LOW CARBON NEIGHBORHOOD: WALKING AND CYCLING PRIORITY URBAN DESIGN

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ABSTRACT

LOW CARBON NEIGHBORHOOD: WALKING AND CYCLING PRIORITY URBAN DESIGN

Following The Industrial Revolution, along with newly developing job opportunities, a rapid migration from rural to urban has begun. With the increasing flow of migration, the urban enlarged. With the increase of the distance in access, wide motorways and railways started to be built up on these areas. Along with major freeways, throughout 20th Century, the natural environment began to be destroyed and fragmented, resulting in urban sprawl and environmental pollution.

Traces of the reclaim of the streets from car dominance were examined and the steps leading to a low carbon living were investigated. As a result, five principles were developed upon this living mode. These principles were scrutinized at the neighborhood scale. Having strong social bond in itself, the neighborhood scale is appropriate for implementing these principles. In the study, single case studies suitable for various low carbon living concepts were examined.

According to the method, the theoretical structure of the study was evaluated, then applied projects were examined, and thus an awareness questionnaire on "low carbon living" was applied with cyclists representing low carbon transportation. This study of "low carbon living awareness" is the first academic study in Turkish case. According to the survey results, cyclists' awareness of low carbon living is promising. In particular, awareness of low carbon transportation is high.

İzmir has potential in terms of low carbon living. In general, there is a certain awareness degree and walking and cycling priority urban design. All of this forms the basis for the formation of low carbon neighborhoods.

Keywords: Low carbon living, low carbon neighborhood, cycling and walking priority design, İzmir

ÖZET

DÜŞÜK KARBON MAHALLE: YÜRÜME VE BİSİKLET ÖNCELİKLİ KENTSEL TASARIM

Sanayi Devrimi'nden sonra, yeni gelişen iş olanaklarıyla birlikte, kırsal alanlardan kentsel alanlara doğru hızlı bir göç başlamıştır. Göçlerle birlikte kentsel alan sınırı genişlemeye başlamış ve mesafelerin artmasıyla birlikte geniş otoyollar ve demir yolları inşa edilmeye başlanmıştır. 20.yy boyunca, yapılan büyük otoyollarla birlikte doğal çevre tahrip olmuş ve sonucunda da tamiri çok zor olan çevresel kirlenmeler başlamıştır. Buna ek olarak, mahalle ve sokaklar insanların yaşam alanı olmaktan çıkmış ve arabalara hizmet eden bir yer haline gelmiştir.

Bu çalışma kapsamında, sokakların otomobil hâkimiyetinden geri alınışı ve düşük karbonlu yaşam anlayışına giden aşamalar incelenmiştir. Sonucunda da, düşük karbonlu yaşam üzerine beş prensip geliştirilmiş ve bu prensipler mahalle ölçeğinde incelenmiştir. Çünkü mahalle ölçeği, sosyal bağların güçlü olduğu ve bu prensiplerin somut bir şekilde uygulanabileceği ölçektir. Çalışma kapsamında, çeşitli düşük karbonlu yaşam anlayışına uygun örnekler incelenmiştir. Bu örneklerle tasarım ölçeğinde, kent halkının farkındalık düzeyini arttırmak için neler yapılabileceği üzerine tartışılmıştır.

Çalışmada kullanılan metoda göre, ilk olarak teorik literatür değerlendirilmiş, daha sonra uygulanmış projeler irdelenmiş ve düşük karbon ulaşımını temsil eden bisiklet kullanıcılarıyla "düşük karbon yaşamı" üzerine bir farkındalık anketi uygulanmıştır. Bu çalışma "düşük karbonlu yaşam farkındalığı" çalışması olarak Türkiye örneğinde ilk kez yapılmaktadır. Anket sonuçlarına göre, bisiklet kullanıcılarının, düşük karbon yaşamı üzerine farkındalıkları iyi bir tablo çizmektedir. Özellikle, düşük karbon ulaşımı üzerine farkındalıkları yüksek çıkmıştır.

İncelenen proje çalışmaları da, İzmir'in düşük karbon yaşam anlamında bir potansiyel içerdiğini göstermektedir. Genel olarak bakıldığında, belli bir farkındalık düzeyi ve bisiklet ve yaya öncelikli tasarımlar mevcuttur. Tüm bunlar, düşük karbon mahalle oluşmasına zemin oluşturmaktadır.

Anahtar Kelimeler: Düşük karbonlu yaşam, düşük karbon mahalle, bisiklet ve yürüme öncelikli tasarım, İzmir.

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CHAPTER 1

INTRODUCTION

1.1. Problem Definition

The rapid rise in the population of cities and thus the increase of the consumption economy cause big problems over the sustainability of modern urban life. Environmental and energy supply problems with the development of globally networked economy are intermingled with other urban problems.

The migration from rural areas to urban areas began through The Industrial Revolution. Because of the fast-growing migration, urban areas have expanded through rural areas resulting in social, economic and physical fragmentations. The acceleration of the urbanization has caused occupation of over the built environment, the natural environment, and unhealthy environmental conditions have begun to occur. As the concept of "speed" became important along with The Industrial Revolution, great advancements took place in the transportation sector. The development of the iron industry improved the rail system, in addition to the construction of large motorways. Work in the field of transport has improved communication and rapid production, causing environmental pollution. The widespread use of natural resources and the increase in motor vehicles in urban areas, prodigally use of water, land, and energy resources have led social and economic inequalities and health problems.

Air pollution in cities has disturbed the carbon cycle in natural balance. Due to the increasing greenhouse gas, the carbon cycle has broken down and the natural balance has begun to deteriorate. Because of rising human influence, the issue of climate change has clearly arisen. Various planning and design studies and urban utopias including the Garden City Project, the Neighborhood Unit project, and the Radburn Project have been staged since the beginning of the 20th century for the restoration of the damaged natural environment. These projects were followed by the concepts of New Urbanism, Landscape Urbanism and Sustainable Urbanism in the 1970s and 1990s. Low carbon living emphasis is also the outcome of the oil crisis in 1973. Until then, the heavy dominance of cars on

roads continued despite above-mentioned studies. Along with the oil crisis, low carbon and light-weight transportation vehicles such as bicycles have been introduced.

The climate change and energy problem in the world began to be discussed more frequently since 1990s, and sustainable city, smart growth, ecological city, slow city, livable cities and intelligent urban concepts have been highlighted. Furthermore, a low carbon urban approach has been developed that promotes reducing carbon emission and energy conservation. Increase in greenhouse gas emissions in Turkey and its resultant effect air pollution originated from the degradation of the natural and cultural character. This situation has increased interest in renewable energies and low carbon transportation systems.

Within the context of this study, concept of low carbon life was examined at neighborhood scale. The neighborhood is the unit in which social relations are strong, where face to face communication is frequent due to intimate social relations. By nature, neighborhood is the best place to adapt to low carbon principles. Besides the most important tool to support low carbon transport is the bicycle. In particular, bicycles have an important place as they facilitate easy access/mobility at neighborhood scale, and adapt the low carbon principles set out in the study.

1.2. Aim of the Study

In this study, the concept of low carbon living that has become one of the important assets in today's climate change phenomenon is examined. In İzmir Province (Turkey), various climate adaptation studies are being applied against these problems. Various bodies such as universities, municipalities give variety supports in this sense. Especially, in the İzmir Metropolitan Municipality's Sustainable Energy Action Plan (2015), important targets related to low carbon have been formulated. The foremost of these objectives is the reduction of carbon emissions up to 20% by 2020. In addition, efforts to raise awareness include the use of renewable energy systems, the modal integration of transportation, and support for low carbon transport such as trams and bicycles are important steps in this regard. The studies done are motivating for this study. It is thought that those macro scale objectives inspired the low carbon life interventions.

Within this study, five basic principles of low carbon awareness were implemented. These principles are; low carbon transportation, green technology / renewable energy / energy efficiency, flood / extreme air and water conservation, green

infrastructure and biodiversity, land use planning. These five principles were examined in the province of İzmir at neighborhood scale as the neighborhood is the most appropriate unit to examine and implement these principles.

This descriptive study is aimed to raise awareness on low carbon living. To this end, it started with questions of "what is low carbon living?" and "what elements does this lifestyle involve?". Later on, these questions were followed by various sub-questions. In the light of the main research questions, sub-questions are investigated in table 1.1.

Table 1.1. Sub-questions of This Study

Chapter 2 -Pre – Modern Period -Modern Period -Postmodern Period -New Approaches: Low Carbon Neighborhood Movements	-What are the stages of the formation of low carbon living awareness in historical track at neighborhood scale?
Chapter 3 -Low Carbon Living -Low Carbon Living Principles -Low Carbon Transportation Concept	-What is the concept of low carbon living? -Low carbon life principles: What does it consist of? -What is the location of the low carbon transportation systems at urban and neighborhood scales?
Chapter 4 Evaluation of Low Carbon Living Principles in İzmir scale - Low carbon Living Awareness with Bicycle Users Was Investigated.	-What is the low carbon life awareness in İzmir?

1.3. Methodology of the Study

The research methodology used in the study includes analysis of the critical literature on the history of neighborhood unit concept, low carbon living principles and low carbon city case studies. After that, low carbon living approach is exemplified by bicycle over urban transportation as bicycle is the best example of carbon-free lightweight transportation. For this reason, the awareness questionnaire was applied to the selected bicycle group for low carbon understanding. These surveys were evaluated using basic statistics.

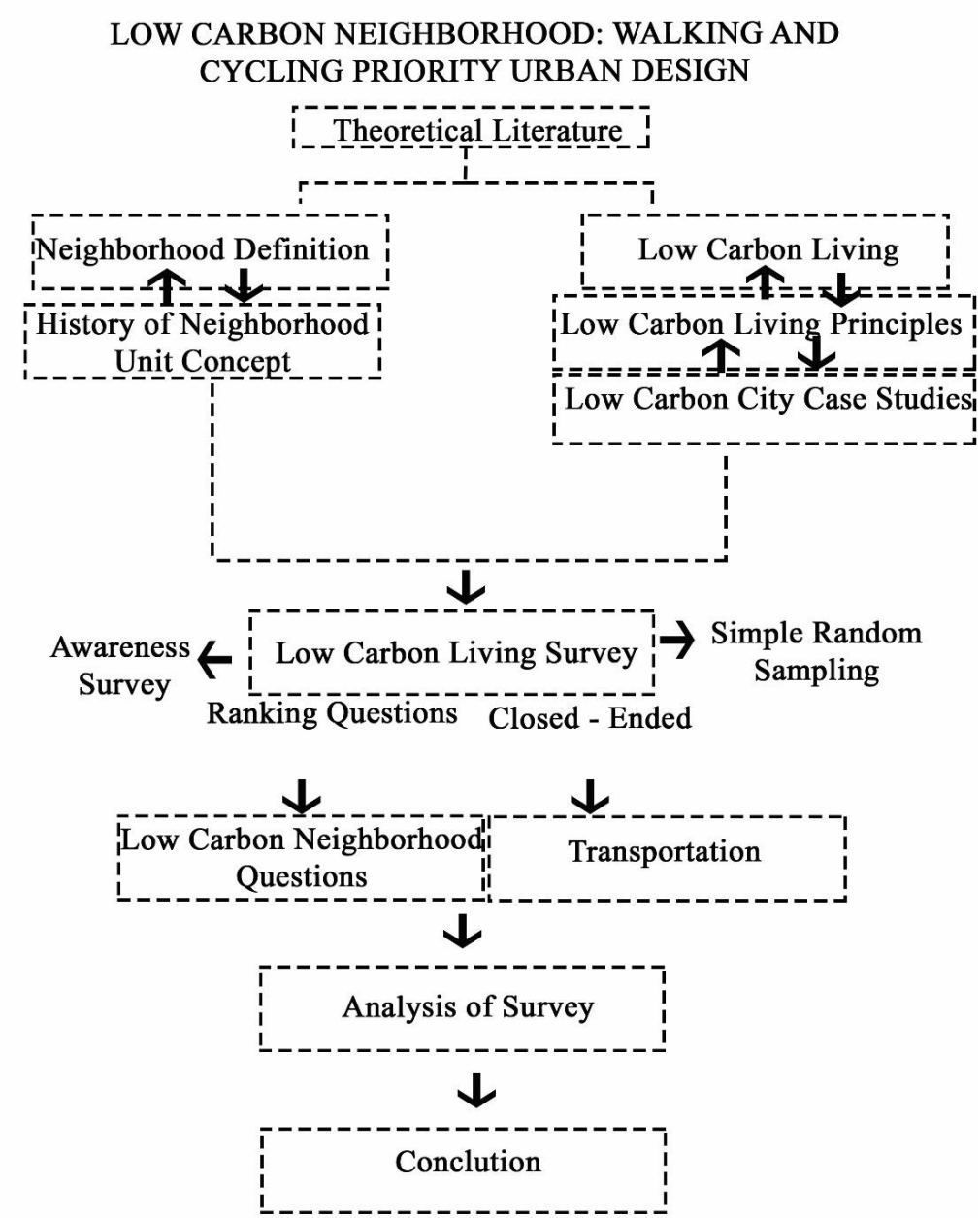

Figure 1.1. Layout of the Methodology

1.4. Structure of the Thesis

This study is based on low carbon life awareness. This concept is explained in all six chapters.

The introductory part consists of "problem definition", "study objective", "methodology of the study" and "structure of the study".

In the second chapter, the definition and history of the neighborhood are researched. Thus, the stages towards low carbon living awareness are examined. These stages are studied in four periods as pre-modern, modern, postmodern and new era approaches. In pre-modern period, neighborhood formation before The Industrial Revolution is examined. Besides, the effects of transportation on urban and rural areas are investigated. In the modern era, the proposal for planning and design solutions to environmental problems arising from the expansion of the transportation network, specifically the dominance of automobiles is examined. Then the post-modern period arising as a critique of modernism is examined. In this period, due to automobile-oriented cities, thoughts have emerged regarding the fact that social relations and neighborhood relations have deteriorated. The design and planning proposals such as sustainable transportation based on walking and cycling developed within this framework are studied.

In the third chapter, the concept of low carbon living is examined and the principles contained in this concept are explained under five main headings as green technology, flooding and extreme weather/water conservation, green infrastructure systems and biodiversity, land use planning and low carbon transportation. The transportation dimension from these principles is discussed separately because transportation is the second largest sector that causes an increase in the carbon emissions in the city, and the study in this area will provide a great contribution to the concept of low carbon living.

In the fourth chapter, low carbon principles are examined in İzmir. In the whole of İzmir, studies that are being done with this consciousness are examined.

In the fifth chapter, there is a survey applied to cyclists on low carbon awareness. This survey study is examined under the five main principles. Later on, the results and discussions in the survey study are explained.

The study concludes with a general evaluation and implications are made on low carbon living consciousness. It has been discussed whether a low carbon design guide can be created. Finally, the low carbon design model is suggested (Figure 1.2).

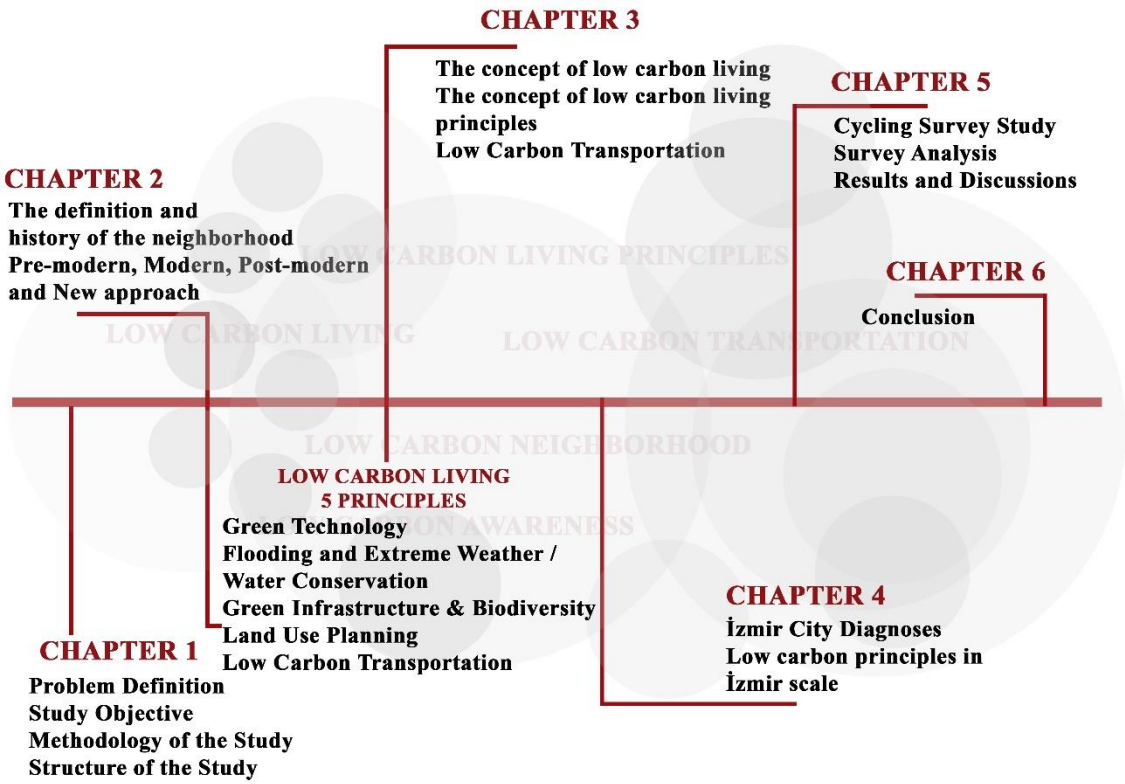

Figure 1.2. Map of Thesis

CHAPTER 2

THEORETICAL FRAMEWORK

The purpose of this chapter is to introduce the concept of the neighborhood, and to give information about the historical process such as the pre-industrial neighborhood understanding and how it is shaped after The Industrial Revolution. Along with these, emerging urban problems are identified and then some urban design approaches to these problems are examined. Approaches such as "New Urbanism" and "Landscape Urbanism" which were developed for the healthy city to be free from automobiles are introduced and the concept of low carbon neighborhood which is formed as a result of these processes is discussed within the perspective of urban design.

2.1. Definition of the Neighborhood

The neighborhood is a place spatially formed by the cluster of residences. Sometimes it is also linked to other land uses. The spatial characteristics of the neighborhood include the structural characteristics of the residential and non-residential buildings such as type, scale, material, design, intensity, infrastructure characteristics such as roads, sidewalks and streetscaping; class status characteristics of the resident populations such as education, profession, income, religion, public services such as schools, hospitals, parks, recreation areas, environmental characteristics such as land, air, water, noise pollution, topographic characteristics, transportation infrastructure, political characteristics, social – interactive characteristics, sentimental characteristics such as historical buildings (Galster, 2001).

According to Martin (2003), the neighborhood is defined as ‘overlapping social networks with specific and changeable time – geographies’. Three different epistemologies, which characterize the neighborhood, have been identified as: 1) typology, 2) stages of change, and 3) economic, administrative, political, and social dimensioning functions. In 1920, urban sociologist Clarence Perry defines the neighborhood as a component of a town and he defines its size based on a five-minute walking radius. In 1942, architect Clarence Stein expanded the neighborhood center’s

definition. He created the towns by banding together the neighborhoods. In the 1920's and 1940's, schools created neighborhood's center and anchor (Treasure Coast Regional Planning Council, 2004). In English, the word neighborhood used in the middle of the 15th century and it was originally used to indicate areas outside the city. In the etymological dictionary, the neighborhood means the community of the inhabitants living in the nearby environment in 1620. After a century-long neighborhood research, the definition became complicated. Academicians expressed the neighborhood as a place where every resident can accommodate the field of activity or point of view and where the physical presence can counteract consciously. In addition, some definitions are quite simple. For example; 'any group between the family unit and municipal government.' In a school curriculum in 1970, 'place, people, and purposes, with the emphasis on the place' was defined as. In 1957, a publication in the New York Post contained a different definition: 'The neighborhood where, when you go out of it, you get beat up.' (Talen, 2016). According to Emily Talen (2016), the neighborhood definition depends on people, behavior, perception, morphology or governments. Academicians are seeking a definition that is theoretically compatible with the dynamics of interest. Talen, for instance, state that; if the attention is illegal drug trafficking in the neighborhood, then a neighborhood is designated by street intersections. If interest is the school, the school district borders define the neighborhood, if the interest is a social connection, the streets where the social interaction takes place should be looked at. If it is to strengthen the social connections of the neighborhood, it is defined as the neighborhood communication concept.

The concept of neighborhood resembles to "Mahalle" in Turkish language. According to the definition of Turkish Language Institution (2017), neighborhood is described as each of the parts of a city, a town, a large village. In Oxford Dictionary (2017), neighborhood is indicated as a district or community in a town or city.

The first of these studies is the definition of a neighborhood by Suzanne Keller in 1968. Keller defines neighborhood as a place with physical and symbolic boundaries. In 1975, Morris and Hess describe neighborhood as 'people and place, with the common sense limit as the area one easily walk over'. In 1982, Golab defined it as a physical or geographical formation with certain boundaries. According to Hallman's definition in 1984, neighborhood is a place where people interact and socialize in a limited space. In 1981, according to Warren's definition, he referred to populations as social organizations where they reside geographically. Another definition was made by Downs in 1981. According to this definition, Downs refers to geographical units where certain social

relations exist. In 1979 Schoenberg referred to it as a 'common named boundaries, more than one institution identified with the area, and more than one tie of shared public space or social network' (Galster, 2001). According to Janet Smith (2014), neighborhood is where proximity is important. Living with neighbors is a form of communication. People living in the same neighborhood have joint experience. There is a synergy between the place and the people (Smith, 2014).

According to Andre Duany and Elizabeth Plater – Zyberk (2008), principles of the ideal neighborhood design include:

1) Neighborhood has a center and edges.

2) The optimal size of neighborhood is quarter a mile from center to edge.

3) Neighborhood includes working, dwelling, schooling, worshipping, shopping, recreating.

4) Neighborhood constructs building sites and traffic on interconnected streets.

5) Neighborhood gives priority to public spaces and proper location of buildings.

According to Yunmi Park and George O. Rogers (2015), neighborhood is defined on multiple scales according to size, level of cohesion, and shared services. In addition, neighborhood hierarchy is based on physical conditions, social relations, and politics. In addition to these, Park and Rogers (2015) have distinguished neighborhood by four levels:

1) A face block. It is the smallest unit called a neighborhood.

2) A residential neighborhood. It is relatively homogeneous physical and socioeconomic places. It includes elementary school or small retail store that serves daily needs of residents.

3) An institutional neighborhood. It involves schools, health centers, recreational and social facilities, and shopping centers.

4) Community. It is a cluster of districts of a city. For example; townships or suburbs.

As understood from these definitions, the concept of neighborhood differs according to the physical dimensions, time, and the way in which researchers handle it. Some researchers have studied this concept at the sociological level and argued that human behavior is the reason for the formation of the neighborhood phenomenon. Others emphasize that the geographical boundaries shape the locality.

2.2. History of Neighborhood Unit Concept

Table 2.1. History of Neighborhood and Transportation

Neighborhood	Transportation
Temporary or permanent settlements in the early Mesopotamian villages are known as the first neighborhoods. **Neolithic Age:** In the middle of the village, there are neighborhoods inhabited. **Chalcolithic Age:** This period is known as the 'Advanced Village Communities' period **Early Bronze Age:** The settlement texture is divided inside (Residence, factory, warehouse) and outside (Street and courtyard) **Medieval Age:** Social neighborhoods of medieval cities have contributed to the concept of neighborhood. The neighborhood is divided into only one race, one religion or one occupation. **14th Century:** A crowded neighborhood is seen in a contiguous area. **Renaissance Age (15th – 16th):** Neighborhoods are divided according to income groups. **Industrial Revolution (18th):** Neighborhoods are broken up due to railroad and road. A rapid migration towards the cities began. People lived in unhealthy conditions.	**Ancient Ages:** People use animals for transportation. The largest road networks are built during the Roman Empire period. Sea transport was very important in this period. **Medieval Age:** There has been no improvement in land transportation. Sea transport is much more advanced. **16th Century:** Roads consisted of land tracks. **Transportation Revolution (18th – 19th):** The emergences of turnpikes, developed bridges, canals, and railroads. New technologies were improved like locomotives. The concept of "Speed" has become important. Along with the development of transportation, the land began to fragment.
19th – 20th Century: Public health and planning are connected because of problems starting in the city. In the city, it started with the idea of creating natural environments. 1902 - Garden City: Public health is the main goal. Neighborhoods and industrial spaces are located at distant places. Neighborhoods are connected to each other by rail. The first neighborhood size was determined with this project.	**19th-20th Century:** Railway transport and road transport have made great strides. 1902 - Garden City: Railway and road transport has a large area in the project. The road without pavement, non-infrastructure, closed streets are criticized. Howard saw the railway as a vehicle for socialization.
The 1920s 1929 - Neighborhood Unit: Neighborhood has a limited population. Land uses were designed at walking distance.	**The 1920s** Neighborhood Unit: Land uses were designed at walking distance. 5-minute walking radius is recommended. This radius is an indicator of the configuration and distribution of land use for a walkable neighborhood.

(cont. on next page)

Table 2.1. (Cont.)

Neighborhood	Transportation
Radburn Plan It is different from traditional street-oriented suburban neighborhoods. It creates the heart of neighborhoods, pedestrian access, child-friendly, open spaces without vehicles. → In both studies, neighborhood center is made up of cultural uses, and a healthy city is the main objective.	Radburn Plan: While the walk distance in the neighborhood unit was 0.4, the Radburn plan was 0.8. Road typology has been changed.
The 1940s and 1950s The concept of the neighborhood unit was reinterpreted. Neighborhood sizes have changed according to the projects.	**The 1940s – 1950s** The number of private automobiles increased in these years. It became a favorite mode of transportation for working class.
The 1960s Automobiles have been criticized by many groups that dominate the cities. Jane Jacobs gives one of the biggest reactions to this situation. Another reaction was shown by Colin Buchanan.	**The 1960s** Automobile domination has been criticized. Colin Buchanan, in Traffic in town, has adopted the design principle that separates the environmental areas from the traffic flow. He defended the environment areas in traffic.
The 1970s and 1980s Donald Appleyard, in his work in 1981, reacted to motorways dividing the neighborhoods. The concept of neighborhood unit is revised by New Urbanists (There is a return to the old). The energy issue has begun to become the main topic of conversation.	**The 1970s – 1980s** With bicycle and pedestrian use, the streets have become places where people live. In 1970, with the oil crisis, protests started. Car-free days were organized.
The 1990s 'Energy' and 'Climate Change' are important issues. Various meetings and conferences were organized for the problem of climate change. For a healthy city, the idea of creating healthy neighborhoods has begun to arise.	**The 1990s** The use of walking, cycling and public transport has become the preferred modes. In this period, Critical Mass activity and "Reclaim the Street" were established.
The 2000s and 2010s The concept of sustainability integrates into the neighborhood unit. The neighborhood unit is being addressed by the concept of sustainability. The low carbon neighborhood is being built.	**The 2000s – 2010s** Low carbon transportation has become important for livable environments.

2.2.1. Pre -Modern Period

Temporary or permanent settlements in the early Mesopotamian villages are known as the first neighborhoods (Hsin Liu, 1978). The basis of today's social and economic order was built during the Neolithic era. In this period, temporary village shelters were moved to permanent village life. Neighborhoods where settlements were located formed the central part of the village. During the Chalcolithic period, the first village communities established in the Neolithic Age was converted into developed village communities (Albustanlıoğlu, 2012). In Early Bronze Age, the settlement texture was divided inside and outside. Indoor space was differentiated as residence, factory, and warehouse. Outer space was differentiated as street and courtyard (Bozkurt and Altınçekiç, 2013). During these ancient times, transportation was usually provided by animals. The largest road networks were built during the era of Roman Empire. Sea transport was very important in this period (Lambert, 2017).

First planned cities of the Greeks reflected their social and political identities in city-state concepts. In addition, social neighborhoods of medieval cities contributed to the concept of the neighborhood (Liu, 1978). In this era, the neighborhood was divided into only one race, one religion or one occupation (Devine, 1975). In addition to these, transportation did not develop much. Sea transport was much more advanced (Lambert, 2017). In the Renaissance period, all socio-economic groups were suggested to live together. At that time, the upper and middle classes, which were separated on the basis of income, are now the basis of the neighborhoods that are now called middle and upper classes. In The Industrial Revolution, automobiles and railroads began to separate the neighborhood (Liu, 1978). A rapid migration towards the cities began. People lived in unhealthy conditions.

In cities before The Industrial Revolution, environmental and technological factors were influential on the city phenomenon. During this period, there were improvements in areas such as wood industry, textile industry, pottery industry, irrigation systems, transportation methods, ornamental arts. Technological developments were limited in this period and humans were less dominant in nature and in their environment through technology. In the pre-industrial era, cities could not develop in these areas because they were also established in places that were not convenient for transportation and agriculture. In this period, in countries with urbanization, the populations of the cities were 10% of the total population. The Cities with a population of over one hundred

thousand were very few. In Rome - Constantinople, Japan, cities like Kyoto, Osaka had populations of over 100.000, and in some cases even millions (Özönder, 2009). In the pre-industrial revolution, cities included pedestrian areas, intensive construction in the city walls. In addition, the rural-urban distinction was clearly seen, there was no functional separation, there was no workplace separation, and there was no obvious class separation (Enlil, 2011). In Gideon Sjoberg's study of pre-industrial cities (1996), population growth slowed down. There was no mechanization in agriculture. For this reason, human and animal power was used and the methods of food storage were not good. That is why there were no food stocks to meet the needs of the urban population. The streets were serving people walking and animals used for transportation. There were no high-rise buildings. In the pre-industrial cities, tools were used to produce energy, such as hammers, spools, and wheels, connected to live energy sources (Sjoberg, 1996).

In the pre-industrial era, there was a cleaner environment because there were no factors that caused carbon emissions. Transportation was mostly provided by pedestrians and horse-drawn cars. For this reason, the roads were mostly serving people, not vehicles. In this period, the tempo and lifestyles were harmonious with nature.

2.2.2. Modern Period

The Industrial Revolution is the period of transition from the production style that depends on human and animal power to the production style that is passed on to machine power. It emerged in England in the 18th Century. Development began first in the textiles sector and then continued in other sectors. The Industrial Revolution is a very important development in human history. It has been accompanied by an increase in living standards with population growth. Emerging machine power brought more raw material production, more manufactured goods, more transportation, more consumers (Küçükkalay, 1997). Turnpikes, developed bridges, canals, and railways developed along with The Industrial Revolution. New technologies were improved like locomotives. The concept of “speed” has become important (Bogart and Majewski, 2011).

The Industrial Revolution took place in two stages, the first being the application of technically simple ideas, secondly, heavy industry was developed. At the beginning of industrialization, there were emergent stages of the capitalist system. Later, iron and coal capital industries emerged as skilled workers needed. After 1830, the second stage of industrialization, the goods industry such as coal, iron, and steel developed. This system

led to the emergence of heavy capital investments. During this period railway was developed, it was a revolution in transportation (Ateş, 2008).

Along with The Industrial Revolution, changing forms of production also changed the urban structures. Factories in any industrial area were located close to the main intersection of transportation systems, water resources such as rivers, lakes, and other water sources. Such formations created the industrial city. In this industrial city, factories, slum neighborhoods with new social and spatial organizations started to be established. If we say that the first characteristic of the industrial city is the production, the second is the poor people who manufacture these products. Public areas and municipal services are at the lowest level in these cities. Following The Industrial Revolution, narrow and filthy routes, airless backyards, and basement houses without sunlight, infrastructure problems and the resulting diseases caused reactions. (Çınar, 2000).

Along with all these developments, it is said that in many sources, the modernist movement has emerged and developed with The Industrial Revolution. Perhaps it would be wrong to say a definite date for the beginning of the modern era, but important steps in architecture and city design were taken up in this period. Because a great immigration has started from the rural to the urban and the boundaries of the cities have begun to expand. In addition, faster construction began with the developing technology.

Modernism is influenced by the technique and ideology of The Industrial Revolution. Modern planning studies first began to remove the negative effects of industrialization and urbanization. In the 1840s, public health organization and planning were linked. In these periods, planning was a tool for the political and ideological purposes of the state and the ruling class. For the 20th Century and beyond, there were three components for the characterization of planning. First, it was seen as an exercise in the design of human settlements and physical planning. Secondly, planning was considered as the product of master plans. The third was defined as a normative task in moving forward the values defined as the ideal environment. British urban planning influenced the radical and utopian planning of the time. The most effective planning form at the time was Ebenezer Howard's Garden City study. In this project, Howard brought back the towns of the village houses together with green roads (Watson, 2009).

In addition, in the 1920s and 1930s, Le Corbusier established the idea of 'Modern City'. Herein, the ideal urban form was developed based on the poor results of The Industrial Revolution. Slum, narrow streets, mixed-use areas were demolished and well-

connected road networks and open spaces were built. In addition, Frank Lloyd Wright in the early 20th Century brought a new definition to the ideal city form (Watson, 2009).

Ebenezer Howard - Garden City

The concept of Garden City was created by Ebenezer Howard in 1902. In 1898, Howard published Tomorrow: A Peaceful Path to Real Reform (Figure 2.1) (Fishman, 1982).

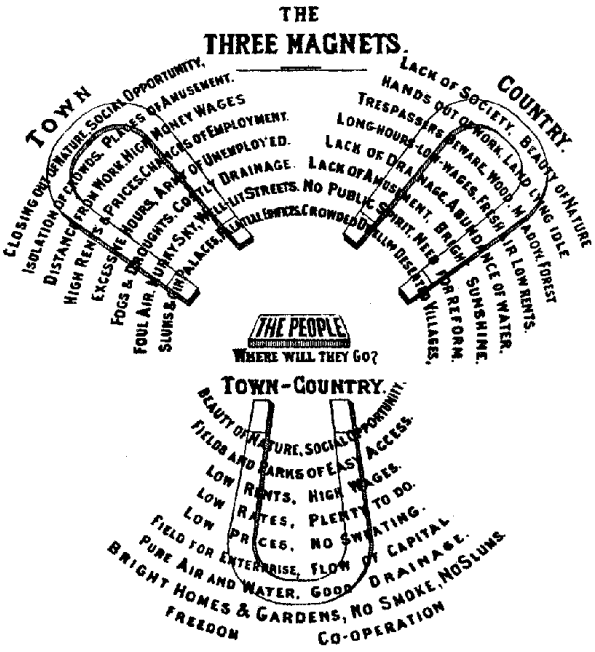

Figure 2.1. Garden City Concept
(Source: http://architectureandurbanism.blogspot.com.tr/2010/10/ebenezer-howard-garden-cities-of-to.html)

Howard suggested designs for the “social city” that tries to build a bridge idea of the trade union, co-operatives and communal land projection between ideals of the capitalist system and the socialist system. With The Industrial Revolution, urbanization has grown steadily and the working class has begun to find no home. Howard's work was only one of the other utopian studies, but his distinctive feature was that he intended to produce a realistic and accessible plan (Butcher, 2010). According to Fishman (1982), Howard was a revolutionary, who was trying to create civilization against capitalism. A good organizer, Howard, offered Labour Churches, settlement units, temperance unions, and the ideal city announced the "Gospel of the Garden City" under the title “The Ideal City Made Practicable, A Lecture Illustrated with Lantern Slides”.

According to Howard's study, "The Three Magnets" was introduced as a new form of the city (Figure 2.1). In the study, towns and country are defined as two attraction sources with strengths and weaknesses, each of which is trying to withdraw the population to itself (Phillips, 1977).

Howard used the magnet symbol to solve the problems caused by The Industrial Revolution. By comparing the advantages and disadvantages of living conditions in town and country, he transformed the advantages of the city and the country into a future-oriented plan. Some of the old utopian proposals that makes this work interesting are practicable in a contemporary, political and social setting. Garden City consists of three elements. The first is the idea of decentralization. This idea is the social process in which the population and the industry pass through distant cities from urban centers. The second is the garden, which means low density order and urban landscape. Howard emphasized that population growth should be limited to 32.000. In this way, the city will not grow bigger and it will be proposed to create an agricultural belt for the agricultural activities of the inhabitants of the city (Figure 2.2) (Evalina and Sawab, 2011).

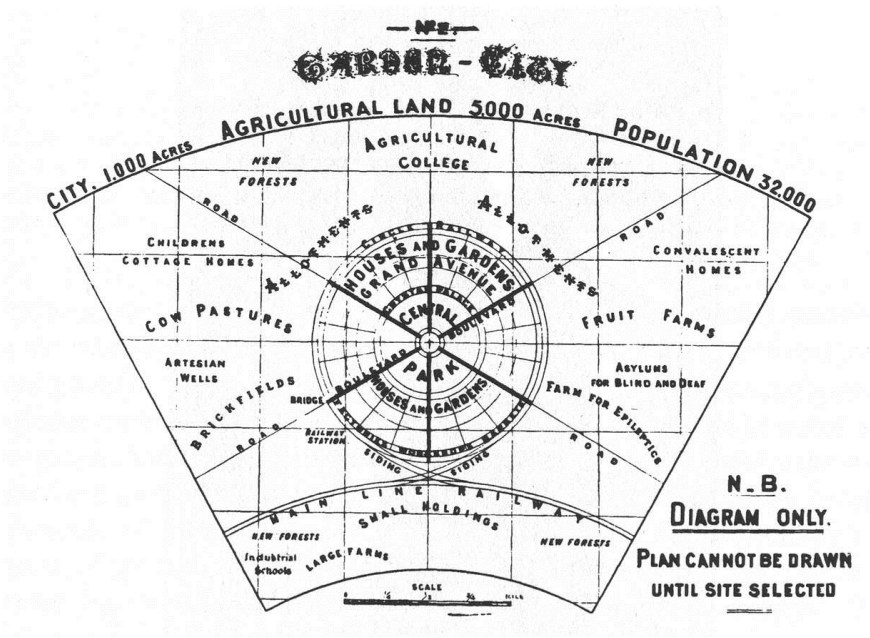

Figure 2.2. Garden City and Agricultural Belt
(Source: http://www.morrissociety.org/worldwide/agregation.boos.fig.2.jpg)

Garden City can be built on 6.000 acres of land near the city center and can be in a circular form of 1.240 meters from the center to the circumference. The city is located around the center of the circle, and there will be 6 large boulevards measuring 36.5 meters

in width. In the center, there is a five and a half acre area, garden, main hall and conference hall, theater, library, museum, picture gallery, hospital. Surrounding this garden there are public buildings, each of which is found on a large area (Howard, 1902).

There is a center with similar cities and a gathering place with rapid transportation connection. In concentrically organized areas, schemes of radial buildings are designed. The central area is surrounded by a circular window with a shopping area and a large central park. This area is followed by the residential area consisting of concentric strips. The residential areas consist of small independent buildings with gardens. The land is not wide, usually ranging from 6x300-meters. The residential areas are divided into 'Grand Avenue' surrounded by terraces (Figure 2.3) (Z. dan and Sawab, 2011). Grand Avenue is a ceremonial promenade. The Crystal Palace, a closed trade street made of glass and steel, shows the monumentality of his design concept (Phillips, 1977). In the outermost part of the garden city, there are factories, warehouses, markets. Circular railway system, which provides the transportation system, is built. There is self-sufficient food production in the city. Howard called this system a ‘Social city’ (Figure 2.4) (Evalina and Sawab, 2011). According to Phillips (1977), ‘Social City’ understanding is the most original of Howard's suggestions. Once the settlement population is over 32.000, the new growth will go beyond the agricultural belt to a second garden city.

