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GLOBAL CLIMATE CHANGE AND CLIMATE-SMART URBAN DEVELOPMENT: THE CASE OF HYLLIE

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ABSTRACT

Global climate change is one of the issues that the world is increasingly discussing. Greenhouse gases are emitted from many human activities such as production, shelter, heating, transportation, and consumption. For this reason, it is accepted that the source of climate problems is human activities. Therefore, the cities where most of the world's population lives stand out as the places where the problem begins, and the solution begins. This study approaches the global climate change problem in terms of cities. In the study, first, the role of cities in the solution of climate problems is emphasized. The study aims to define the concept of a climate-smart city and its components and to emphasize that climate-smart urban development and planning should rise on four components. The study focused on the example of a climate-smart urban space project developed by the Municipality of Malmö in an area called Hyllie. The stages of a climate-smart urban development were analyzed by evaluating Malmö Municipality's policies, reports, plans, and programs regarding Hyllie. Examining the case of Malmö within this framework it has emerged that a fourth component should be added to the three components that are predicted to be necessary for a climate-smart urban development in the literature. The analysis of the Malmö experience added the idea of executing all these processes with a governance approach (iv) to the idea of blending climate orientation (i) with smart city systems (ii) in urban planning (iii).

Keywords: *Climate Change, Smart City Systems, Urban Planning, Climate Orientation, Governance.*

Jel Codes: *Q54, R11.*

KÜRESEL İKLİM DEĞİŞİKLİĞİ VE İKLİM-AKILLI KENTSEL GELİŞİM: HYLLİE ÖRNEĞİ

ÖZ

Küresel iklim değişikliği dünyanın giderek daha fazla tartıştığı konulardan biridir. Üretim, barınma, ısınma, ulaşım ve tüketim gibi birçok insan faaliyetinden sera gazı yayılmaktadır. Bu sebeple, iklim sorunlarının kaynağının beşerî faaliyetler olduğu kabul edilmektedir. Dolayısıyla, dünya

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nüfusunun çoğunluğunun yaşadığı kentler sorunun başladığı ve çözümün başlayacağı yerler olarak öne çıkmaktadır. Bu çalışma küresel iklim değişikliği sorununa kentler açısından yaklaşmaktadır. Çalışmada öncelikle iklim sorunlarının çözümünde kentlerin rolü üzerinde durulmuştur. Çalışmanın amacı, iklim-akıllı kent kavramını ve bileşenlerini tanımlamak, iklim-akıllı kentsel gelişim ve planlamanın dört bileşen üzerinde yükselmesi gerektiğini vurgulamaktır. Çalışma, Malmö Belediyesi'nin Hyllie isimli bir alanda geliştirdiği iklim-akıllı bir kentsel alan projesi örneğine odaklanmıştır. Malmö Belediyesi'nin Hyllie ile ilgili politikaları, raporları, plan ve programları değerlendirilerek, iklim-akıllı bir kentsel gelişimin aşamaları analiz edilmiştir. Malmö örneğinin bu çerçevede incelenmesiyle, literatürde iklim-akıllı bir kentsel gelişim için gerekli olduğu öngörülen üç bileşene, bir dördüncü bileşenin eklenmesi gerektiği sonucu ortaya çıkmıştır. Malmö deneyiminin analizi, iklim odaklılık anlayışı (i) ile akıllı kent sistemlerinin (ii) kentsel planlamada (iii) harmanlanması düşüncesine, bütün bu süreçlerin yönetişim yaklaşımıyla (iv) yürütülmesi düşüncesini eklemiştir.

Anahtar Kelimeler: *İklim Değişikliği, Akıllı Kent Sistemleri, Kentsel Planlama, İklim Odaklılık, Yönetişim.*

JEL Kodları: *Q54, R11.*

1. INTRODUCTION

Discussions on climate change have started around issues such as the depletion of the ozone layer, global warming, the melting of glaciers, and the change of seasons. In the news and the media, these issues were presented together with photos or videos showing the arctic regions and the dry lands one after the other. At first, climate change was perceived as a general problem of the planet. Since there is no problem that individuals and administrations can fix immediately, there has been no significant attempt in this direction. However, as time passed, it began to be stated that the problem of global climate change was behind extreme weather events and some natural disasters. Houses and cars damaged in the hurricane and flooded in the flood brought the damaging effects of this global problem to the door.

