking and domestic water with modern technology will reduce water consumption to a certain extent, either in agricultural and industrial applications. In this case, when all these systems are into consideration water consumption will be saves about 40 liters of water per day per capita in Kocakır.

Strategies for rainwater harvesting, reuse of wastewater and gray water have been proposed to reduce water consumption in the area and promote sustainable use. The method of collecting rainwater from the roof of the building, which will be used to reduce water consumption in planning method is unlikely to spread in Turkey. This method will be an important contribution both in environmental and economic terms.

Proposing systems to reduce rainwater harvesting, reuse of treated wastewater and use of gray water to reduce regional water consumption in the project area will contribute positively to the reduction of water resources consumption in the area.

Although there is no land registered as polluted and approved soil or groundwater pollution by official institutions and organizations within the project area, it is aimed the use of renewable energy sources and cogeneration system and photovoltaic panels meet the energy need, rainwater and waste water collection system management of water demand, solid waste management system to obtain energy from solid wastes, soil, air and water, especially to prevent environmental pollution. In addition, solutions are proposed to reduce dependence on road and private vehicles against environmental impacts such as greenhouse gas emissions and air pollution, diversifying transportation alternatives and increasing accessibility.

4.4.2 Spatial criteria

4.4.2.1 Location

As mentioned in the conceptual framework location subtitle, the area where an ecological settlement is located requires first of all to be located close to the existing settlement areas and transportation networks. In this context, according to the 1/2000 Scale Urban Design Report of Kocakır Reserve Building Area, it is foreseen to be designed as a settlement on the main transportation network. The project area is located 10 km to the central business area of the city, 5 km to the city connection road, 300 m to the projected southern ring road, approximately 2 km to the Eskişehir South Ring Road, 10 km to the high speed train station, 10 km to the city bus station, Osmangazi University is 6 km away. There are also 2 universities and technology development zones, organized industrial zones, small industrial and storage areas within 10 km distance (Kocakır Reserve Building Area Component 4.2 Report, 2015).

Another issue for site selection is to determine the suitability of the area according to topographic, geological and infrastructure analysis. According to the studies, the suitability of the settlement in the planning area was determined as 80% of the site, 15% of the problems that could be prevented and 5% of the site was unsuitable for settlement. 80% of the project area is suitable for the settlement as a topographic slope does not have more than 20% and the bedrock is shown to be close to the surface.

An ecological settlement needs to be close to the city center, to be located on the main transportation network, the neighborhoods where the existing settlement areas and basic service units are located and to be suitable for the topography. When the project is evaluated in this context, it is seen that it is not close to the city center and not surrounded by the existing settlement areas. It reveals that the project area overlaps with the category of settlements on the transportation arteries and its accessibility is strong.

4.4.2.2 Urban form

Depending on the eco-city planning and design criteria, the eco-city should be providing mixed-use development, accessible social infrastructure, green and public spaces, not separating the land according to the income group of the population, and planning a suitable residential area for children and the disabled people.

In order to prevent urban sprawl in the area, Kocakır project has been planned with approaches providing walking distance to higher density residential areas, mixed land use, public transportation systems and social equipment areas. Regarding the density allocations in the compact settlement areas, the regions that have access to the transportation facilities within the first degree walking distance have been identified as high density settlement areas.

The main spatial objective of an eco-city is to have compact and mixed residential areas, to reach the service areas and public transportation stops by foot, and to include diversity and liveliness.

Considering eco-city planning criteria and *"Spatial Plans Construction Regulation",* the main strategies for compact and mixed use developed for the project area are as follows:

- Establishing a well-accessible land use, adjusting the distances to provide walking distance to public transportation stops and using alternative transportation facilities will be ensured.
- At least 50% of residential and non-residential uses will be a bus stop 400 meters from the entrances.
- Living spaces should be at a minimum distance of at least 5 of the different usage units.

- The spread of the area in the region will be prevented.
- Schools, kindergartens, children's playgrounds will be located close to residential areas, shops and workplaces will be located under the buildings.
- The proximity of the social reinforcement facilities will be considered.
- Most of the building entrances will open to public spaces, squares or parking spaces.

All mixed-use ecological settlements in the project area are connected to each other by main transportation networks and pedestrian axes extending in the east-west direction. Socio-technical infrastructure areas, residential and commercial areas and office units are envisaged to be located on these axes. The green corridor and the points intersecting the urban agricultural areas constitute the squares. Squares were designed on intersecting and integrated points with the urban, residential, social equipment, commercial and office spaces, as well as light green spaces and small-scale urban agricultural areas on the main pedestrian and transport axes (Kocakır Reserve Building Area Component 4.6 Report, 2015). The design of these squares will also positively affect the social lives of the people with the contribution to the city form.