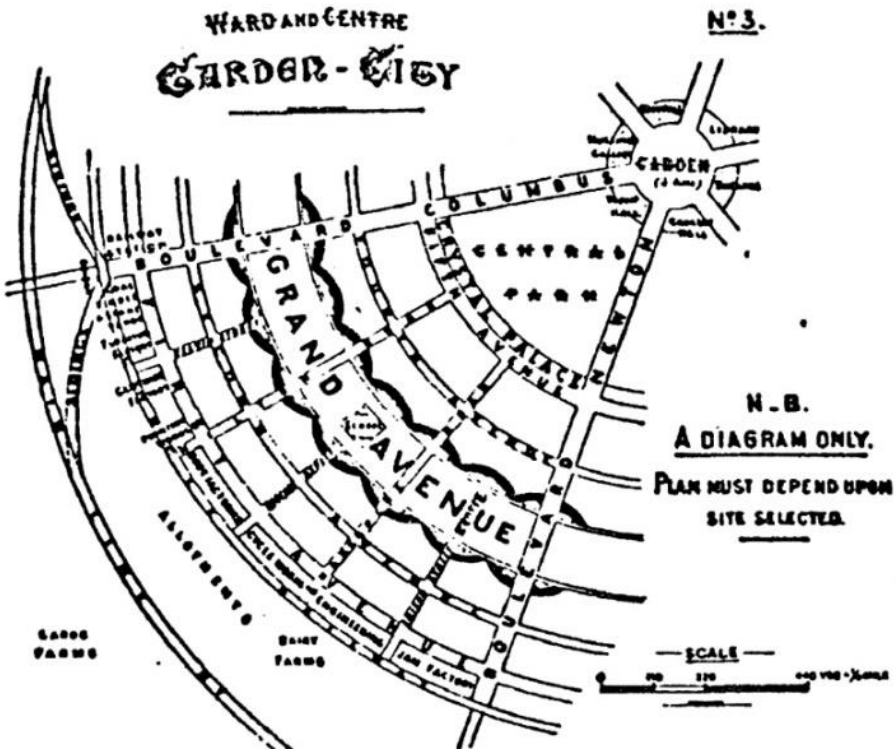

Figure 2.3. Grand Avenue in Garden City
(Source: Phillips, 1977)

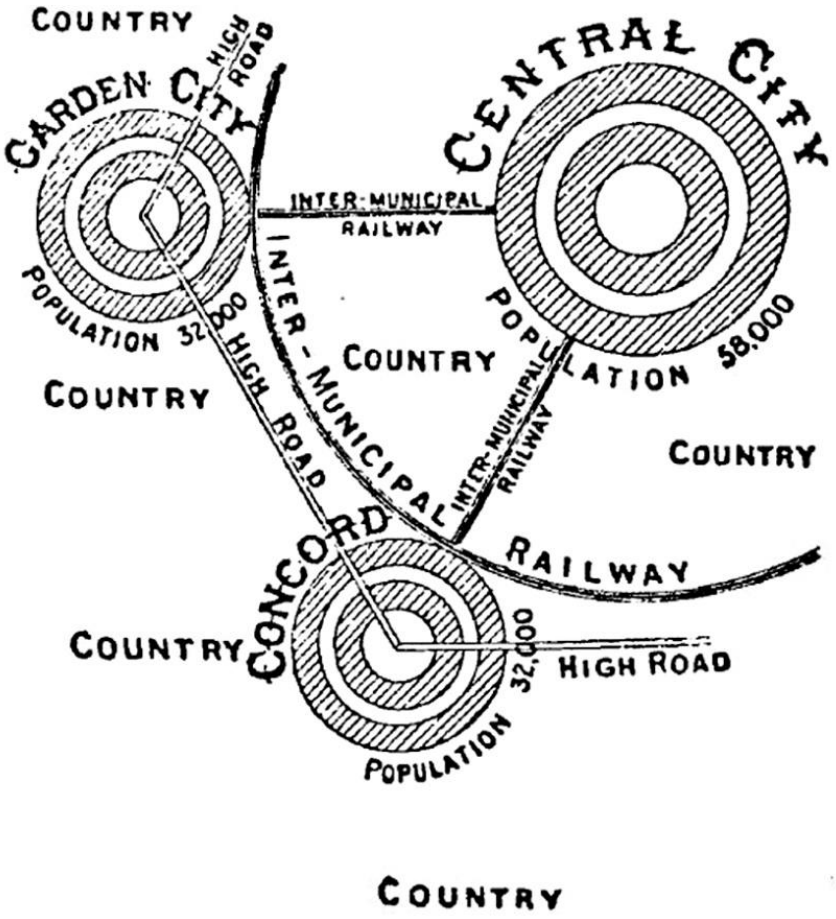

Figure 2.4. Social City
(Source: Phillips, 1977)

According to Howard (1902), Garden City is not just a plan, it is a work planned for the newest of modern needs. Howard emphasized that replacing a fresh material with a new instrument is better than replacing it with an old one. The whole area of Garden City Concept is indicated in Figure 2.5.

Howard was also influenced by other people while he was preparing his study. These people are composed of various kinds of people, from radical people, utopian thinkers to social reformers. For example, Claude - Nicolas Ledoux has an important place among socialist thinkers. The work named 'Chaux' is like the preliminary work of Ebenezer Howard's Garden City Thought. Another is James Silk Buckingham. In the Buckingham study, two themes were discussed; the ideal city in terms of architecture and physical structure, and the second, the ideal society that targets health and happiness. Owen, a community reformer, has set up factories by grouping green spaces with their living spaces. In addition to these, the Frenchman, Ledoux, Pemberton, and others are in the midst of idealistic urban reforms (Çınar, 2000).

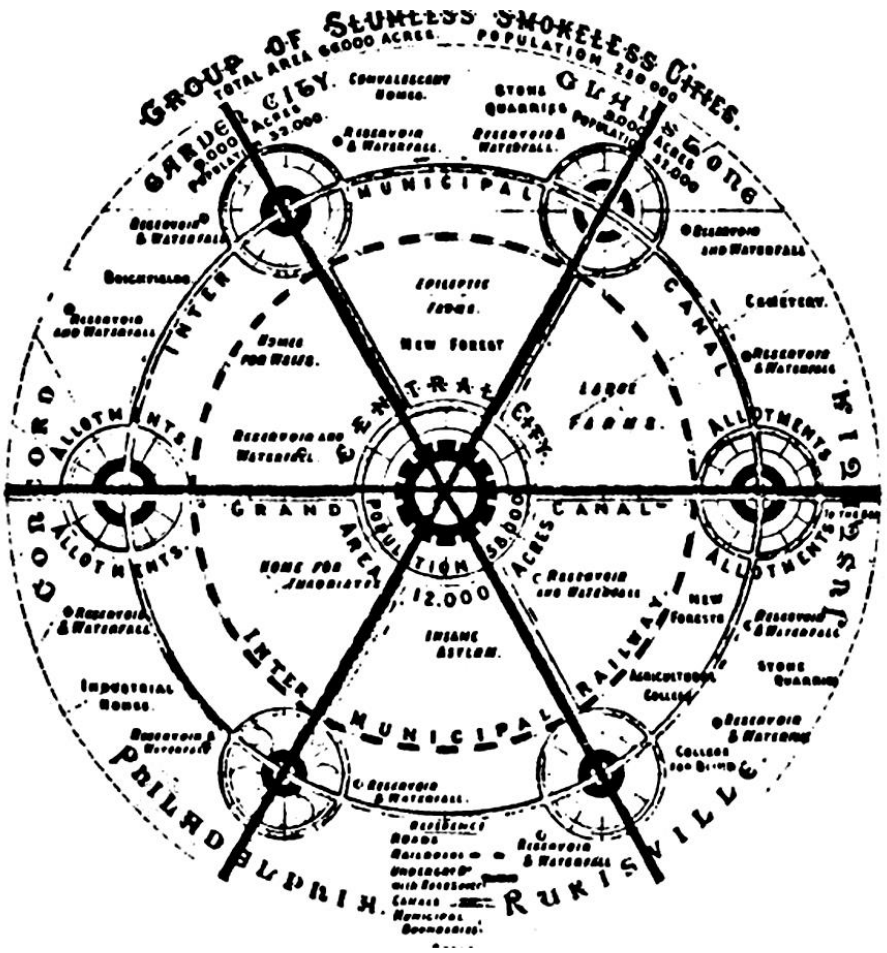

Figure 2.5. The Concept of ‘Garden City’
(Source: Phillips, 1977)

Evaluation

In Howard's project, the first neighborhood size is determined. The neighborhoods are connected to each other by a railway and boulevards and so circulation is provided. This project is the most important step in the solution to the unhealthy conditions after The Industrial Revolution. Neighborhoods are located away from the factories so that people are not affected by them.

Neighborhood Unit Concept

Throughout history, cities were divided into smaller units so that services can be provided well and handled more easily at the municipal level. In antique and medieval cities, the neighborhood or a particular section was divided into only one race, one

religion or one occupation. In early American communities, division of the city into subdivisions was seen in old designs. The partitioning of the city in this way was supported by various designs. In Howard's study, the city was divided into sections, and Howard thought that in point of urban identity, stability, and city cohesion were important (Devine, 1975). American architect Clarence Perry thought that in the 1920s, the increase in car use affected the character of good neighborhoods. Perry put forward a philosophy to protect the human-scale neighborhoods, which were a significant influence in the twentieth century and are also notable today (Figure 2.6) (LeGates and Stout, 1996/2011).

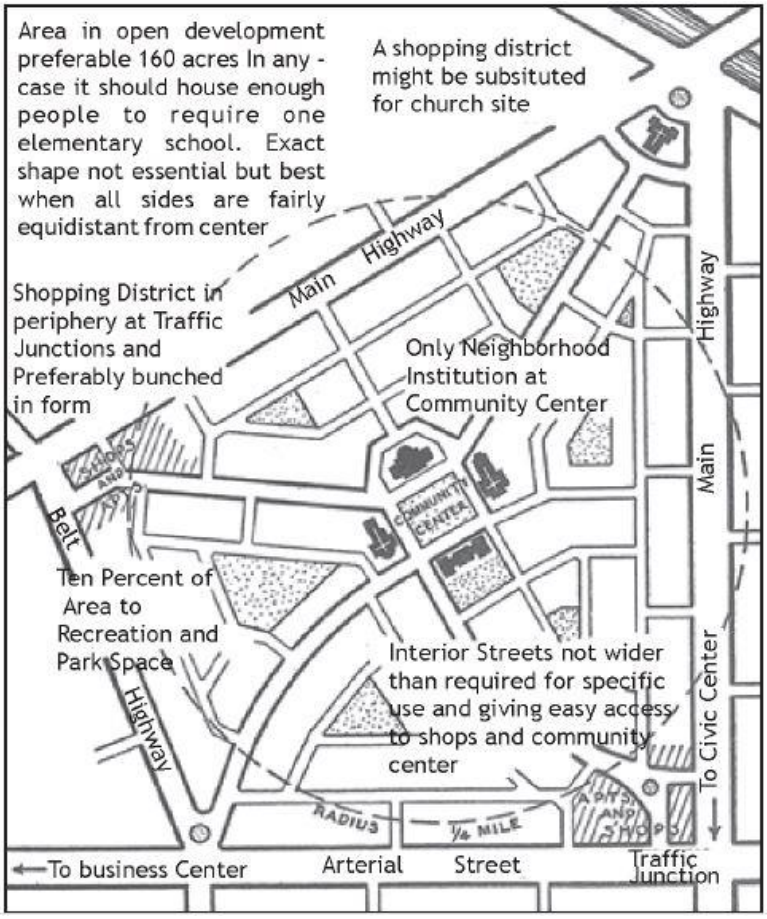

Figure 2.6. Neighborhood Unit Concept Diagram
(Source: Meenakshi, 2011)

Perry described the neighborhood unit as a population area which would require and support an elementary school with a population of 1.000 to 1.200 pupils. This means exactly 5.000 to 6.000 inhabitants. The neighborhood unit was developed as a low-density residential area with a population of 10 families per acre. The neighborhood unit was thought to have an area of approximately 160 acres and schools were supposed to be in

places where children would quickly arrive. 10% of the neighborhood area was considered to be a recreation area, and the streets would be surrounded by traffic arteries. In addition, a community center where shopping facilities, churches, and the library were linked to the school was considered (Meenakshi, 2011) (Figure 2.6). According to the project, the 5-minute walking radius is an indicator of the configuration and distribution of land use for a walkable neighborhood, and the daily needs of neighborhood residents are provided in this area. Commercial and community uses are located in the neighborhood and on the edges of the neighborhood (Figure 2.6) (Calgary Regional Partnership, 2011).

Perry designated six neighborhood unit principles (1929):

1) Size: A residential unit development, depending on population density, should provide housing that includes the population that a primary school needs.
2) Boundaries: The neighborhood unit should be restricted from the arterial roads to facilitate by-passing in the traffic.
3) Open Space: Small parks and recreation areas should be provided to meet neighborhood needs.
4) Institution Sites: Schools and institutions with service areas overlapping the boundaries of the units should be grouped via a central point or common area.
5) Local Shop: One or more shopping district sufficient for the population should be laid out at traffic junctions, similar adjacent to similar districts of adjoining neighborhoods and circumference of the unit.
6) Internal Street System: The unit should be proportional to the traffic load, provide the street system, and facilitate the circulation of the street network as a whole and prevent it from being used for traffic (Perry, 1929/2011).

Neighborhood unit principles provide health, open space, recreational facilities, safe traffic area, shopping areas, social and cultural facilities (Wang, 1965).

Perry created an outline for the industrial section (Figure 2.7). Perry saw this sketch as a study that could be designed around factories and railways. If this place had been established with factories, the areas without settlements would have increased and the daily distance of many workers would have increased. There is a wide railway along the northern border of the area. The southern part is within the bounds of one of the city's main arteries. This site constitutes surface traffic, a high railway, and wide roadway. The station is located opposite the center of the Southern border (Figure 2.8) (Perry, 1929/2011).

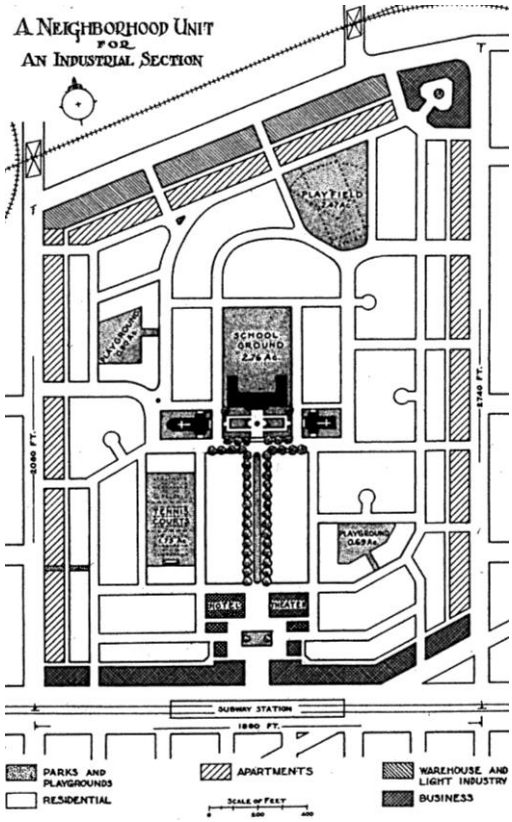

Figure 2.7. Neighborhood Unit for Industrial Section
(Source: Perry, 1929/2011)

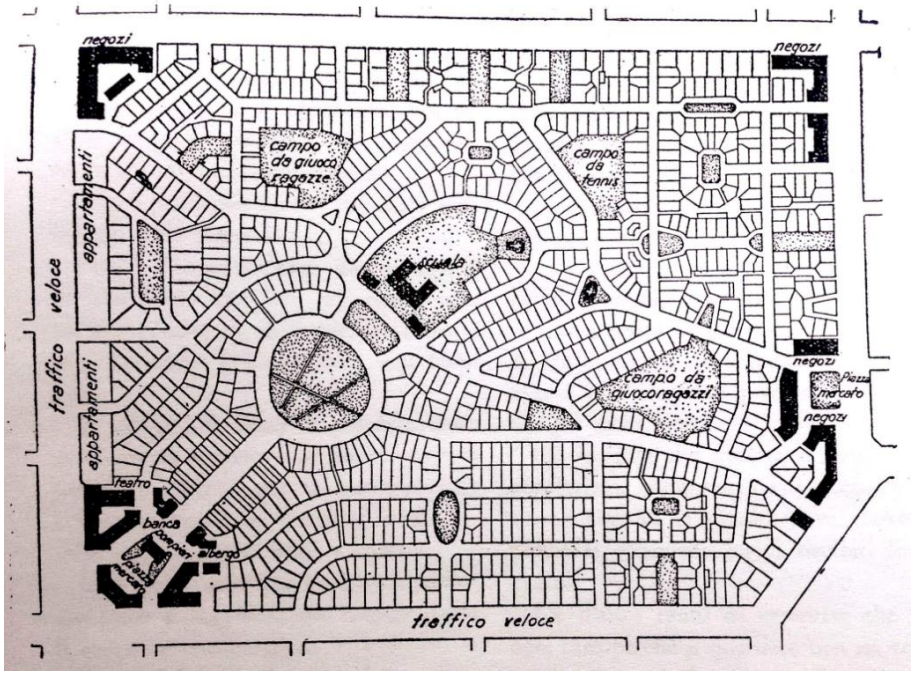

Figure 2.8. A Subdivision for Modest Dwellings Planned as a Neighborhood Unit
(Source: Perry, 1929/2011)

The concept of neighborhood was criticized by some people for class differences emergence. Some people found the neighborhood concept too romantic and idealistic for modern life to be practical. In some quarters, it was assumed that the neighborhood concept was too large for social behavior and neighborhood relations. The concept was criticized too much for its focus on schooling. In addition, the increase in small parks and public spaces were thought to bring too much care. Critics question urban services as economic efficiency of neighborhood units. It was also been argued that the benefit of the concept of a common meeting space can only be understood as the diversity of individuals (Meenakshi, 2011). Nicholas N. Patricios (2002) identified Perry's neighborhood concept as the city's self-contained building blocks. According to Patricios (2002), Perry identified four urban locations where the idea would apply. These are new sites in the suburbs, vacant sites in the central area, apartment district, and central areas that had suffered deterioration and required rebuilding.

Evaluation

Perry, in his project, emphasized that the neighborhood must be designed within walking distance. The land use plan was also made according to this understanding. Large motorways designed around the neighborhood.

Pedestrian and vehicular spaces were strictly separated. According to Nicholas N. Patricios (2002), Perry interpreted the neighborhood as a city unit. In addition, Perry emphasized that the use of the car changed the neighborhood character.

The Radburn City Model

Industrialization of the post-World War I United States has led to immigration from rural areas to the city. For this reason, in the 1920s, cities began to grow very quickly. The population density in the cities also caused many problems. In addition, the car, which is an important transportation mode for America, has caused more problems. In order to save people from horse-drawn cars, to provide more housing and to meet the needs of 'Modern Society', radical changes had to be made in urban design. As a result, the 'Motor Age City' Radburn was created in 1929 (Figure 2.9) (Gatti, 1969 / 1989).

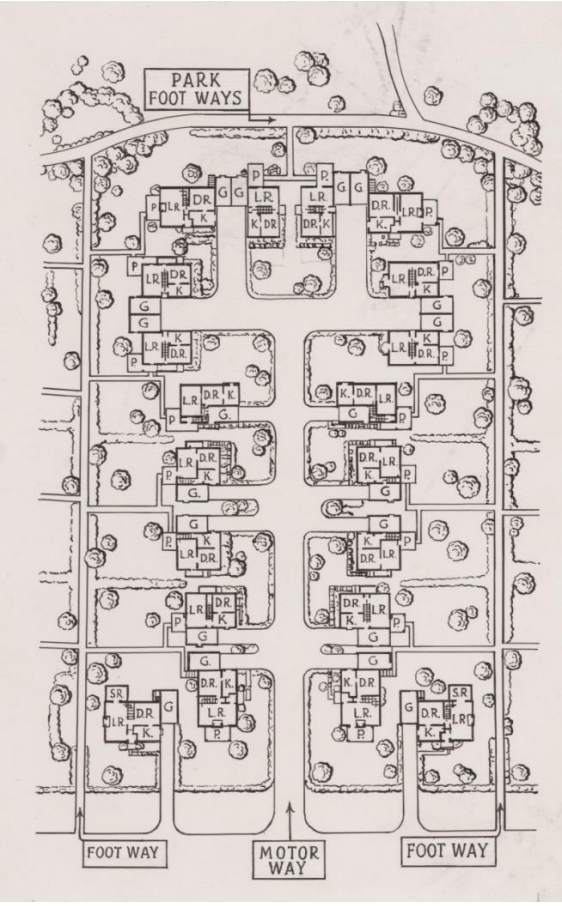

Figure 2.9. Clarence Stein's Radburn Plan
(Source: https://digital.library.cornell.edu/catalog/ss:8330058)

The Radburn project is one of the studies of members of the American Regional Planning Association. RPAA was created by architects, engineers, economists, and sociologists with similar minds in 1923. Despite the fact that the RPAA is influenced by the European concept of regionalism, in Radburn, British garden city ideas were made available to the district for legal and social areas customs of the United States. The RPAA worked on a Radburn project as a team and developed new methods. One of the members of RPAA, Clarence Stein stated that there were no records for studies of that period except their memory. The design was not prepared with the understanding of traditionalist architecture (Birch, 1980).

Radburn model was a separate thought from traditional street-oriented suburban neighborhoods in the United States. Gardenesque (style of the planting design), pedestrian accessible, child-friendly, open space without a vehicle is the heart and identity of the neighborhood. Because Radburn was the first independent element of radical change programs and it could be embraced in later planning models (Martin, 2004).

The first innovation of the Radburn project was to separate vehicle traffic and pedestrian traffic. This was made with a new design called the superblock, with the grid type street model removed from the center. The specified superblock is a land surrounded by main roads. Each of the houses designed is grouped around the main road (Figure 2.10). The service areas look towards the road while the living quarters of the houses look at the garden and parking area. Walkways that are surrounded by cul-de-sacs in the garden of houses separate the cul-de-sacs from each other and from the central park area. A pedestrian underpass and an overpass connecting the specified superblocks are provided. Schools, shops, churches are designed to be going on foot (Gatti, 1969 / 1989).

No entry fee is required to enter public places. This project is designed to house 25.000 people. The community area is located in Saddle River in the east of the area, Erie Railroad in the west, Glen Rock border in the north, and Saddle Brook Township in the south. Radburn is covered on 149 acres. There are 430 single family homes, 54 semi-attached houses and a 93 apartment unit, 90-row houses, parks, amenities, and shopping center in this area (Gatti, 1969 / 1989).

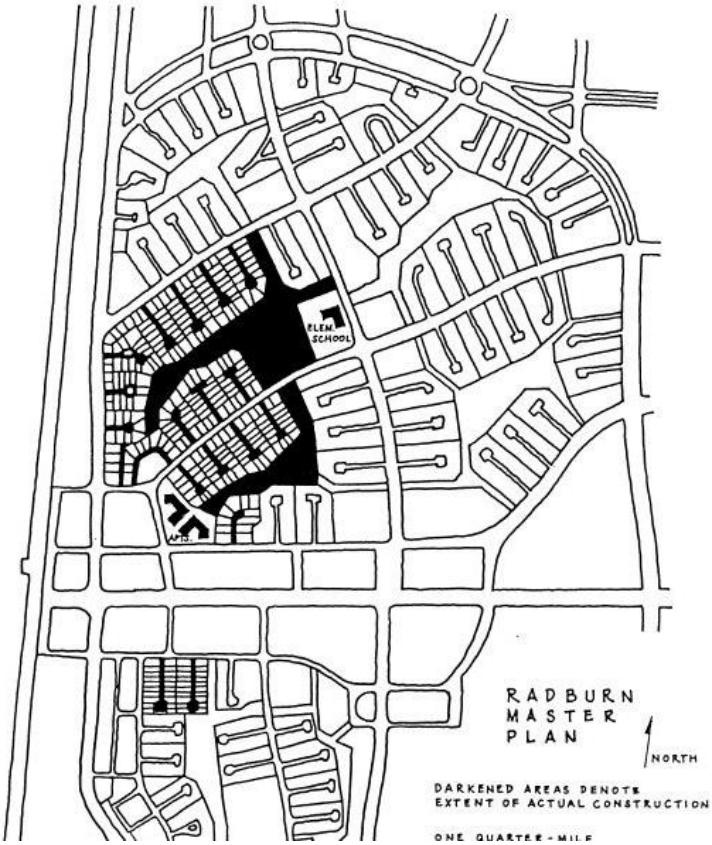

Figure 2.10. Radburn Master Plan – 1929
(Source: Martin, 2001)

According to Nicholas N. Patricios (2002), Clarence Stein and Henry Wright, members of RPAA, like Perry, thought the neighborhood should be limited by the population needed to support an elementary school. Other similarities are that the pedestrian and vehicle traffic are separated, and a road system that is safe for pedestrians. There is a school in the center and the open spaces are in a significant number of places. In both designs, Stein and Wright preferred more natural forms in the Radburn model, although the arterial streets were usually used for the neighborhood boundary form. Another difference is that the Radburn model had a walking distance of 0.8 km and a neighborhood unit model of 0.4 km. In addition, what separates the Radburn model from other designs is the superblocks with its green spaces, road hierarchy, pedestrian paths and street forms. Perry designed the neighborhood as a separate city unit. Stein and Wright set aside areas to support large-scale activities.

Evaluation

The Radburn plan is seen on residential streets as one of the first US developments that openly limit traffic flow. This plan also offered a new approach to road typology. Clarence Stein criticized the road networks made at that time and argued that cars are a threat to city life (Infrastructure USA Content Coordinator, 2016).

Just like Perry's project, neighborhood boundaries have been defined, and in the same way, automobile use is at the forefront. At Radburn, the walking distance has increased from 0.4 kilometers to 0.8 kilometers (Patricios, 2002). According to Stein's project, 3 adjacent neighborhoods constitute a town supporting a high school, one or two major trade centers. According to Yunmi Park and George Oliver Rogers (2015), Stein's neighborhood appears like residential neighborhood subsuming 500 acres of land, and his town is like an institutional neighborhood.

Both in the neighborhood unit study and the Radburn plan, there are cultural uses in the neighborhood center. In both studies, boundaries are unknown. Stein, in 1942, expanded the neighborhood by gathering them, and he constituted towns (Treasure Coast Regional Planning Council, 2004). In both projects, the neighborhood was considered a walking distance. In this way, the most important step in reducing car dependency has been taken.

After World War II, the concept of neighborhood unit played an important role in the development of new towns and existing towns (Patricios, 2002). For example; in

1943, N.L. Engelhardt presented a different size of neighborhood. The nursery school and children's playground 0.4 km and primary school a maximum radius of 0.8 km. Engelhardt, like Clarence Stein, classed the neighborhoods. According to Engelhardt, one neighborhood is seen as a residential neighborhood, two neighborhood units create institutional and residential neighborhoods depending on the type and number of regional activities, and four neighborhood units create large institutional neighborhood (Park and Rogers, 2015).

In 1945, Pan Nelson divided the neighborhood into four levels, inspired by Perry: 1) A Residential neighborhood 2) A Neighborhood 3) A District 4) A Section. In 1961, Jane Jacobs divided three levels: 1) Street neighborhood 2) Large district 3) The City. In 1975, Marans and Rodgers separated the neighborhood according to physical conditions: 1) A Micro-Neighborhood 2) A Macro Neighborhood 3) Community. American Planning Association, in 2006, and Suttles, in 1972, distinguished three degrees: 1) Face-blocks 2) Residential neighborhood 3) An institutional neighborhood. In 1979, Birch and 1982, Galster and Hesser divided the neighborhood into four levels: 1) The primary neighborhood 2) The secondary neighborhood 3) A heterogeneous neighborhood 4) Sub areas of cities. And lastly, Chaskin in 1997 and Suttles in 1972, separated neighborhood in four levels: 1) A face Block 2) Defended neighborhood 3) Community of limited liability 4) Expanded Community (Park and Rogers, 2015).

In general sense of the modern era, it can be seen as a process of finding solutions to the urban problems that arise after The Industrial Revolution. In different years different designers developed and presented their own proposals. The common feature of all of them was that instead of separating people from nature their designs placed nature at the center of their lives.

Automobiles have become the center of our lives in this era when technology has entered into our lives together with industry. Designers often proposed pedestrian-oriented designs to minimize the use of cars.

However, despite all these efforts, especially in the 1950s, the number of private cars increased. In particular, special vehicles became a preferred mode of transport for the working class (Headicar, 2015).

2.2.3. Post-Modern Period

The term post-modernism is formed by the combination of the English "post" meaning "after" and the word "modern" meaning "contemporary" in English. (Bayram, 2007). This concept is thought to have emerged in the 1960s and more intensely in the 1970s, that is, at the beginning of the debates on globalization (Sevinç, 1999).

Jane Jacobs criticized the modernist point of view in the book "The Death and the Life of Great American Cities" published in 1961(Harvey, 1990/1991/1992). In this study, Jane Jacobs demonstrated the value of life in the "Urban Village" and the benefit of the streets as an activity center for both people and cars (Fulton, 1996). In addition to this, she has stated that social housing projects have become a much worse crime than poor neighborhoods. Jacobs saw the built highways, promenades that no one uses, standardized shopping centers, cultural centers without bookstores, luxurious housing projects as the plundering of cities. She emphasized that urban planning does not respect the diversity processes inherent in the city's population, suggesting that urban designers do not accept this process. Postmodernism has emphasized that it means searching for the aesthetics of diversity (Harvey, 1990/1991/1992).

According to David Harvey (1990), postmodernism adopts transient, fragmented, deciduousness, and chaotic. Postmodernism is in the fragmented and chaotic flow of change. However, while postmodernism abandons historical continuity and memory emotion, it is also capable of using parts of the history as a dimension of the present. In addition, according to Harvey, most of the postmodern thinkers are under the new possibilities of the production, transfer, and analysis of knowledge (Harvey, 1990/1991/1992).

David Harvey thinks that in urban design and architectural disciplines post-modernism signifies a break with the modernist idea that planning and development should focus on large-scale, technologically rational, metropolitan-wide, and efficient urban plans backed by absolutely no-frills architecture. Contrary to this, however, Harvey also adds that in Post-modernism, the city must necessarily be seen as fragmented. He sees today's urban uses as "collages" that stack up like "palimpsest". In addition, according to Harvey (1990), urban design is intended to be sensitive to regional traditions, local historians, specific wishes, needs and fantasies (Harvey, 1990/1991/1992). According to Koray Velibeyoğlu (1999), urban design emerged as a by-product of

postmodernism. Postmodern approaches are addressed through social problems within urban design discipline. In addition, it has a great potential to overcome future problems.

Postmodernism is described as a process of change. In this process of change, new forms of work and identity formation are realized along with rooted structure and self-differentiation. Together with these, bringing together different groups in terms of social and cultural life of cities reveals the problems of urban integration. In this process, cities are the most problematic places in the countries, while at the same time they are the places with the highest standard of living. The aggressive, unreliable environment of cities has caused the gated community to be some time later. With the arrival of the gated community, urban fragmentation is also clear. The neighborhood-based lifestyle that started with modernism has left its place to superficial aesthetic activities with post-modernism (Kaypak, 2013).

Niki Amiri (2016) described the character of post-modern architecture as follows:

- The social, cultural, historical and economic characteristics of people using buildings,
- The characteristics of streets, roads, shopping centers,
- Climate conditions,
- Contains the daily life patterns, needs, and habits of people living in the buildings.

In the next section, NIMBYS, New Urbanism, Landscape Urbanism, and Historicism will be discussed. How these trends emerge, what kind of thoughts they represent, what are the trail in the urban areas will be discussed.

Not in My Backyard (NIMBY)

When we look at the “urban dictionary”, not in my backyard is usually defined as a state opposition. For example; it can be said that a person opposes a project or a construction. If we give an example to this situation, Jane Jacobs' opposition to the construction of the Lower Manhattan Expressway, which would cause the destruction of present-day neighborhoods such as SoHo, Greenwich Village, and TriBeCa. This is defined as good NIMBYism. On the contrary, the bad NIMBYism is to oppose a cause which will give a resultant benefit. For example; opposing a new subway line or water tunnel, which would benefit the city for years to come, because of construction noise in our neighborhood? In addition, they can be defined as residents opposing property development where they live (Urban Dictionary, 2017). According to another definition, it refers to the opposition to the organization, which recommends land uses close to the

current settlements. NIMBYism is defined as actions aimed at citizens, aiming to prevent the development of housing, which is usually near existing housing, even though it appears in every developmental context, from luxury shopping centers to educational establishments. NIMBYism can reflect the zoning rules applied by large urban jurisdictions (Ware and Peuquet, 2003).

Not in my backyard" (NIMBY) is the most powerful, most popular concept in land planning, drawing attention to conflict with local people. This concept has gained academic significance since the 1980s and has been used by US academics to explain local opposition in waste incineration facilities, social facilities, nuclear waste, power plants, wind turbines, and the allocation of the new road infrastructure (Figure 2.11). On the basis of these circumstances, NIMBYism is the protective attitudes and tactics adopted by groups that are faced with unwanted development in the environment. NIMBY protests are defined as locally organized campaigns against unwanted land use (Coppens, 2007).

This idea can reflect the community environment, the environment and public health, property values and service levels in various forms (Figure 2.12). In addition, it may reflect racial and ethnic prejudices that are hidden under legitimate concerns. This can be shown as opposition to certain types of housing, as opposition to changes in the character of the community, or as opposition to any development (Advisory Commission on Regulatory Barriers to Affordable Housing, 1991).

In another source, concepts of NIMBYism and environmentalism are discussed. Environmentalism is defined as attitudes and behaviors that focus on conservation so that the natural environment is not polluted or destroyed. Environmentalism is a general attitude that gives importance to and supports the natural environment for human life. Environmentalism is related to how people use natural resources such as water, air, soil, plants in their daily life. NIMBYism, on the other hand, has been regarded as an oppositional attitude against specific developments in the name of protecting the environment (Smith, Michaud and Carlisle, 2004).

Examples of NIMBY Protests

Figure 2.11. Protests Against Wind Turbines Near Tolpuddle in England
(Source: http://www.dorsetecho.co.uk/news/)

Figure 2.12. Protests Against the Construction of High-Speed Trains in Beijing.
(Source:http://picssr.com/tags/%E7%BE%A4%E4%BD%93%E4%BA%8B%E4%BB%B6)

New Urbanism

Following Perry's study, neighborhood unit concept has been renewed by Andrés Martin Duany and Elizabeth Plater-Zyberk founders of New Urbanism. Furthermore, Douglas Farr, in 2008, presented sustainable neighborhood concept.

According to Duany and Zyberk, the relationship between transit and land use is important. High-intensity uses and mixed uses are concentrated at existing public transport stops and at major intersections. These uses are shared with neighboring

districts. In addition, the streets in the inner district are connected to the streets of the neighboring districts (Figure 2.13) (Calgary Regional Partnership, 2011).

In 2008, Farr proposed a multifunctional green road and open space network, green infrastructure systems such as rain gardens, permeable pavements, rainwater boulevards, public recreation network (Figure 2.13) (Calgary Regional Partnership, 2011).

New Urbanism is stated as the most important fact that began in American architecture during the Cold War era. This movement has been completed by its own charter, annual conferences, and increasing membership in the official Congress for the New Urbanism (CNU) organization. At the beginning of 1980s, this movement was expressed by many as an architectural breath, and it continued to grow at all times (Bohl, 2000). This Congress for New Urbanism was established by a group of architects called CNU. Each member has worked in a conservation environment, as well as buildings, quarters, and areas that provide a high quality of life. The first project of the New Urbanism approach prepared according to traditional approach is prepared for mixed and various uses such as residual - retail, park and administrative. In this project, the emphasis was placed on creating walkable, functional, habitable, dynamic neighborhood units. After 1993, various congresses were organized with a humanistic new urbanization approach (Rahnama, Roshani, Hassani and Hossienpour, 2012).

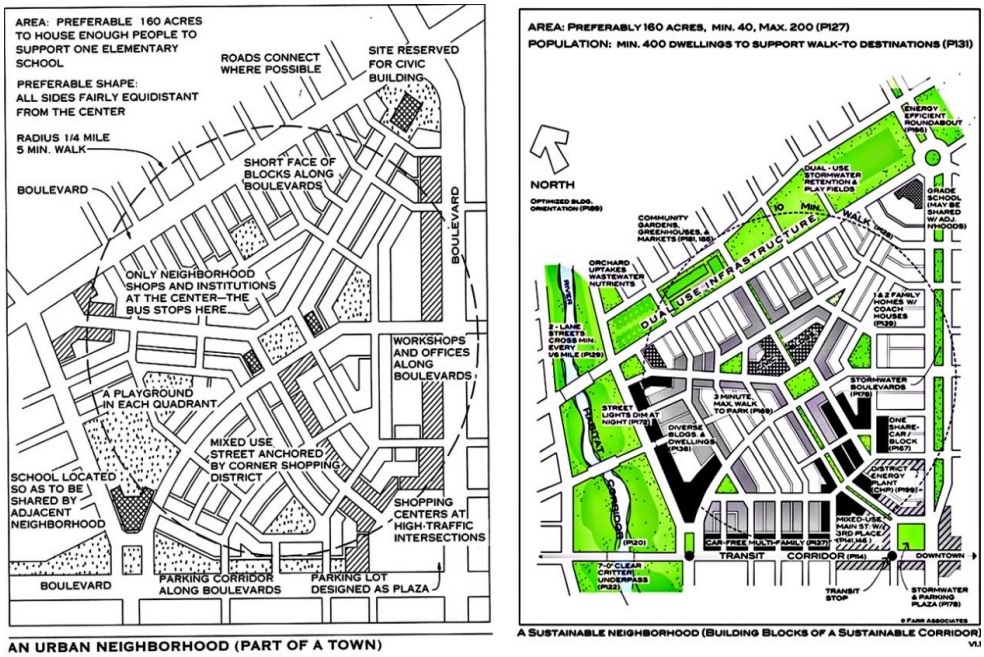

Figure 2.13. Duany and Zyberk Concept -Left- Farr's Sustainable Concept -Right- (Source: Park and Rogers, 2015)

New urbanism has come to the fore as a response to regulations and practices that caused urban sprawl. Advocates of the New Urbanism movement pointed out that the spreading areas should be reorganized as real neighborhood units and various neighborhoods, and that cultural heritage must be preserved (Tekin, 2010).

According to Yunmi Park and George Oliver Rogers (2016), the Neighborhood Unit is being conducted through New Urbanism movement that constitutes the current neighborhood-based design concept. In addition, the New Urbanism movement uses "traditional" urban forms to build/rebuild cities, towns, suburbs, neighborhoods (Bohl, 2000). The new urbanization movement is an umbrella term that includes Traditional Neighborhood Design (TND), Neo-Traditional Neighborhood Design (NTD), Smart Growth (SG), Urban Villages (UV), and Transit Oriented Development (TOD) concepts (Davies and Townshend, 2015). These concepts are briefly addressed below;

Traditional Neighborhood Design: The TND resembles the 1927 American neighborhood unit and the European neighborhood unit. The advantage of this model is that the neighborhood ratio in the pedestrian street is high. As the vast majority of residents are within walking distance of the center, bus passage is effective even at low densities. The central area is not divided by a high-capacity street. For this reason, the space quality of the collected areas is not deteriorated due to excessive traffic. A disadvantage of this system is that the commercial use in the center cannot be benefited from traffic on the main thoroughfare, so it can be continued with the neighborhood retail (Duany, Plater-Zyberk and Company, 2003).

Neo-Traditional Neighborhood Design: Neo-traditional design and traditional design are applications with different effects within the approach of New Urbanism (Davies and Townshend, 2015). NTND has a path hierarchy. For example, some roads are heavier. Access to the streets is limited as it is in standard suburban design. Neo-traditional neighborhood designs offer various routes for trips. Narrow streets are built and small intersections are created. Land density and use are not fixed. In these designs, multi-lane streets and crossroads are found. In NTND projects, street designs include active uses. In the streets, factors that interfere with the speed of drivers such as parking spaces, bicycles, and pedestrians are used (U.S Department of Transportation Federal Highway Administration, 2013).

Smart Growth: Smart Growth is a movement that represents American architecture, social and political change. Smart Growth is a concept that has been created for communities to live in a better, more economical, fairer built environment. This

system promotes better planning and policy for efficient use of land. In the 1970s-1980s it was developed from the jurisdiction of growth management laws and was fully established and gained momentum in 1990s. Smart growth policies involve the creation of housing choices and opportunities, the creation of walkable communities, the conservation of open spaces, farmland, critical environmental areas, and the diversity of transport options (Edwards and Haines, 2007).

Urban Village: Urban Village is a settlement concept small enough to create a community. An urban village can be created on a Greenfield or Brownfield site, or out of an existing development. Features of this settlement are high density, mixed use, mixed tenure, high quality, based on walking. Population is usually between 3000 and 5000. There are areas away from one side to the other, usually within 10 minutes (Urbuilfor and Huxford, 2015).

Transit Oriented Development (TOD): TOD is similar to the railroad suburb of the 19th century. The pedestrian shed is located at the center of the railway transit station, which overlaps with a large street. The pedestrian shed of the Transit Oriented Development model is traditionally drawn in a semi-circular. The advantage of the TOD model is that each railway station is supported by a high population density within the pedestrian area due to the railway being the most effective transit and expensive. In addition, it is gathered around a transport node for corporate and commercial use (Duany, Plater-Zyberk and Company, 2003).

Prinsible of New Urbanism

Walkability:

-In design, spaces should be at a distance where many users can go from home to office.

-Street designs should be done in accordance with the pedestrian. For example; buildings must be adjacent to pavements, there should be greenbelts surrounding the streets.

-Streets should usually serve the pedestrians. They must be protected from automobiles.