Another urban-form indicator, which is designed for different demographic, socio-cultural and income groups, was developed within the scope of the project and both single-family and multi-family housing types were planned. In line with it is seen that all these objectives and strategies considered for Kocakır project meet the urban form indicators adequately.

4.4.2.3 Transportation

At the beginning of an eco-city transport system, strategies should be developed like increasing pedestrian access, increasing access by bicycle, minimizing vehicle priority in transportation, priority giving to public transportation, decrease parking areas, car sharing or bike sharing near public transport stops, transport demand management and accessible transportation for disabled people.

As mentioned in the literature review, in order to create a high-quality transportation system, the space must first be compact and the shortest distance must be provided for access to residential and non-residential uses. At least 50% of the existing and planned residential and non-residential units within the project should be within 400-800 m

walking distance to the existing transportation and public transportation facilities. In this context, almost all of the proposed stops for public transportation were kept within the reach of the residential islands around 400 m to provide effective access to the stall areas. The distance between the bus stops is an average of 800 meters. The suggested stops for the electric minibus are located more frequently than the bus stops and close to the social reinforcement areas and trade areas (Kocakır Reserve Building Area Component 4.6 Report, 2015).

One of the most important transportation targets of ecological settlements is the development of pedestrian priority and the strategies to promote the use of bicycles. Within this context, planning area has been designed as a pedestrian priority in order to have a sustainable transportation system. Pedestrian pavements on the main roads are thought to be 5 meters in both directions and the priority is given to pedestrians and disabled people in the connection of social reinforcement areas. All roads are provided with dimensions, slopes and materials to provide a comfortable level of mobility for pedestrians. All pedestrian axes design is proposed in the socio-cultural and life corridor, connected to public transportation stops, open spaces and social reinforcement areas, as well as for recreation and walking purposes. Bicycle lanes were proposed on both sides of the motorways and the aim was to increase the share of the city in bicycle transportation. (Kocakır Reserve Building Area Component 4.6 Report, 2015).

As seen in world cases, what makes an eco-city successful is the limitation of the use of private vehicles. This is necessary not only because of the reduction of carbon emissions, but also of the creation of environmentally friendly living spaces as well as the positive impact on human health. Reduction of parking spaces in the area is the main limitation of private vehicles. For this reason, the number and area of the parking lot that will be needed in the project have been determined and it is aimed to reduce the number of parking lots. It is estimated that a total of 19,000 cars will be needed, considering that 1 family will have 1 car and 2/3 of the families will have cars in the future. This will cover an area of approximately 6.25 hectares. Each parking area will be designed to be less than 8.000 m^2 in size, 10% of which is planned as aboveground and the rest as underground parking. (Kocakır Reserve Building Area Component 4.3 Report, 2015). However, this number is quite high for an eco-city project. Another way to reduce the number of parking spaces and the use of vehicles is to expand the

use of shared vehicles as in the case of Vauban and Bo01. Accordingly, no strategies have been considered for the Kocakır project.

4.4.2.4 Buildings and structures

In eco-cities, it is necessary to start determine strategies from building scale in order to minimize the damage to the environment. At first, sustainable green buildings should be designed, the height of the buildings should be maintained and the distance between the buildings should be maintained, the correct orientation and roof slope should be applied for the buildings to benefit more from solar energy, the use of construction materials to reduce energy consumption, the use of green facades are the main indicators of eco-city buildings.

In the project area, the following targets have been determined in order to make energy costs sustainable, reduce all kinds of risks and protect the environment:

- 90% of the buildings should be energy efficient
- Ensuring the correct orientation of buildings and structures to get more sunlight
- Buildings have heating, cooling and renewable energy systems
- Establishment of green roofs
- Reduction of heat island effect
- Methods of reducing water consumption in buildings

According to eco-city planning and design criteria and *"Green Building Regulation for Buildings and Settlements"* and *"Regulation on Energy Performance in Buildings"* in the project area, it is aimed to achieve minimum building energy efficiency in 90% of multi-unit and over four storey residential buildings, including non-residential buildings and mixed-use buildings, by complying with green building standards.

The main way to design a sustainable building in eco-cities is to utilize solar energy with PV panels and implementing green roofs. By placing solar panels on flat terraced roofs of office and commercial buildings, which will be located in Kocakır ecological area, it is aimed to generate electricity and supply hot water. In addition to solar panels, green roofs will be made in residential buildings. The main objective in green roofs is not only to ensure that buildings are energy efficient but also to reduce the heat island effect.

One of the most important methods of reducing water consumption in ecological settlements is to design the roofs of the buildings in such a way that they can collect rainwater and to ensure that the collected water is treated and reused. The roof designs of the planned buildings in the project area are designed to be suitable for rain water collection and the daily water saving amount is calculated separately for each planning stage.