Connectivity:

-It should be a linked street network for traffic circulation and made walking easy,

-There should be a hierarchy between narrow streets, boulevard and lanes,

-It should be done high quality walking network, and public realm.

Mixed Use & Diversity

-In residential areas, shopping malls, offices, apartments, houses should be mixed use,

-There must be diversity of people from different ages, different cultures, and different classes.

Mixed Housing

-Housing units of different models, size, and costs should be close to each other.

Quality Architecture & Urban Design

-Beauty, aesthetics, importance of human welfare, creation of a space way, use of places in the community and determination of civil places, architecture with humanistic scale and beautiful environment is caused to make human spirit comfortable.

Traditional Neighborhood Structure

-Having distinctive and distinguishable edges,

-The presence of public spaces in the centers,

-The importance of public realm and open spaces,

-Including variety of uses and congestions within walking distance (Rahnama et al., 2012).

Transect Planning:

- The transect system is expressed as a classification of zoning patterns, depending on the correlation of various landscape elements from rural to urban. 6 segments determine Transect in neighborhood structure. These can be defined as Rural Preserve, Rural Reserve, Suburban, General, Center, and Core Zones (Figure 2.14). Three of these (Sub-urban, General, and Center) follow the natural internal structure of the neighborhood. The density of the rural outside of the urban area and the combination of several neighborhoods determine the core zone. Each region is defined as a place where all component elements strengthen each other to intensify and create a specific urban character (Duany, Plater-Zyberk and Company, 2003). For each transect zone, features and qualities of streets, densities, functions, buildings, frontages, public spaces, intersections, parking, sidewalks, streetscapes, lighting, and green areas are defined by the transect system (Özdemir, 2010).

Increase Density:

- Building of residential units, stores and closer services that facilitate walking to develop resources and services and create a convenient location.

Smart Transportation:

- High-quality rail system that supports cycling and walking, and designs that emphasize walking for daily use.

Sustainability:

-Environmentally friendly technologies that respect nature and environment.

-Energy efficiency and less use of fossil fuels.

Quality of Life:

-Providing quality of life by creating designs that allow walking in neighborhood units (Rahnama et al., 2012).

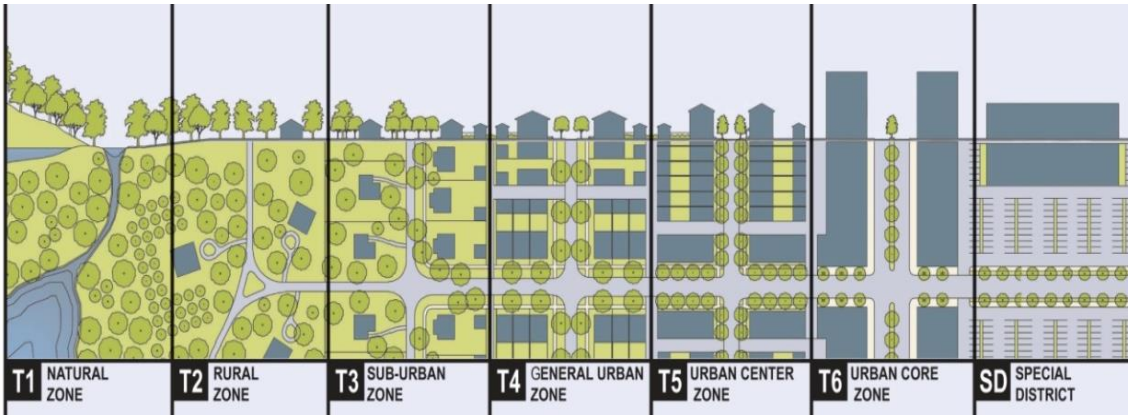

Figure 2.14. Transect System
(Source: http://kronbergwall.com/zoning-codes-101-the-transect/)

Landscape Urbanism

Landscape Urbanism is a term that emerged in the United States, followed by Europe and Australia. The concept of Landscape Urbanism was developed by the University of Pennsylvania and Harvard, which is expressed as the intellectual twin towers of landscape architecture (Bolleter, 2015). James Corner, Stan Allen, Alex Wall, and Charles Waldheim are the key contributors to this concept. In addition, Chris Reed, Christopher Gary, Peter Connolly, Richard Weller, and Jusick Koh contributed to the definition of the concept (Duncan and Seltzer, 2010).

According to Charles Waldheim (2006), the landscape has emerged as a model that explains the conditions of urbanization that are radically decentralized, in a context of contemporary urbanization, and particularly in the complex natural environment. The renewal concept of landscape discipline is raising environmental awareness in the debate about the city. In general, the landscape is the most appropriate discipline for discussions historically in landscape architecture and urban design.

Landscape urbanism emerged in the second half of the twentieth century to describe urbanized landscape studies. It is a product of earlier rationalist, positivist, functional teachings. It is a term that attempts to solve what has been done in the urban

landscape in the past years. In addition, this concept examines climatic, topographic, cultural differences in observed and developed patterns (Girot, 2006).

In 2010, Jeff Stein and Charles Waldheim shared their thoughts on Landscape Urbanism in the AB / Architecture Boston magazine. Charles Waldheim, landscape urbanism, began about 15 years ago as a method of trying to explain what is already happening in urban design and landscape architecture. Jeff Stein described landscape urbanism as a process of a framework that examines city as a living, changeable entity (ab l Architecture Boston, 2010).

Landscape urbanism, as another definition, is described as a concept that combines the natural and cultural systems in the city, and in addition, it is centered on the planning process so as not to destroy nature and landscape (A. Çabuk, S. Çabuk, and Mirici, 2013). Kaplan (2013) emphasizes that landscape urbanism is based on defining, shaping and managing natural and cultural living environments in the context of 'landscape system and integrity' in the region, city, and local scales. At the same time, he has also pointed out the boundaries of Landscape Urbanism. Furthermore, Kaplan emphasized that defining the problems of complex and different scales, the whole city, and function changed regions, in the 'landscape system' makes this concept meaningful. He considered landscape as a key concept that defines the 'evaluation lens' in the physical environment and the 'object' that shapes that environment.

In addition to all these, Çabuk et al. (2013) included discussions about landscape urbanism in their study. One of the most important debates is that the idea of creating ecological cities is not a new study and that these studies are already inherent in the landscape architecture profession. In respect to this, it is thought that landscape urbanism thinking is not a new idea. Another discussion is that the design of large green spaces on a human scale would lead to transportation problems and the street culture would be destroyed.

In addition to these, Mohsen Mostafavi and Ciro Najle (2003) emphasized in their work the five principles James Corner expressed for landscape urbanism. These are (1) horizontality, (2) infrastructure, (3) forms of process, (4) techniques and (5) ecology. Along with them, Corner describes Landscape Urbanism as ‘a complex amalgam . . . more than a singular image or style: it is an ethos, an attitude, a way of thinking and acting’.

Landscape Urbanism Examples

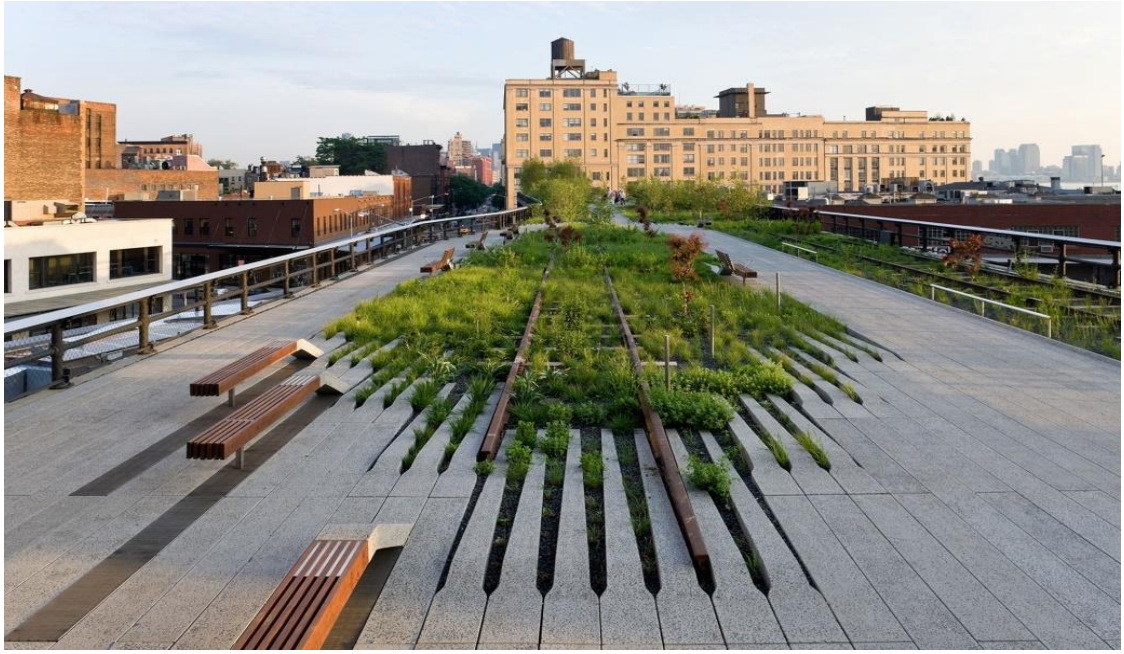

Figure 2.15. High Line Park, New York
(Source: http://www.fieldoperations.net/project-details/project/highline.html)

Figure 2.16. Parc de la Villette, Paris
(Source: https://www.archdaily.com/92321/ad-classics-parc-de-la-villette-bernard-tschumi)

Figure 2.17. West Louisville Food Port
(Source: http://www.archdaily.com/601730/oma-designs-food-port-for-west-louisville)

Sustainable Urbanism

According to Nooshin Roohani Tezangi (2014), sustainability is a conceptual framework that improves humanity and nature. This concept depends on conserving land use, energy, and resources without consuming resources. Since the 'Brundtland Report' study, sustainable development has been the main goal of many sectors to produce urban policy. This situation affects urban theories and urban practices. Over the years, this has led to many planning principles, concepts, and frameworks (Roggema, 2016).

Sustainable urbanism has been described by Douglas Farr as a walkable and transit-served urbanism integrated with high-performance infrastructure and high-performance buildings. The main target of sustainable urbanism is the design of the urban environment. These designs are intended to produce sustainable solutions (Roggema, 2016).

According to Anirban Adhya, Philip Plowright and James Stevens (2010), Sustainable urbanism is a new term in urban design and planning. In today's rapidly urbanizing world, urban design and sustainability studies are rooted together with contemporary metropolitan environments. According to them (2010), compactness (density) and biophilia (human access to nature) are the basic values of sustainable urbanism. They have argued that if the concept of sustainability is at the core of the

contemporary urban design paradigm, concepts such as health, place specificity and social ethics must be defined that cut the professional boundaries of sustainability and categorical paradigm additions.

In various years, various researchers have set out the principles for sustainable urbanization. The first of these was Eirini Kasioumi in 2011, who has identified three basic principles: 1) technology, 2) community and economic development, 3) land use and urban design (Kasioumi, 2011). Secondly, Nooshin Roohani Tezangi identified three basic principles of sustainable urbanism; 1) density, 2) accessibility, 3) biophilia (Tezangi, 2014). And finally, Rob Roggema described the principles of sustainable urbanism in 6 under six headings; 1) close cycles at the lowest possible scale 2) create spaces for the unknown 3) Design anti – fragile spaces 4) Let people own their environment 5) use the landscape as the basis for urbanism 6) create innovative designs (Roggema, 2016).

In addition to these, to support sustainable development, a rating system called the Leadership in Energy and Environmental Design for Neighborhood design (LEED for ND) has been developed. It is different from the previously described smart growth and new urbanism movements, with green building criteria, rewarding high density, compact developments, various sizes and types of buildings and access to various mixed land uses (Szibbo, 2015). LEED defines development projects for neighborhood development that successfully protect and improve the overall health and quality of natural surroundings and communities. The goal is to reduce the negative effects of the built environment, such as increased greenhouse gas emissions, excess water use and energy consumption (U.S. Green Building Council, 2012).

Evaluation

In 1970s and 1980s, neighborhood concept was seen in new urbanism projects, neo-traditional and traditional neighborhood development projects. Neighborhood concept principles are seen in mixed-use planning, walking distances, pedestrian-oriented internal road patterns and architectural quality. In this way, the neighborhood concept is adapted in these days. In Radburn's plan and neighborhood unit concept, insertion of residential, open spaces, commercial and civil land uses are now highlighted in mixed-use planning (Patricios, 2002).

In most of the new urbanism projects, schools, churches, and kindergartens are located in the center of the neighborhoods. Walking distances from the center of the neighborhood were determined between 0.4-0.8 kilometers (Patricios, 2002). The transit-oriented development that has developed with the new urbanism movement has created popular neighborhoods over time. It is aimed to ensure safety through the creation of continuous activity areas throughout the neighborhood (Consulting Inc and Center for Transit Oriented Development, 2013).

With this period, "Energy" is starting to come to the agenda. Smart grow, energy efficiency has begun to take place in projects. In cities, ideas are presented for the use of natural systems.

Along with the postmodernism period, the problems created by motorways in the neighborhoods and the surplus of vehicles in the city have been criticized. One of the most essential critics of this situation is Jane Jacobs, as mentioned earlier. Jacobs is a researcher who emphasizes the importance of human and neighborhood relations. She argued that the streets are people's living space. For this reason, she argued that roads must be saved from car domination (Jacobs, 1961). Another criticism was made in 1963 by Colin Buchanan, who defended the environmental areas in the traffic (Figure 2.18). He thought that environmental standards would determine the traffic level.

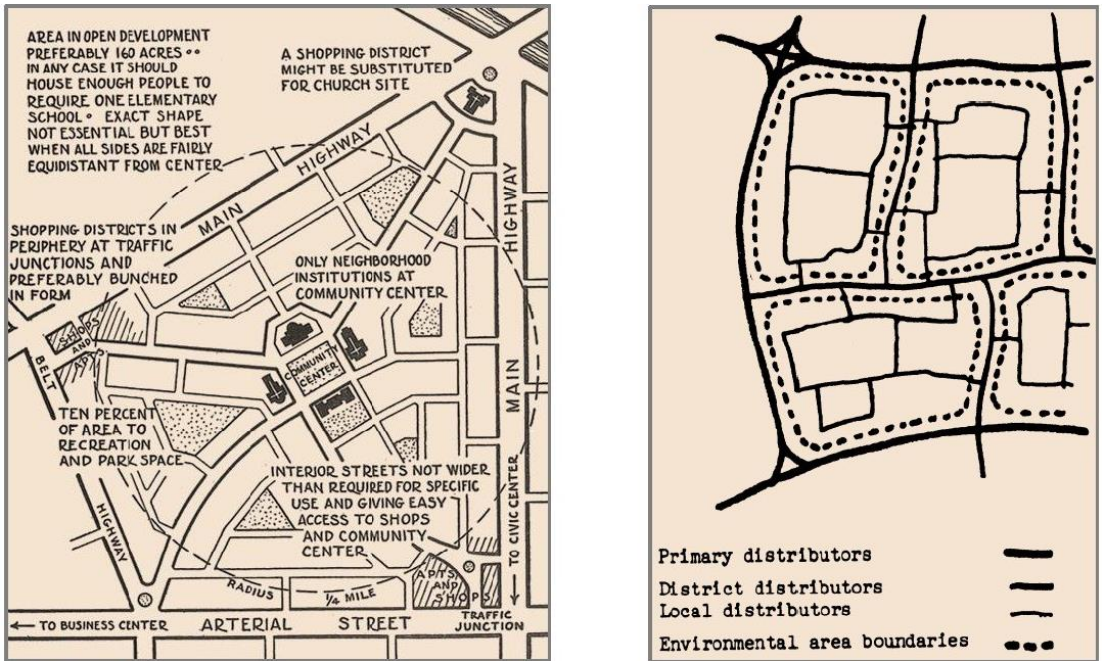

Figure 2.18. C. Perry's Neighborhood Unit and C. Buchanan's Environmental Area (Source: http://i2.wp.com/www.infrastructureusa.org/wp-content/uploads/2016/08/streets-figure1.jpg)

In the Traffic in Town study, Buchanan identified a number of design principles based on the separation of traffic flow from environmental areas. In the works of Clarence Perry in 1929 and Colin Buchanan in 1963, traffic was restricted in the streets of residence. Traffic has been left to arterial streets and motorways surrounding residential neighborhoods (Infrastructure USA Content Coordinator , 2016).

Years after Jane Jacobs and Colin Buchanan, a similar criticism was made in 1981 by Donald Appleyard in the study of “Liveable Street”. He said that the motorways that divide the neighborhood alienate people from each other and their surroundings (Infrastructure USA Content Coordinator, 2016). Appleyard confirmed this idea in his three street research in San Francisco. According to the research, pedestrians who encounter traffic hazards in the streets where traffic density is high do not communicate very often with their neighbors. However, where there is little traffic, they are communicating with their neighbors along the way, being able to meet each other more often, young children playing on the streets. There is a sense of trust in the streets where automobiles are less, but in the streets where there is heavy traffic, there is alienation and therefore a lack of confidence (Hart, 2015) (Figure 2.19).

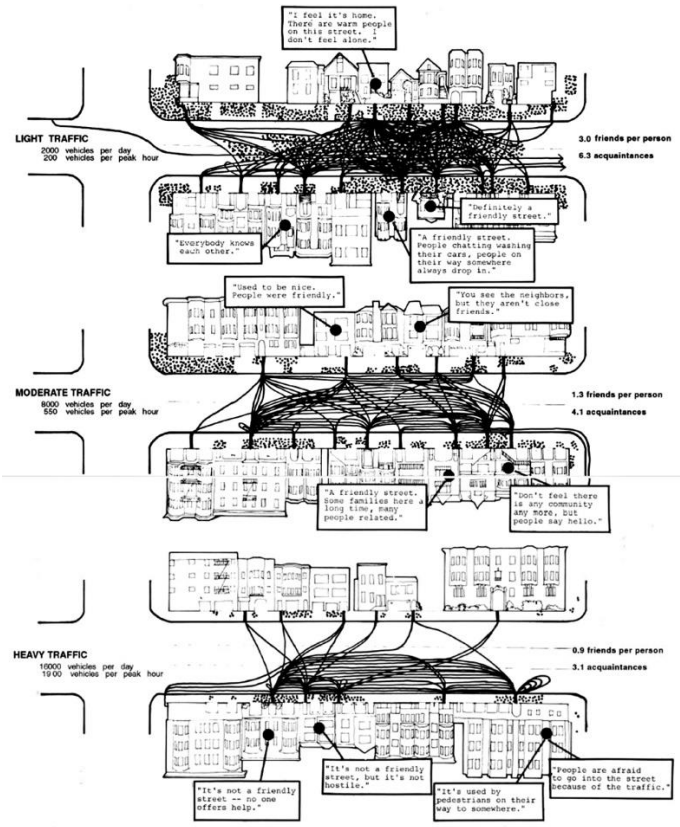

Figure 2.19. Donald Appleyard’s Study. In Three San Francisco Streets
(Source: http://www.bikewalk.org/pdfs/forumarch0305.pdf)

In addition to this, in this period, the public initiated protests against the surplus of cars in the city and organized various organizations related to this subject. For example; in 1970, with the oil crisis, the first car-free day organization was established (World Carfree Day - History, 2012). In 1979, protests were started for safe and livable cities in Amsterdam. During 1980s, protests continued for cities without cars (Wagenbuur, 2011). In 1991, "Reclaim the Street" was established. This movement was an ecological uprising (Blanco, 2013). It was defined as an anti-car system for free public transport, for increased walking and cycling use. In 1992, the "Critical Mass" action, which still continues today, has begun (Bellem, 2015). When it came to the year 2000, on September 22nd, it was declared "International Car Free Day" (World Carfree Day - History, 2012). Colin Buchanan's report is the first official document describing that traffic growth threatens the quality of urban life. According to this report, the neighborhood should be protected by closing the streets and giving a one-way traffic flow (Canadian ITE and Transportation Association of Canada, 1999).

2.3. New Approaches: Low Carbon Neighborhood Movements

Problems aroused with the increasing urbanization rate after the industrial revolution have been dealt with through various approaches as examined in the previous section. The common goal of the proposals is to reduce toxic gas emissions, especially caused by industry and transport sectors, and create more livable environments. However, especially after 1980s, with the development of economic activities, too many problems have arisen on nature and environment (Tekeli, 2016). One of the most important features of modernity is that it can think about the positive or negative consequences it made. In addition, it has been able to develop new institutional arrangements that could negate negatives caused by it. In short, modernity has improved capitalism. At this point, modernity escaped from the ecological crises created by destroying nature, creating environmentalist movements (Tekeli, 2016).

Climate change effects, which started with the destruction of nature, has become the most important problem of our time. Emissions of greenhouse gases such as carbon dioxide, methane, nitrogen dioxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride started to accumulate in the atmosphere, fossil fuels, changes in land use, deforestation caused the problem of climate change. (T.C Çevre ve Şehircilik Bakanlığı, 2012a). Against these, adaptation programs for climate change began to be developed.

The most important steps are the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol (KP), Intergovernmental Panel on Climate Change (IPCC) and the European Climate Change Program (ECCP) (Batan and Toprak, 2015).

As climate change effects began to increase in 1990s, discussions on greenhouse gas were intensified (Batan and Toprak, 2015). On top of that, between 3 - 14 June 1992, at the United Nations Conference on Environment and Development (Rio Conference) climate change and desertification were on the agenda. In this conference, the United Nations Framework Convention on Climate Change was signed to limit the number of greenhouse gases emitted by the atmosphere as a result of human activities in order to stop global warming. According to this contract;

- Reduction of greenhouse gas emissions from arising own country

- It is stated that the countries that cause the increase in the greenhouse gas should meet the costs.

- It was agreed that developed countries should lead in measures to reduce the danger of climate change (Özdemir, Yazıcı, Yağmalı and Pılgır, 2009).

The Kyoto Protocol, signed in 1997, does not address adaptation to climate change. In the 3rd Assessment Report of the IPCC, the human-induced climate change process was included. This has been recognized as an important step in the adaptation process (Batan and Toprak, 2015).

According to İlhan Tekeli (2016), it is very important that promised countries especially the developed countries reduce the greenhouse gas. Greenhouse gas emissions are measured on carbon dioxide equivalent. Therefore, it is very important how much-developed countries will reduce greenhouse gas emissions. However, countries that consume large amounts of energy using fossil fuels have refrained from promising. In 1992, the Kyoto Protocol signed by 166 countries, including Turkey. But there are no major greenhouse gas producers than USA and China. In 2015, Obama announced the Clean Energy Plan, which aims to reduce gas emissions of power plants in the country by 32% by 2030. In this way, it has begun to adhere to the targets.

According to the Ministry of Environment and Urban Planning of the Republic of Turkey’s data, when we look at the energy indicator of 2007 International Energy Agency, the world average primary energy consumption per capita was 1.82 tons of oil equivalents, and The Organization for Economic Co-operation and Development (OECD) average was 4.64 tons of oil equivalents. Turkey's primary energy consumption per capita was 1.35 tons of equivalent oil, below the world average and OECD average. In 2007,

greenhouse gas emission per capita was equivalent to 5.3 tons of carbon dioxide. In the same period, OECD emissions were equivalent to 15.0 tons of carbon dioxide and 10.2 tons of carbon dioxide in 27 countries of the European Union. While the total amount of greenhouse gas emissions in Turkey in 1990 was 170 million tons of carbon dioxide, in 2007 this value was determined as 372 million tons of carbon dioxide equivalent (T.C. Çevre ve Şehircilik Bakanlığı, 2012b).

All these changes have negative effects on cities as well as the neighborhood unit. In 1999 Towards an Urban Renaissance report, a sustainable city was associated with creating a sustainable neighborhood. The use of cycling, walking, and public transport has been the mode of transportation most preferred for the sustainable urban form. In the report, the neighborhood unit comprises of a primary school, doctor, corner shop, community office, community center, pub, and post office within 400-600 meters of the center (Figure 2.20). In this study also, the spaces are designed within walking distance. Systems such as the use of energy supply systems, advanced insulation systems in buildings, photovoltaic modules were on the forefront in 2000s. The energy issue became the most fundamental issue (Urban Task Force, 2002).

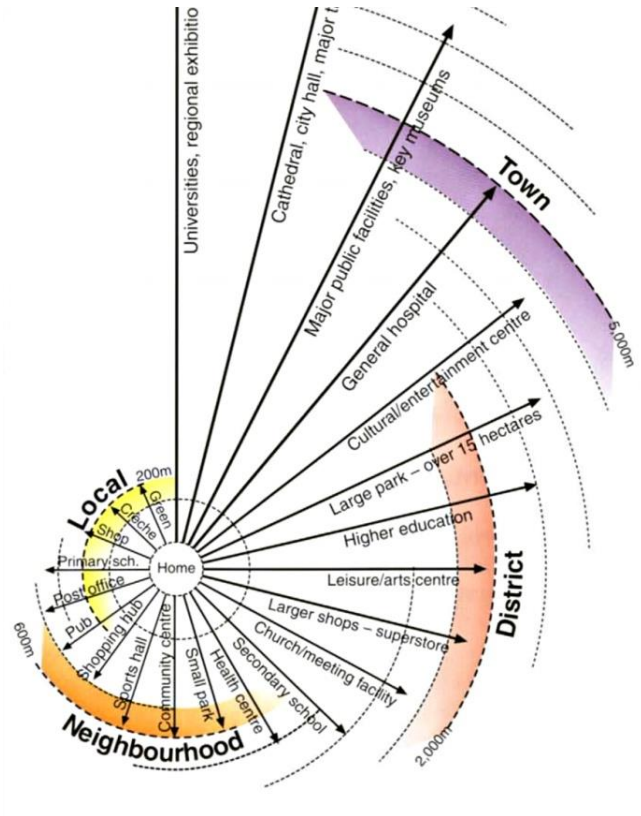

Figure 2.20. The Sustainable City Diagram
(Source: Urban Task Force, 2002)

The Urban Task Force handles the neighborhood unit from the standpoint of mixed land use. In the neighborhoods, mixed income groups and therefore mixed uses are very important. These uses should appeal to every income group, so that these people do not have to leave their neighborhoods. Besides, to support sustainable urban development, new housing must be the interconnected concept of “long-life”, “low energy” and “loose-fit” compatibility (Figure 2.21) (Urban Task Force, 2002).

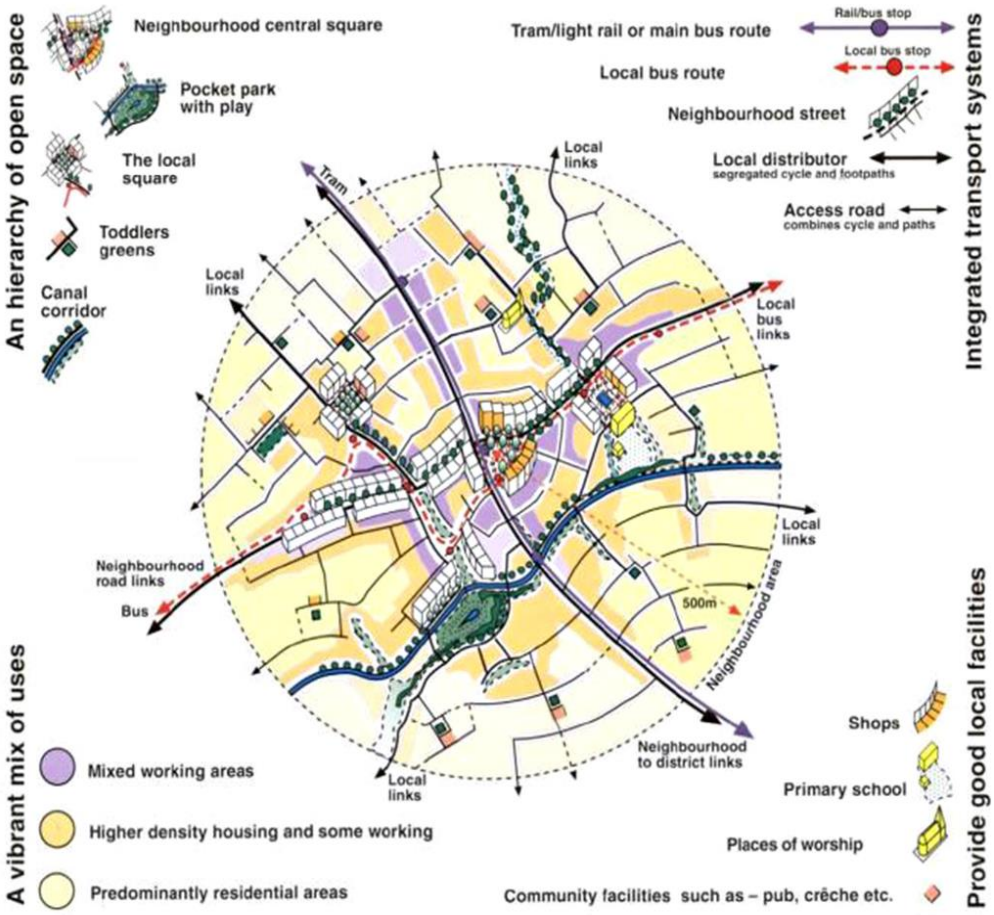

Figure 2.21. A Model of Mixed-Use and Integrated Urban Neighborhood
(Source: Urban Task Force, 2002)

In the next sections, how to create low carbon awareness, low carbon principles, design, and practices in the neighborhood unit in order to achieve the low carbon neighborhood will be discussed. First of all, the stages leading to the concept of the low carbon neighborhood were examined. In historical development, what events constituted the basis of this concept was explained in previous chapters. In this chapter, how the

concepts of neighborhood and transportation are combined under the low carbon title will be explained.

Low Carbon Neighborhood

After the Industrial Revolution, unhealthy environmental conditions caused by the fragmentation of urban areas with motorways, transportation, and factories were tried to be removed with the projects of Garden City, neighborhood unit and, Radburn. Designing land use at the walking distance, inclusion of alternative transportation systems, and the idea of integrating urban nature constitute the basis of today's low carbon neighborhood understanding. During 1960s, the protests for the problems caused by the high number of vehicles in the cities emphasized the importance of alternative transport modes. With the oil crisis in 1973, the emphasis on low carbon life has increased. Bicycle was determined the best alternative of transportation mode in this period. Post-modernist projects that started with these periods emphasized the importance of the relationship between transportation and neighborhood. The most important emphasis of these projects, such as new urbanism and landscape urbanism, sustainable urbanism was to create healthy environments. The most important representatives of this period, Andres Duany and Elizabeth Plater Zyberk have linked the use of transportation and land to continue circulation throughout the neighborhood. The climate change and energy problem in the world began to be discussed in 1990s. During this period, as a solution to climate change and energy problems, green infrastructure systems began to come to the fore. With natural based solutions, urbanization problems were tried to be solved.

As one of these efforts, advantages of energy efficient use created the touchstones of creating a low carbon neighborhood. This concept, which started to be discussed with 2000s – 2010s, was formed with the experience of the previous periods and gained integrity with nature oriented technological studies. This concept emphasized the importance of the relationship between neighborhood and transportation. It includes concepts such as water conservation, green technology, energy efficiency, and biodiversity (Figure 2.22).

Neighborhoods are not small spaces for creating sustainable communities; it is a starting point for developing low carbon ideas and technologies to create a sustainable society. Low carbon neighborhood remarks livable neighborhood environment, low

energy consumption building, flexible traffic systems, higher energy use efficiency, perfect municipal facilities, low carbon and environmental protection consciousness and effective public participation ability (Wang, Zhao, He, Wang, Peng, 2016). The most important role of sustainable neighborhoods is to create a livable environment for future generations. A sustainable neighborhood can meet the demands of many residents in the future and provide high quality of life. Neighborhood scale studies contribute to improve green infrastructure such as urban flora, transportation, buildings and water systems (Elgadi and Ismail, 2016). Trappey et al. (2012) have focused on energy conservation and carbon emissions reduction to reduce the social and environmental impacts of global warming. They stated that the key solution of the problems is to create low carbon cities and communities.

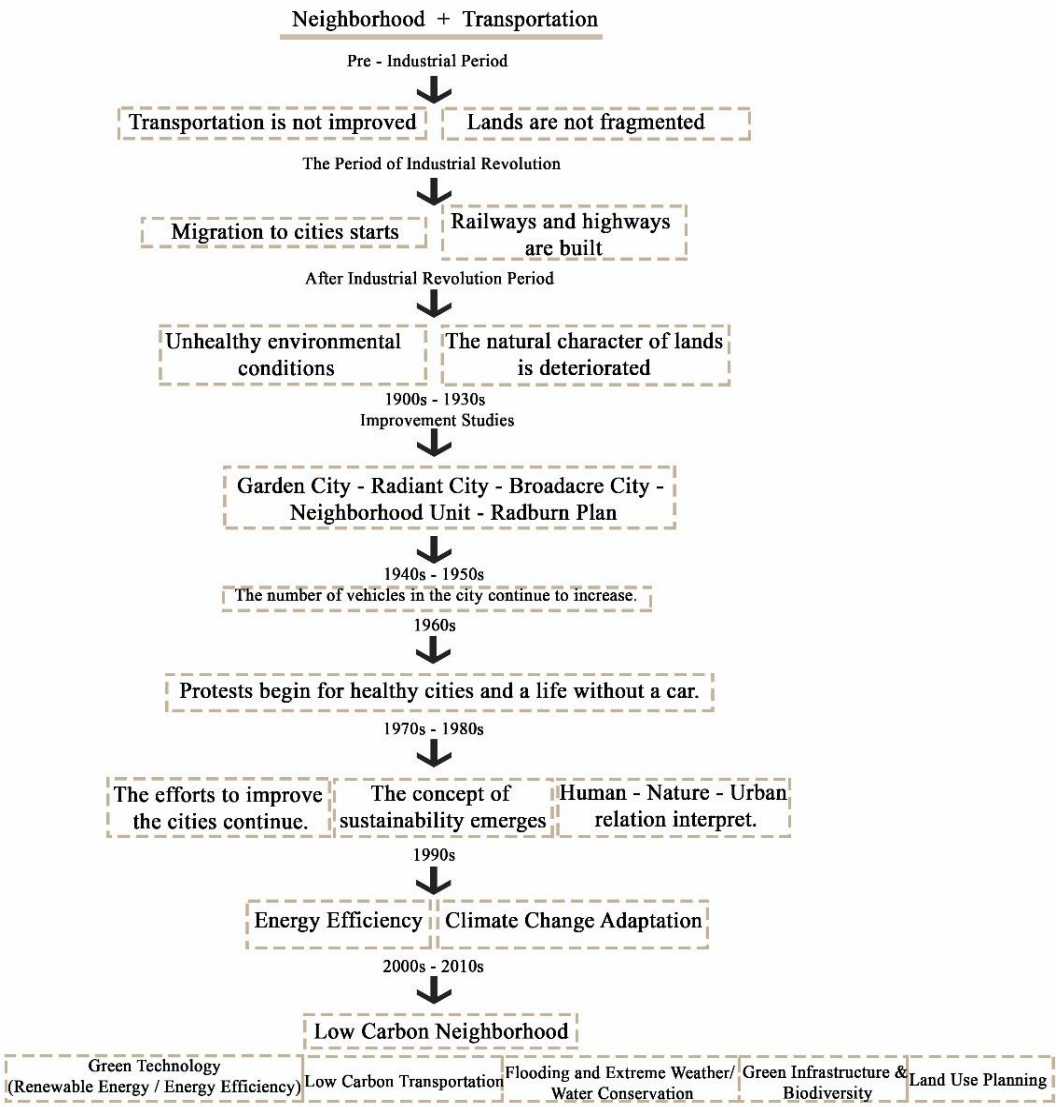

Figure 2.22. Constructing Low Carbon Neighborhood

Various strategies have been emphasized for the concept of a successful low carbon neighborhood. First of all;

Chattopadhyay, Banerjee, and Sen (2016)' study emphasized three principles for successful low carbon neighborhood: technological interventions, adopting sustainable urban design and planning strategies, and human behavioral change.

1. Technological interventions indicate innovation technologies such as water management, water supply and sanitation, household energy conservation, renewable technology, transportation systems, intelligent power distribution system.

2. Sustainable urban design and planning strategies involve neighborhood master planning practices. For example; green open spaces, transport infrastructure, amenities for the residential community.

3. Behavioral changes are important to create low carbon neighborhood. Human behavior change influences water usage behavior, commuting behavior, vehicle ownership status, the nature of energy consumption, solid water recycles and segregation behavior, housing typology (Chattopadhyay et al., 2016).

In the study of Wang et al. (2016), six stages were proposed to develop technologies of low carbon neighborhood planning, and to control energy consumption and carbon dioxide emissions;

1. Layout planning involves consulting about neighborhood, comprehensive research.

2. Traffic planning aims to build low carbon traffic system.

3. Architecture planning and design aim to create low carbon buildings to protect human health, reduce pollution.

4. Environment planning is necessary for a better life, harmony of nature.

5. Municipal engineering planning (MEP) is the significant role of construction of low carbon neighborhood.

6. Construction management aims scientific management of low carbon neighborhood planning formulation and implementation (Wang et al., 2016).

In Low Carbon Neighborhood guidebook, low carbon neighborhood principles were prepared by Centre for Sustainable Energy (2016);

1. Sustainable and resilience issues
2. Mitigating climate change: renewable energy
3. Mitigating climate change: energy efficiency
4. Mitigating climate change: sustainable transport

5. Adapting to climate change: green infrastructure & biodiversity.

Low Carbon Neighborhood Movements

The global increase in greenhouse gas emissions, which cause climate change, has been tried to be decreased by various meetings and agreements. Several sustainable mobility action plans were prepared over the transport sector, which is the most common cause of increased carbon emissions. Within these plans, it was aimed to minimize air and noise pollution, to provide safe roads, to direct urban dwellers to public transportation and low carbon transportation vehicles, in short, to create livable environments.

With the onset of Industrial Revolution, number of cars increasing in daily life led many thinkers to react. Guy Debord, a Situationist, expressed the best of alienated life for private vehicles and he said that this situation must be overcome gradually. In addition, Raoul Vaneigem views cars as an alienating vehicle that allows us to work and consume, harm rural areas, free up time and kill ourselves. The biggest concern of Lewis Mumford is that 'the dominance of the automobile over post-war American life'. With the increase in automobile use, ecological problems were seen more clearly with the emergence of oil crises at the beginning of the 1970s (Horton, 2009).

Before 1960s use of cars, especially the damages on pedestrians and bicycles, began to be emphasized. Debates about the acceleration of the proliferation of cars, increase in traffic congestion, destruction of neighborhoods and communities grew day by day. In 1960s and 1970s, the damage caused by automobiles to the community and the environment drew attention (Horton, 2006).

Concerns about the environment began to increase day by day as cars dominate the roads. At the very beginning of the environmental movements against automobiles, there were actions where bicycles were put into the forefront.

Along with these actions, cycling has become a symbol of healthy life and started to become widespread in all cities adopting low carbon life. In these cities, roads were designed for pedestrian and bicycle use, and this understanding was supported by necessary laws.

Some of These Bicycle Movements

1) Movement for safer, livable cities and the environment in Amsterdam in 1970s

Figure 2.23. Cyclist Protest Tour 1979, Amsterdam
(Source: http://www.thebikecomesfirst.com/wp-content/uploads/2014/11/protest1979.jpg)

2) Amsterdam in 1980s

Figure 2.24. Painting Cycle Lanes, Amsterdam 1980
(Source: https://bicycledutch.wordpress.com/2011/10/20/how-the-dutch-got-their-cycling-infrastructure/)

3) "Reclaim the Street" was established in 1991. It is an anti-automobile action.

Figure 2.25. “Reclaim the Street” Movement in 1995, London
(Source: Blanco, 2013)

4) Critical Mass movement was established for the dream of car-free city in 1992, in San Francisco.

Figure 2.26. Critical Mass in 1992 in San Francisco
(Source:http://www.foundsf.org/index.php?title=Critical_Mass_Xerocracy:_San_Francisco_1992-93)

5) Critical Mass mobility has been an activity spreading all over the world.

Figure 2.27. Critical Mass Posters, 2007-2011
(Source: https://bicycledutch.wordpress.com/2011/10/20/how-the-dutch-got-their-cycling-infrastructure/)

6) An action was taken on the Blackfriars Bridge in London. In this action, expansion of the roads on the bridge, raising the speed limit from 20 mph to 30 mph, limitation of bicycle routes by 1.5 m and removed the pedestrian crossings were protested.

Figure 2.28. Blackfriars Protest Tour, 2011
(Source: https://aseasyasridingabike.wordpress.com/2013/07/18/leon-daniels-and-knee-jerk-reactions/)

7) İzmir/Turkey Critical Mass Community is protesting every month between Konak and Alsancak with the slogan "Trafik Biziz ". This community is protesting motorized vehicle pollution in the city.