Especially in residential buildings, solar energy, which is a sustainable energy source, plays an active role to provide climatic comfort. Based on the eco-city planning and design criteria, it is aimed to place the buildings and structures in the project area in an appropriate way in order to benefit from sunlight effectively. In this direction, considering the topography of the project area, the existing street network and the areas to be protected, approximately 75% of the buildings are planned to be placed especially on the east-west axis. It should be ensured that one axis of the building is designed to be 1.5 times longer than the other axis and the long axis is oriented geographically at an angle of 15 degrees to the east-west axis (Kocakır Reserve Building Area Component 4.6 Report, 2015).

Materials to be used during construction in eco-cities must also be sustainable, with minimum damage to nature. The materials used to be constructed and recycled materials instead of traditional materials. In this context, no information is given about the materials to be used in the project area and the low-impact materials. Another indicator that should be in the design criteria in eco-cities but not considered on a project basis is the design of green building facades as in other world samples.

4.4.2.5 Open public spaces and green areas

The planning of green spaces and open public spaces, which have an important place among the spatial criteria of eco-cities and are main indicator of ecological settlements, should provide four heading. Increasing green areas comes first and the amount of green area per person varies according to the legal framework of the countries. According to "*Spatial Plans Construction Regulations"* the amount of green area per person is set as $10m^2$ in Turkey. Within the scope of the project 112 hectares – per capita $15m^2$ of open green areas, parks, squares and recreation areas were proposed. It is seen that this figure meets the purpose of the regulation sufficiently.

The integration of newly developed green spaces in eco-cities to the existing green system is important for the protection of urban natural structure. In this context, topography, climate, natural structure and the existing vegetation taking into account the active and passive recreation areas, open green areas are designed. 3 types of corridors have been defined as concept design: habitat and ecological corridor, green infrastructure corridor and socio-cultural life corridor (Figure 4.2).

Figure 4.2 : Parks and recreational areas in Kocakır project (Kocakır Reserve Building Area Component 4.4 Report, 2015).

As stated in the conceptual framework of the thesis, the existence of public open spaces positively leads to the creation of more livable spaces, an increase in the quality of life and the development of people's social life.

Planning of access to public spaces, including the disabled, children and the elderly, is one of the main principles of ecological settlements. A total of 7 green infrastructure corridors intersect with the socio-cultural life corridor extending in the east-west direction and the habitat and ecology corridor parallel to it in the south direction and feed these two important corridors recreative and strengthen the urban green system. The socio-cultural life corridor is the main corridor that combines both recreation, trade and agriculture functions. This corridor is also the main arterial carrying the most attractive and dynamic public open spaces of urban character, including pedestrian and bicycle axes. Habitat and ecological corridor is one of the biggest recreation areas in the project area (Kocakır Reserve Building Area Component 4.6 Report, 2015).

In an eco-settlement, it is important to design streets and streets with pedestrian priority. In the project area care was given to afforestation on pedestrian roads and streets designed in the socio-cultural life corridor. The aim of this afforestation is to shade the streets and sidewalks and to create a micro-climate effect on this corridor. The areas to be afforested are foreseen to select tree species in accordance with the width of the streets, as well as the location.

When the objectives are examined accessibility condition pedestrian roads, sidewalks and ramps will be designed in accordance with the defined standards in order to enable people such as children, the elderly and the disabled to use these spaces comfortably.

Designing open and green spaces generally meets all eco-city indicators. Designing enough public spaces and considering access to these public spaces, designing shaded streets and integrating them into the existing green system could be evaluated positively in this context.

4.4.3 Socio-economic criteria

4.4.3.1 Quality of life

When the current urban life quality of the Kocakır project area is examined, it is seen that the social, economic and spatial problems of all 3 neighborhoods in the area are almost equal. Lack of infrastructure, unemployment, lack of social equipment and transportation are defined as the most obvious problems. Lack of infrastructure both affects people's social life negatively and causes environmental problems. Lack of job opportunities for the young population has accelerated migration to the city center, resulting in loss of population. Apart from this, lack of education and health facilities, playgrounds and cultural facilities, odor problems due to lack of sewage system and electrical problems affect the quality of life of the people living in these neighborhoods negatively (Kocakır Reserve Building Area Component 4.2 Report, 2015).

Improving the quality of urban life means to ensure the safety and equality of the people living in that area, to provide affordable accommodation for everyone, to increase job opportunities, to provide sufficient numbers of education and health institutions and to reduce carbon emissions to improve air quality. According to the 1/25.000 Scale Eskişehir Metropolitan Area Central Region Master Plan the vision of the planned area is not only to create an environmentally friendly healthy living space

while preserving ecological natural values, but also to improve the quality of urban life.