Figure 2.29. İzmir Critical Mass, 2017 – İzmir

8) Another action is the Fancy Women's Bicycle Tour. The action, which started in 2013, continues every year. The emphasis of action is to show that there are women in traffic and to suggest alternatives to people who are affected in automobiles.

Figure 2.30. Fancy Women's Bicycle Tour, 2017 - İzmir

9) With the aim of creating livable and healthy cities by adopting sustainable modes of transportation, activity was organized in İzmir on 22 September 2017 in European Mobility Week.

Figure 2.31. Car Free Day, 2017 – İzmir
(Source: http://www.izmirmag.net/2017/09/dunya-otomobilsiz-kent-gunu-22-eylulde.html)

Figure 2.32. Car Free Day Organizations, 2017 – İzmir
(Source: http://www.egepostasi.com/haber/otomobilsiz-hayat-cok-rahat/92214)

CHAPTER 3

LOW CARBON LIVING

This chapter presents the identification of low carbon concept. Low carbon is one of the most important solutions to climate change effects. The main aim of the study is to recognize the low carbon awareness, and its components, such as renewable energy, energy efficiency, flooding and extreme weather, water conservation, green infrastructure & biodiversity, green technology, land use planning, low carbon transportation, and to measure the awareness at neighborhood scale.

3.1. The Scope of Low Carbon Living

Carbon, a significant building block of life, is exchanged in the carbon cycle (Figure 3.1). The carbon cycle consists of two interrelated exchanges of carbon as biologically and ecologically. The exchange of carbon between plants and animals involves the biological carbon cycle. In this cycle, carbon dioxide obtained from animals combines with water during photosynthesis in plants, allowing oxygen to be released. Fossil fuels come from the ecological carbon cycle. As plants and animals die, chemical and physical compositions of carbon slowly changes into fossil fuels through ecological processes. Since the Industrial Revolution, fossil fuels have been used to add value to the economy. This has destroyed the natural balance of these cycles. Normally excess carbon that was trapped in earth's crust now exists in the atmosphere. Since The Industrial Revolution, the rate of carbon in the atmosphere has also increased (Blazer, 2011). As a result of all these, the threat of climate change has become the most important problem of nowadays.

Climate change has caused a lot of irreversible problems. There are many problems such as public health, biodiversity, natural disasters, diminishing water resources, and ecosystem services, change of precipitation regimes, sea level rise and especially damage of coastline areas. Besides these, social and economic sectors are also affected negatively.

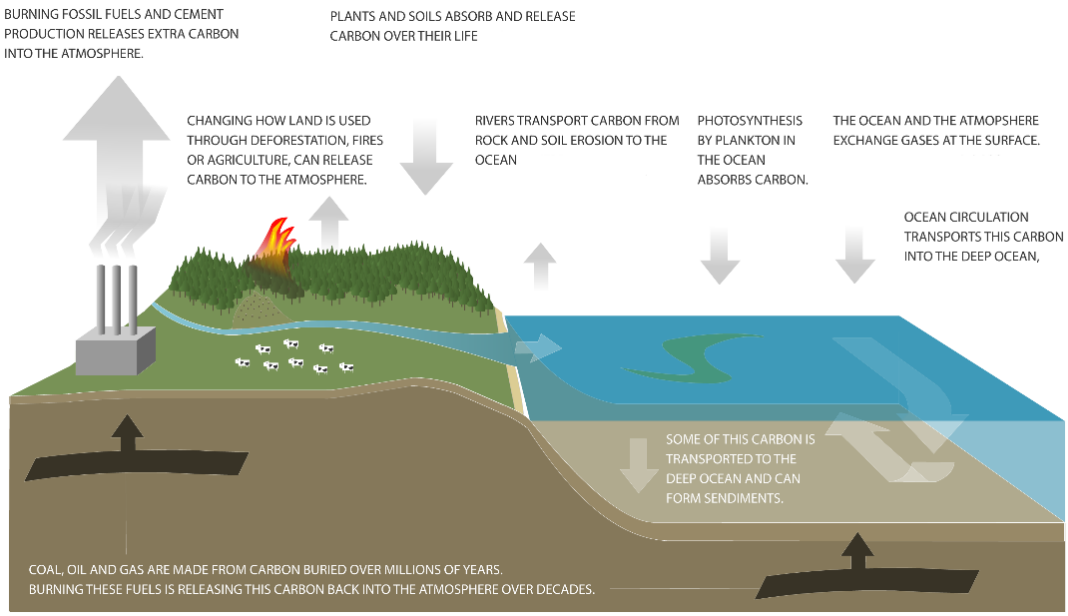

Figure 3.1. Carbon Cycle
(Source: https://www.niwa.co.nz/gallery/carbon-cycle-diagram)

The major factors contributing to climate change related to human activities are transportation, industrial, agriculture, households, and services. According to the information given by Giuseppe Inturri and Matteo Ignaccolo in Special Expert 3 (2016), the industry sector used 41.1% of all energy and the transport sector used 31.6% of all energy in 2013. According to the 2016 study of the World Resources Institute, 23% of global greenhouse gas emissions come from the transport sector and 70% come from cities (Dasgupta, 2016).

The ecological footprints of industrialized nations were first published in 1972 in the report "Limits to Growth" published by the Club of Rome. Twenty years after this publication, in 1992, the Rio Earth Summit defined the concept of sustainable development. In 1997, the Kyoto Protocol initiated its first study to reduce global emissions with the goal of limiting carbon dioxide emissions in developed countries (Chattopadhyay et al., 2016).

The concept of low carbon aims to increase urban energy efficiency, water efficiency, and sustainable transport systems, promoting innovative technological developments and depending on these to reduce greenhouse gas emissions in cities. The emphasis on low carbon is public health, mobility, smart growth, climate change adaptation, quality of life, technological innovation, sustainable urban policy, non-motorized transportation, safety.

Carbon emissions continue to increase as a result of human activities. If no precaution is taken, life will become increasingly difficult and responsibilities for future generations will be increased. According to the study of Peter Newton (2014), for the decarbonization of modern societies, there are multiple ways and he categorized them into three groups: technological change, sustainable urban design and behavior change. Chattopadhyay, Banerjee, and Sen (2016) describe similar classification for low carbon neighborhoods in their study. According to them, three principal categories of change is identified for lower energy, technological interventions, adopting sustainable urban design and planning strategies and human behavioral changes.

For low carbon living, there are urban design studies in various scales, such as cities, neighborhoods, individual buildings, around the world. The aim of low carbon communities is to create eco – friendly and livable environments. A low carbon community should include the ten principles for livable communities identified by Tyler Blazer (2011) and Daniel Williams' study Sustainable Design: Ecology, Architecture, and Planning:

1. Human scale
2. Provide choices
3. Encourage mixed–use development
4. Preserve urban centers
5. Vary transportation options
6. Build vibrant public spaces
7. Create a neighborhood identity
8. Protect environmental resources
9. Conserve landscape
10. Design matter (Blazer, 2011; Williams, 2007).

Blazer (2011) also indicated benefits of successful low carbon communities in his study: Cutting greenhouse gas emission, closing local resource loops, enhancing local environmental quality, creating a healthy environment, increasing street safety, increasing accessibility and freedom of choice, equity and social inclusion, local work opportunities, value of local community, increasing local self-determination.

Several cities developed policies, design and planning studies to implement these stated principles. Some of these can be specified as follows; In China, many cities have been implemented bicycle sharing program to support the concept of low carbon (Karki and Tao, 2016). In 2008, Taiwanese government implemented the Sustainable Energy

Policy on World Environment Day. Governments improved laws to increase energy efficiency, make a certain stable energy supply, enhance clean energy. In 2009, Taiwan improved a master plan of Energy Conservation and Carbon Mitigation. With this plan, energy savings and carbon reduction was promoted and seven specific policies and measures were involved in this project; green transportation, energy conservation, covering renewable energy, low carbon construction, environmental greening, resource recycling, and low carbon living (Trappey,Trappey, Hsiao, Ou, Li,Chen, 2012). According to He, Zhou, Hong, Fridley, Zhou (2014)'study, Chinese government aims reducing carbon intensity by 40% to 45% by 2020. For them, low carbon eco city development is the key approach. Most countries, including Australia, have prepared their projects in the transport sector, which led to increased carbon emissions. Within the context of the European Union project, Sustainable Urban Mobility Plan was prepared. In 2013, in Southern Italy, a bus rapid transit line was designed. In Slovenia, bike sharing system was implemented in 2011 (Inturri and Ignaccolo, 2016).

3.2. Low Carbon Living Principles

In the light of these studies, five principles were determined for the low carbon living within the scope of this study (Figure 3.2).

1. Green Technology / Renewable Energy / Energy Efficiency
2. Low Carbon Transportation
3. Flooding and Extreme Weather / Water Conservation
4. Green Infrastructure & Biodiversity
5. Land Use Planning

Each item contains various design tools. These design tools illustrate how the given principles can be adapted to the city. All of these design tools are interrelated, and their use in a harmonious manner affects low carbon life positively.

In addition to these, these principles guide urban design studies. The design tools mentioned in the table are the basic tools that can be applied to a city that targets low carbon living. These principles and the design tools they contain are all interrelated.

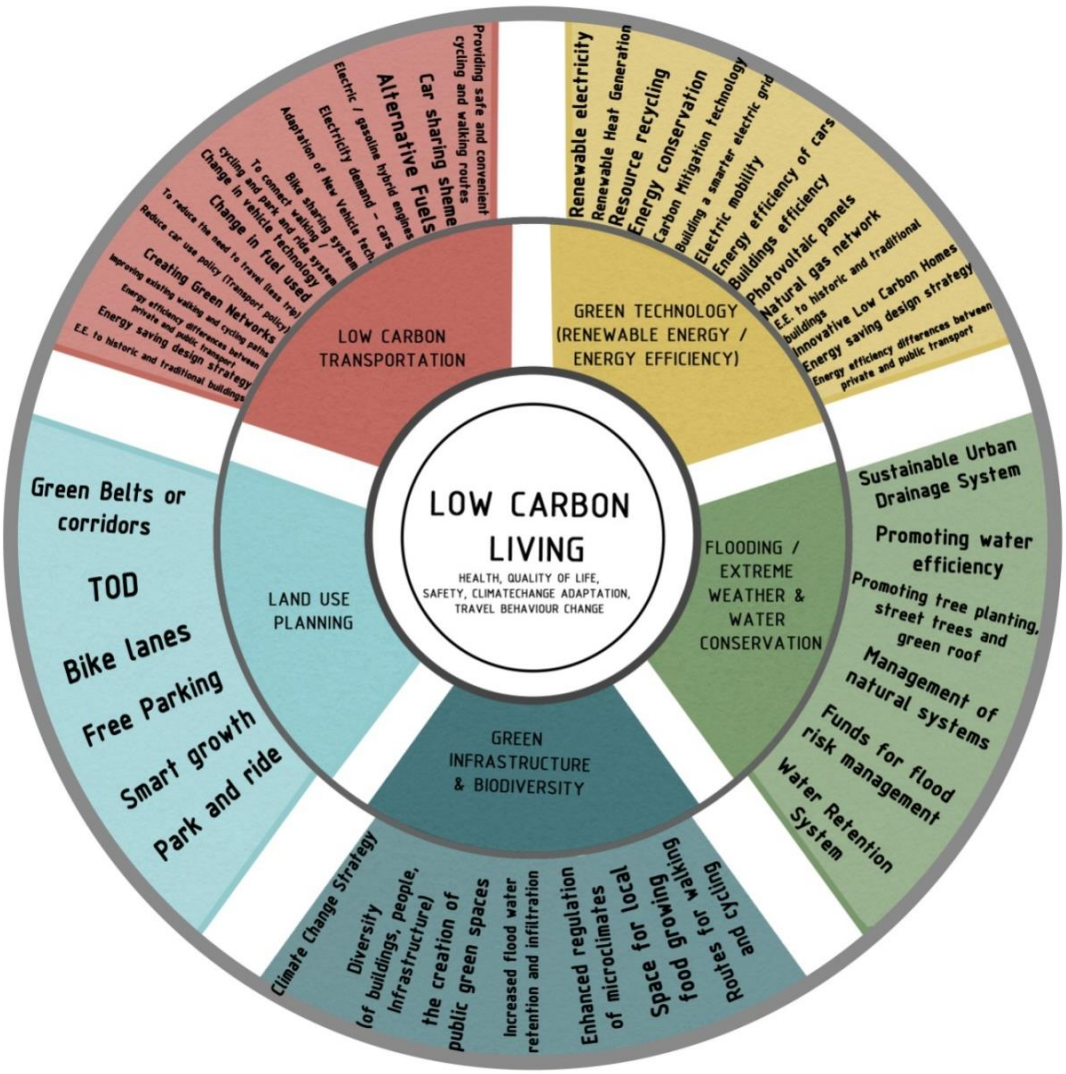

Figure 3.2. Low Carbon Living Principles

3.2.1. Green Technology

Green technology is an environmentally friendly technology which minimizes and reduces the negative impact of human activities. It uses the necessary systems, equipment and products to protect the natural environment, and resources (Bhardwaj and Neelam, 2015). The green technology aims to increase environmental performance. It is related to sustainable technology. Different sector of communities is using these technologies, which are called green or clean technology. The various green technologies are energy conservation, water treatment, environmental remediation, air pollution control, sewage treatment (Bhowmik and Dahekar, 2014).

Green Technologies in Urban Life:

- Hydrogen and Fuel Cells: For power cars, fuel cells are efficient. Energy efficiency is around 40-60%.
- Renewable Energy can be defined as a category of energy source. For example; hydro, geothermal, sunlight, wind, heat etc.
- Green Buildings are designed by using resources efficiently, using internal recycling, renewable energy sources, recyclable or biodegradable construction materials, and blending.
- Cleaner Conventional Energy is non-conventional fossil fuel. Some of the conventional energy sources are cleaner coal, cleaner oil, cleaner gas.
- Green Industries contributes to sustainable economic growth and promote sustainable economies.
- Green Transport means environmentally sustainable transport technologies. Green transport positively contributes to environmental, social, and economic sustainability of the communities. Some of the green transport systems are electric vehicles, hybrid vehicles (Bhowmik and Dahekar, 2014).

Renewable Energy / Energy Efficiency

Renewable energy is the use of wind, solar, ocean, geothermal, hydro sources for transportation, cooking, buildings. 18% of the world's energy demand came from renewable energy, with 9% coming from the traditional use of biomass, and other half is modern forms of renewable in 2010. The International Agency describes the traditional use of biomass as the use of charcoal, wood, agricultural residues (International Renewable Energy Agency, 2015). Renewable energy technologies are wind energy technologies, building technologies, geothermal technologies, solar electric and storage technologies, waste to energy technologies (Anderson, Antkowiak, Butt, Davis, Dean, Hillesheim, Hotchkiss, Hunsberger, Kandt, Lund, Massey, Robichaud, Stafford, and Visser, 2011).

In order to reduce greenhouse gas emissions in the cities, sustainable transport systems should be particularly emphasized. For reducing transport energy use and greenhouse gas emissions, there are three basic strategies:

Avoid: By reducing travel needs and trip length, transport use will be decreased.

Shift: By encouraging sustainable transport modes, the number of units of transport and the energy required per unit of transport will be reduced.

Improve: By increasing the efficiency of transport systems, the impact per unit of energy used will be reduced (Inturri and Ignaccolo, 2016).

The identified strategies are implemented with a set of actions: These actions are categorized into five instruments:

- Planning Instruments include the special planning of transport infrastructure, public transportation, and non – motorized modes.
- Regulatory Instruments involve all norms such as emissions and speed limits, traffic restrictions, maximum parking regulations.
- Economic Instruments; charges and taxes.
- Information; public awareness campaigns and mobility management schemes.
- Technology; fuel improvement, new propulsion technology, and intelligent transport systems (Inturri and Ignaccolo, 2016).

3.2.2. Flooding and Extreme Weather / Water Conservation

One of the most important consequences of climate change is flooding and extreme weather.

Center for Sustainable Energy has determined neighborhood plan policies against flooding and extreme weather;

- Promoting the use of Sustainable Urban Drainage Systems, such as swale, streams, storage ponds, to manage water, maximize infiltration, and deliver ecological benefits.
- Promoting rainwater harvesting systems for water efficiency
- In new developments, promoting tree planting, street trees, green roofs (Centre for Sustainable Energy, 2016).

3.2.3. Green Infrastructure & Biodiversity

Green infrastructure is the blend of blue and green networks that enhances urban and rural areas as social, economic, and environmental. It includes natural characters such as, park, forest, marines, and wetlands also man–made features such as ecoducts and cycle paths (Science for Environment Policy, 2012), streams, rivers, recognized nature reserves as well as obvious assets such as trees, canals, railway corridors, drainage ditches, hedgerows, road verges, and disused land (Centre for Sustainable Energy, 2016). The

roles of Green Infrastructure is to promote ecosystem state and biodiversity, improve ecosystem functioning and ecosystem services, promote social well-being and health, support the development of a green economy, sustainable land and water management (Science for Environment Policy, 2012).

Neighborhood Plan Policies for Green Infrastructure strategies:

- To provide the connectivity of green infrastructure and improved biodiversity.
- In the regions, to increase the number of street trees.
- To integrate biodiversity into renewable energy installations.
- Designing regional green spaces
- Protecting front gardens to paving
- Preventing loss of back garden space (Centre for Sustainable Energy, 2016).

3.2.4. Land Use Planning

Land use planning is a significant tool for low carbon neighborhood design. As land use patterns influence mobility, land use planning is related to climate change (Owens, 1995). Greenhouse gas emissions are affected by land use, from plant practices to park policies, and development policies to site selection. Slow changes in land use have a significant impact on issues such as climate, economic opportunities, access, and equity. Land development decisions determine mode selection, travel distances, private vehicle ownership. These decisions have long-term effects on climate, air quality, energy use, access, quality of life. As a result of population growth, land use limits begin to expand. Accordingly, the distance between parking spaces, places of work, home, and school is increasing and by extension, motor vehicle use is expanding (Kockelman, 2010).

For low carbon cities and energy efficiency, transport and land use planning is a very difficult and long-term strategy. According to Inturri and Ignaccolo (2016), there are three approaches for land use and transport planning.

- Public Transport Network
- Smart Growth
- Transit Oriented Development

3.2.5. Low Carbon Transportation

One-third of carbon emissions comes from the transport sector. Polcar and Ausserer (2012) expressed the problems that arise with the increase in the number of vehicles in urban areas as follows;

- The decrease in physical activity
- Increase in air pollution of green houses gases emission
- Accidents caused by cars

The transportation sector is interrelated with the public health, safety and climate change adaptation (Figure 3.3). Disadvantages in the transportation sector directly affect other subjects. For this reason, it is important to understand the relationship between these three areas and transportation, according to the subject matter.

Figure 3.3. Relation of Transportation to Other Subjects

<u>Public Health</u>

The transportation sector is an important sector for decreasing carbon emissions in the city. If low carbon transportation vehicles are developed in the urban area, greenhouse gas emissions are reduced further and a healthy urban environment is created. In 1999, the World Health Organization addressed health and transport issues. It is stated that national and international measures will be taken in the conference to prevent problems caused by transportation such as air, soil, water and noise pollution, accidents,

greenhouse gas emissions and damaging forests, and to increase the level of health. In addition, it is emphasized that active transportation modes such as cycling and walking and public transport must be increased (WHO, 1999).

As a result of the researches, it is determined that bicycle use provides physical activity, reduces cardiovascular health-risks and morbidity, and reduces obesity. In addition to these, it is determined that the risk of traffic-related health issues decrease, furthermore, as the bicycle levels increase, the rate of injury is reduced (Pucher, Dill, Handy, 2010). Increasing walking and cycling distances helps to reduce diseases such as diabetes, depression and heart attack, cerebrovascular disease, dementia, ischaemic heart disease. Effective policy is needed to realize the stated health benefits. In cities such as Copenhagen, New York, and London, bicycle use is improved and accident rates are reduced. In addition, the increase in bicycle and walking ratios are linked to the right planning of street designs and land uses. Designed at short distances, use is more convenient (Woodcock, Edwards, Tonne, Armstrong, Ashiru, Banister, Beevers, Chalabi, Chowdhury, Cohen, Franco, Haines, Hickman, Lindsay, Mittal, Mohan, Tiwari, Woodward, Roberts, 2009).

Safety

Along with the increase in the use of walking and cycling in neighborhoods and cities, street life and neighborly relations are developing. In addition to these, safety is starting to increase in the streets. In land use planning, the proximity of places, mixed-use street designs give people a sense of security.

In the streets, in the neighborhood, the presence of pedestrians, buildings, public spaces are natural observations that improve the sense of security. This is one of the basic principles of 'Crime Prevention Through Environmental Design' (Healthy Spaces & Places, 2009). In Jane Jacobs' study "The Uses of Sidewalk: Safety" in 1961 she drew attention to this issue and used the concept of "eyes on the street". With this concept, Jacobs emphasizes that a vibrant street life is important for neighborhood safety (Jacobs, 1961).

In addition to these, in neighborhood the presence of walking and cycling provides, reduction of traffic speed, increase in pedestrian activities, and reduction of private car priority and thus reduction of a car accident.

Climate Change Adaptation

As mentioned in previous issues, the transport sector is at the forefront of the sectors that cause an increase of carbon emissions. An excessive number of private vehicles in the neighborhood causes carbon emissions to increase. In this case, it triggers climate change. In order to prevent all these problems, walking and cycling are important for the concept of low carbon transportation.

Bicycle and walking is a zero-carbon and environmentally friendly solution for city dwellers. Walking and cycling trips both reduce traffic and improve the community and urban health (Chapman, 2007). In order to reduce carbon emissions, it is necessary to encourage urban dwellers to walk and bicycle use. In addition, it is necessary to reduce travel distances, travel needs, and provide easy access to local services and facilities (Banister, 2011).

3.3. Low Carbon Transportation Concept

Together with the increasing economic and social needs in cities, transportation needs are also increasing. If transportation is sufficient in the city, work efficiency and quality of life are good depending on it. Therefore, transportation is an important influence on the development of a city. However, with the increasing population growth, the number of motor vehicles increases and as a result, cities started to expand its fringe. In addition, residents of the city have recently become dependent on private vehicles. Even the shortest distances are gone by private vehicles. In this case, it leads led to major problems. At the beginning of the problems, there are damages to the natural environment. Increase of carbon emissions triggers the increase of greenhouse effect throughout the city. In consequence, the ecological balance begins to deteriorate. Distortions in the water cycle and the carbon cycle cause city's natural character to change. All these problems provide the development of low carbon transportation.

According to Global Environmental Facility (GEF) (2010), “Sustainable low carbon transport” is a strategy that reduces short and long-term negative impact on the local and global environment, provides viable infrastructure and operation that offers safe and secure access for both persons and goods. It also includes reducing oil imports, improvement in air quality, and improving traveling facilities (GEF Stap, 2010). Low carbon transportation aims to reduce traffic and parking congestion, increase vehicle efficiency, improve mobility options for non – drivers, increase safety and security,

improve public fitness and health, reduce air pollution. Furthermore, low car carbon transportation reduces greenhouse gas emission, provides economic, social, and environmental policy objectives and has an impact on sustainable development (Lah, 2015). There are four supporting systems of low carbon transport; industrial supporting system, infrastructure supporting system, life-supporting system, and policy supporting system. Low carbon industry depends on low carbon consumption and low carbon emissions. The transportation sector includes a large majority of emissions that affects global climate change. The transportation infrastructure provides traffic lanes and runways for the transportation sectors such as motorways, railways, and airlines. And participation of urban people and various laws developed are important for the spread of low carbon transportation (Huang, 2012).

Many countries improved transportation strategies to reduce the negative effects caused by transportation and create livable environments. For example; In China, low carbon transportation has been established in 10 cities. Huang emphasizes, in his study, non–motorized vehicles – particularly walking and cycling modes – are ideal modes for reducing carbon emissions in China (Huang, 2012). Sudeep Grover, G. Tiwari, and K. Ramachandra Rao (2013), as the results of their research show, determined that in order to reduce carbon emissions to the least, policies should be developed against cars, independent roads should be designed for buses, and bicycle - walking routes should be established in India.

Daniel Bongardt, Manfred Breithaupt, and Felix Creutzig (2010), in their study, have determined components of a vision for low carbon transportation;

- Intense but mixed and green used cities that are close to people's living area, such as shopping areas, recreational facilities,
- Good integration of high-quality connections and long distance centers into local transportation,
- High-quality alternatives for private car users, such as public transport and non-motorized transport,
- Vehicles that include inter-modal freight transportation and intelligent urban logistics,
- Green and advanced technologies. For example; electric motorbikes and cars, electric/gasoline hybrid engines, alternative fuels (Bongardt, Breithaupt, and Creutzig, 2010).

Benefits of Low Carbon Transportation

Low carbon transportation provides air quality, access and mobility, public health, energy security, road safety, reduced noise pollution, and reduced traffic congestion. Air quality is one of the most important issues contributed by low carbon transport. Low carbon vehicles provide a clean environment by reducing various gases such as sulphur dioxide, carbon monoxide, hydrocarbon, toxic metals, nitrous oxide, which affect human health. It also reduces noise pollution, which can cause problems such as heart disease, hearing loss, and learning difficulties in children. It reduces car dependence. Prepared strategies to reduce carbon emissions also help to reduce transportation costs. Thanks to low carbon transportation, the attractions of the city centers increase and access to public spaces such as business, school, shopping are ensured. Bicycles, walking and public transits are developed to provide safe transportation for workers and tourists, especially for disadvantaged groups. In cities, cycling and walking are improved to reduce health problems such as diabetes, obesity. Besides these, the rate of traffic accidents is reduced (Lah, 2015).

3.3.1. Walking and Cycling

Bicycling and walking are among the most important mode of low carbon transportation. In the context of the study, bicycle is the vehicle in which we can measure the concept of the low carbon neighborhood in the most concrete way. Because bicycle is a transportation vehicle that can be best adapted to a city, easily used by people and integrated into social life (Figure 3.4). Moreover, bicycles are the most preferred means of transport for reducing greenhouse gas emissions in the city.

Along with the increase in population, the number of vehicles in cities started to increase that caused air and noise pollution, socioeconomic marginalization, traffic congestion and accidents, deteriorated urban life quality. Besides, the increase in the number of vehicles caused city dwellers to become dependent on the vehicles (Yılmaz and Gerçek, 2013). In 2011, a research was made on walking and private vehicle use in England and Wales. According to this research, the rate of commuting from home to work by private vehicle was 67.1%, public transportation was 17.8%, walking was 10.9% and cycling was 3.1%. As a result, while UK and Wales are dependent on cars for travel, they only use active transport for health (Goodman, 2013). In another study, it was determined that the rate of walking in United States from 1960 to 2009 decreased, but the rate of

cycling increased by 0.2% from 1980 to 2009. The rate of use of public transport vehicles decreased by 7.9% from 1960 to 2009 (Pucher, Buehler, Merom, and Bauman, 2011).

Figure 3.4. Walking and Cycling
(Source: https://clahrc-west.nihr.ac.uk/)

Along with the increased number of private cars, social, economic, environmental problems begin in the city. One of the biggest problems caused by the excess vehicle is climate change. The surplus of greenhouse gases in the cities is triggering climate change every passing day. All these problems have increased the importance of sustainable transportation and bicycles have begun to be integrated within urban transportation (Yılmaz and Gerçek, 2013).

Walking and cycling are expressed as an active means of transportation. It is seen as an important physical activity in terms of human health. These types of transportation have an important place in sustainable transport as they improve human health and reduce air pollution, carbon emissions, traffic accidents, noise. (Pucher, Buehler, Merom, and Bauman, 2011).

According to a study conducted in 17 cities in 12 countries, increasing use of walking and cycling depends on housing density, land use mix - access, street connections, aesthetics security, and infrastructure (Emond, Reis, Schofield, Dyck, 2015). Together with these, in order to increase the use of walking and cycling, various necessary measures are improved. These measures include developed infrastructure such as sidewalks, crosswalks, bike paths and lanes, intersection crossing; improved traffic

education; strict enforcement of traffic regulation; reductions in motor vehicle speed limits; traffic calming of residential neighborhoods; and land use policies that foster compact, mixed-use developments (Pucher, Buehler, Merom, and Bauman, 2011).

The increase in walking and cycling provides a healthy environment, safe roads, quality of life, climate change adaptation, and a changing travel behavior of urban residents, both in the neighborhood and across the city.

3.3.2. Electric Vehicles

The first electric vehicles started to be produced by Germans in 1880. During these times, electric suburban railways, electric trams, trolley buses were produced. In the same period, the first electric powered cars started to be produced. In the beginning of 1990s, as the problem of climate change began to come on the agenda, interest in electric vehicles began to increase (Shukla, Dhar, Pathak, Bhaskar, 2014).

Electric vehicles are electric motor-driven vehicles instead of internal combustion engines. The engine operates with power stored in the batteries. The batteries are often charged by plugging in any mains supply (Figure 3.5).

Figure 3.5. Electric Vehicle
(Source: http://www.greencarreports.com)

Electric vehicles are known as zero emission, environmental friendly vehicles. Because the moving parts are few, maintenance of them is infrequent. There is no engine

oil change, tune-ups or timing, and exhaust. Electric vehicles are much more energy efficient than gasoline engines (Bansal, 2014). There are two types of electric vehicles: first, battery electric vehicles. They use the batteries only for energy storage. The other vehicle is plug-in hybrid electric vehicles with both a battery and a liquid fuel storage system (Fulton, Seleem, Boshell, Salgado and Saygin, 2017). Electric transport vehicles are generally involved in transport policies to reduce carbon emissions throughout the city. For example, the scope of "The Penghu Low Carbon Island Development Project" in Taiwan, it has been decided that a green transportation policy model and electric scooter vehicles should be widespread throughout the city in order to save energy and reduce carbon emissions (Trappey, Trappey, Hsiao, Ou, Li, Chen, 2012).

In addition to these, electric mobility increases the energy efficiency of transport and reduces the impacts per unit of energy use. If the transportation sector transfers to the electric system, it is estimated that the current energy consumption will decrease by one-fifth. The transport sector promotes sustainable ways of generating electricity, such as wind and solar. These systems have advantages in terms of air quality and human health. For example, particle pollution and acid rain are reduced (Inturri and Ignaccolo, 2016).

3.3.3. Public Transportation

Sustainable urban transport system involves mobility, accessibility, affordability, social equity, efficiency, safety, security, low carbon, convenience, comfort, and people and environment friendliness. It also includes improving human health through the reduction of urban air pollution, tackling climate change, reducing the number of deaths and injuries from road accidents, controlling excessive motorization, encouraging more active transportation (walking and cycling), and the specific needs of urban poor, women, the elderly people, children, youth. Public transport systems contain bus rapid system, subway, light rail system, walking and cycling, bus, shipping, etc. (Figure 3.6) (Pardo, 2010).

With public transport, European cities are becoming major metropolitan areas. For example;

- Stockholm general plan in 1952 and its heavy rail system,
- In Paris, the Reseau Express Regional rail system, built in 1965, connecting to the city center,
- Berlin’s City Express network (Inturri and Ignaccolo, 2016).

Figure 3.6. Public Transportation
(Source: https://www1.toronto.ca/wps/portal/contentonly)

Energy use is less in public transport systems than in private vehicles. Public transport can operate in renewable energy sources without oil (gas, hydro–electric, nuclear). Energy efficiency is also higher in public transport. Energy use among different modes is also different. For example; In USA and Canada, buses are the most energy-consuming vehicles. Ferries use the most energy because of the friction forces per kilometer. There is no big difference between different rail systems such as suburban rail system, metro system, and light rail system (Kenworthy, 2003).

Public transport services change from country to country. For instance; Chinese cities use non-motorized transportation vehicles. Middle Eastern cities mostly use minibus systems. American cities were using extensive transit system in the early twentieth century. This situation changed later. However, in the last 5 years, the railway system has been given priority. Now public transport services are high level in Eastern and Western Europe, high-income Asian cities, Latin America and African cities (Kenworthy, 2003).

3.3.4. Park and Ride

The park and ride system has an important place in development of low carbon transportation network in the city. Thanks to this system, the city dwellers leave their vehicles to the designated places for parking and they can go to schools, work, and

shopping centers via public transportation (Figure 3.7). Thus, the problems caused by excess vehicle in the city are reduced. Most importantly, carbon emissions are decreased across the city.

Park and ride system is a key feature of a multimodal transportation network. These systems have a wide range of use from being a small, simple place to park a few vehicles temporarily, to an upscale, grand multimodal hub (Florida Department of Transportation Transit Office, 2012).

Figure 3.7. Park and Ride
(Source: http://news.trimet.org/2016/07/trimet-expands-parking-options-in-milwaukie-with-new-park-ride-opening-aug-1-near-max-orange-line/)

Park and ride systems include many practical strategies for reducing roadway congestion, enhancing community mobility options, supporting public transportation. Providing multimodal options, such as light rail transit, bus rapid transit, and commuter rail transit for passengers is a crucial issue against inefficient transportation system and in intense areas. Park and ride system provides the opportunity to transit between public transports. Creating a good network of park and ride systems provides many benefits for society and transportation systems (Florida Department of Transportation Transit Office, 2012).

More importantly, the park and ride system is an environmentally sensitive system. It provides significant contributions to environmental movements. For example, in Florida, the "Going Green" movement is an important environmental action to reduce greenhouse gas emissions. Park and Ride system is an important step to support this movement. This system helps reduce the number of vehicles in traffic, reduce the costly motorway restorations, and reduce road maintenance cycles. The park and ride design

offers an attractive landscape design, provides no-automobile use and a bicycle and pedestrian network (Florida Department of Transportation Transit office, 2012). In addition to all these benefits of park and ride, this system provides cost savings to users, travel time savings, increased transit ridership, enhanced mobility, improved transit system efficiency (Reynolds, Smith and Hills, 2009).

3.3.5. Bike Sharing Program

Bike sharing is a system that allows users to travel from one point to another for short distance trips. This system supports non-motorized transportation. Users can pick up a bicycle from any bike sharing station, and they can return it to any other bike sharing station (Figure 3.8) (Toole Design Group and the Pedestrian and Bicycle Information Center, 2012). Bike sharing programs are increasing in Paris, London, Washington DC, New York City, Denver, Barcelona and many other cities. In this way, an economic, flexible and carbon-free transportation system develops from car to bicycle. A successful bicycle-sharing program reduces car dependence, reduces traffic congestion, and enhances human - urban health (On Bike Share, 2016). E-Cards are usually needed to use bikes. In North America and Europe, the first 30 minutes are used free of charge and after 30 minutes it is used for a fee (Karki and Tao, 2016).

Figure 3.8. Bike Sharing Program
(Source: http://transportpolicy2013.blogspot.com.tr/2013/06/why-every-city-needs-bikeshare-program.html)

The bicycle sharing program first started in Amsterdam in 1960 with the name "White Bicycle Program". There were bicycles at various points in the city for free use. However, the program was not very successful due to the users. The second bicycle sharing program was implemented in 1995 in Copenhagen. But it was not successful either. Because there was no limit for use, so people were occupying bicycles. The second reason is that bicycles were stolen by unknown users. The third experiment in the bicycle sharing program was implemented in 1998 in Rennes, France, and this time it was successful. Because, smart cards have been developed for these programs, making bikes easy to follow (Karki and Tao, 2016). In 2011, in Ljubljana, the bike sharing program began to spread. This program included 36 bicycle parking spaces and 360 bicycles. The aim of this program is to improve the quality of air and to provide quick and easy access around the city (Inturri and Ignaccolo, 2016). Benefits of this program are to reduce greenhouse gas emissions and provide healthy transport mode for short commutes, ensure easy access to low-income families and support low carbon transportation around the city (Karki and Tao, 2016).

3.3.6. Car Sharing Program

Carsharing was popular in Europe for a very long time. However, over the last dozen years, its popularity has increased much more in North America. The oldest known car sharing organization in Europe was called Sefage. It provided a car for a non-car access. It is now called a complementary good for high-intensity travel (Figure 3.9) (Stillwater, Mokhtarian, and Shaheen, 2009).

Figure 3.9. Car Sharing Program
(Source: http://www.polskieradio.pl/42/5351/Artykul/1791069, Car-sharing-czyli-auto-na-minuty-nie-na-benzyne)

The modern Carsharing program first started in Switzerland in 1987. It then began in Germany in 1988 and grew rapidly until 1990. In countries such as United States, Canada, and Japan, it began to spread widely in the mid-2000s. By 2014, the number of members was nearly 4.8 million. Approximately 104.000 vehicles are used for this system. In underdeveloped countries, there are few carsharing programs. There are 22 carsharing operators in developing countries such as Brazil, China, India, Malaysia, Mexico, South Africa and Turkey (World Resources Institute, 2015).

Car Sharing program increases equality by improving movement of disadvantaged people in transportation, increases economic productivity, mobility, reduces congestion, road and parking facility cost, accidents, pollution, resource consumption and other environmental impacts (Litman, 2015).

3.4. Low Carbon City Case Studies

Along with the ever-increasing effects of climate change, urban governments, architects, urban designers, city planners, and landscape architects of different countries began to take action in this regard. Related to this topic, various technologies are developed, design guidelines are prepared and various projects are implemented. Generally, low carbon principles included in case studies are **low carbon transportation**, green technologies (renewable energy), land use planning, water management, green infrastructure systems. Based on the subject of the thesis, case studies related to low carbon transportation for the reduction of carbon emissions are introduced.

In this section, case studies of projects that consist of low carbon designs from various parts of the world are explained. The priorities of the studies prepared with low carbon principles are to create healthy, safe and high-quality urban life. Within the scope of this study, Greenwich Milennium Village London, Hammarby Sjöstas Stocholm - Sweden, Bo01 (Vastra Hamne) Malmö - Sweden, Stellwerk 60, Cologne - Germany, GWL Terrein, Amsterdam – The Netherlands, Vauban, Freiburg - Germany are analyzed.

Beyond low carbon transportation, the case studies involve well-planned road connections and land uses, use of renewable energy and green infrastructure systems, use of new technologies, and the resulting low carbon life. Selected projects are at the forefront as a result of the research titled "Low Carbon Life" and "Low Carbon Communities". Along with these studies, urban life has dramatically changed to adapt to low carbon life. For example, for low carbon life, as in GWL Terrein and Stellwerk 60,

automobile-free transportation concept is proposed, or as in Greenwich Millennium Village, Hammarby Sjöstad, Bo01 Vastra Hamnen, Vauban Freiburg, the use of green - new technology systems are proposed, green infrastructure systems are adapted and along with these, importance of renewable energy sources, such as "water" is emphasized.

3.4.1. Greenwich Millennium Village, London

Greenwich Millennium Village is located on Thames River in East London 9 kilometers from the center of London. This area is known as a redevelopment area of 121 hectares of brownfield occupied by urban gas. This regeneration project occupies 29 hectares of land on the sought eastern side of the Greenwich Peninsula and it includes mixed-use, brownfield redevelopment, well served by transit with strict parking regulations and a layout that limits through car traffic (Figure 3.10) (Foletta, 2011a).

Figure 3.10. Greenwich Millennium Village in London
(Source: Google Earth)

English Partnership started a competition to design and implement Greenwich Millennium Village in 1997. Greenwich Millennium Village Limited won the competition. After two years, the construction of Greenwich Millennium Village began. Phase 1 and 2 of the building were finished by 2002. These phases include 1.095

residential units, a village square with shops, an artificial lake, and an ecology park. The 3rd and 4th phases of the project were planned to be completed in 2014 (Foletta, 2011a).

Greenwich Millennium Project includes seven sustainable communities nationwide. Each community involves new commercial, high-density housing, green spaces, healthcare, leisure facilities, producing quality places, good transport links, easy access to shop and recreation facilities (Figure 3.11) (Foletta, 2011a; Wimpey, 2017). In the scope of this project, studies were carried out on issues such as energy efficiency and water management, transport, building defects, recycling and health, and safety in order to achieve sustainability targets. The project aims to reduce car dependency, increase the number of cyclist and pedestrians, provide access to high-quality public transportation to create environment–friendly design (Foletta, 2011a).

Figure 3.11. Greenwich Millennium Village Master Plan
(Source: http://www.gmv.london/site-plan/masterplan/)

Design Strategies

The green components of the project are parking, transport, building construction, and combined heat and power. Parking is designed underground and at the periphery of the Village to decrease auto impact. For cyclists and pedestrians, an infrastructure of routes is designed (Rebecca, 2006). For every housing unit, bicycle storage facilities and

2 – 3 bicycle parking spaces are provided (Foletta, 2011a). Over 12.000 trees are planted around the river. Energy consumption is reduced with the high level of thermal insulation, efficient appliances, and windows, controlled lighting of common areas, daylighting of interiors. In addition to these, water use has been minimized with low flush toilets, low flow taps, and highly efficient appliances (Rebecca, 2006).