In the planning area, a total of 42 study areas have been proposed in order to provide the standards and access distances specified in the "*Spatial Plans Construction Regulation*", and it is thought that 1 primary and 1 secondary schools will serve to each neighborhood unit. In the region close to the techno park area, a vocational high school was proposed to be in close relationship with the techno park area, and an education-culture zone was reserved in the 2nd stage recreation area. In addition, 13 family health centers, 4 cultural facility areas, sports and worship areas, regional-scale recreation area located in the neighborhood, techno park area, university area and a regional-scale cultural center have been proposed (Kocakır Reserve Building Area Component 4.2 Report, 2015).

In general, it is seen that strategies and targets have been developed to improve the quality of urban life in the project area. Conducting geological and geotechnical analyzes for compliance with the settlement to be approved by the *"General Directorate of Disaster Affairs"*, and the creation of mixed-use and compact residential areas are important for the safety of people. Designing diverse public spaces addressing different age and gender groups will help ensure equality and community coverage. Ensuring the access of disabled people, elderly and children to transportation and public spaces is another factor that increases the quality of urban life.

4.4.3.2 Public participation

For a project to be effective and inclusive, firstly, the active participation of the society in the decision-making processes must be ensured. As mentioned in the section 2.5.3.2., the participation process should be open and transparent and the ideas that will arise in this process should be turned into action. Urban regeneration projects, in particular, should involve a broader process of participation in social, economic, environmental and spatial terms. Social study programs should be established before project design, and collective management organizations should be established before living starts in the area and necessary legal and administrative infrastructure should be prepared for this. The aim of the social study program is to analyze the economic, social and urban quality of life of the people living in urban transformation areas and to find solutions for the problems identified as a result of the analysis. The main task

of this program is to improve the places where people living and working in the urban transformation area live.

Since Kocakır reserve building area is also an urban transformation project, it is considered that the participation of actors and stakeholders in the planning processes should be taken as a basis and various meeting methods and forms that ensure this participation will be realized systematically. In addition, it is planned to establish a collective structure management unit in the planning area and to conduct life cycle analysis by this management unit and calculate the total benefit provided by the settlement each year.

It will be positive for the implementation of this project that the participation of actors and stakeholders is taken as a basis in the plan and project making processes and the systematic realization of the various meeting methods and forms that will participate. However, this situation should be considered and implemented from the decision stage of the project.

4.4.3.3 Healthy economy

The livelihood of each of the three neighborhoods settled in the planning area is based on agriculture and animal husbandry. Agricultural activities continue to a great extent with the land being generally flat and fertile agricultural soils. However, because lack of infrastructure and insufficient support, animal husbandry has been left behind and has difficulty in meeting these activities economically. Apart from this, it is seen that daily, nature, culture and eco-tourism in Kayapınar district in planning area, daily and cultural tourism in Yukarıçağlan and thermal tourism potential in Aşağı Çağlan are supported (Kocakır Reserve Building Area Component 4.2 Report, 2015).

Efficient use of renewable energy sources reduces external dependence of electricity needs, reduces water consumption of sustainable green buildings, design of mixed-use and high-density areas, reduces public transport and private vehicle use, plans transport improvements that improve accessibility or expand the environment, integrated solid waste management disposal methods will be developed, new fields of employment to be created by developing trade and service sectors, creating market areas where people engaged in agricultural activities can market their products will lead to sustainable economic growth of Kocakır settlement.

4.5 Assessment of Kocakır Project within The Framework of Eco-City Planning and Design Criteria

As in the whole world in Turkey urbanization process causes population growth in urban centers, environmental problems, and need the establishment new city centers. On the other hand, the lack of infrastructure in the existing urban areas, the presence of debris areas, structures and reinforcement areas are not suitable for shortage and use of urban transformation projects brings new urban areas planning. Eskişehir, which is evaluated within the scope of the Law № 6306 on the *"Transformation of Disaster Risk Areas"*, aims to create a healthier, safer and exemplary ecological area through urban transformation in settlements under disaster risk.

Review of Kocakır Reserve Building Area 1/5000 scale Master Plan Report, 1/1000 Scale Implementation Plan Report, 1/2000 scaled Urban Design Report shows that the project includes pioneering approaches to sustainable urban development and ecological urban studies in Turkey. As a result, in this section it has evaluated of the project which is important for Turkey in terms of eco-city planning and design criteria developed within the scope of thesis (Table 4.2).

Table 4.1 : Assessment of Kocakır project in terms of eco-city planning and design criteria.

	Parameters	Objective	Indicators	Kocakır project
Ecological	Energy	Providing energy production from renewable energy sources	Use of solar energy	✓
			Use of wind energy	✓
			Use of geothermal energy	n/a
			Use of biomass energy	✓
	Biodiversity	Protecting biodiversity and ecologically important areas	Use different types of plants to protect the biodiversity	✓
			Revitalization of local vegetation	✓
			Evaluation of forest	n/a
	Waste management	Ensuring effective recycling	Separate waste collection	✓
			Recycling of wastes	✓
			Generating biogas energy from wastes	✓

Table 4.1 : (continued). Assessment of Kocakır project in terms of eco-city planning and design criteria.