Sustainable Approaches:

- To reduce primary energy consumption by 80%,
- To reduce water use by 30%,
- To reduce construction waste by 50%,
- To reduce car usage by 25% with 10 years of implementation,
- To reduce construction cost by 30% (Shin, 2006).

3.4.2. Stellwerk 60 – Cologne, Germany

Stellwerk 60 is 2.5 km away from the city center of Cologne. It is a car-free development of 700 homes in Cologne's Nippes region (Figure 3.12).

Figure 3.12. Stellwerk 60, Cologne – Germany
(Source: Google Earth)

Car ownership is 20% less than compared to the surrounding neighborhoods (Figure 3.13) (Field, 2011a). According to the data in 2007, Cologne is the fourth largest

city in Germany with a population of 995.397. In 1965, Germany's first radial motorway was built in here (Melia, 2009). Stellwerk 60 involves pedestrianized streets, some houses, and apartment blocks. The center of the site is bounded by removable bollards. These bars are only being removed for emergency vehicles (Melia & Mulley, 2014).

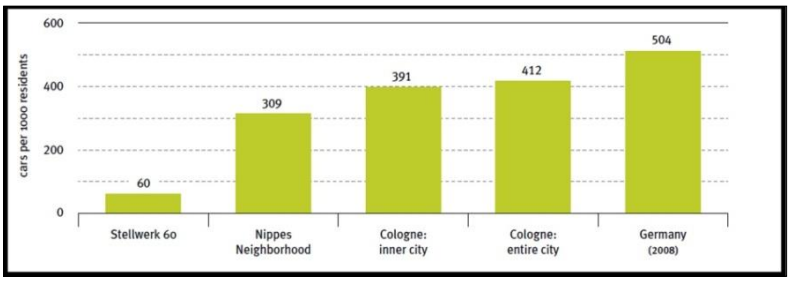

Figure 3.13. Car ownership in Stellwerk 60 as Compared to Surrounding Area
(Source: Field, 2011a)

There are shopping malls, markets, kindergartens, primary schools and hospitals within 600 meters of the development, reachable via open-air cafés. In addition, there are small playgrounds, recreation, and green space. Within this area, homeowners and tenants must sign a legal agreement that they agree not to use motor vehicles, create new parking spaces, or park in certain areas (Field, 2011a). Roads are often used by cyclists, pedestrian, and children playing games (Figure 3.14). Every house has a small garden (Melia & Mulley, 2014).

Figure 3.14. Road Design
(Source: Field, 2011a)

Bicycles and pedestrian paths provide access to public transport stations. The residents are directed to non-motorized vehicles in applications such as street furniture, street narrowing, and traffic calming. Stellwerk 60 is especially designed for cyclists and pedestrians. For each residential area, an average of 30 square meters of parking space is constructed and these parking areas are designed to be easily accessible by ramps (Field, 2011a).

In general, low carbon is generally maintained throughout the site. There are very few exceptions to access permits for motor vehicles. However, this situation presents difficulties in transporting heavy products. For this reason, "mobility center" was established at the southwestern entrance of the area. Free cars can be hired in this place. This way, necessary deliveries are provided to houses and safe and noiseless nature of the area is protected (Field, 2011a).

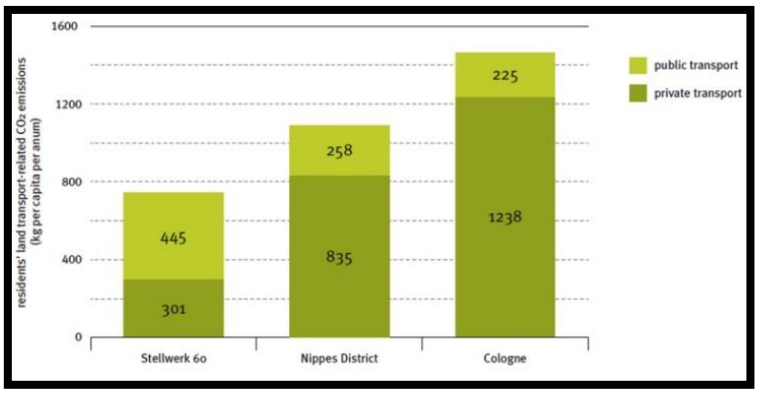

Figure 3.15. Transport Related Carbon Emission
(Source: Field, 2011a)

In Stellwerk 60 the per-capita carbon dioxide emissions from private vehicle use are 64% lower than other regions and 75% lower than Cologne (Figure 3.15) (Field, 2011a). It is the evidence of the importance of using public transport and non-motorized vehicles for a carbon-free life.

3.4.3. GWL Terrein – Amsterdam, the Netherlands

GWL Terrein is located in the western part of the famous bicycle city Amsterdam, at the tip of the tram line, three kilometers from the city center and this area covers six hectares (Foletta, 2011b). The project area was created by five housing development associations by Amsterdam Westpark (Figure 3.16) (Morris, 2006).

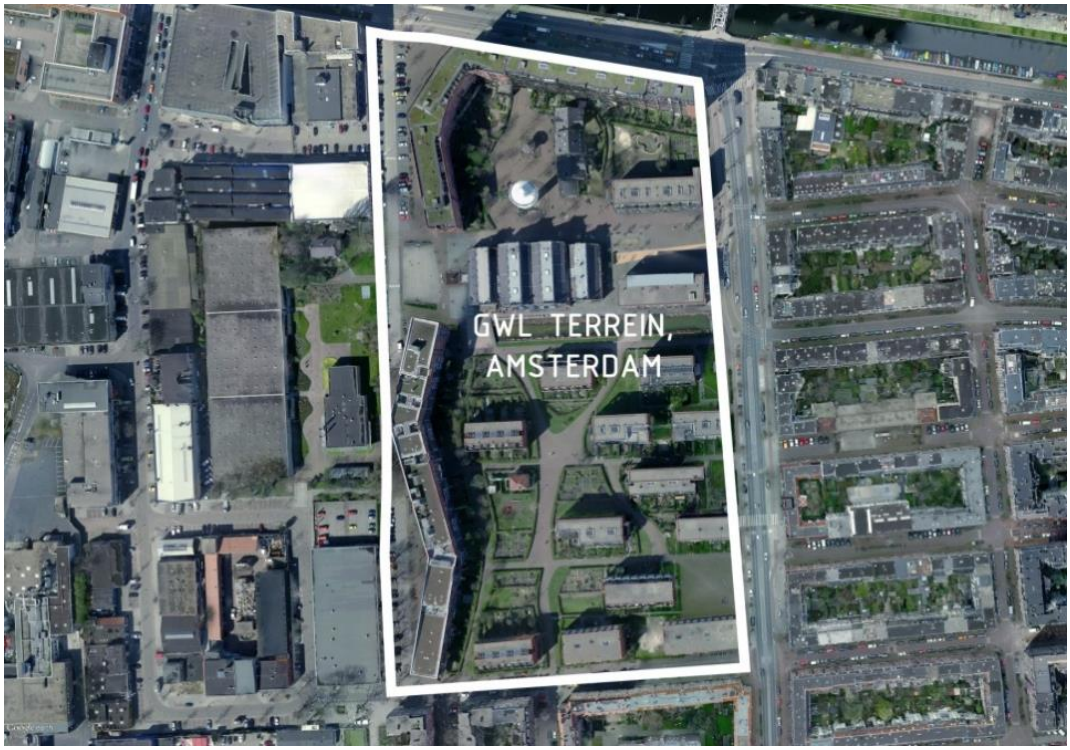

Figure 3.16. GWL Terrein, Amsterdam – The Netherlands
(Source: Google Earth)

The main objective of the project was to create housing needs, but the reduction of environmental impacts and the increase of green spaces were among the main objectives of the project (Figure 3.17) (Morris, 2006).

Figure 3.17. Green Spaces and Cycling Routes
(Source: https://www.rainproof.nl/droge-voeten-op-het-gwl-terrein)

The car-free concept is not a new idea for Amsterdam. Since 1945, parking provision has been exempted in the redevelopment of the houses in the old city center.

Because local governments wanted to protect the character and function of the pre-industrial city (Scheurer, 2001).

GWL Terrein environmental and social goals involve cleaner, safer place for neighbors, energy-efficient building design, and sustainable transportation to reduce the carbon footprint of residents (Foletta, 2011b). This project, which started with the idea of including nature in a dense residential area, has become a place to be sampled later by other cities. The project has sustainable developments that include low carbon life strategies such as the use of rainwater for toilets flushing, landscape rooftops. Wastes are separated into four fractions, including green wastes. These wastes are collected in underground storage tanks and removed by collecting trucks (Scheurer, 2001). Due to the fact that the area is a high-density development, it does not have a private garden for every dwelling unit. For this reason, shared spaces such as green spaces, children's playgrounds, common gardens and mixed-use roads are available. An artificial channel divides the field into two parts. The area to the north is a nine-story residential area, and the area to the south is more garden-focused, such as green areas, children's play areas (Figure 3.18) (Foletta, 2011b). In addition to these, this area includes several small shops and services, internet cafes, restaurant, a TV studio (Scheurer, 2001).

Figure 3.18. GWL Terrein, Amsterdam – The Netherlands
(Source: https://www.rainproof.nl/het-gwl-terrein)

In GWL Terrein, public transport use is common. The tramway is separated from car line. In this way, speed of the tram is increased. In addition, two bus lines and smart card system for public transport are developed. Throughout the site, parking is limited for the development. According to this system, none of the site dwellers will be able to park in front of the house. Park permits are available for each residence, and those on the waitlist can wait up to seven years for a permit. The carsharing system has been developed to reduce car ownership. In this area, there are five carsharing vehicles in the parking spaces (Foletta, 2011b).

GWL Terrein project includes many features for sustainable living. This project has important effects on human health, human behavior change, and quality of life. In addition, this project provides a car-free life. Since the location of the city center supports public transport, bicycle, and pedestrian access, a low carbon life is provided in this region.

3.4.4. Vauban – Freiburg, Germany

Freiburg is a settlement located in the south-west of Germany, which for many years has come to the forefront with environmental practices and policies. The Vauban is an urban renewal area in Freiburg. There are 5.000 inhabitants (PRP, URBED and Design for Homes, 2008). Vauban is one of the “model sustainable districts” that includes 2.000 low carbon energy homes (Figure 3.19) (Field, 2011b).

Figure 3.19. Vauban, Freigburg – Germany
(Source: Google Earth)

In 1992, a competition for a mixed-use eco-suburban town in the city of Freiburg was held. Rieselfeld won the competition with 3-5-story energy efficient buildings, streets without traffic jams, and a new tram line, which opened in 1997. Later, a new arrangement was introduced in Vauban, a 41-hectare area emptied by the French army in 1992. But what is important in the design of this place is to create safer streets without traffic, without vehicles (Field, 2011b).

The Vauban study was completed in 2006. The project has an attractive, child-friendly design with architectural features. Throughout the project area, carbon dioxide emissions are reduced, especially by solar energy use and other technological improvements (Figure 3.20). Major changes are made in the transport behaviors of the residents. About 50% of household have given up being car owners (PRP, URBED and Design for Homes, 2008). In the neighborhood, a parking-free and car-free life is supported. The neighborhood is entirely designed as a 'district of short distances'. Most places are within walking distance (Architecture and Design Scotland, 2011).

Figure 3.20. Low Carbon Life in Vauban, Freiburg
(Source: https://commons.wikimedia.org)

Vauban's street character is U-shaped. Private vehicle traffic is allowed but parking is not permitted on these streets. In the northern part of Vauban, there is a boulevard only for pedestrians and bicycles, with a network of non-motorized vehicles in the northern side of the development. The roads serve mostly children and recreational activities instead of cars (Field, 2011b). Among the residential blocks, there are green

spaces that allow recreational activities. In the southern part of the area, there are walking trails and recreational areas for families who need to travel. Supermarket, offices, health center, cafes and restaurants, organic market, school, pharmacy are located in the center of the area (Field, 2011b). Vauban's tram system connects the city center and the train station to the region. Energy saving braking systems are used on the tramway. The area is designed to provide safe and enjoyable accessibility. There is absolutely one bicycle parking space in every house and it is possible to access it by the ramp. By bicycle, the city center and train station are reachable in 12 minutes (Figure 3.21) (Field, 2011b).

Figure 3.21. Energy Saving Houses and Sustainable Transportation in Vauban
(Source: http://guidewithme.com/apk/Germany/content/data/12072.html)

Methods for Low Carbon Living in Vauban

- Using CHP (combined heat and power) and solar system, to increase energy efficiency by 40% - 80%.
- Separating the wastes into four separate boxes.
- Rainwater is collected for use in homes. Using permeable surfaces that infiltrate water instead of impervious surfaces. Using mature trees to ensure biodiversity and microclimatic weather in the neighborhood.
- Using climbing plant to create a natural environment in the neighborhood.
- To limit the height of the buildings to 12.5 meters in order to get cool air from the mountains in summer (PRP, URBED and Design for Homes, 2008).

3.4.5. Bo01 Vastra Hamnen - Malmö. Sweden

Malmö is located in the center of the Oresund region. It is the third largest city in Sweden with a population of 280.000 (Figure 3.22) (Nilsson and Andersson, 2007).

Figure 3.22. Bo01 (Vastra Hamnen / Western Harbour) - Malmö, Sweden
(Source: Google Earth)

Malmö, formerly a heavy industrial city, is known as a city of knowledge in recent years (Nilsson and Andersson, 2007). In 2000, access to Copenhagen, Denmark and to the rest of Europe was improved considerably with the Oresund Bridge (Austin, 2013). Historically, Malmö is known as a city of parks. Due to its proximity to the sea, there are many public beaches (O'Byrne, 2006).

Malmö has improved a strategy for sustainable development across general documents such as the Local Agenda 21 Plan and Environmental Strategies. In 1997, LA 21 plan identified the environmental situation in the city and explained its vision of sustainable development. In 1998, the prepared Environment Program set targets for reducing the effects of climate change and resource use in both buildings and daily life

(Fossum and Nilsson, 2002). In the same year, Malmö University was opened and three years later the Bo01 home exhibition was held (Sustainable City Development, 2012).

Bo01 is a permanent neighborhood near the historic area of the city. The theme of Bo01 is Tomorrow's city with a sustainable knowledge and prosperity society. This district is a driving force in the development of Malmö towards environmental sustainability. 14 objectives were developed by Swedish Parliament. These objectives include clean air, high quality groundwater, sustainable lakes and watercourse, flourishing wetlands, a varied agricultural landscape, a magnificent mountain landscape, a non – toxic environment, balanced marine environment, sustainable coastal areas and archipelagos, no eutrophication, natural acidification only, sustainable forest, a good urban environment, a safe radiation environment, a protective ozone layer (W/E Consultants Sustainable Building, 2001).

Design Approach

In the scope of the study, a grid system was established for vehicles and non-motorized vehicles. While the buildings around the master plan constitute the main texture, the buildings in the inner parts of Bo01 are mostly on human scale. This form of buildings provide a microclimatic atmosphere in the surroundings. For this study, twenty-six architectural firms and twenty development companies worked to create the diversity of the neighborhood (Austin, 2013). All buildings were designed according to the determined quality program. Low energy use and sustainable energy were supported for buildings. The sustainability of people has been combined with ecological sustainability in the shape of good architecture, beauty, social interaction and functionality (Figure 3.23) (Fossum and Nilsson, 2002).

The energy requirement in the region is only provided by the energy coming from renewable energy sources. The energy production in the region is based on wind, solar, water and biogas energy. Electricity is produced from energy generated by wind energy and photovoltaic. A great majority of the heat is provided through heat pumps from the sea water and the aquifers (Fossum and Nilsson, 2002).

Thanks to conscious planning, nature is presented throughout the city. Rich and varied plant texture along streets and in parks, has a positive effect on the health of visitors and residents. The impervious surfaces of the city are balanced by green roofs and green walls. Rainwater does not interfere with sewage in this area. It reaches the water channels

directly and indirectly and then it is transmitted to the lake, the fountains and the channels. The waters are biologically cleaned (Sustainable City Development, 2012).

Figure 3.23. City of Malmö, Bo01 Area
(Source: https://urbanecologycmu.wordpress.com/2015/11/02/western-harbor-malmo-sweden-district-combined-heat-and-power-system/)

The use of non-motorized vehicles is widespread because everything is within bicycle and walking distance in Malmö. There are 8.185 meters of new cycle paths in Bo01 area (Sustainable City Development, 2012). In Malmö, 30% of all trips are made by bicycle and 40% of trips to school or work are by bicycle (Austin, 2013).

3.4.6. Hammarby Sjöstad, Sweden

Hammarby Sjöstad is a district of Stockholm, which is developed as a sustainable neighborhood, near the city center. Initially, in 1996, it began to be designed for the redevelopment of the industrial waterfront. It was later designed as an Olympic Village for the 2004 Summer Olympics. It is now a sustainable waterfront residential neighborhood (Figure 3.24) (Gaffney, Huang, Maravilla, Soubotin, 2007).

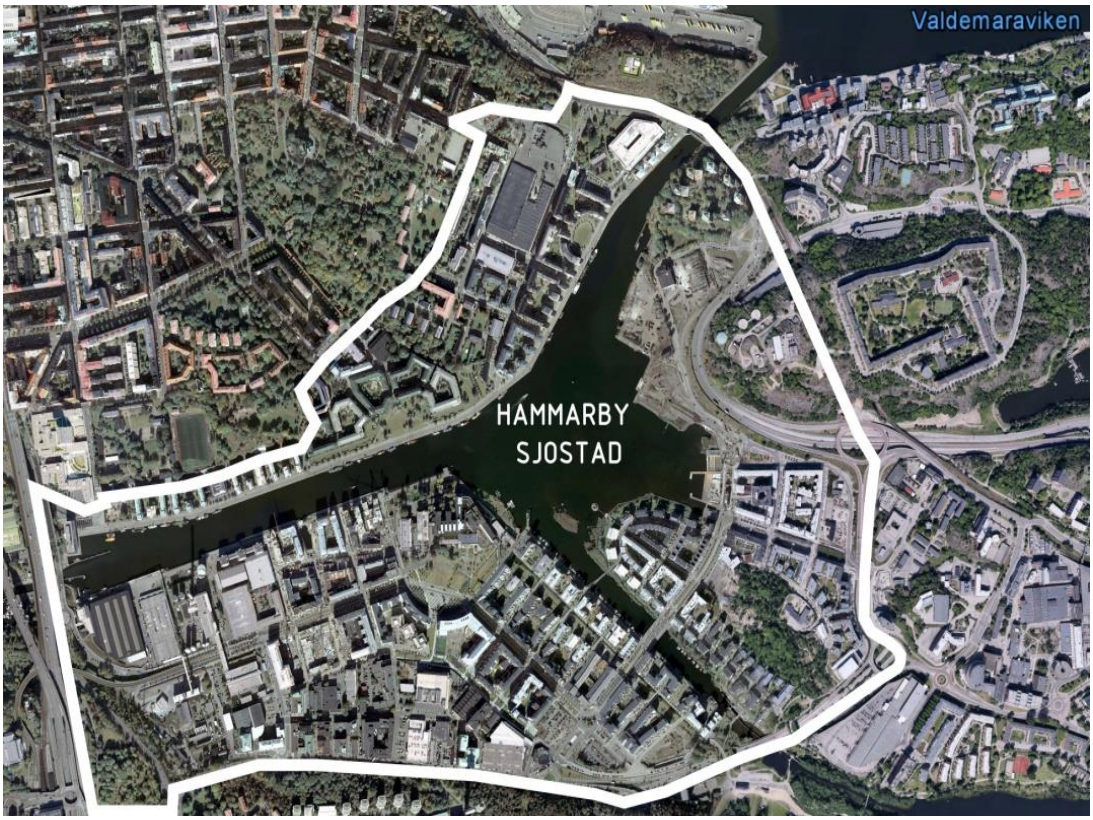

Figure 3.24. Hammarby Sjöstad in Stockholm, Sweden
(Source: Google Earth)

Design Approaches

The Hammarby Sjöstad project is known around the world for its combination of sustainable resource use, low carbon transportation, and various ecological designs. It is built on an area of 160 hectares (Figure. 3.25). Hammarby Sjöstad's success is based on strong environmental goals such as land use, transportation, material use, energy and water efficiency, waste assessment.

The first phase of the plan is the development of the master plan. The plan is divided into 12 neighborhoods to be improved. Later, the design and planning team created urban code for each sub-neighborhood, including landmark buildings, public spaces, and walkways (Figure 3.25).

The key component of the project is land use planning and sustainable transportation. Transportation investments include bus services, cycle paths, pedestrian bridges, ferry services and extension of the tram line (Figure 3.26) (Foletta, 2011c).

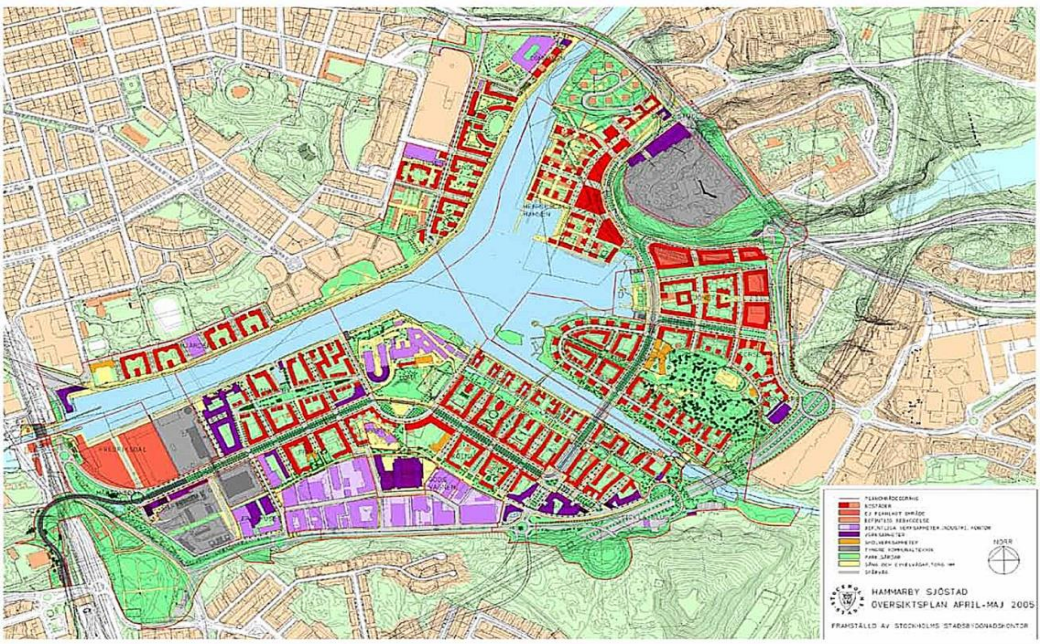

Figure 3.25. Hammarby Sjöstad Site Plan
(Source: Foletta, 2011c)

The design theme of the Hammarby Model conceptually depends on the UN's Agenda 21 human settlement Objective 7.5. This goal provides a framework for supporting sustainable developments that are socially and environmentally sustainable. The goals of the program include human settlement management, sustainable land use planning and management, the integrated provision of environmental infrastructure: water, drainage, and solid – waste management, and sanitation, transportation and sustainable energy for human settlement, human resource development and sustainable construction industry activities and capacity-building for human settlement development (Gaffney et al, 2007).

Figure 3.26. Bikeways and the Tram Line
(Source: Foletta, 2011c)

In addition to these, in the scope of the project, Hammarby model, which consist of an ecological cycle, was developed. The eco cycle deals with energy, water, waste, sewage for residential, office and commercial units (Jernberg, Hedenskog, Huang, 2015).

One of the biggest goals of the project is to provide a healthy life for people. For this reason, bicycle paths, walking paths, footbridges were built and bicycle sharing programs were developed and public bicycles were provided for all residents. With the Car sharing program, 37 low carbon cars were provided. Outdoor activities such as parking areas, green spaces, plazas, walking paths were provided throughout the project. The building blocks of Hammarby Sjöstad were arranged around the inner courtyard. The average building heights are 18 meters or 6 stories. Generally, green technologies are used in the buildings (Foletta, 2011c).

Finally, In 2010, the Hammarby Sjöstad project won European Green Capital City competition. Together with the project, carbon emissions have reduced by 25% since 1990. This study shows that the link between land use plan and transportation is very important for low carbon life. In addition to these, information and incentive meetings have been organized to influence the behavior of residents in the long term. High-quality transportation has an important role in the behavior of residents and in the formation of low carbon neighborhoods (Foletta, 2011c).

3.5. General Evaluation of the Case Studies

Six studies were examined on the low carbon neighborhood principles: 1) Greenwich Milennium Village (London), 2) Hammarby Sjöstad (Sweden), 3) Bo01 Vasta Hamnen (Sweden), 4) Stellwerk 60 (Germany), 5) GWL Terrein (Amsterdam) 6) Vauban (Germany). In all of these case studies, it is seen that the site places that had previously been altered or damaged by human interventions were (re)shaped by low carbon principles and their resultant design tools.

In the majority of the studies, first of all, the relationship between land use and transportation is planned in order to support low carbon life. Because a large majority of carbon emissions comes from the transportation sector, it is the right planning decision to lead the residents of the neighborhood/residents of the city to non-motorized transportation through cycling and walking. In this regard, firstly, studies were carried out on changing people's mode of transportation behavior. Applications such as street narrowing, traffic calming, parking restrictions (as in GWL Terrein), supporting bicycle

use, building additional bicycles and walking paths, designing bicycle parking spaces are some of the studies that support the use of non-motorized vehicles and change people's transportation behavior. Spaces are designed close to together to support walking and cycling. Common gardens and roof gardens within land use are planned both to create a microclimatic atmosphere in the neighborhood and to minimize the negative effects of storm waters and to increase biodiversity. In particular, plant species in these gardens are chosen to feed underground waters and to easily drain the water.

In the city and neighborhood, water management is a very important issue. Especially the case studies show that rainwater can be used in our daily life through various technologies. Some of these technologies are green infrastructure systems such as green walls, roof gardens, water tanks, sewage systems, permeable surfaces. It is important to use renewable energy sources such as wind, solar, and water throughout the project. In this regard, many of the factors that ascend carbon emissions disappear. The adaptation of the low carbon principles in the overall studies is examined in Table 3.2.

Table 3.1. Low Carbon Living Principles of Case Studies

	LOW CARBON LIVING PRINCIPLES				
	Green Technology	Flooding Extreme Weather & Water Conservation	Green Infrastructure & Biodiversity	Land Use Planning	Low Carbon Transportation
Case Study 1	- High level of thermal insulation - Efficient appliances and windows - Controlled lighting of common areas, day lighting of interiors	- Low flush toilets - Low flow taps	-Ecology Park -Artificial Lake -Green Spaces	-Mixed Use -Brownfield Redevelopment -Ecology Park -Artificial Lake -Green Spaces -Planted Area around the river -Parking Spaces	-Bicycle and Pedestrian routes -Public Transportation -Parking Spaces

(cont. on next page)

Table 3.2. (Cont.)

	LOW CARBON LIVING PRINCIPLES				
	Green Technology	Flooding Extreme Weather & Water Conservation	Green Infrastructure & Biodiversity	Land Use Planning	Low Carbon Transportation
Case Study 2	- Eco – Friendly technologies +Solar cells +hydropower technologies +Bio Fuel technology +Solar Panels -Eco friendly cars	-Sewage systems -Drain systems	- Waste management -Renewable raw materials -Sewage systems -The wastewater treatment plant -Roof gardens	- Parking areas - Green spaces - Cycle paths -Walkways -Hammarby Sjöstad includes 100 retail units, restaurant, office, light industrial uses	-Walkways - Bus services - Cycle paths - Pedestrian bridges - Ferry services - Tram line -Parking areas -37 low carbon cars
Case Study 3	-Energy production from wind, solar, water and biogas -Electricity production from wind energy and photovoltaic -Wind Turbine	-Sewage systems -Wetlands -Heat Pumps from the sea	-Sustainable lakes and water course -Wetlands -Green Roof and wall -Rich and varied plant texture along streets and in parks, in squares	-Green spaces -Wetland -Agricultural landscape spaces -Mixed use -Parks	-The use of non-motorized vehicles -Cycle and walking paths
Case Study 4	-Non – motorized transport		-Small Gardens	-Parks -New parking spaces -Children playing games -Small garden -Public transport station -Street narrowing -Car sharing spaces -Parking garage	-Non – motorized transport -Cycle and pedestrian paths - Public transport station -Street narrowing -Traffic calming -Car sharing spaces

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Table 3.2. (Cont.)

Case Study 5	-Double glazed windows -CHP unit and heat exchanger	-Use of rainwater for toilet	-Landscape Rooftops -Use of rainwater for toilet	-Green public spaces -Common gardens -Mixed use roads -Private gardens	-Cycle and pedestrian paths -Tramway line -Smart cards for public transportation and bicycle -Carsharing vehicles -Car – free concept
Case Study 6	- Energy efficient buildings - Energy saving braking systems -CHP (combined heat and power) and solar systems - Permeable surfaces	- Permeable surfaces -Rainwater management -Drainage channels - Mature trees for biodiversity	-Using Climbing plant to create a natural environment -CHP (combined heat and power) and solar system -Common gardens	-Green spaces -Mixed use -Common gardens - Bicycle parking space	-New tram line -Parking free -Walking trails - Bicycle parking space -Green energy for tram system -Carsharing vehicles

CHAPTER 4

İzmir City Diagnoses

İzmir province was investigated with low carbon principles that were mentioned in the previous section. In this sense, what kind of studies are being carried out in İzmir and what are the goals for creation of low carbon lifestyle will be explained. In this section, an answer will be sought as to how İzmir will adapt to this lifestyle. First of all, location, topography, the population of İzmir will be explained.

4.1. Overall City Description

İzmir is the third populous city in Turkey, after Ankara and İstanbul. İzmir province is located in the middle of the Aegean coasts and west of the Anatolia Peninsula. It is surrounded by Balıkesir from the north, Manisa from the east, and Aydın from the south. Total surface area of İzmir is 12.007 km^2. The length of İzmir from north to south is about 200 km; the length of it from east to west is about 180 km (Türkiye Istatistik Kurumu, 2013).

According to TUIK data, it has about 4.2 million inhabitants. İzmir occupies 41% of the Aegean region and 5.3% of the population of Turkey. It has 30 sub-provinces and it has 30 municipalities except for metropolitan municipality (Türkiye Istatistik Kurumu, 2013). Karabağlar, Buca, Bornova, Konak, Karşıyaka, and Bayraklı are the biggest towns in terms of the number of inhabitants. Karaburun is the smallest town in terms of the number of inhabitants. Balcova is the smallest town in terms of area and Bergama is the largest town in terms of area (Figure 4.1).

İzmir is under the influence of Mediterranean climate. Winters are mild and rainy and summer is hot and dry. There is all kind of Mediterranean plants (Türkiye Istatistik Kurumu, 2013). Because of the complex geological structure of the Aegean region and the gradient of the valley systems extending in the east–west direction of the mountains, the formation of different parts of İzmir province are different from each other.

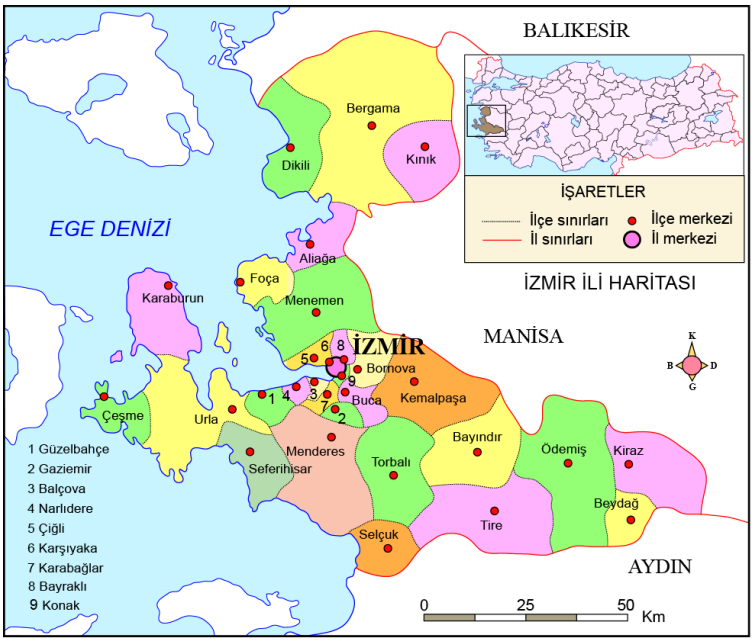


Figure 4.1. İzmir Districts Map
(Source: http://cografyaharita.com/turkiye_mulki_idare_haritalari3.html)

Three of the water basins in Turkey are located in the province of İzmir. These are Bakırçay basin in the north of İzmir, Gediz basin in the west, Küçük Menderes basin in the south. Because of fires, forests disappeared and generally in these areas, marquis flora is expanded. 60% of İzmir province is covered by fertile agricultural areas, hills, mountainous areas. 59.9% of land use is agricultural areas, 30.5% is forest and wood areas, 0.6% is pastures, 0.4% is water body and 8.6 % is settlement areas.

İzmir is a rapidly growing city that has received migration from rural to urban since 1950s. Apart from its rapid growth, it has been exposed to air pollution, heat island effect and loss of natural areas, extremely hot seasons, flooding. In addition, the urban periphery expanded and the sharp border between urban and rural began to rise. New urban areas along roadways and coastline were built. The land structure showed a change from 1963 to 2005. In the agricultural areas, the rate of the built area increased from 8.2% to 28.2%. Agricultural land decreased from 13.65 to 5.19%. Because of the dense structuring in İzmir, heat island effect also increased. The urban green area changed from 1995 to 2014. Natural green areas changed and decreased down to 11.07%. According to Turkish State Meteorological Service, the average annual temperature of İzmir between 1938 and 2016 is determined as 17.9^{o}C. In consequence of climate change, annual cooling loads are bigger than annual heating loads.

İzmir draws a poor picture in terms of increase in carbon emissions. Carbon emission rate per capita is 5.31 tons in İzmir. The polluted emission rates measured in İzmir/Bornova region are as follows; 41.66 µ / m3 PM10, 10.75 µ / m3 SO2 and 753. 91 µ / m3 CO. In order to reduce carbon emissions, the presence of large green areas throughout the city is important. Another dangerous situation in İzmir is the risk of heat wave. Due to rapid urbanization and global warming, the heat wave has increased.

In the whole city of İzmir, energy consumption is also remaining with the increase of construction. According to İzmir Metropolitan Municipality sustainable energy action plan 2016 data, energy consumption is 40% in the buildings and 41% in the industry. In this case, the greenhouse effect is triggered. According to İzmir Metropolitan Municipality sustainable energy action plan 2016 data, there are greenhouse gas emissions in the industry 44%, in the buildings 12%, in the commercial 8%, in the transportation sector %19 and in the other sectors 36%. According to 2015-2019 Strategic Plan prepared by İzmir Metropolitan Municipality, the Republic of Turkey 10th Development Plan, KENTGES, and İzmir Regional Plan activity areas which are determined in compliance with. These areas of activity are Environmental Management; Friendly City İzmir, Transportation; eco-friendly, uninterrupted and easy access to quality transportation. According to the İzmir Sustainable Energy Plan, 20% reduction of urban emissions by 2020 is targeted. In particular, it is aimed to take measures in two main sectors, namely urban infrastructure and transport. According to the "Energy Efficiency Strategy Paper 2010-2023" study, it is aimed to decrease 15% in industry and service sector, 15 – 30% in building stock and 3 – 4% emission reduction in household appliances and vehicles (İzmir Büyükşehir Belediyesi Çevre Koruma ve Kontrol Dairesi Başkanlığı, 2016).

Due to the increase in con-structuring and various economic activities, water resources have become increasingly polluted and flood risk has increased throughout the city. For example; The Gediz River, the second largest river in the Aegean region, is polluted by various chemical wastes and industrial activities.

İzmir Province is a unique city with the fertile agricultural area and water resources. However, like many cities of Turkey, also in this city, due to the rapid increase of population and various economic activities, the natural structure has started to gradually deteriorate. As the number of cars per household increases, problems caused by transportation begin to occur. All around the world, the phenomenon of climate change, which has become a major problem, has begun to affect the city as a whole.

4.2. Evaluation of Low Carbon Living Principles in İzmir Scale

In chapter 3, low carbon principles, which are low carbon transportation, green technology (renewable energy and energy efficiency), flooding / extreme weather & water conservation, green infrastructure & biodiversity, land use planning (Figure 4.2), are depicted. In this chapter, these principles will be explained on İzmir. In this sense, studies that are prepared and are suggested in İzmir will be discussed.

Figure 4.2. Low Carbon Living Principles at İzmir Scale

<u>Green Infrastructure Systems for İzmir</u>

The scope of the green infrastructure system prepared in İzmir City scale includes protection of the environmental resources inner city, control of urban growth, preparation

of planning, design and management subject on urban renewal. The most important reasons of the İzmir Green Infrastructure Strategies involve;

1) Blue–Green infrastructure solutions integrate into gray infrastructure
2) Blue–green network system is established within the urban – region continuum.
3) In the scope of nature base solutions, green infrastructural promotion application projects will be prepared (İzmir Büyük Şehir Belediyesi, 2018a).

The aim of the green infrastructure systems prepared throughout İzmir is to bring together the green system surrounding İzmir and nature based solutions. These solutions are examined under the five main topics; 1) Planning and governance 2) Water Areas 3) Green Areas 4) Corridor and connections 5) Structures, inactive and repaired areas (İzmir Büyük Şehir Belediyesi, 2018a).

Planning and Governance

One of the most important components that provide creation of green infrastructure system is the concept of planning and governance. Under this heading, data collection, analysis, planning and implementation phases are included. In this process, natural, physical, social and economic data is obtained. Then, thematic maps are created with the generated information. Later on, together with these decisions, planning decisions are taken. Finally, the problem solving elements related to the central green belt is discussed (İzmir Büyük Şehir Belediyesi, 2018a).

Water Areas

Because the city of İzmir is connected to underground and overground resources, it constitutes the general scope of the green infrastructure strategy. The water system, green system, and urban infrastructure are approached integrally and ecologic solutions are produced (İzmir Büyük Şehir Belediyesi, 2018a).

Green Areas

The main aim is to create green network starting from green areas, such as picnic areas, open public gardens, neighborhood and urban parks, and spreading all over the city. The main goal of this issue is green areas are created as a whole network (İzmir Büyük Şehir Belediyesi, 2018a).

Corridors and Connections

Within the scope of this theme, a combination of surface green, linear green, and point green will be provided throughout the city with corridors and connections. It is very important in this sense to consider the green texture as a whole (İzmir Büyük Şehir Belediyesi, 2018a).

Structures, inactive and repaired areas

It is important to evaluate, repair, revitalize and re-use inactive areas such as open mines, industrial areas, and residential areas in and out of the city (İzmir Büyük Şehir Belediyesi, 2018a).

Nature Based Solutions in İzmir

Within the scope of the Urban GreenUp Project, studies supporting low carbon living are being carried out in İzmir. The first of these studies is the integration of the water system with the green system and the urban infrastructure. In this study, problems caused by water are discussed over the basin and regional scale. For example; the decisions of protection of water have been received such as, the restoration of hydro morphology of waterbed, the protection of rainwater and over groundwater is related to the underground water systems, ecological, engineering solutions to problems such as sea level rise and wave effect, the suggestion of recreational use in waterfront, the water system in places such as Homeros Valley in Halkapınar and Pinarbaşı should be discussed as a whole with the groundwater system (İzmir Büyükşehir Belediyesi/İzmir Doğa, 2018).

The second study is corridor and connection relations. The important decision is the handling of the green texture as a whole. When connection regions are established, greenway and corridor, biodiversity, bird migration routes issues are emphasized. Within the scope of this subject, public transportation and bicycle use are discussed. It is envisaged that structures which damage wildlife such as highways will be taken underground and eco-bridges will be established instead of these structures. In addition to these, new corridors will be created with design and planning studies in sea, river, and stream. The circulation of wind will be provided in the city. Supporting green corridors through the use of existing refuges and viaducts, linking urban green areas to each other with a "green corridor" to increase biodiversity, using local plants at roadside plants and building different plant areas, and conservation of monumental trees are evaluated in this section (İzmir Büyükşehir Belediyesi/İzmir Doğa, 2018).

In addition to these, it is aimed that, the creation of the green network in the whole city by using all of the green areas. In parks, it is suggested to use natural and local plants to improve the ecosystem. Urban design guidelines for thematic areas, such as campus, urban parks and botanical gardens, will be created. It is proposed to develop green space strategies to adapt to climate change. Urban agriculture areas have been proposed in the scope of study such as İnciraltı and Sasalı (İzmir Büyükşehir Belediyesi/İzmir Doğa, 2018).

Transportation is one of the sectors that cause the increase in greenhouse gas emissions. In this sense, in whole İzmir Province, the variety of studies has been done. İzmir Metropolitan Municipality organized various workshops on the subject. Within in the context of these workshops, important decisions and suggestions were taken. For example; public transportation uses were proposed instead of using private cars in all of the city. It is proposed to increase the integration between public transportation systems. Besides, the increase in walking and cycling uses were suggested. The best way to support low carbon transportation is to support pedestrian and bicycle use in the city. In this sense, it is aimed to increase the continuity of pedestrian roads and pavements in the city. Pedestrianization projects have been proposed where there is pedestrian flow. Deciding to use bicycles for transport in the city is an important step. Bicycle-transit integration, bicycle-focused business designs are equally important suggestions. Sea transportation has an important place in the province of İzmir, and it is recommended to be supported and developed (İzmir Büyükşehir Belediyesi Ulaşım Daire Başkanlığı/Ulaşım Planlama Şube Müdürlüğü, 2017).

Based on the prepared studies and decisions taken, İzmir Province is taking the considerable step to adopt low carbon lifestyle. Within the scope of Urban GreenUp, started in 2017 within the frame of EU Horizon 2020 Project, “Biodiversity” has been given an important place. İzmir is a wealthy city in point of water resources, for this reason, evaluating of natural values, such as underground/overground waters, micro and macro basins, river, stream, lake, and these values bring in the natural structure is a very significant step. In addition to this, urban design approaches are developed for flooding risk caused by water surfaces. Transportation issue is very important for low carbon living. Because, as mentioned before, transportation is the second sector in cities that causes increased carbon emission. In this sense, decisions taken from urban to neighborhood scale are very important. In the scope of the study, city dwellers are tried to be directed to carbonless transportation vehicles. Continuous bicycle route advice and walking-cycling-public transport coordination help reduce the carbon rate.

In addition to these planning and design approaches, bicycle activities are organized to decrease carbon rate in the city. The first activity is the “Fancy Women's Bicycle Tour” which started in 2013 under the “Carfree Day” organization. This organization started to spread to the whole country in short time. Last September, in 50 cities, it was organized simultaneously. Another event is “Critical Mass”. This organization is planned on the last Friday of each month with the slogan” Trafik Biziz”.

Other low carbon-based - bicycle activities are organized by non – governmental organizations. In addition to these, some bicycle groups such as “Çarşamba akşamı bisiklet grubu”, “Perşembe akşamı bisiklet grubu”, “Cuma akşamı bisiklet grubu”, “Bike İzmir”, “Pedal 35”, “Pedalperest Kadınlar”, come together to cycle in traffic on certain days of the week. The main slogan of these activities is “Get out of Your Car, Ride Your Bike” and these groups want to create awareness of the healthy environment.

4.3. Case Studies in İzmir

Projects carried out by the İzmir Metropolitan Municipality are studies that have the potential to create low carbon neighborhoods throughout the city. These studies, prepared in different scales and different concepts in various regions of İzmir, adapt the concept of walking and cycling in the daily life of urban people. In this section, studies carried out in İzmir are examined.

<u>İzmir People Park</u>

İzmir People Park (Halk Park) is designed by the İzmir Metropolitan Municipality, on the edge of Peynircioğlu Stream in Mavişehir region and on the area of 88 thousand square meters. The construction of the park was completed in 2018. The area where the park is located is a land that was not used before, and it has gained a function with the prepared design (Figure 4.3) (İzmir Büyükşehir Belediyesi, 2017).

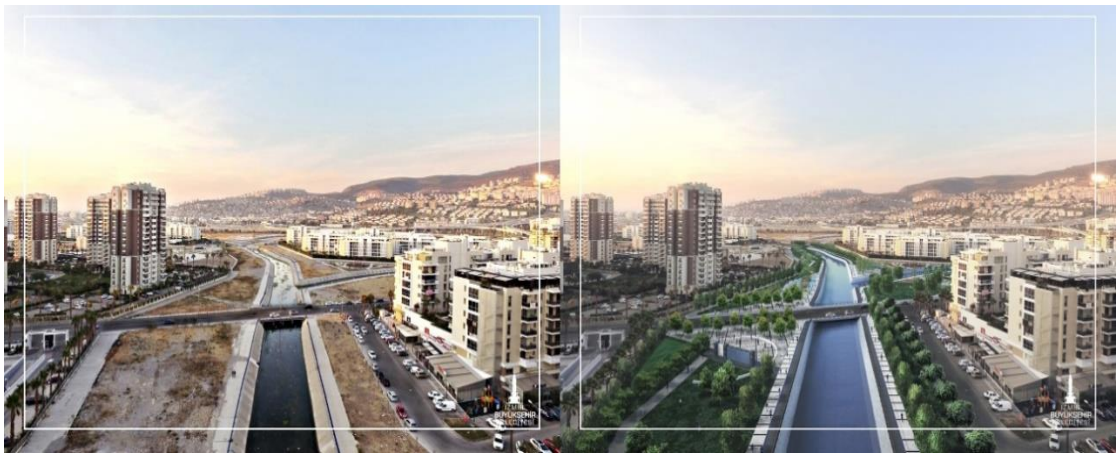


Figure 4.3. Before and After Use of Area
(Source: http://www.izmir.bel.tr/tr/Haberler/izmirin-hyde-parki-olacak/22320/156)

A special part of the park that has live wall invites people to reflect on their lives and share their personal aspirations is resembled as the Hyde Park of İzmir. The park forms a microclimatic environment between the high-rise buildings, with vegetation and with the Peynircioğlu stream located in the region. Neighborhood dwellers can reach the park by uninterrupted cycling and walking. The area is also connected to sea transportation, bus lines, Alsancak-Menemen İzban line and Karşıyaka tramway (Figure 4.4). The connection of the pedestrian and bicycle route with other public transport vehicles is an ideal design for carbon-free transportation. Bicycle users in this area can use other mode of public transport to easily reach the area they want with their bicycle. Neighborhood dwellers, without using any transportation mode, can walk easily to places they want.

Figure 4.4. Karşıyaka-Mavişehir Bicycle, Bus, İzban-Metro and Tramway Routes (Source: Google Earth)

People Park is a frequent area for the people of the region due to its location. Thanks to this design, the area has become a place to live day and night. Dwellers living in the surrounding residences can spend time with their family or neighbors and they can perform various recreational activities here (Figure 4.5).

Other design elements in the park also support bicycle use. For example; sitting units under the shaded trees form resting points for bicycles. In addition, the lighting elements in appropriate locations create a safe environment for cycling at night.

Figure 4.5. İzmir People Park

İzmir Deniz Project

The project was prepared by İzmir Metropolitan Municipality in order to strengthen the relation of İzmir people with the sea. The project team included urban planners, architects, industrial designers, engineers, landscape architects and academicians (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

The main concern of the study is how to achieve sustainable urban development throughout İzmir. Within this scope, 4 strategic decisions were developed;

1) Being a local management having a say in the world economy,

2) To avoid destruction of İzmir with false projects and to try to improve the quality of life of İzmir people,

3) To ensure that the city's economic development, in order to both fulfill universal responsibility and to ensure the realization of urban rights, fulfills the ecological sustainability condition,

4) To ensure participation of urban dwellers in project development and decision-making processes related to the city. In this way, dignified life right of people is respected (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

These four strategies ensure the development of various sub-strategies. Each item draws attention to being a livable city.

Within the boundaries of İzmir Metropolitan Municipality, projects were prepared in 11 different coastal regions from Mavişehir to Yenikale. These 11 coastal regions are;

1) Mavişehir-Bostanlı Pier,
2) Bostanlı Pier-Karşıyaka Pier,
3) Karşıyaka Pier-Alaybey Shipyard,
4) Alaybey Shipyard - Turan Crossover Road,
5) Turan Crossover Road - Alsancak Port,
6) Alsancak Port-Cumhuriyet Square,
7) Cumhuriyet Square-Konak Pier,
8) Konak Pier-Konak Crossover Road,
9) Konak Crossover Road-Mithatpaşa Industrial Vocational High School,
10) Mithatpaşa Industrial Vocational High School - Üçkuyular Pier,
11) Üçkuyular Pier-Yenikale.

In addition to these, the design of the Gulf as a demonstration space and the urban design projects on the slopes were prepared. On the way all these, four major design regions were identified in the Gulf. 1) Mavişehir-Alaybey Shipyard; 2) Turan-Alsancak Port; 3) Alsancak Port-Konak Crossover Road; 4) Konak Crossover Road-İnciraltı Urban Forest (Figure 4.6) (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

Figure 4.6. Design Regions
(Source: Reproduce from İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

In order to spread the use of bicycles in the city, 4 bicycle tracks are designed with a length of 43 kilometers. The first of these tracks is a 9 km long road from Alsancak Port to Üçkuyular Pier; 2. Tarck is a 7 km bike path extending from Bayraklı Turgut Özal recreation area to Soğukkuyu; 3. Track is a 25 km long cycling route from Bostanlı recreation area to Çiğli Urban Forest, Sasalı Natural Life Park and İzmir Bird Paradise. The fourth route is the two-kilometer-long road between Gaziemir and Sarnıç. Bicycle rental points, which are called Bisim stations in İzmir, were also created on these routes. Thus, important steps were taken to promote bicycle transportation throughout the city (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

In this study, some studies that are completed or under construction will be investigated. In these studies, neighborhood and bicycle-pedestrian connections will be examined in particular.

Bostanlı Footbridge and Sunset Terrace

This area is within the scope of the İzmir project, it is located on Mavişehir-Alaybey coastline, which is called the 1st Region (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).The location is at the intersection of bicycle route, Alaybey-Ataşehir tramway, Bostanlı pier and bus stops. There are high-rise buildings around (Figure 4.7).

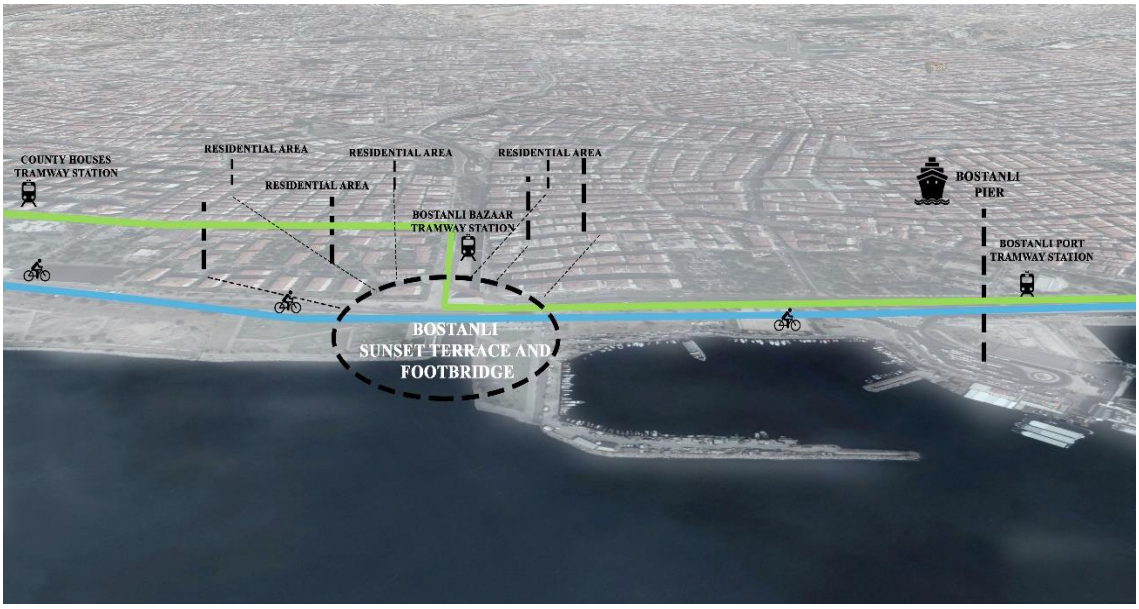


Figure 4.7. Relation of Bostanlı Sunset Terrace-Footbridge and Its Surroundings (Source: Google Earth)

This area can be easily transferred from residential areas. The "Bostanlı Pedestrian Bridge" has been proposed to bring the two parts of the stream together. With this design, the uninterrupted walking axis on the edge of the coast is completed. Neighborhood dwellers that live in the district can rent bikes at the nearest “Bisim” station and can go cycling along the coast, or they can come by public transport from nearby regions and continue their bicycle transportation (Figure 4.8). These uses save city dwellers from car dependence.

Providing recreational activities to the people of the region, the study ensures that the area is a place to live day and night. The presence of the area in the coastal belt and the support of various plant materials have created a natural environment for the people in the city.

Figure 4.8. Bostanlı Footbridge and Sunset Terrace

Göztepe-Üçkuyular Coastline

This study extends from the Göztepe pier to the Üçkuyular pier. The project area consists of 1.5 kilometers long and 30.000 square meters coastal strip. As in other studies, public transport and bicycle routes are integrated Region (Figure 4.9) (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

Göztepe, Poligon, Güzelyalı, Küçükyalı Üçkuyular residents use bicycles on this route. They can go uninterrupted to Alsancak direction by bicycle or to Konak by Tramway.

With the newly designed urban furniture, sufficient lighting elements and the green texture, the city became more attractive for the city dwellers. Especially the sufficient number of lighting elements ensures that bicycle rides are safe (Figure 4.10).

This route is close to İnciraltı urban forest, which also makes the region an attraction. This area, with its various plant species and its lagoon, creates a natural habitat in the city. Besides, it is the best place for cycling and pedestrian use because it creates a microclimatic atmosphere inside the region. Bicycle users in other areas can easily access here by bus and tramway.

Figure 4.9. Göztepe-Üçkuyular Coastline
(Source: Google Earth)

Figure 4.10. Göztepe Coastline

Mithatpaşa Square and Underpass Project

Within the scope of the project of meeting the city dwellers with the coast, a square study is being done in the region where the Mithatpaşa Vocational High School, which is important from the historical point of view, is located. Mustafa Kemal Coastal Boulevard (6 kilometers long), which is made by the editing, is a region with high traffic flow and high speed (İzmir Büyük Şehir Belediyesi, 2018b).

The project study is carried out in two stages. At the first stage, the road underpass arrangement was made on Mustafa Kemal Coastline Boulevard. The 400-meter-long area acquired from the underpass is designed as a square (Figure 4.11) (Hürriyet Newspaper, 2015). With this design, neighborhood dwellers living in that region can pass uninterruptedly by bike or by foot to the coastline. Here, pedestrian, bicycle and tramway circulation are all provided. People living in this area can easily reach Konak-Alsancak direction or Üçkuyular-İnciraltı direction without needing an automobile. With this arrangement made on Mustafa Kemal Coastline Boulevard, noise pollution caused by traffic is aimed to be minimized.

Figure 4.11. Mithatpaşa Square and Underpass Project
(Source: Google Earth)

The first stage of the project includes an area of approximately 71,500 square meters and a coastline of 1200 meters. In the second phase of the study, "ferry pier" and "berthing places" are designed to strengthen sea transport (İzmir Büyük Şehir Belediyesi,

2018b). In this way, the bicycle-pedestrian-tramway-ferry relationship becomes stronger. In this case, it will contribute to the creation of low carbon living consciousness in the region. With the pedestrianization project, people living in this area will be able to reach the pedestrian and bicycle routes without interruption (Figure 4.12).

Figure 4.12. Mithatpaşa Square Construction

Bayraklı Deniz Project

Bayraklı region, which is located between the Turan-Alsancak port, is the 4th region in the coastal design project, it covers a coastline of 7, 98 km. The traffic density of this region, also called the new city center, is quite high. In this region, high-rise buildings began to take place (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012). According to other regions, in this area, the relationship between residential areas and coastal is limited. The reason is that, in other parts of the coast, shipyards, industrial establishments and ports are located (Figure 4.13).

In the overall project, appropriate points of footbridges are provided to increase the relationship with the coastal and residential areas. The capacity of the parking lot under the viaduct was increased and the bicycle route on the viaduct was designed. Bicycle parking lot designs were prepared, in addition, the console amount was increased to suit pedestrian and bicycle use. A bridge connecting the bicycle and pedestrian line was built on the Bornova Stream. Bisim and bicycle parking areas were designed as in other parts of the coast (Figure 4.14). In addition to all these, a tramway is planned

between Bornova and the Salhane Suburb station until 2020 (İzmirdeniz/İzmir Büyük Şehir Belediyesi, 2012).

Figure 4.13. Bayraklı Region
(Source: Google Earth)

As mentioned above, there is no uninterrupted bicycle-pedestrian-neighborhood transportation. However, according to the old design of the area, along with the coastal project, a certain potential is currently moving. Along with these, increasing the parking capacity is an important step in reducing the proportion of cars in the region.

Figure 4.14. Bayraklı Coastline Design
(Source: www.hurriyet.com.tr/bayraklida-kiyi-duzenlemesinde-acilis-zamani-40816194)

Urla-Çeşme-Karaburun Peninsula Project

Independent from other studies, the "Peninsula Project" covering the districts of Urla, Karaburun, Çeşme, Seferihisar and Güzelbahçe and aiming at the development of these sites has been prepared. The main outcome point of the study is the "asset-oriented approach". The project aims to assess the protection and potential of the natural and cultural assets of the peninsula. For this reason, studies on thematic issues such as agriculture, tourism, education and environment are being carried out. Within this scope, Eurovelo Mediterranean Bicycle Network, Mediterranean Model Forest Network and World Biosphere Reserve Network were prepared (İzmir Kalkınma Ajansı, 2014).

Within the framework of the Eurovelo Mediterranean Bicycle Network, bicycle routes were created throughout the peninsula (Figure 4.15). The routes created here are very important in terms of spreading the study area in general and providing an alternative transportation mode to the city people.

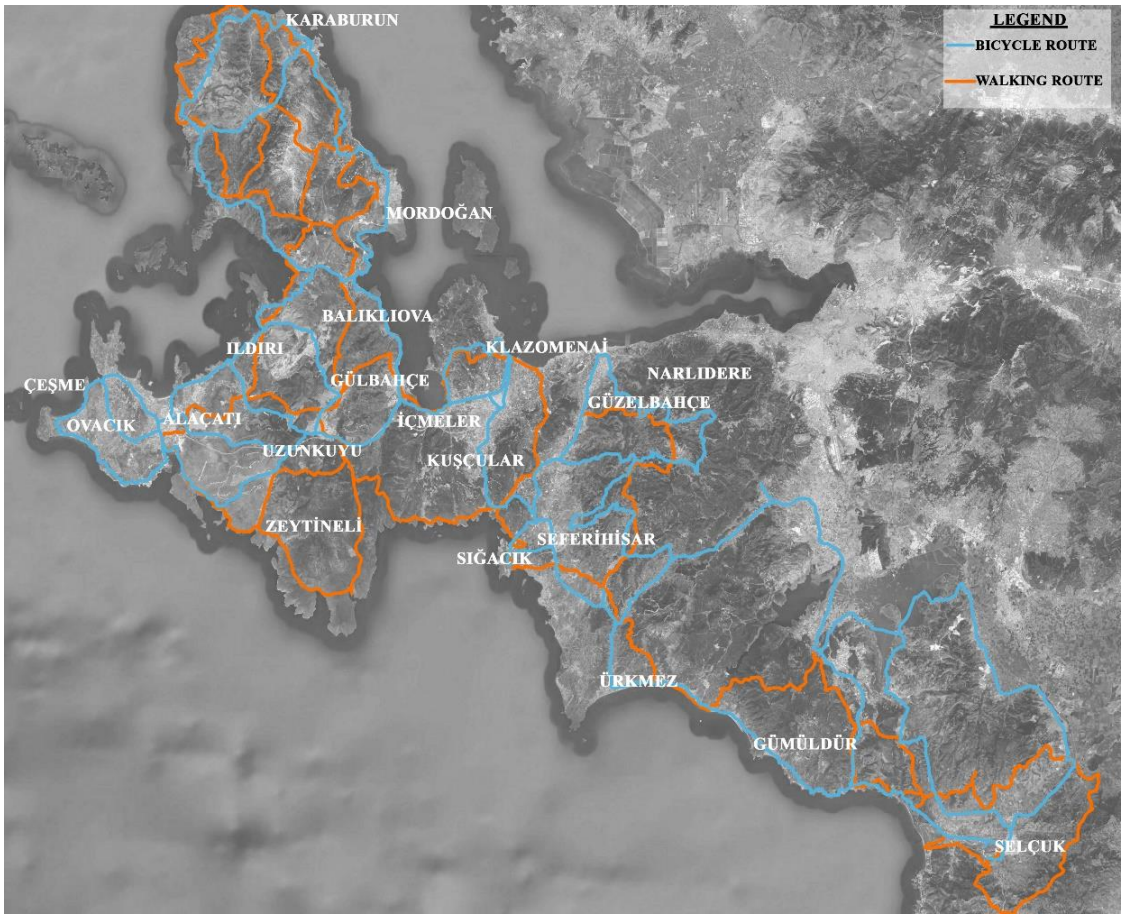


Figure 4.15. Cycling and Walking Routes along the Peninsula
(Source: Reproduce from http://rota.yarimadaizmir.com/tr/Rotalar/1/1)

4.3.1 General Evaluation of the Case Studies in İzmir

The projects support low carbon living by adapting walking and bicycle routes to the city. These studies are important solutions that enable city people to get rid of car dependence. Because, in these studies, bicycle-pedestrian-tramway-ferry and bus connections are well planned. Thanks to these connections, city dwellers can travel from their homes to their schools, works or any place they want to go by bicycle using less cars.

People Park is one of the most significant examples of study of neighborhood and transportation relationship. Neighborhood dwellers can use the bicycle routes in the park to pass through other areas via tramway or İzban, as well as they can provide transportation by using coastal routes. On the coastal route, bicycle rental places have been identified at various points. Thus, even if neighborhood dwellers do not have a bicycle they can provide transportation without using cars. Bicycle routes can be integrated with tramway, bus and metro routes.

Furthermore, in Bayraklı region, the increase in parking capacities is one of the most important design decisions that direct the city dwellers to public transportation. This study is an example of the "park and ride" system. Likewise, the design of bicycle rental points (bisim stations) in the coastal zone is a model of the "bicycle sharing system". These systems, along with the pedestrian bridges designed in Bostanlı and Bayraklı regions, are important designs that provide the disappearance of the disconnections that forms on the coastline.

In Göztepe-Üçkuyular study, while there are continuous cycling roads along the coast, the neighborhood dwellers sitting in the inner parts of the region cannot provide easy access to the coastline. The reason for this is that the bike route does not go to the inner regions and the public transport and bicycles do not work integratedly.

All these are important steps in the formation of a low carbon living. For the success of the projects, neighborhood and transportation emphasis is very important. If carbon-free transportation models are well integrated into the neighborhoods, low carbon living in the city becomes conscious.

Furthermore, Peninsula project provides unity with the routes prepared within the scope of the "İzmir Deniz Project" and supports the uninterrupted cycling destination throughout the city (Table 4.1).

Table 4.1. Low Carbon Design Tools of İzmir Case Studies

	Low Carbon Transportation Design Tools
Public Park	-Bicycle and pedestrian road -Tramway -Bus services -Metro-İzban line
Bostanlı Footbridge and Sunset Terrace	-Bicycle and pedestrian road -Footbridge -Tramway -Bus services -Bicycle sharing points (Bisim) -Cycling parking spaces
Göztepe-Üçkuyular Coastline	-Bicycle and pedestrian road -Footbridge -Tramway -Bus services -Bicycle sharing points (Bisim) -Cycling parking spaces
Mithatpaşa Square and Underpass Project	-Pedestrian square -Tramway -Bicycle and pedestrian road -Bicycle sharing points (Bisim)
Bayraklı Deniz Project	-Pedestrian square -Tramway -Bicycle and pedestrian road -Bicycle sharing points (Bisim)
Peninsula Project	-Bicycle and pedestrian road - Cycling parking spaces

CHAPTER 5

LOW CARBON NEIGHBORHOOD AWARENESS IN İZMİR

5.1. Survey Design

Within the scope of the study, “Low Carbon Transportation” is emphasized among 5 low carbon living principles. Because, as mentioned in previous chapters, the transport sector is the biggest factor for the increase in the carbon rate after the industry. In the case of İzmir scale, the residential sector is the leading sector that increases greenhouse gas emissions. The residential sector is followed by the transportation sector. For this reason, transportation is tackled in this study, and besides, cycling, which is one of the modes of transportation representing low carbon transportation, is selected as a sample in this study (Figure 5.1). Since it is not a concrete example for the “Low Carbon Neighborhood”, it starts by understanding its awareness of study. In this context, a survey was made with cyclists, who the closest groups to low carbon living. In this survey study, their level of awareness of low carbon living was evaluated. The questionnaire includes two parts including “Low Carbon Neighborhood Concept” and “Transportation”.

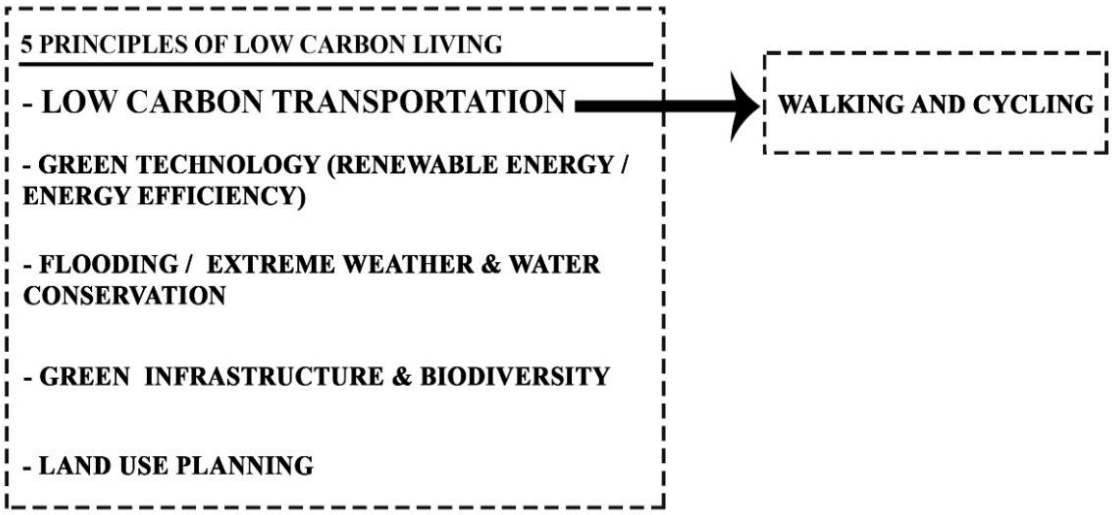


Figure 5.1. Sample of the Study

In the first section of the survey, there are questions involving five principles of low carbon living. This section contains thirteen questions except for demographic information. Questions usually consist of sorting questions. In the study, green infrastructure systems, recycled materials, precautions against flood risk, urban ecosystem and biodiversity, low carbon transportation systems, energy production opportunities, energy saving systems conceptually asked. In section two, the relationship between the modes of transportation preferred, the reasons for choosing bicycles, and the relationship between the use of bicycles with a low carbon lifestyle investigated through nine questions. As a result, there are questions that emphasize the relationship between the two sections.

For the questionnaires, “Low Carbon Neighborhood Guidebook” prepared by Center for Sustainable Energy, “Cycling Transportation” questions by İzmir Metropolitan Municipality, “Transportation Plan Households” questions by İzmir Metropolitan Municipality and “Carbon Footprint Calculation” questions are used. (Figure 5.2).

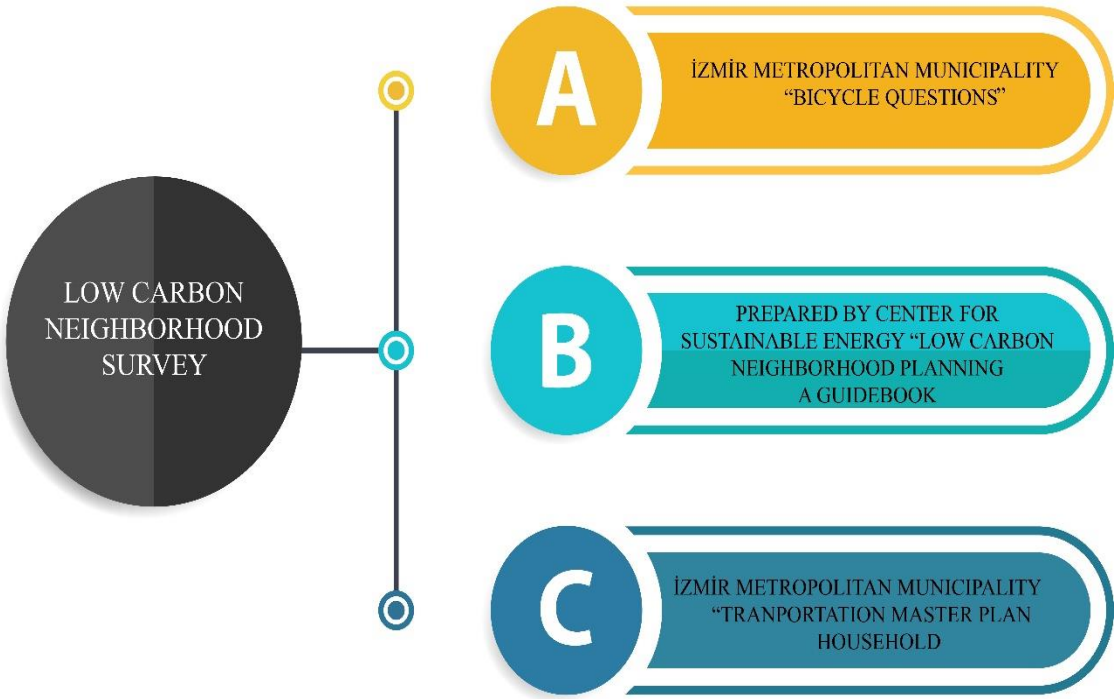


Figure 5.2. Low Carbon Neighborhood Survey

5.2. Survey Analysis

This survey is designed to measure the low carbon awareness of cyclists. Each question has been prepared to include in low carbon principles. The first, third, fourth, 9th, 12th, and 13th questions in the first part of the questionnaire concern renewable energy, energy efficiency and green technology. Questions 5, 6, and 11 are questions about low carbon transportation. The 9th question in the first part of the questionnaire concerns the issue of flood and extreme weather and water conservation. Questions 2, 7, and 8 were asked about green infrastructure and biodiversity. Questions 8 and 10 are questions involving land use planning. As the second part of the questionnaire deals with transportation, these questions take part in the low carbon transportation section.

The survey was made with a total of 212 people. 127 of these surveys were made digitally and 85 of them were face to face surveys. Since the participants misunderstood the sorting questions, only 23 of the digitally conducted surveys were considered valid. That is to say, the sorting questions 4-3-2-1 or 3-2-1 were given the same answer, or signed the "X". In addition to these, some surveys were missing. Therefore, these surveys were considered invalid. In the last case, 108 surveys were evaluated. 73 of the participants were male and 35 were female the age range of bicycle users is between 26 and 35 years old, followed by 36 and 45-year-olds (Table 5.1). Participants responded to the questionnaire in approximately 5-10 minutes. Surveys were started on January 30, 2018, and finished on February 10, 2018. In some of the questions in the questionnaire, images were used to describe the question. This method provided participants with easily answering the questions.

The survey was made in the districts of Üçkuyular, Göztepe, Bostanlı, Alsancak, Bornova, Çankaya, Seferihisar, Urla. In particular, certain cafés and bicycle stops, which are frequented visited by cyclists, were selected to make surveys. The main stopping points of cyclists; Göztepe Pier, Üçkuyular Pier, Güzelbahçe Hermes Bike café, Küçükyalı Velespit café, Alsancak Candela Bike café, Seferihisar Mamma Sweets Bike café (Figure 5.3). Often on weekday evenings certain groups meet at Göztepe or Üçkuyular pier and head towards Güzelbahçe or Bornova. In the weekends, cyclists prefer Seferihisar, Urla, Tire and Karaburun (Figure 5.4). The majority of the participants live in Karşıyaka (13%), Karabağlar (13%), Bornova (13%) and Konak (11%) (Table 5.1).

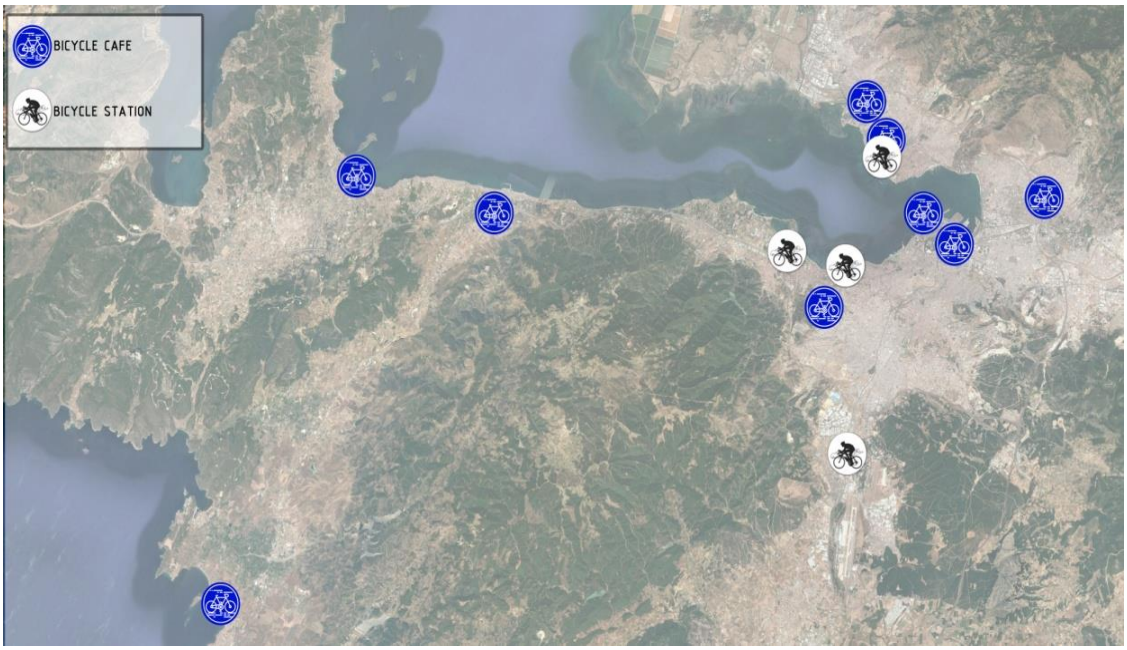


Figure 5.3. Cyclists' Stations

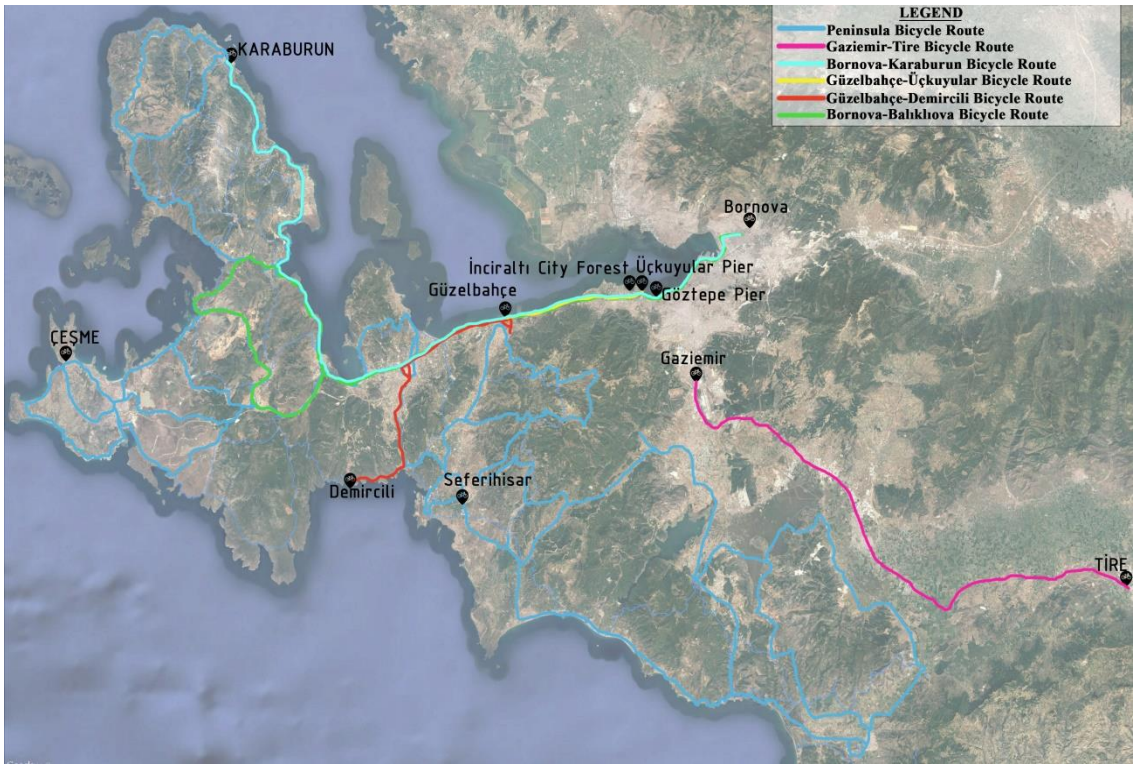


Figure 5.4. Bicycle Routes

Table 5.1. Demographic Information

		Number	Percentage (%)
Gender	Female	35	32
	Male	73	68
Age	15 – 25	20	19
	26 – 35	37	34
	36 – 45	32	30
	46 – 55	12	11
	56 – 65	7	6
District	Karşıyaka	14	13
	Bornova	14	13
	Buca	9	8
	Balçova	4	4
	Bayraklı	4	4
	Alsancak	9	8
	Konak	12	11
	Göztepe	6	6
	Üçyol	1	1
	Güzelbahçe	2	2
	Karabağlar	14	13
	Çiğli	2	2
	Narlıdere	2	2
	Gaziemir	1	1
	Urla	4	4
	Torbalı	1	1
	Seferihisar	9	8

In the first question, information on renewable energy/energy efficiency of participants was wanted to be evaluated. For this, it was determined in their neighborhood that whether they have heard that recycled materials such as "food, paper, aluminum,

plastic, and glass" were separated. The percentage of those who never heard of the food item is 30%. This ratio was higher than the others. Participants who said "I heard, but never used", was referring to aluminum which came out at 24% as the highest amount. The substance called "I heard and I use" came out at 28% glass (Figure 5.5). In this question, it is a very interesting situation that the proportion of people who have never heard of food from recycled materials is high. Because food is the most recycled material in nature.

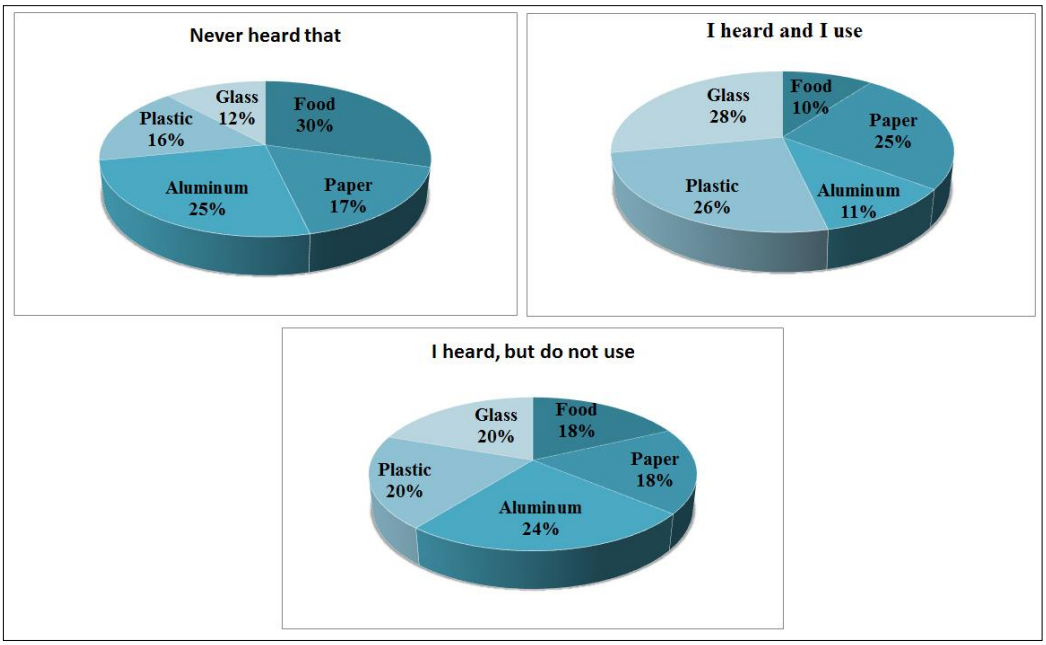


Figure 5.5. Information on Renewable Energy/Energy Efficiency of Participants

In the sixth question, participants were asked to rank according to the options given to the obstacles to create safe routes in their neighborhoods. In %49 of survey responses, the most important of the obstacle to creating safe roads is insufficient road widths. The least important one is seen as "inadequate enlightenment" by 73% (Figure 5.6). Inadequate road width is an expected response. However, the lack of lighting elements is actually as important as the others. Many users complained about face-to-face conversations as much as others because of their inadequate lighting in their neighborhoods.