	Parameters	Objective	Indicators	Kocakır project
Ecological	Waste management	Ensuring effective recycling	Composting systems for organic waste	✓
			Wastewater recovery and reuse systems	✓
	Water	Protecting water sources and consumption	Rainwater recovery and reuse systems	✓
			Reuse the water for irrigation, washing, fire-fighting or non-domestic use	✓
			Reducing water consumption in buildings	✓
	Air	Ensuring air quality	Reducing greenhouse gases and carbon emission	✓
	Soil	Ensuring soil quality	Preserve pollution of soil	✗
			Reuse of contaminated land	n/a
Spatial	Location	Suitable field selection	Close to the city center	✗
			Close to main transportation networks	✓
			To be compatible with climate conditions	✓
			The presence of existing settlements around	✗
	Urban form	Providing mixed-use and compact development	At least 20 services within 400 meters of the residences	✓
			Accessibity to urban facilities	✓
			Different housing typologies	✓
	Transportation	Providing sustainable transportation system	Increasing pedestrian access	✓
			Increasing access by bicycle	✓
			Minimizing vehicle priority in transportation	✓
			Priority giving to public transportation	✓
			Decrease parking areas	✓
			Car sharing or bike sharing near public transport stops	✗
			Transport demand management	✓
			Accessible transportation for disabled people	✓

Table 4.1 : (continued). Assessment of Kocakır project in terms of eco-city planning and design criteria.

	Parameters	Objective	Indicators	Kocakır project
Spatial	Buildings and structures	Reduction of energy need	Design of low energy consuming structures	✓
			Taking into account the distance between buildings and buildings height	✓
			Orientation of the buildings to the south	✓
			Energy saving material usage	✓
		Design of structures in harmony with climate	Establishment of green roofs for reducing heat island	✓
			Increased green facades	✗
		Providing efficient water management	Optimization of water use in buildings	✓
			Establishment of green roofs for water accumulation	✓
	Open public and green spaces	Providing open and green areas	Increasing green surfaces and areas	✓
			Accessible open spaces for disabled people	✓
			Afforested and shaded streets	✓
			Integration with the existing green system	✓
Socio-economic	Public participation	Ensuring social sustainability	Involvement of the residents during the planning, accepting advice, organizing workshops and integrative initiatives	✗
			Providing public education on ecology and environment	✗
	Quality of life	Increasing life satisfaction	Providing social justice, better and safety life, health, education opportunities	✓
	Healthy economy	Ensuring economic sustainability	Creating the right amount of job opportunities	✓
			Affordable houses for everyone	✓
			Proximity home and work distance	✓

When the project is evaluated according to location and site selection criteria, it can be evaluated positively because of its location on main transportation arteries and priority given to mixed-use residential areas in terms of accessibility. On the other hand, when the ecological settlement area is evaluated in terms of its proximity to the center, it is seen that this area is quite far from the center and that there are no neighborhood settlements in its immediate vicinity. However, the development of

strategies to reduce home-work distance, which is primary importance, can provide high input to increasing success. The existence of a university and technology development zone proposed in the Thermal Tourism Center in the west of the project area and in the 1/25.000 Eskişehir Metropolitan Area Central Zone Master Plan, and suggesting the recreation area which will be of great importance for Eskişehir in the north-east, reveal both the spatial advantage of the project area, as well as supporting the development of a mixed-use project. In addition, the fact that 80% of the project area is suitable for the settlement resulting from topographic analysis shows a positive approach. In this respect, the evaluation of the project in this category shows that it partially provides the indicators.

Designing the Kocakır project as a self-sufficient, mixed-use and accessible settlement in all stages means meeting one of the main objectives of the eco-city criteria. Spreading the working areas to the whole planning area, spreading the residential and commercial areas along the main streets, the proximity of the residential areas and the social reinforcement areas will both increase the viability of the city in each region and reduce the dependence on vehicles by shortening the walking distance.

In addition to shortening the home-work distance, public transport and alternative transport routes are one of the methods of reducing vehicle dependence. In this context, transportation strategies and targets of Kocakır project are at a level that will provide success even if there are some deficiencies. The transportation of the road connected to the city center by hybrid buses to be operated on lanes separated from other traffic during the rush hours and the use of electric public transportation vehicles to ensure mobility within the planning area will positively affect the carbon emissions that may occur in the area. Decisions on pedestrian and bicycle paths are also at high level in the project. If the planning area is planned as a mixed-use and compact settlement, the average journey length will be 2 km and 65% of the journeys will be made on foot. In addition, a total of 6.25 hectares of land is planned to be allocated according to the strategy to reduce parking spaces in the project area. However, it is obvious that this number will not give positive results in the parking reduction solution since it is quite large for an eco-city.