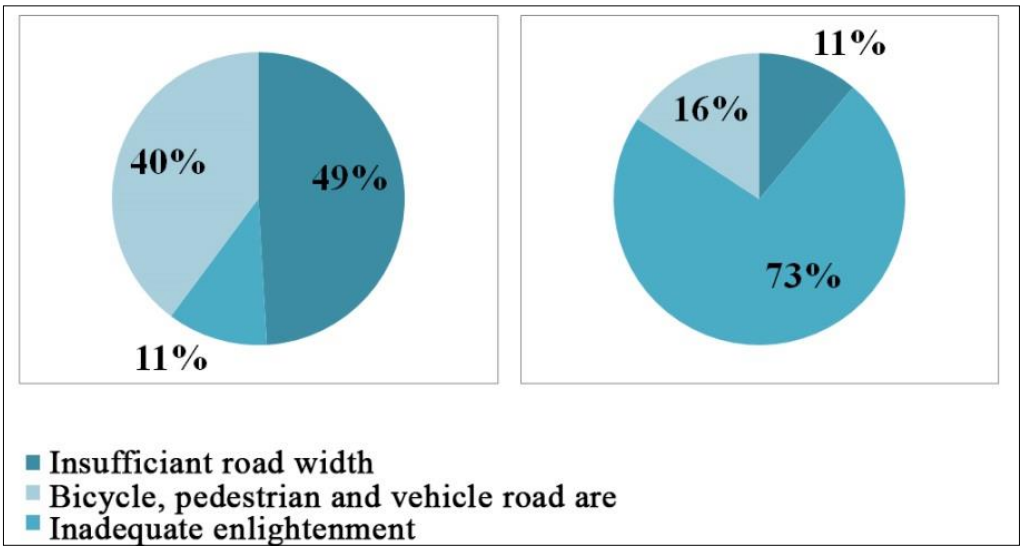


Figure 5.6. The Most Important Reason (left); The Least Important Reason (right).

In the seventh question, land use planning in low carbon living principles was asked. Participants were asked to range importance of park areas and green spaces within the land use planning. According to responses, the most important reason of existing of these areas for them is seen as urban ecosystem and biodiversity, the least important reason is seen as tourism and business opportunity (Figure 5.7). Participants were thought to consider these areas to be recreationally important, but it is really important that the participants attach importance to biodiversity and urban ecosystem. It will be examined in detail in the discussion section.

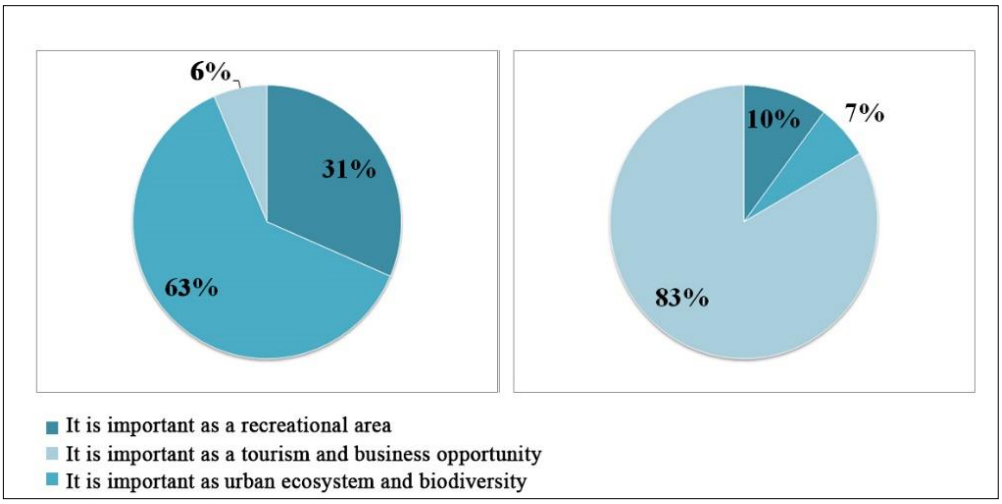


Figure 5.7. The Most Important Reason (left); The Least Important Reason (right).

In the eighth question, information on green infrastructure & biodiversity of participants were wanted to be measured. Therefore, precautions against extreme weather and flooding risk were asked. The percentage of respondents who answered "I heard these systems, but I do not use them" is high. 74% of respondents stated that they heard rainwater conservation systems. These systems are followed by green roof systems by 69%, sustainable drainage systems by 61%, planting open areas by 55% (Figure 5.8). These systems are not commonly used systems. So, it is considered a low possibility to know these systems. However, they have already heard of these systems and are aware of their existence. This is an important condition for high awareness. In particular, most participants place great importance on planting open areas. In addition, "green roof systems" have attracted a great deal of attention in international studies.

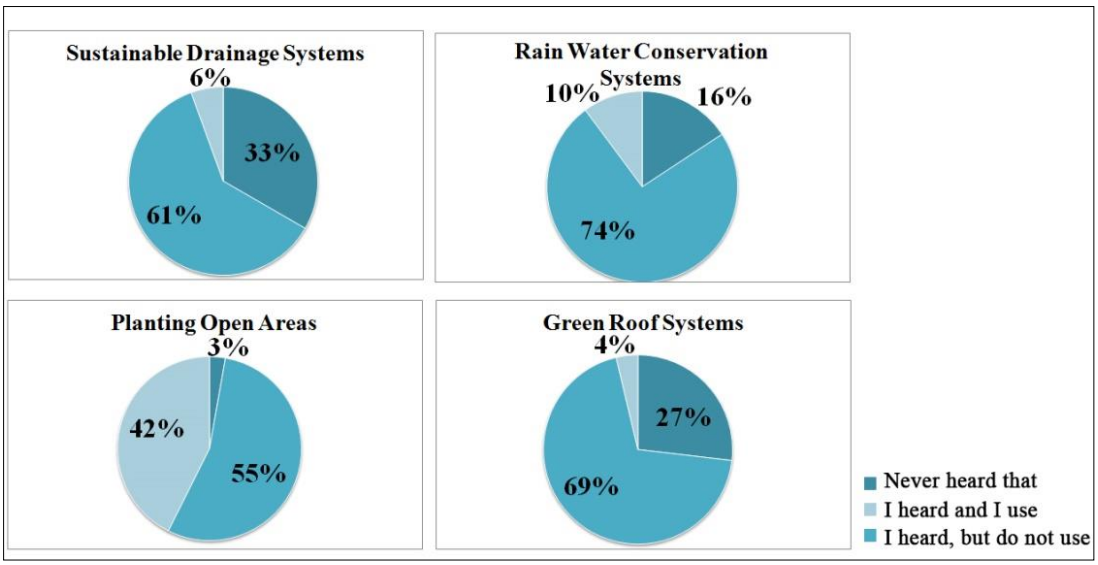


Figure 5.8. Information on Green Infrastructure & Biodiversity of Participants

In the eleventh question, participants were asked to measure their knowledge of green technology and energy efficiency. Because of this, whether they use energy production systems in their everyday life were asked. According to responses, participants heard at least the photovoltaic panels. The energy production system, which they most often hear and do not use, is the wastewater production system. The energy production system, which they most often hear and use, is the thermal insulation in buildings (Figure 5.9).

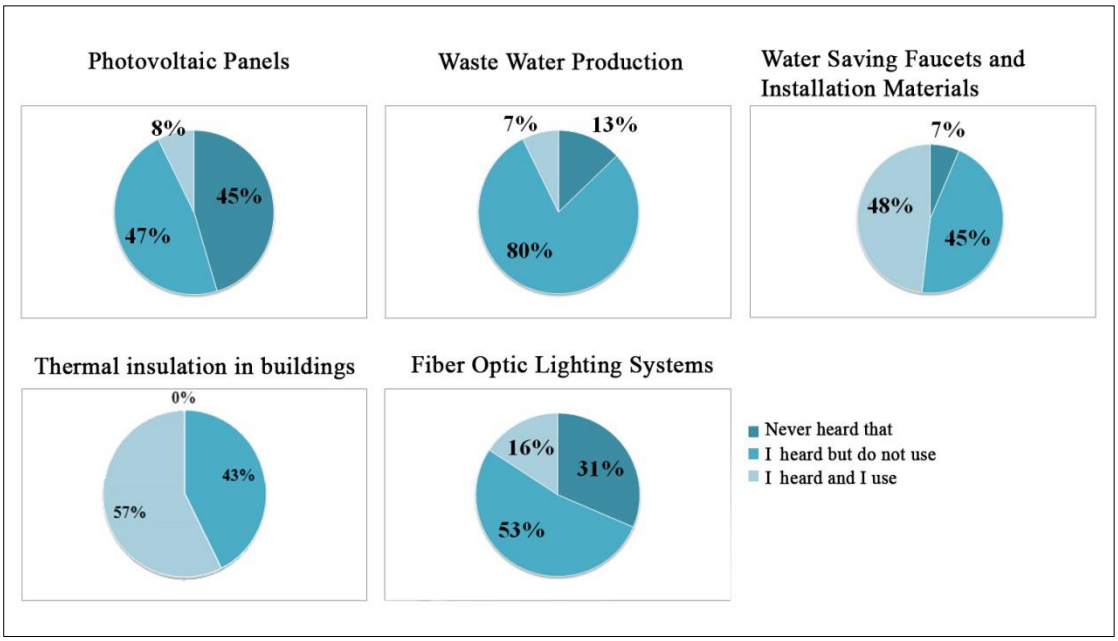


Figure 5.9. Information on Energy Production Opportunities of Participants

In twelfth and thirteenth questions, information on low carbon living was wanted to be measured. According to the twelfth question, participants think of the healthiest life when the low carbon urban said, in addition to this, they understand “other” option the least. When it is called low carbon urban, the participants pointed out the most "healthy life" option. After the "healthy life" response, the second most determined option is the concept of "sustainable city". (Figure 5.10). As the participants were cyclists, more transport-oriented answers were expected in this question. However, "healthy life" came to the forefront, as it is in other studies about bicycle transportation. In addition, it is also important to link sustainable urban understanding with low carbon urban understanding.

In the thirteenth question, participants were asked to learn their contribution to low carbon living about low carbon awareness. They prefer the most public transportation; the least selected option in the answers was the "other" option (Figure 5.11). It is important to link the option of using public transport with low carbon consciousness in this question. However, although in the first question, their level of consciousness on the question of using recycled materials was low, they attached importance to this question. It is creating the contradiction in this case.

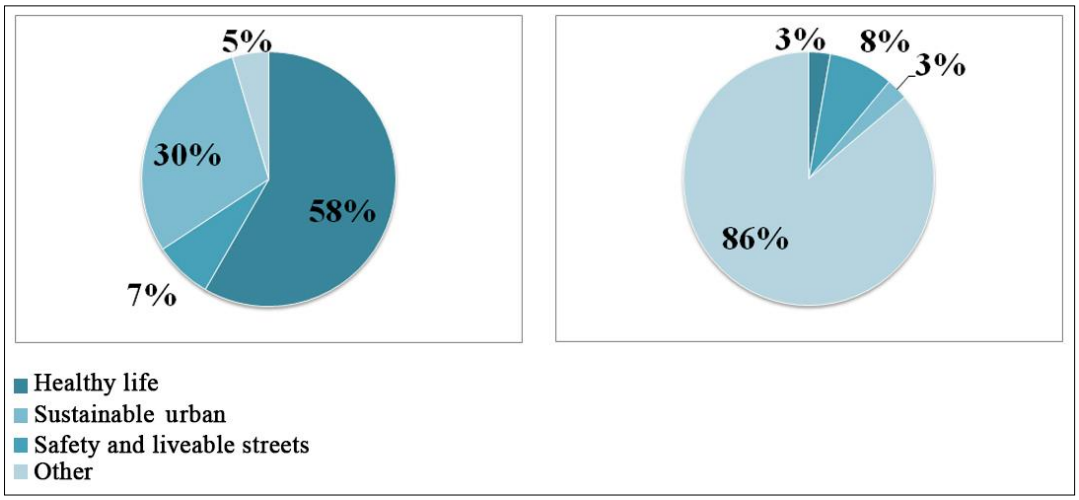


Figure 5.10. The Most Thoughtful (left); The Least Thoughtful Option (right).

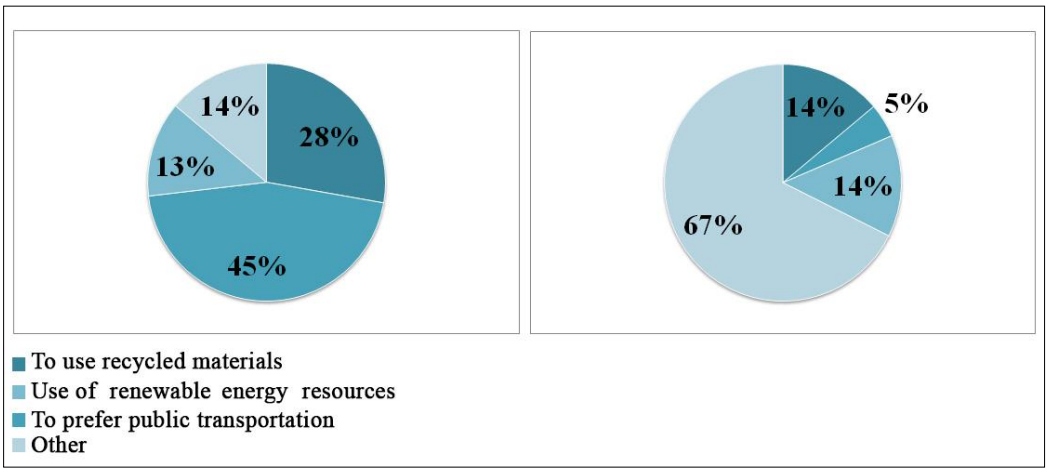


Figure 5.11. The Most Action (left); The Least Action (right).

In the second section of the survey, questions were asked about low carbon awareness. In the third question, bicycle users were asked for what purpose they preferred to bike. Participants preferred bicycle because they are most useful for health. In addition to this, not being affected by traffic congestion was another most important reason (Figure 5.12). Most cyclists use motorless modes of transportation because they think it is important for health. In fact, this idea is consistent with the answers given in the first section. The same situation is seen in other studies prepared with a sustainable approach. This issue will be examined separately in the discussion section.

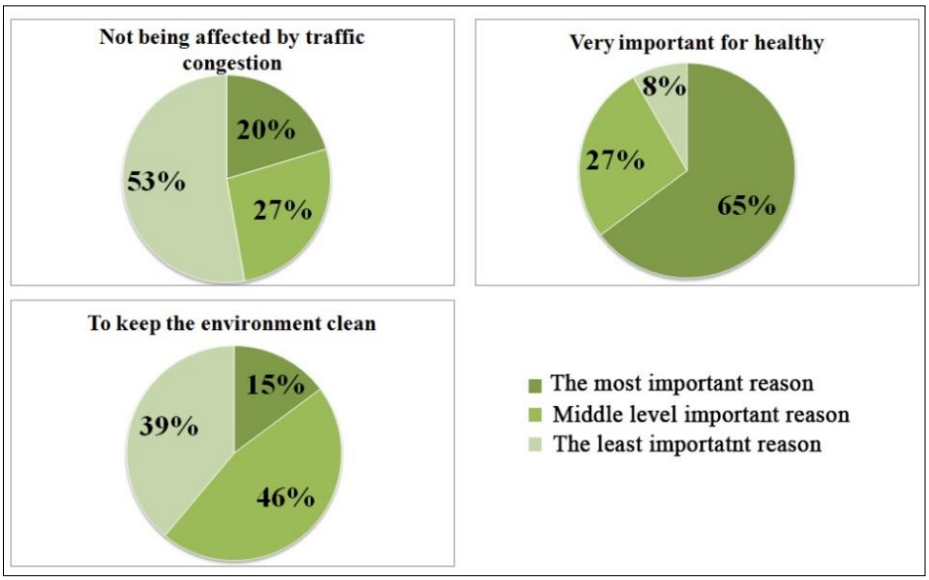


Figure 5.12. The Image Shows the Purposes Why People Prefer Using Bicycles.

In the fourth question, participants were asked for the purpose of bicycle preference. According to responses, the main reason they prefer bicycle is sport/exercise, they do not prefer to use bikes as business vehicles such as delivery, carrying (Figure 5.13). For this question, bicycle users were expected to adopt the bicycle to their daily lives, but they often stated that they used it as a sporting activity. This answer shows that most of the participants do not yet use bicycle as a transportation mode.

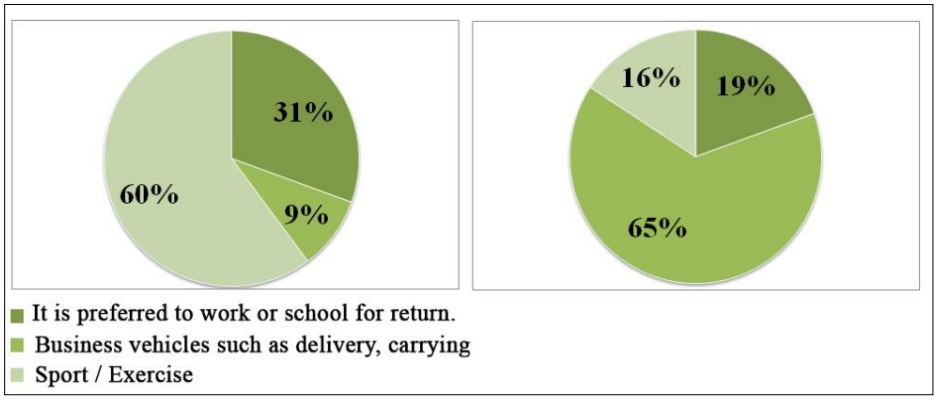


Figure 5.13. The Main Reason (left); The Least Important Reason (right).

When the whole city considered, bicycle users are using bicycle to provide the most sustainable transportation support. The reasons for least preference for cycling were to contribute to recreational activities. Creating a low carbon city consists of 33% of the answers (Figure 5.14) (Graphics are detailed in Appendix A).

According to these answers, participants want to support sustainable transport and, in addition, they are targeting low carbon life. This picture shows that low carbon living awareness levels are developing. Supporting sustainable transportation by participants shows that they will use bicycle as the main transportation mode in the future.

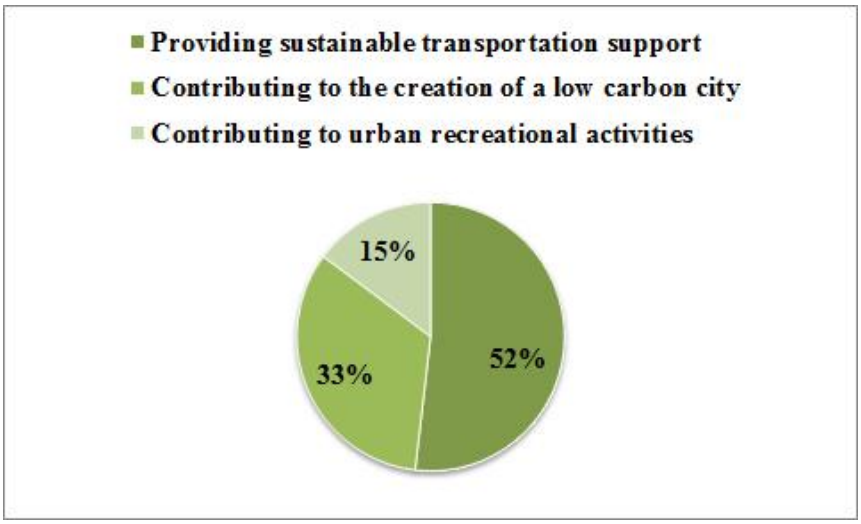


Figure 5.14. This Picture Shows Why the Bicycle is Preferred All over the City.

In the eighth question, participants were asked which public transport vehicle they were using integrated with the bike. According to responses, Metro-İzban public transportation vehicle was the most selected. Municipal buses are the least used vehicle of transport by participants (Figure 5.15). In many cities, bicycle use is integrated with metro transport. This situation is the same in the province of İzmir as seen in the surveys. Cyclists often choose Metro and İzban, because they stated that they carry their bicycles comfortably with this transportation mode.

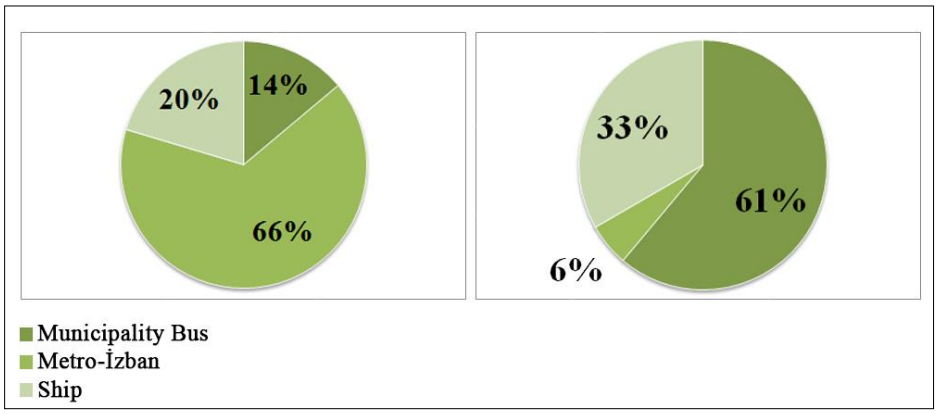


Figure 5.15. The Most Preferred (left); The Least Preferred (right).

In the ninth question, the importance of increasing bicycle use in the city was asked. According to responses, participants selected the option of "Carbon rate decreases in the city". The least selected choice is “traffic accidents are reduced” (Figure 5.16). In this question, it is confirmed that the users give importance both to urban ecosystem and biodiversity and to low carbon life.

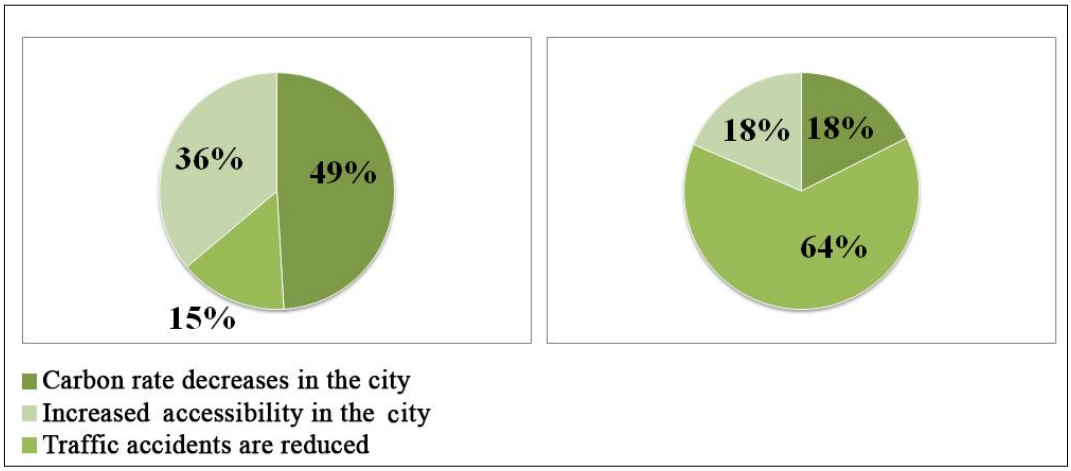


Figure 5.16. The Most Important Reason (left); The Least Important Reason (right).

5.3. Results and Discussions

The study of the survey was conducted to measure the level of awareness of cyclists. Cyclists were sampled for this survey because they represented low carbon transportation well. Low carbon awareness is not a place to be idealized in the city, so low carbon awareness is emphasized in the survey study. This survey is answering the question "What is the awareness of bicycle users?” In the first stage of this section, survey results in Turkey will be discussed, other studies were carried out on this issue and in the second stage, questions will be discussed within itself.

In the previous studies, the survey was made with 154 cyclists in Tekirdağ, 151 in Edirne, 175 in Lüleburgaz (EmbarQ Turkey, 2016), 636 in Sakarya, 706 in Eskişehir, 167 in Antalya (Elbeyli, 2012), 120 in Bolu (EmbarQ Turkey, 2015) and 140 in Isparta (Uz and Karaşahin, 2004). Besides these, 200 questionnaires by face-to-face survey method and 3611 by online questionnaire method were made with bicycle users in İstanbul (EmbarQ Turkey, 2014).

When the gender distributions of cyclists are examined, the proportion of male users is generally high. The proportion of male users is about twice that of female users. The reason for this is that women do not prefer to use bicycles too much for safety reasons. The average age of the users is in between 25-40 years, as in other studies. This group usually consists of working people, so they usually use bicycles in evening work outs or on weekends. As it is understood from this situation, participants usually prefer bicycle use for recreational activities. However, it does not constitute a very bad picture for transportation use rate. When this situation is examined in detail according to the cities;

In this study, the use of bicycles for transportation in İzmir is determined as 31%; In the survey of 140 cyclists in Isparta, bicycles are used for transportation purposes by 44,3% (Uz and Karaşahin, 2004); in the survey of 154 cyclists in Tekirdağ by 24% for transportation, by 43% for hobby and leisure purposes; in Edirne (in the survey of 151 cyclists), it is used by 29% for transportation, 40% for hobby and leisure purposes; In the survey of 175 cyclists in Lüleburgaz, it is used by 24% for transportation purposes, 44% for hobbies and entertainment purposes (EmbarQ Turkey, 2016); in face-to-face surveys of 200 people in İstanbul, bicycles are used for transportation by 15%, by 75% for hobby and entertainment (EmbarQ Turkey, 2014); in the survey of 120 cyclists in Bolu, bicycle is used for transportation by 43%, for 29% for hobby and entertainment (EmbarQ Turkey, 2015); in the survey of 636 cyclists in Sakarya bicycle is used to go to work by 50%; in the survey of 706 cyclists in Eskişehir, it is used to go to work by 32%; It is used to go to work by 38% in Antalya (in the survey of 167 cyclists) (Elbeyli, 2012) (Figure 5.17). According to a survey conducted in Konya, bicycle has been used as a means of transportation since the 1920s. Cycling throughout the city is preferred as a lifestyle (Mert and Öcalır, 2010).

İzmir's situation is average compared to other cities. In this case, İzmir started to use bicycles as low carbon transportation mode, and besides, it seems that the development about this issue has approached positively. In addition to this situation, it is understood from this result that the road designs should be developed in İzmir in general. Especially the increase of female users is related to this issue. Bicycles can become the main means of transportation if the urban design elements are given the necessary importance along with the road designs.

In order to understand the extent to which cities have adopted low carbon transportation, the reasons for the cyclist's preference for cycling need to be examined. In İzmir, bicycle use is preferred for health by 58%, to keep the environment clean by 43%;

It is seen that bicycle use is preferred for health in Edirne (29%), Lüleburgaz (21%), Tekirdağ (27%) and, İstanbul (according to face to face survey, 33,3%; according to online survey 20,9%). It is preferred in Bolu because it makes bicycle users feel good primarily, and because it is thought to be more economical in Sakarya, it is also preferred because it is thought to be more economical in Eskişehir. Looking at these results, the health issue is one of the most important matters for İzmir. For low carbon life, the health issue has a significant place. Creating a healthy city forms the basis for the idea of creating low carbon living conditions. İzmir shows that the residents of the city give importance to this situation and support the low carbon life.

Except for bicycles, which transportation vehicles are used, shows the support given by urban people to low carbon transportation. In İstanbul, according to the online survey, rail systems are preferred as an alternative to bicycles by 12%, and buses are preferred by 9, 1% and according to face to face survey, buses are preferred by 40%, rail systems are preferred by 3% (EmbarQ Turkey, 2014). In Eskişehir and Antalya, importance is given to the use of public transportation vehicles; the highest percentage of preferred public transportation vehicles is determined as 26% tramway in Eskişehir and 31% municipal buses in Antalya (Elbeyli, 2012). In Bolu, the use of private vehicles prevents the use of public transportation; the use of vehicles such as buses / minibusesses is 4% (EmbarQ Turkey, 2015). In Lüleburgaz, Edirne, and Tekirdağ, the use of automobiles is also ahead of public transport (EmbarQ Turkey, 2016). When the situation is evaluated for İzmir, 47% of the public transportation vehicles are preferred as an alternative to cycling. Looking at these ratios, it seems that İzmir's adaptation of low carbon transportation will be quite easy. In face-to-face surveys, users in İzmir stated that they do not want to use their private vehicle especially because of traffic jam and because they want to adopt a healthy life. Therefore, when looking at the overall picture in İzmir, low carbon awareness is positive compared to other cities (Figure 5.19).

In cities, it is also necessary to discuss the frequency of car use and of cycling in order to discuss compliance with low carbon life. In the survey conducted in İzmir, the participants stated that they frequently used bicycle by 46%. The rate of those who use bicycle every day is 31%. The proportion of car users in daily lives is 20%. According to EmbarQ Turkey İstanbul survey, 53, 5% of cyclists have vehicles and 94, 5% of them have bicycles at the same time. 44, 5% of the participants have a bicycle use frequency of once a week (EmbarQ Turkey, 2014). In Sakarya, Eskişehir, and Antalya, the frequency of cycling is determined by users as "more than once every day". However, in

Eskisehir and Antalya, private car ownership is also seen in important places (Elbeyli, 2012). In Bolu, 83% of the participants use motor vehicles (EmbarQ Turkey, 2015). The frequency of bicycle use is determined as 53%. For Edirne, Tekirdağ, and Lüleburgaz, the number of persons with motor vehicles is quite high, but besides this, the number of people with bicycles is an important issue. The frequency of bicycle usage is determined as "every day more than once" in Edirne; In Tekirdağ, 29% uses bicycle 3 to 4 times a week; 38% in Lüleburgaz "less than 1 in a week" has been determined (EmbarQ Turkey, 2016).

Despite the presence of automobiles, the fact that the community chooses bicycle transportation proves that bicycle can be used as an alternative to automobiles in the city. This picture shows that urban people will adapt easily to low carbon life, as mentioned earlier. When İzmir's situation is assessed according to other cities, support for low carbon life is quite high. In this case, it is indicated that their support for other studies for low carbon living will be high.

As it is seen in the above discussions, the view of the city dweller on bicycle use is positive. However, some problems prevent the use of bicycles. These problems are the same for almost all cities. In this issue, if the problems are taken into account considering the cities surveying bicycles, the biggest obstacle to the formation of safe bicycle routes for İzmir is seen as "not enough road width". The second major reason is that "bicycle, pedestrian and vehicle path are not separated from each other". The biggest problem that bicycle users have experienced in İstanbul is determined as "conflicts with other vehicles". The second major reason is that "the roads reserved for cycling do not show continuity". The biggest problems for bicycle use in Tekirdağ, Edirne, and Lüleburgaz are inadequate network-designed bicycle routes, insufficient road width for cycling, and the lack of road safety. The same problems are seen in Bolu province. In this city, one of the most important problems is motor vehicles. The most important problem in Sakarya is that bicycle routes and necessary signs are not made.

If a general evaluation of other cities that use bicycles together with İzmir is held;

- Most of the bicycle users are between 25 and 40 years old.
- The proportion of men among bicycles is higher than that of women.
- The rate of bicycle use for the purpose of transportation does not make a bad picture and it is open to development.
- The health factor is helping to increase the use of bicycles. The health issue is one of the important issues that low carbon life aims for.

Especially for İzmir, Eskişehir, and Ankara, the rate of public transportation usage is high. In addition to bicycling, public transport can also be developed for low carbon living in these cities.

- Common problems for bicycle use; inadequate road width, lack of adequate bicycles and pedestrian paths, and lack of continuity on bicycle paths.

Until this section, the second part of the questionnaire has been discussed. The questions in the first part of the questionnaire will be discussed according to low carbon living principles.

Most of the participants did not know that the systems involved in the options were green infrastructure systems. Among these concepts, they expressed "water tank" was the most heard. Although "Green Roof", "Green Wall", "Permeable Pavements" were applied at various points of the cities, the number of those who do not know these systems was high. In relation to this question, they stated that in the eighth question, the systems mentioned in the measures taken against extreme weather conditions and flood risks were never used in their neighborhoods but they heard before. The use of this system is not yet widespread in İzmir and Turkey. Therefore, it is normal for the participants not to use it in their daily life. What is important here is that they have heard these systems before. This is an important situation in terms of awareness levels. The "planting of open spaces" part of the options is being used more frequently than the other options. In interviews with the people surveyed, they said that they were paying attention to planting in the gardens of their apartments or houses. Participants living in the apartments want to create a natural environment in their surroundings by planting the balcony.

Another issue in the same category is energy efficiency. According to the responses of participants, the rate of those who said "I have never heard of energy saving systems" was very low. Participants often try to use these systems in their daily life. Some participants pay particular attention to energy efficiency. Some participants emphasized that they only hear "double glass" and roof insulation systems from the options offered, and have never heard other options before. Participants who say "I have never heard of energy production opportunities" in the eleventh question are at high rate. Among these systems, the ones who said I have never heard the option of "photovoltaic panels" is especially very high. In fact, photovoltaic panels are systems that began to settle in everyday life and the use of these systems is increasing. In this respect, the knowledge of these systems is rather low. The awareness level of renewable energy / energy efficiency / green technology principle from low carbon living principles is more positive.

Generally, they do not know the green infrastructure as a concept, but 5 out of 108 participants stated that they especially use rainwater in vegetal irrigation.

Participants attach great importance to park areas and green areas within land use planning. Participants emphasized, in particular, that the presence of green spaces and parking spaces is important for "urban ecosystem and biodiversity". Most of the participants complained that there are few in the green areas. However, they do not make any contribution to this. Environment-friendly individuals usually plant vegetables in their apartment surroundings. They prefer green spaces and park areas to get away from the stressful life of the urban area.

Bicycle users' awareness of low carbon transport is quite high. Many participants offered a variety of ideas about how road designs should be in their neighborhoods. As mentioned before, the importance given to road designs in land use is not enough, there are many problems. This is, in fact, the worst situation since the industrial revolution. Several suggestions have been made in this regard, but still, there are not many innovations in design study today. Studies, such as “İzmir Deniz Project”, “People Park”, and “Urla-Karaburun Peninsula Project” that include bicycle designs in İzmir are also continuing. These projects have not yet entirely reached the neighborhood scale, but their potentials are high. In these projects, one of the principles of low carbon life is provided when efforts on seamless cycling and pedestrian access is provided.

With pedestrian and bicycle priority designs, users can socialize together in their neighborhoods. These designs have been discussed since 1960. Neighborhoods and streets must belong to the city dwellers. In 21st century, the streets are still not a livable place for urban people. The rapid life that urbanization causes is influencing road designs. Because of this situation, city dwellers prefer to use public transportation or private vehicles for business trips due to safety. Because, as a cyclist, they do not ride their bicycles safely on the roads. Bicycle users, instead of their neighborhoods, usually determine the Alsancak-Göztepe-Üçkuyular pier as a meeting place for various cycling activities. Later on, they make journeys by setting routes along the road.

Overall, the awareness levels of cyclists are not at a very bad level. Especially awareness on low carbon transportation is high. Some users can use public transport, even if they cannot use bicycles, instead of using private vehicles. In addition to these, it is very important that they attach importance to the urban ecosystem. However, knowledge levels of them about green infrastructure systems, energy efficiency, sustainable living is not in good condition.

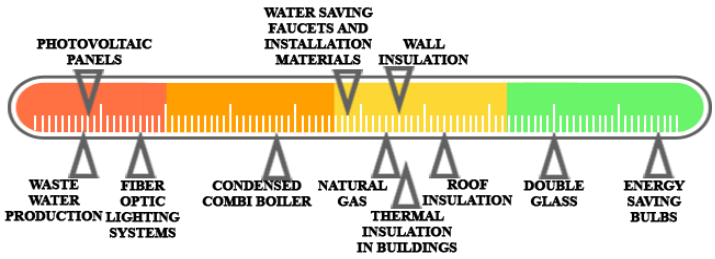
Survey Evaluation on Low Carbon Neighborhood Design

According to the survey responses, the level of preparation for low carbon neighborhood design is not very high. There is not a low level of awareness about these principles, but this awareness has not yet passed through the design process. The fact that road designs and green infrastructure systems are at a low level is a responsibility of local authorities.

In table 5.2, the most commonly used and most known low carbon design tools are mentioned. According to this table, if low carbon neighborhood is designed, it will be the fastest adaptation to "renewable energy, energy efficiency, and green technology". Because the participants' use of the design tools on this principle is higher than the other principles (Table 5.2).

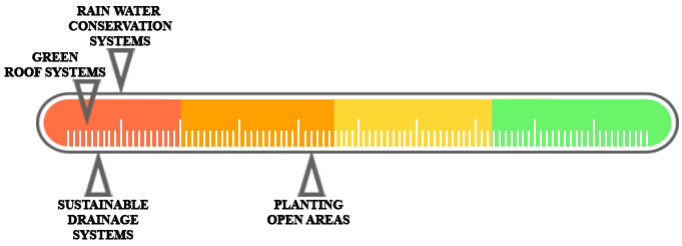
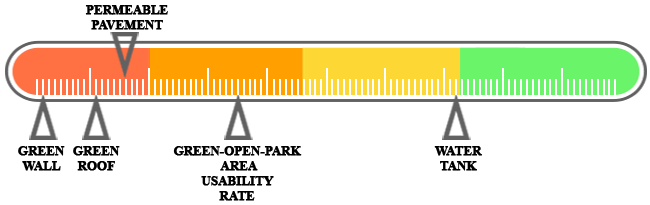
When the other four principles are examined, the preparation level for creating a low carbon neighborhood is not very high. However, in time, the use of design tools in these principles is expected to increase. The reason for this is that the consciousness levels of the participants are high and studies like "People Park", "Deniz Design Project", and "Peninsula Project" are designed in İzmir.

Table 5.2. Survey Evaluation on Low Carbon Neighborhood Design

	Design Tools
Green Technology (Renewable Energy / Energy Efficiency)	 The most used recycled materials are glass (28%) and plastic (26%). (It is prepared according to the most known and most used rate.)
Low Carbon Transportation	-Traffic jam is high density -Road width is insufficient -Bicycle, pedestrian and vehicle path are not separated

(cont. on next page)

Table 5.2. (Cont.)

Flooding and Extreme Weather/Water Conservation	 (It is prepared according to the most known and most used.)
Green Infrastructure & Biodiversity	 -The number of park areas, open spaces, green spaces are insufficient. (It is prepared according to the most known and most known.)
Land Use Planning	-The number of park areas, open spaces, green spaces are insufficient, -Road width is insufficient, -Bicycle, pedestrian and vehicle path are not separated.

The most important step in creating a low carbon neighborhood is to adapt low carbon living principles to neighborhoods. These principles guide the design studies. In this study, which is the user dimension, what is to be done in the dimension of the place, "walking and cycling" is tackled as the priority design;

<u>First case study is İzmir People Park;</u>

In this study, the connection of the walking and bicycle routes with the neighborhood and other transport vehicles is good. However, the bicycle and pedestrian routes that uninterrupted in the park must continue until the public transport stations in the immediate environment (Figure 5.17). Besides, the lack of sufficient microclimatic weather prevents the bicycle and pedestrian access to be done every hour of the day (Figure 5.18). In the project area, the existence of the Peynircioğlu stream is very important and it is necessary to increase the relation of the users with the water (Figure

5.19). It is important both for making the transportation enjoyable and creating a natural environment in the city. Urban furniture used in neighborhoods and parks increases bicycle and pedestrian use in transportation. Designing bicycle parking spaces at apartment entrances and in neighborhoods, designing wind and sunlight cutters on bicycle paths increase bicycle use. It is important that bicycles and pedestrian paths are separated from each other by color and various materials. In this way, there is no accident during transportation.

Figure 5.17. Proposed Bicycle Route
(Source: Reproduce from İzmir Büyükşehir Belediyesi/Park ve Bahçeler Müdürlüğü)

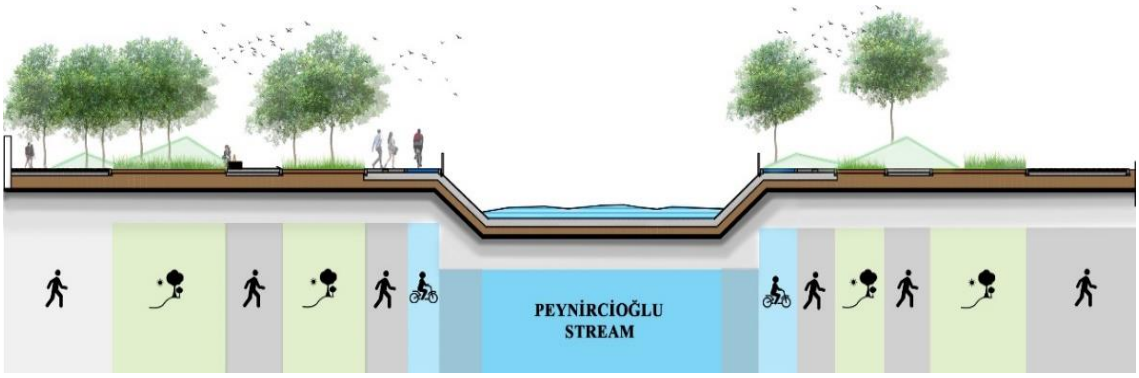


Figure 5.18. People Park Existing Section
(Source: Reproduce from İzmir Büyükşehir Belediyesi/Park ve Bahçeler Müdürlüğü)

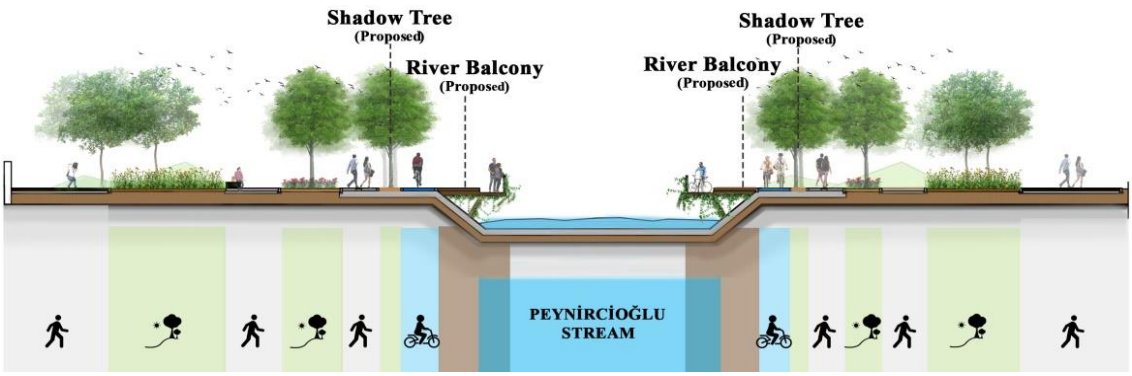


Figure 5.19. Proposed Design Study

Second case study is İzmir Deniz project.

İzmir Deniz design project, cycling and pedestrian access along the coast continue uninterruptedly. However, as mentioned earlier, bicycle and pedestrian routes are not designed on the axis leading from the coastline to neighborhoods. Only in Bayraklı region, bicycle routes and pedestrian overpass designed on the viaduct are a beginning for these designs.

In the context of urban design, to target low carbon living, pedestrian and bicycle priority transport must be designed throughout the city. Especially, it is important to establish coastline and neighborhood relations, in studies that are low carbon potential like the coastline project. Road designs should be separated as bicycle, pedestrian and vehicle path. Designed paths should be distinguished from one another by using separating materials or by using different colors. Road signs and lighting elements must be included in the design tools. The design should be supported by natural and artificial landscapes. Appropriate designs should be made to ensure the transportation of pedestrians and cyclists on hot summer days or during rainy winter days. At certain points in neighborhoods, a bicycle parking lot should be designed. In order to ensure the widespread use of low carbon transportation, it is necessary to pay special attention to safety. In Figures 6.4, several suggestion designs are mentioned.

In Figure 5.20, Göztepe is chosen as an example for coastline and neighborhood connection. However, the suggestions are given here apply within other regions. It is very important to establish an association with the neighborhood in all of the coastline studies. One of the design tools that constitute the most important link between the neighborhood and the coastline is the walking and cycling roads. If these roads cannot be designed due

to the intensive settlement, this relationship can be achieved with designs such as pedestrian and bicycle bridges.

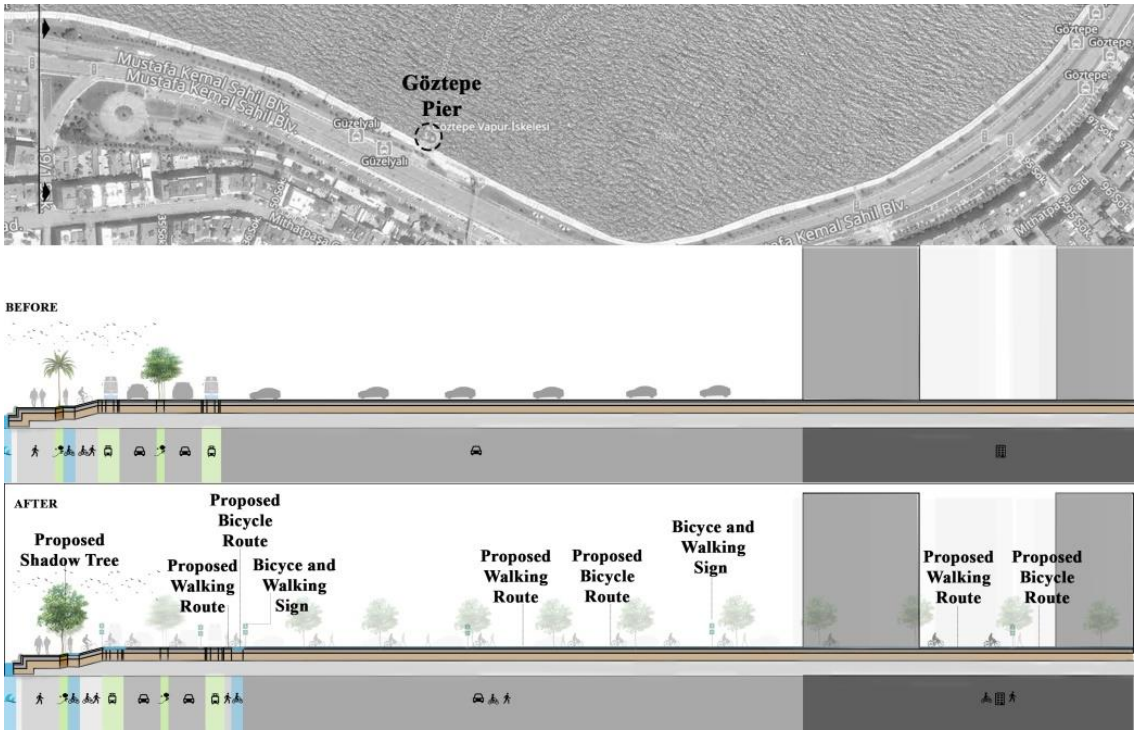


Figure 5.20. Existing and Proposed Road Design in Göztepe

CHAPTER 6

CONCLUSION

This part of the study consists of five sections. The first section summarizes the general flow of the study, in the second part, the case studies from the world and the studies in İzmir are compared. In the third section, the findings of the literature study and the findings of this study are compared. In the fourth section, it is stated how the urban design process should be done while considering the low carbon neighborhood. In the last part, the general evaluation of the study is presented.

Summary of the study

Along with The Industrial Revolution, the migration towards cities brought out dire environmental problems. The increase of urbanization rate caused the urban environment, natural environment, and energy problems to grow rapidly. The developing technology brought innovations in urban life, but it also caused the degradation of the natural environment. Innovations made in the transportation sector positively affected the industrial life but resulted in destruction of natural areas, air, water, and soil. Increasing carbon ratios in urban and rural areas destroyed the carbon cycle, an important part of the natural balance, and caused the worldwide increase of harmful gases called greenhouse gases. As a result, the issue of climate change came into our agenda.

Intense air pollution, rapid destruction of natural resources, irregular settlements resulting from rapidly increasing migrations to the city became the biggest problem of cities. Along with all this, due to big motorways and railroads being constructed, neighborhoods and streets were separated from each other and people were alienated from each other. Streets came out of people's habitat and became car-oriented. As a result, insecure and inanimate streets and neighborhoods have formed. All these problems created the subject of planning and design in the following processes.

First of all, the Garden City project was prepared in 1902. In this project, public health was kept in the foreground and interconnected neighborhoods were connected to each other by railway networks. Then the neighborhood unit project was developed and the streets that were invaded by cars were designed to be restored by designing the land use in walking distance with this project. The Radburn plan, which was later developed,

was designed to plan environmental friendly spaces and to adapt to the concept of the healthy city. Despite all the efforts, however, the streets and neighborhoods could not be saved from the cars and caused to begin the actions that led by Jane Jacobs in the 1960s. Jacobs argued that the streets should be living streets and the city should be an activity area.

With the oil crisis that broke out in 1973, the day of car-free cities started to be organized. Along with these actions, the use of bicycles increased and the concept of accessibility improved in the streets. When it came to 1980, the concept of the neighborhood unit was revisited again by New Urbanists, whose pioneers were made by Andres Duany and Elizabeth Plater Zyberk. Energy began to become the main theme of projects. In these projects, low carbon transportation vehicles were also emphasized. In 1990s, the issue of "climate change" was discussed extensively and "energy" projects were developed. With New Urbanism, concepts such as Sustainable Urbanism and Landscape Urbanism came to the agenda. At the core of all these concepts were "healthy cities" and "public health" thoughts.

All these processes led to the creation of a "low carbon life" consciousness that began to develop after 2000s. In this study, it was tried to develop low carbon neighborhood understanding with this concept. The neighborhood is an important measure to create sustainable communities, even if it is a small place on the city scale. The most important role of low carbon neighborhoods is to create viable and healthy environments for future generations to come. In this sense, the study focuses on the five principles that make up low carbon living. These principles constitute from a land-use planning, low carbon transportation, green technology-renewable energy-energy efficiency, flood extreme weather & water conservation, green infrastructure, and biodiversity. In the study, subheadings of each headline are included.

The whole study was built on transportation and neighborhood. Transportation was chosen because it was one of the largest sectors that caused an increase in the carbon ratio in the city, and neighborhoods were chosen because it was the ideal place for low carbon consciousness to be idealized. The five principles mentioned providing the link between these two elements.

The concept of low carbon neighborhood was a very new formation. For this reason, each stage of the concepts was tested. The awareness of the users and the extent to which they adapt to this issue were measured within the scope of the study. In short,

"Proof of Concept" approach was used in the study. The steps, methods and design elements that should be in the low carbon urban design guide were described.

Comparison of case studies

These studies, which are designed in İzmir and abroad, are studied within the scope of low carbon principles. In particular, the design tools of low carbon transportation within these principles are examined in project study in the context of urban design. To compare low carbon transport mode in these studies; in world studies, pedestrian, bicycle and vehicle paths are often separated. Bicycles and pedestrian paths continue uninterruptedly throughout the neighborhood and are connected to other parts of the city. In İzmir, bicycle and pedestrian paths are usually designed on the coastline and there is no connection with the neighborhood. Neighborhood-transportation relation is mostly seen in "People Park" project.

In world case studies, there are car parks on the neighborhood fringe. City dwellers park their cars in the park areas and can use public transport. A similar example in İzmir is seen in the project designed in Bayraklı region. Under the viaduct, the parking area is expanded and city dwellers park their cars here. Other design tools are car and bicycle sharing systems. In world studies, these design tools are very common. In İzmir, bicycle system becomes widespread with "Bisim" design, but no car sharing system is used. Besides, electric cars are one of the most preferred vehicles for low carbon living in abroad. Although not very common in İzmir, this practice is seen. An example of this is; Electric buses are offered to the city by İzmir Metropolitan Municipality. In Table 6.1, low carbon design tools used in the world and in İzmir is summarized.

One of the most important design tools for creating a low-carbon neighborhood is low carbon transportation. For this reason, in design, neighborhood dwellers should definitely be directed to bicycle and pedestrian priority designs. In this sense, urban design discipline has great responsibilities.

As can be seen in the table, İzmir has a certain potential as low carbon transportation, but it has to develop.

Table 6.1. Comparison of Case Studies from the World and İzmir

World Case Studies Low Carbon Transportation Design Tools	**İzmir Case Studies Low Carbon Transportation Design Tools**
-Non-motorized transport -Bicycle and pedestrian routes -Public transportation (Tramway, bus services, metro, ferry) -Car Parking spaces -Bicycle parking spaces -Low carbon cars -Electric car -Electric bicycle -Pedestrian bridges -Car sharing program -Bicycle sharing program -Street narrowing -Traffic calming -Smart cards for public transportation and bicycle -Parking free -Green energy for tram system	-Non-motorized transport -Bicycle and pedestrian routes -Public transportation (Tramway, bus services, metro, ferry) -Bicycle sharing program (Bisim) -Smart cards for public transportation and bicycle -Parking spaces -Pedestrian and bicycle bridges -Electric bus services -Electric vehicle station

In the third part of this chapter, the findings of this study are evaluated with the findings of the literature;

-Today, actions and organizations are being organized for livable streets and cities without cars. At the beginning of these, Critical Mass acts and the Fancy Women Bicycle Tour come. Similar slogans like "car-free cities" in 1960s has also been seen in today's bicycle organizations. According to Coleman (1986), well-organized individuals are also successful in terms of social responsibility. Actions provide public benefits. Social communication, social unity is important in terms of feeling the safety of the society. In this context, the actions taken hold the individuals together and help spread the emerging concept. Instead of individuality, being united is successful in emphasizing the action made.

-As researchers such as Jane Jacobs, Donald Appleyard, and Guy Debord expressed, private vehicle density has alienated people. This judgment is also seen today. Bicycle users cannot meet and organize any activities in their neighborhood.

-In previous studies, alternative solutions such as electric bikes and electric cars were developed besides bicycles for carbon-free transportation, but as it is seen in this study, the most suitable alternative vehicle type is determined as bicycles. Because bicycles are an economical means of transportation, they appeal to people from every income.

-Within the scope of this study, transport was associated with public health, safety, and climate change adaptation. As seen in the answers to the questionnaire survey, participants were most attracted to these issues. They especially emphasized the importance of "health" in relation with bicycles.

-In literature studies, it is emphasized that social relations will develop with decreasing of private vehicles in healthy cities, sustainable cities, and low carbon cities. As it is seen that bike is a socialization tool for participants in this study.

-In the low carbon urban project studies examined, bicycle parking lot and uninterrupted cycling routes are highly valued, and cyclists emphasized that they will never use private vehicles if bicycle paths and bicycle parking areas are built in the city.

-It is emphasized in the literature that the increase in bicycle and pedestrian usage depends on the improvement of the infrastructure, land use planning and street connections. In this study, the users pointed out that the lighting elements should be increased and the urban equipment should be suitable for bicycle use.

-In the literature, to create low carbon neighborhoods, designs such as common gardens, eco-friendly technologies, environmental friendly vehicle use, green roof - green walls are used. In the questionnaire survey, it was tested whether the users would be able to adapt to these designs. According to the results, they did not have much information about the concepts, but it is seen that they support the application.

Urban design process

Both in previous studies and in this study, important duties were given to local governments. With the decisions made by the local government, the behavior of users can be changed easily. In the first phase of the project processes, local governments' opinion should overlap the needs of the local community and neighborhood. A low carbon neighborhood must be created in a friendly and safe environment. Because the healthy and safe environment created in the neighborhood affects the society. It is very important that the local neighborhood people participate in the study. They should be included in local proposals for the solution of the problems together with local authorities. In this

process, various interviews, focus group meetings, various opinion meetings with the neighborhood people should be held. At these meetings, if the issues are discussed under the headings of low carbon principles, the solutions are based on a certain basis. For example; what is needed for land uses: parking lots, park areas, green areas. How do we provide energy efficiency in neighborhoods; using energy-saving bulbs in apartments, streets, using double glass, roof insulation materials, condensing combi boiler at homes. If there are large drainage problems in the area, stormwater conservation systems can be used and sustainable drainage systems can be classified as available.

For determination of the problems, the analysis study done in neighborhoods is very important. Good and detailed analysis ensures that solutions are robust. Besides, various workshops and meetings with the neighborhood management are effective in the fact that the process is fast and the solution is definite. It is important for neighborhoods to draw out the "problems, opportunities and expectations" scheme at the meetings held.

After this, the design phase begins. In the design phase, it is important that land use planning is established within walking distance. The design of the neighborhood unit, proposed by Clarence Perry in 1920, emphasizes the importance of this. Close proximity of land uses makes walking and cycling a priority, preventing the increase of carbon in the whole neighborhood. Within land uses, parking spaces, green spaces, pedestrian and bicycle paths should be strictly observed. Particularly in İzmir, it is necessary to take precautions against flood risks of many settlements. Therefore; green infrastructure such as green walls, green roofs, permeable surfaces, sustainable drainage systems are needed. It is important that the use of renewable energy starts at the neighborhood scale. In this sense, the use of fiber optic lighting systems in the streets, the use of photovoltaic panels, and the use of wastewater as irrigation water is important. In addition, the recycling of waste in the neighborhoods are an important application for the energy cycle. Separate waste boxes should be created for materials such as food, paper, aluminum, plastic, glass.

One of the most important design elements for low carbon neighborhood is low carbon transportation. At the neighborhood scales, the use of carbon-free means transport ensures that large impacts occur on the city scale. In this sense, it is of utmost importance that the neighborhood dwellers are encouraged especially for carbon-free transportation vehicles such as bicycles. Within the neighborhood, in road designs, bicycle, pedestrian, and vehicle paths should be separated from each other and constructed according to specific strands. Even detailed designs such as rubbish bin, lighting elements should be designed to increase the use of bicycles. It is absolutely necessary to place bicycle parking

places in the neighborhood. Residents of the neighborhood should be able to park their bikes safely. In addition, there should be sufficient information and warning signs throughout the neighborhood.

Lifestyle of neighborhood dwellers should be changed by design studies. Relations between land use and transportation are important. Because use of planned land affects low carbon transportation positively. And also, water management issue is very significant. Use of green infrastructures is of great importance in this respect. Rainwater is collected and used as irrigation water or in various areas of daily life. Open green spaces within land use are also of importance. Because these areas are both social space and a means of ensuring clean air cycle.

The five principles of low carbon living were examined in neighborhood scale. As mentioned earlier, neighborhood is the most suitable and most concrete measure of low carbon living. The study, which started at the neighborhood scale, can spread to whole city and create great effects. Use of bicycles is an important key player in accelerating and expanding the spread. In this sense, the design elements mentioned above are important for the increase in bicycle use throughout the city. In addition to these design elements, it should be done in educational activities that increase the level of awareness of the users. All of these define the process that makes up the urban design guide.

In the scope of the study, case studies from the world and from İzmir were examined, principles of low carbon living were defined, awareness survey was made with cyclists, in the context of urban design, walking and cycling priority designs were considered in the neighborhood scale. All these results show that İzmir carries a certain low carbon living potential when compared to world case studies. İzmir does not include all of the low carbon principles, but it is progressing especially in transportation. Besides, "Sustainable energy action plan" and "İzmir green infrastructure strategy" studies prepared by İzmir Metropolitan Municipality constitute low carbon and healthy life scenarios. In particular, it is aimed to reduce the carbon footprint ratio of İzmir until 2020 in the sustainable energy action plans. In addition to these studies, it is seen that there is a certain level of awareness about low carbon living in the questionnaire with cyclists. In respect to this, İzmir has users with a certain level of awareness, as well as urban design studies that give priority to both walking and cycling. This is an important basis for the formation of low carbon neighborhood. In short, in this study, tools that promote low carbon neighborhood understanding is urban design project studies with low carbon

potential, users with this lifestyle awareness, walking and cycling priority design studies (Figure 6.1).

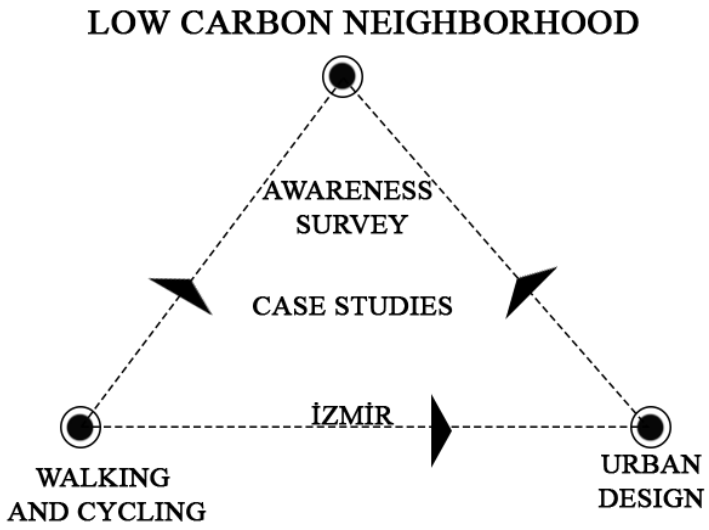


Figure 6.1. Process of Low Carbon Neighborhood

In the city, the role of urban design study is crucial in supporting low carbon living. Within the scope of this subject, the issue of transportation, which has an important place in our lives, was discussed. However, also important design studies need to be done in green infrastructures, renewable energy, energy efficiency, and land use planning. The design tools of the low carbon principles should be adapted to the neighborhood. In the future, it is important to develop design proposals for these principles. As the use of these tools increases, the awareness of the people of the neighborhood will also increase. Moreover, laws developed on this subject should ensure that the people of the city get rid of car dependence. In particular, the "Park and ride" system, which is common in abroad studies, should be adapted to throughout the country. In addition, by law, new buildings should be designed to be appropriate for urban health. With all these practices, people will have a change of behavior and a healthier environment will be created.

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APPENDIX A

SURVEY QUESTIONS

I am a graduate student at the department of City and Regional Planning / Urban Design at İzmir Institute of Technology. The following questionnaire was prepared to test the relevant concepts for the postgraduate thesis entitled "Low Carbon Neighborhood: Walking and Cycling Priority Urban Design".

Contact Information: E- mail: handegundel9@gmail.com

1. Have you heard that the following waste is recycled or decomposed in your

Personal Information	
Age:_____	Gender:_____
Which neighborhood / District do you live in?	

neighborhood?

2. Rank the green infrastructure systems mentioned below "4" as you

	Never heard that	**I heard, but do not use**	**I hear and I use**
Food			
Paper			
Aluminum			
Plastic			
Glass			

know most, "1" you know least.

( ) Water Tank ( ) Green Wall ( ) Green Roof ( ) Permeable Pavement

3. How do you get warm in your house?

a) Natural Gas b) Electric c) Wood/coal

4. **Have you heard the following energy saving systems?**

	Never heard that	**I heard, but do not use**	**I heard and I use**
Energy Saving Bulbs			
Wall Insulation			
Double Glass			
Roof Insulation			
Condensed Combi Boiler			

5. **What do you think about the traffic jam in your neighborhood?**

   a) High-Density b) Middle-Density c) Low-Density

6. **Rank the reason of obstacles which hamper creating safe routes in your neighborhood "3" as the most important reason, "1" the least important reason.**

   ( ) Insufficient road width
   ( ) Inadequate enlightenment
   ( ) Bicycle, pedestrian and vehicle path are not separated

7. **Why is the presence of parking spaces, green spaces within your neighborhood land use important for you? (The most important reason= 3, The least important reason= 1)**

   ( ) It is important as a recreational area
   ( ) It is important as an urban area and biodiversity
   ( ) It is important as a tourism and business opportunity

8. **Have you heard the measures against extreme weather conditions and flood risks mentioned below?**

	Never heard that	**I heard, but do not use**	**I heard and I use**
a)Sustainable Drainage Systems			
b) Rain Water Conservation Systems			
c) Planting Open Areas			
d) Green Roof Systems			

9. **What do you think about park areas, open areas, green spaces within your neighborhood?**

   a) Useable b) Not available for use c) Insufficient their numbers

10. **What type of transport do you use most often? (You use most often= 4, You use least often= 1)**

( ) Automobile ( )Public Transportation ( ) Electrical Bicycle ( ) Bicycle/walking

11. **What do you think about the following energy production opportunities?**

	Never heard that	**I heard, but do not use**	**I heard and I use**
Photovoltaic Panels			
Waste Water Production			
Water Saving Faucets and Installation Materials			
Thermal Insulation in buildings			
Fiber Optic Lighting Systems			

12. **When it is said low carbon city which of the following do you think? (The most known= 4, the least known= 1)**

( )Healthy Life ( )Safe and liveable Streets ( )Sustainable Urban ( ) Other

13. **What are you doing to support low carbon awareness in the city? (The most action= 4, the least action=1)**

( ) Use recycle materials

( ) Prefer public transportation

( ) Use of renewable energy resources

( ) Other

<u>SECTION 2</u>

1. **Which transportation mode do you personally use except for the bike, including your commuting?**

( ) Automobile ( ) Public transportation ( )Walking

2. **How many hours a week do you spend in a car as a cyclist?**

   a) Less than 5 hours b) Among 5 – 15 hours c) Among 15-25 hours

3. **With what purpose do you prefer to cycle on the road**? **(The most preferred= 3, The least preferred=1)**

   ( ) Not being affected by traffic congestion
   ( ) Very important for health
   ( ) To keep the environment clean

4. **For what purpose do you prefer to cycle on the road**? **(The most preferred= 3, The least preferred=1)**

   ( ) To work or school for going/returning are preferred
   ( ) Business vehicles such as delivery, carrying
   ( ) Sport / Exercise

5. **What is your reason for choosing a bicycle, when you think of the whole city? (The most= 3, the least= 1)**

   ( ) Providing Sustainable Transportation Support
   ( ) Contributing to the Creation of a Low Carbon City
   ( ) Contributing to Urban Recreational Activities

6. **How often do you use bicycle on the road?**

   a) Every day b) Frequently c) Sometimes

7. **Which routes do you use as a priority when you cycle? (You use most often= 4, you use least often= 1)**

   ( ) Coastline
   ( ) Routes that are parallel to the current vehicle traffic
   ( ) Routes within existing pedestrian traffic
   ( ) Other

8. **Which public transportation do you use integrated with your bike? (You use most often= 4, you use least often= 1)**

   ( ) Municipality Bus ( ) Metro – İzban ( ) Ship

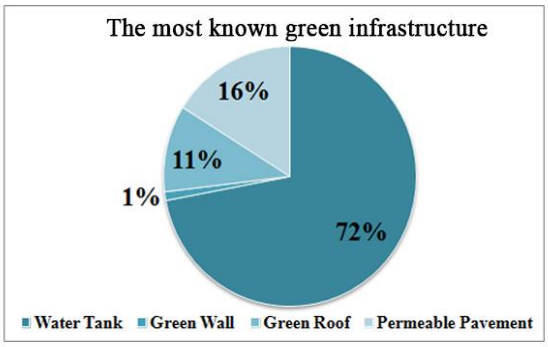
9. **Why is it important for you to increase the use of the bicycle in the city?**

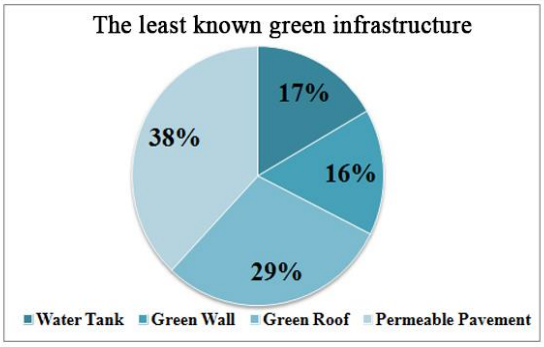
   ( ) Carbon rate decreases in the city
   ( ) Traffic accidents are reduced ( ) Increased accessibility in the city

APPENDIX B

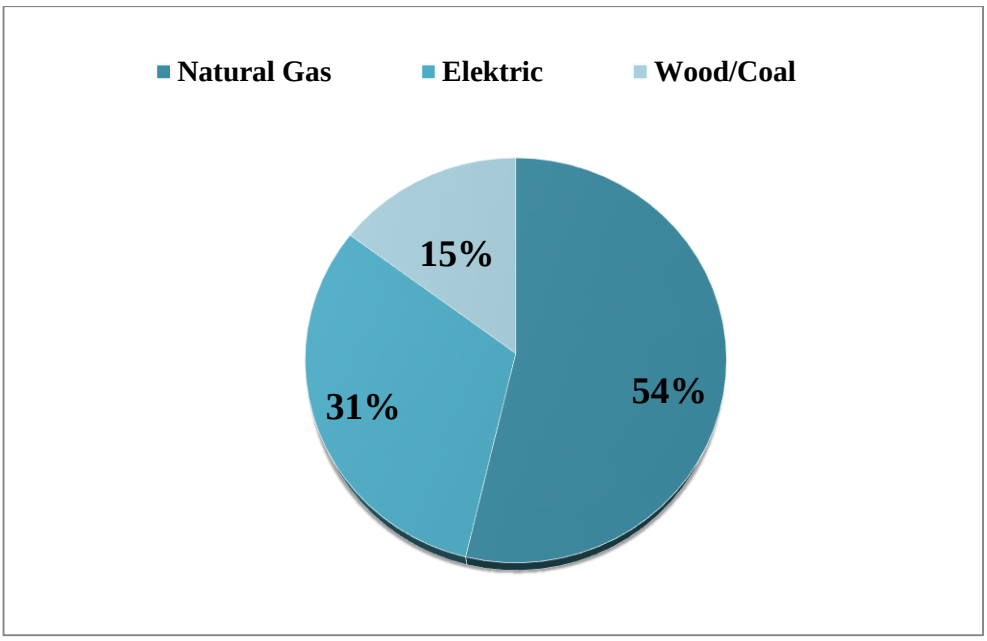
DETAIL OF SURVEY ANALYSES

-In the second question, participants' information on the green infrastructure was assessed.

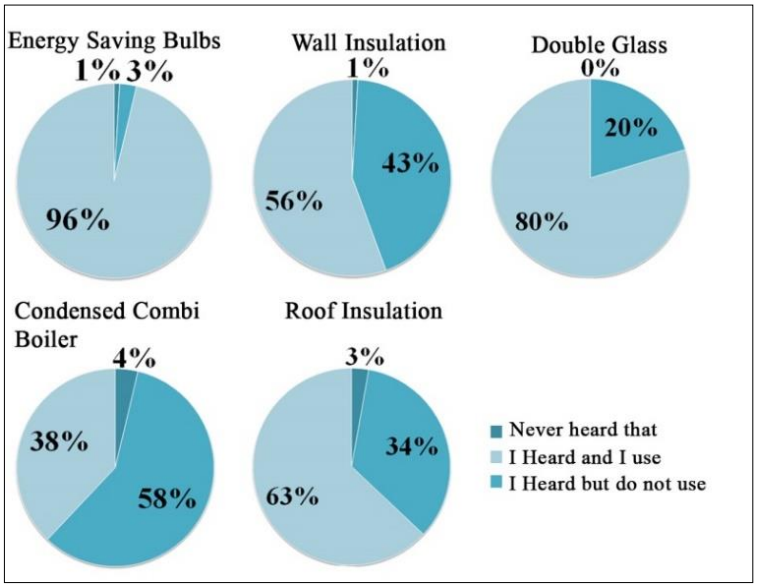




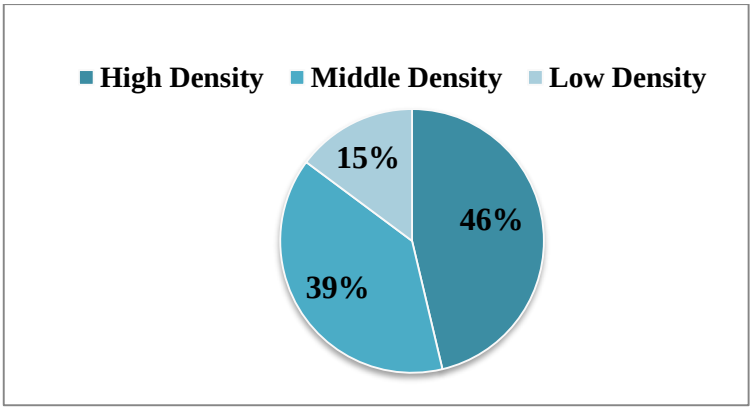
-In the third question, participants were asked how they heat their homes



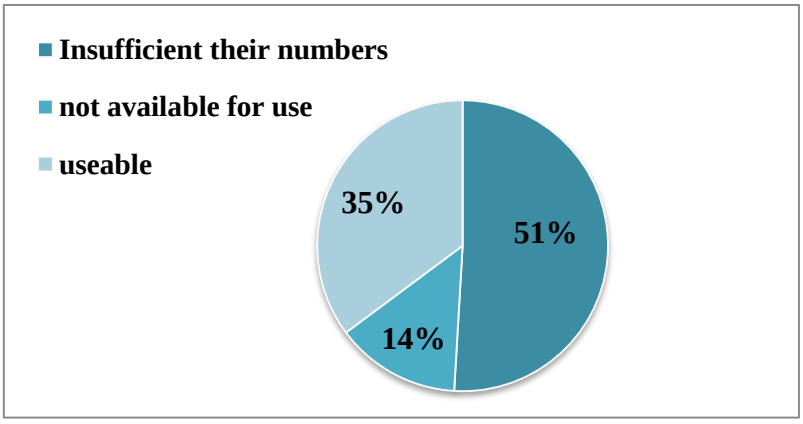
-In the fourth question, information on energy saving systems of participants



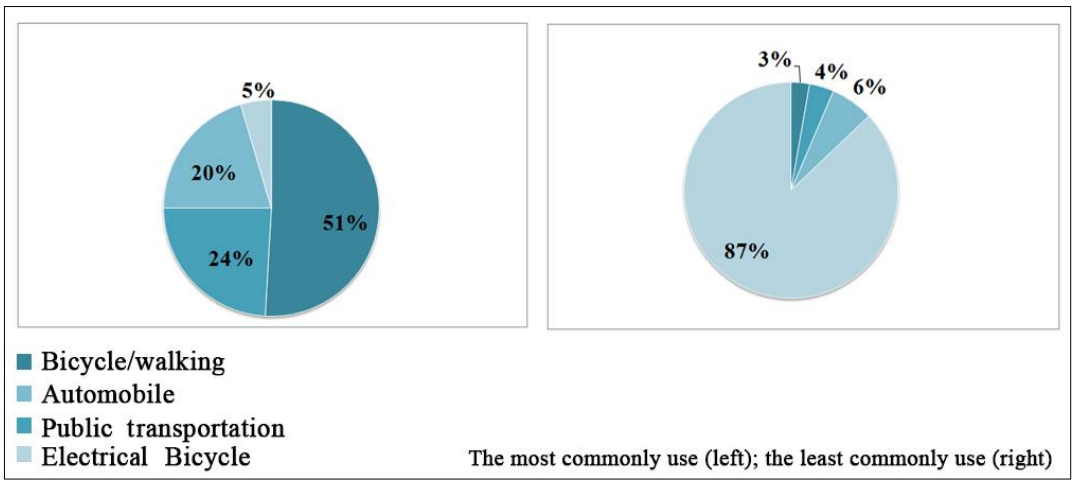
-Traffic Intensity in participants' neighborhoods



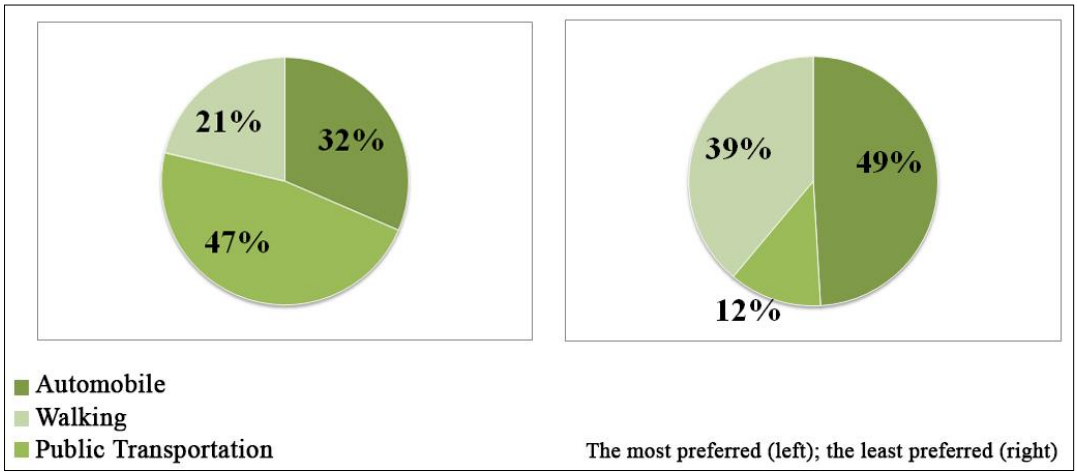
-The availability of parking spaces, open spaces, green spaces in neighborhoods.



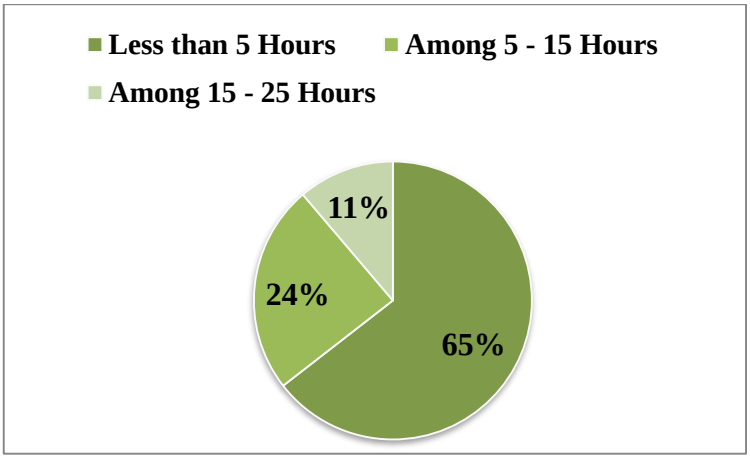
- The type of transportation participants use to go to their most often visited places



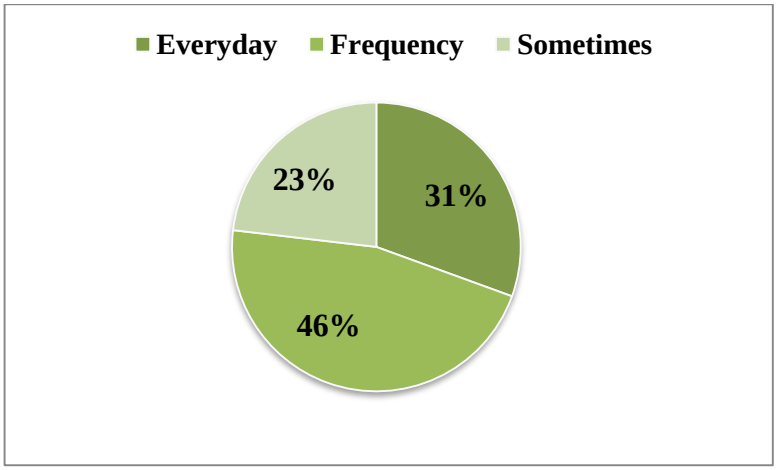
-Preferred transportation mode except bicycle.



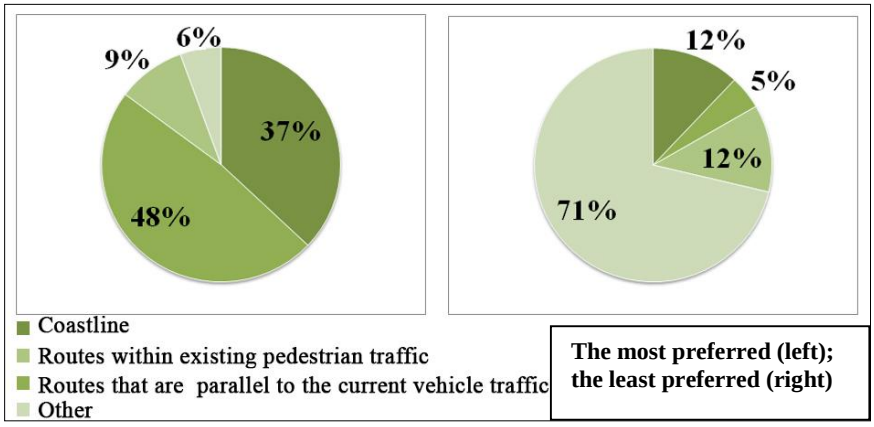
-Weekly driving periods of cyclists.



- Participants' frequency of bicycle use in transport.



- Preferred routes when cycling



-The diagrams show the reason why bicycle users prefer bicycle.