When the indicators of buildings and structures are examined, it is seen that Kocakır project provides 6 out of 11 indicators. The aim of the buildings and structures to be as energy efficient as possible, to have heating, cooling and renewable energy systems,

to ensure the orientation, taking into account the distance and heights between buildings receive positive results according to the eco-city criteria for this category. In the Kocakır project, strategies such as designing green facades in other world examples were not included. Implementation of a gray water recovery system for buildings and collection of rainwater from the roofs of buildings to collect rain water and use it for various indoor purposes will play an important role in reducing water consumption.

High importance was attached to the design of green spaces and public spaces, which are the most important indicators of eco-cities. It can be evaluated positively because it has an approach that allows active and passive recreation, especially considering the elderly, disabled and children. Identifying and integrating corridors such as habitat and ecological corridor, green infrastructure corridor, socio-cultural life corridor and integrating it into the existing urban system have formed an integrity in this indicator. Topography-sensitive development, conservation strategies for agriculture and forest areas have enabled it to meet the criteria of the natural environment category.

The category of social cohesion and participation is one of the three basic dimensions of eco-city designs. In this category, it is seen that Kocakır project has achieved some success. Although the objective of the project is to provide an effective and inclusive social participation process and to support the democratic participation of rights holders in decision-making processes, detailed information is not provided. As a result of the survey, it is seen that the people living in all three neighborhoods are not aware of this project and approximately 30% of the population regards this project as negative. In this regard, workshops should be organized in order to raise awareness of the people, the ideas of the people living there should be taken into consideration before the project design and implementation and strategies should be developed without affecting their social life.

To ensure social equality is one of the national priorities in Turkey. Developing mixed income groups and price accessibility strategies is an important element that will contribute to ensuring equality. The project appears to contain design criteria for mixed income groups, which are directly related to new business opportunities. In order to ensure social equality, alternative housing types for different demographic, socio-cultural and income groups have been adopted in residential building blocks.

As can be seen from the world examples, when the examples of implemented eco-cities are examined, it is seen that the use of renewable energy systems and ensuring the integration of technologies to the city are the prominent criteria in terms of sustainability of eco-cities. Kocakır project also performed successfully in this context. Whether using solar energy or converting waste into energy, the project will have the capacity to generate enough energy in the project area. It appears that the design has taken significant steps in energy and climate issues, but targets for reducing air pollution have not been defined.

Since the current livelihood of the people living in the project area is agricultural, the protection of these areas is among the project objectives. Integrating these agricultural lands with urban areas will increase the product potential both by ensuring sustainability and by promoting urban agriculture.

As a result, when the Kocakır project is evaluated according to the determined indicators, it meets mostly ecologically and spatially criteria, however for the socio-economic criteria need to be developed especially in terms of ensuring the participation principle.

Kocakır Reserve Building Project is under the duties and responsibilities of different institutions and organizations. It was thought that implementation of the project under the Environment and Urban Ministry regulations however some decisions also were taken into account which they are not available on Turkey legislation.

In addition to the eco-city criteria evaluation the strategies and targets to be implemented in the Kocakır project are evaluated in the context of the legal framework. It is seen that they contain many laws and regulations including eco-city planning. However, the eco-city planning and decisions necessary for the design, but were not included in the legislation system Turkey. It is aimed to use local energy resources in the project area, thereby encouraging the generation of its own energy, and reducing the amount of air pollution and carbon emissions. Regarding this issue, there is no legislation in Turkey. In addition to this, there are no regulations the reduction of indoor water consumption and the establishment of roof gardens to be used in rain water management, and the targets for lagoons for rain collection. Another decision that is considered to be implemented in Kocakır project and which does not have any relevant legislation about the aim of the project is to reduce the heat island

effect in the area by increasing the landscaping areas, decreasing the hard surfaces and implementing the green roofs. As regards transportation there is no legislation on the reduction of parking space law in Turkey.

5. CONCLUSION

In parallel with scientific and technological advances, increasing population, wrong policies and actions applied in the past, decrease in natural resources, not only cause global climate change and many environmental problems, at the same time, it started to affect people's lives both economically and socially and caused consumption habits to change. As of 1972, the concept of sustainability, which has been included in our lives, has started to be effective in every field and the implementation of sustainability principles has become effective especially in urban areas. Although the basic quest of this concept is not cities, its focus on environmental problems and ecosystem affects cities and human life at some point.

In recent years, new urban models have emerged in order to create high-quality residential areas compatible with nature and to reduce urban problems. These cities such as compact cities, slow cities, green cities, smart cities, low-carbon cities, eco-cites, which show different approaches than traditional cities regardless of their name, offer solutions that are diversified with similar concerns in planning and design approaches.

Ecological policies and strategies are needed to ensure the balance of energy and environment in cities and to solve climate change, socio-physical and infrastructure problems. Active and efficient use of resources can be ensured through ecological land use decisions defined by the principles of public interest, environmental awareness, renewability, transparency, participation and democracy. This process can be solved by eco-city planning, which creates an ecological urban model and maintains a balance between conservation and use (Yıldız, 2016).

According to Register, who used the concept of ecological city for the first time, no eco-cities were found until then. The concept of eco-city has attracted great interest in the academy since its use and has had a positive impact on the policies of cities. Main features of an eco-city: planning as a natural city, adapting to the climate, prevention of environmental pollution, protection of natural sources and biodiversity, re-use of rain water, renewable energy sources in heating, cooling and transportation, recycling

of solid wastes and the use of advanced technology is known as raising awareness of local people through ecological training. In this context, the planning and design criteria of the eco-city within the conceptual framework that constitutes the second part of the thesis have been researched under three headings and constitute the main structure of the thesis. These criteria are separated from ecological, spatial and socio-economic aspects and indicators and targets are examined in accordance with each other. Eco-city criteria were determined according to performance indicators and evaluated within the scope of projects developed by different organizations in different countries.

The main feature of eco-cities is the integration of environmental protection policies with spatial planning. Getting rid of carbon waste, providing energy from completely renewable sources and re-creating nature as a green city by integrating nature with the city means planning an eco-city. Ecological criteria should be met first in the planning of these cities. Increasing environmental pollution with increasing population, increasing energy usage and energy policies to meet the needs of the increasing population cause climate change along with human health. In the eco-cities planned to be planned in this direction, firstly, it is planned to establish environmentally healthy settlements and healthy living spaces. The environmental criteria of the eco-city are grouped under four sub-headings, namely the use of renewable energy, the provision of biodiversity, waste management, and the provision of water, air and soil quality.

To use renewable energy sources such as wind, solar, biomass, geothermal for efficient and less use of energy, to take measures to reduce water consumption by protecting natural water resources, recycling of domestic wastes to obtain energy and at the same time to reduce the ecological footprint, conservation of species within the ecosystem and ensuring biodiversity are among the environmental criteria of eco-city planning.

The second one is spatial criteria and it is important for eco-cities to incorporate the morphological features of the cities correctly. One of the most important spatial decisions for the sustainability of eco-cities is the right location. The potential area should be close to the main transport arteries, the surrounding area should be covered by the existing settlements, and should be selected by considering topographic analyzes. Other spatial decisions that need to be taken to protect the natural structure and to create a sustainable eco-city are suitable for human scale, compact, mixed and high-density residential areas, walking as far as possible to urban functions and social

facilities, taking measures to reduce the use of vehicles, sustainable green buildings design, taking into account the climate and solar orientation in the positioning of buildings, per capita green areas and increase the use of common areas.

The last and important socio-economic criterion focuses on improving the life quality in urban areas, ensuring effective public participation in planning processes and increasing the economic prosperity of the city. Ensuring urban security, having sufficient social reinforcement areas, reducing environmental pollution, ensuring social justice and equality, designing all social groups with the concept of livable cities are the main principles for improving the quality of urban life. The main goal of the eco-city approach is to create a global and local model to achieve balance in all urban systems. Ensuring effective public participation in eco-city project design and implementation, ensuring social acceptability of environmental policies, and providing sufficient employment opportunities for the people who will live there are important for social sustainability.

The full implementation of these ecological city criteria is possible in urban areas that will be opened to new settlements. Another option is to initiate urban regeneration projects in existing urban areas by planning ecological settlements. According to literature studies, the number of ecologically sustainable urban approaches has increased and continues to increase in recent years especially in developed and developing countries around the world. In the third part of the thesis, four world eco-city examples are examined through eco-city planning and design criteria, and detailed information is given about general design decisions and implementation approaches and evaluated within the specified criteria. These examples are respectively Dongtan, Vauban, Bo01 and Eco-Viikki. Although the samples examined have some differences, they basically meet the criteria of eco-city settlement in terms of environment.

The Dongtan project was designed as a newly developed area and the other projects were designed as urban expansion and retrofit projects. As a result of the evaluation of the samples within the framework of eco-city planning and design criteria, common planning features are as follows: All examples tried to make use of renewable energy sources as much as possible. Existing vegetation for conservation and development of biodiversity has been preserved and biodiversity has been achieved by using different plant species. They showed a positive situation in terms of waste management and use

of rain water. In all samples, it was taken care to separate the wastes at the source and recycling of the collected wastes was ensured. At the same time, rain water and wastewater are evaluated and cleaned for reuse. The examples were designed with the principle of compact urban design, the distance between home and work was reduced and access to social reinforcement areas and public transportation stops was achieved by walking. In all cases, the transportation system was planned in accordance with the principles of sustainable transportation system, strategies to extend pedestrian, bicycle and public transportation use were developed to reduce the number of vehicles, parking spaces were reduced and restricted. Targets that are suitable at the scale of the building are the use of green roofs in order to save water in buildings, the use of sustainable construction materials that do not harm the environment, and the design of the building considering the height and distance between them. Socially and economically, only the goals of improving the quality of life are seen as a common feature.

In the fourth and last part of the thesis eco-city development planning and legal framework in Turkey, applicability by which institutions and organization, Eskisehir – Kocakır project evaluated within the framework of the eco-city planning and design criteria that have been developed within the scope of thesis, problems and potentials are identified.

Sustainability Performance Urban Transformation Project has been developed in Kocakır area within the scope of the Law on Transformation of Disaster Risk Areas signed between the Ministry of Environment and Urbanization and Istanbul Technical University. Within the framework of this project, five main strategies and 64 targets were identified and grouped under the headings of land use and correct site selection, energy generation, water supply and use, waste management and sustainable transportation system. Project covering an area of 838,3 hectares to increase the global warming and climate change adaptation capacity and resources created to be used as effectively, but also it is very important for being the first public housing application examples made on this issue in Turkey.

Within the scope of the project, it is possible to evaluate the heat generated by the buildings with appropriate mixed use consisting of optimum energy efficient structures, to produce its own energy with renewable resources, to store, to use it, to collect the domestic and rain water in a separate system, to treat the domestic

wastewater, to recover and reuse the waste water and rain water, the ecological and spatial planning criteria of eco-city planning by encouraging practices that provide green and urban agricultural areas, access to equipment, trade and workplaces by pedestrian and bicycle paths and public transport, limiting the use of fossil fueled individual vehicles, and evaluating construction and other wastes from transformation (Akalın, 2017).

As mentioned in section 4.5, Kocakır project falls behind in terms of socio-economic criteria compared to other criteria. The applicability of an ecological urban planning should be realized with the cooperation and coordination of the public, local government and non-governmental organizations. The socialization of environmental awareness enables the ecological development of space (Yıldız, 2016). Given the current situation of ecological urbanization, it is not a lifestyle that can take place suddenly. The determination of strategic problem areas and the applications allocated to the stages require an interdisciplinary effort. As in the case of Dongtan eco-city planning, there may be problems in the implementation of an eco-city project that is not adopted by the local people with environmental awareness and the plan decision stage does not develop with public participation. The city councils, which enable local people to protect and protect the identity of the city and to take part in the decisions regarding the future of the city, ensure that urban and environmental problems are addressed in a democratic negotiation environment.

Ecological city planning in recent years on behalf of Bursa in Turkey - Nilufer, Gaziantep - Kilis, Eskişehir - Kocakır is designed as eco-city projects, but none has yet to pass the application phase. The reason for this as the responsibility for environmental issues in Turkey and granting more authority to the institution and inter-agency integration has been shown to be poor. This situation causes institutional confusion and problems in practice (Çiğdem and Akyol, 2016). At the same time, it is known that environmental policies are limited within the framework of legislation and there are deficiencies in transferring them to urban space (Yıldız, 2016). In this context, the integration of institutions of different scales other than eco-city planning and design criteria will play an important role in the development of holistic policies. Ecological policies should be established at all levels of planning and central and local governments should take an active role in both implementation and supervision.

Consequently, eco-city is an important in order to create a healthier and more livable city in Turkey. Conservation of ecological balance, minimizing ecological footprint, efficient and efficient use of renewable energy sources, transparency, equality should be considered not only with the decisions of ecological space usage but also with social and spatial decisions.

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CURRICULUM VITAE

Name Surname **:** Nigar Aliyeva

Place and Date of Birth **:** Baku, Azerbaijan 23.07.1994

E-Mail **:** alinigar94@gmail.com

EDUCATION

- **B.Sc.** **:** 2015, Azerbaijan Architecture and Construction University, Faculty of Architecture, Architecture.
- **M.Sc.** **:** 2017, Azerbaijan Architecture and Construction University, Faculty of Architecture, Department of Buildings and Constructions Architecture.
- **M.Sc.** **:** 2019, Istanbul Technical University, Department of Urban and Regional Planning, Urban Planning Program.
  : 2019, Frankfurt University of Applied Sciences, Faculty of Architecture, Department of Urban Agglomerations (Exchange Semester).

PROFESSIONAL EXPERIENCE

- 2015-2016 : Architect at Baku State Design Institute
- 2019-present : Architect at Baku State Design Institute