In the 1980s, the problem of climate change started to be discussed together with environmental and sustainability issues at conferences organized by international organizations. It has been emphasized that human activities, especially industry, cause environmental and climate problems. The agendas of subsequent international conferences focused more on climate change. Climate panels have been arranged and contracts have been opened for signature by governments. One of the weightiest matters emphasized in these meetings is the relationship between climate change and cities. The cause of climate change problems is human activities. Cities with dense populations cause more greenhouse gas emissions. Therefore, cities have crucial duties and responsibilities.

Although it has global consequences, it is necessary to focus on the local causes of climate change. There are more greenhouse gas emissions in settlements where the population is concentrated, and human activities are intense. This study emphasizes the role of cities in the global climate change problem and its solution. The study aims to reveal the basic components of creating a climate-smart city. In the study, it is adopted to adopt the climate-oriented approach as a principle in the urban development and planning phase and to use the most modern and environmentally friendly smart systems. However, it is argued that this can be achieved with the participation of the public and other stakeholders and a governance approach.

2. THE ROLE OF CITIES IN SOLVING CLIMATE CHANGE ISSUES

Mitigating the negative effects of global climate change is a vital issue that needs to be worked on before it's too late. And it needs to be addressed on a local/urban scale for the following reasons (Dodman, 2009: 198):

- First, local governments and authorities have the potential to implement mitigation programs effectively because of the types of responsibilities they have for land use planning, local public transport, and enforcement of industrial regulations. Urban authorities can also set ambitious targets for emission reductions. For example, the City of London, in its Climate Change Action Plan dated 2007, set the target of fixing carbon dioxide emissions below 60% of 1990 levels by 2025 (Mayor of London, 2007: 7). According to the 2018 London Environment Strategy, London will achieve the best air quality among major world cities by 2050, become a zero-carbon city with energy-efficient buildings, clean transport, and clean energy, more than half of the area is green, and by 2030 it will be urban. It has set big goals such as recycling 65% of its solid waste, being resistant to severe weather conditions and longer-term climate change effects and transitioning the city to a low-carbon circular economy (Mayor of London, 2018: 25).
- Second, the concentration of the population and industrial establishments in big cities provides an opportunity for technological innovations such as combined heat and power systems that can produce electricity more efficiently and waste-to-energy plants. It also makes public transportation and transportation systems cost and time efficient. Such efforts are increasingly seen, even in cities in low- and middle-income countries. For example, in many countries, heating and cooling systems are being developed with energy efficiency and low-carbon principle.
- Third, this concentration also provides an opportunity for the rapid diffusion and adoption of new ideas and innovations in both technical and behavioral solutions. For example, efforts are made to find smart and practical solutions as well as environmentally friendly and sustainable ones to reduce the negative consequences of climate change. Research and development studies are gaining importance to develop new technologies.

- Fourth, reducing greenhouse gas emissions brings with it a variety of other urban benefits. For example, making urban transportation with more environmentally friendly vehicles will reduce both greenhouse gas emissions and transportation costs. It will reduce traffic density and bring results that support pedestrian safety and health.

It is increasingly being voiced that local governments should be involved in global efforts to reduce greenhouse gas (GHG) emissions. However, it is useful to point out one point. Just as city centers register different levels of development and roads, cities do not contribute to global warming at the same level. Carbon emissions per capita in cities in low- and middle-income countries are a fraction compared to affluent urban areas. For example, the average per capita emissions in Los Angeles are four times higher than in Mexico City. Therefore, the priority of local governments may not be to reduce carbon emissions. However, it is by no means that urban areas in middle-income countries should take a passive stance toward this global concern. Rather, they need to take action by citing climate change to promote sustainable urbanization models. They need to make energy-efficient means of production and consumer goods (and services) accessible to more people, without endangering natural resources, ecosystems, and people's livelihoods at local, national, and global levels (Romero Lankao, 2007: 520).

The world has experienced an unprecedented degree of urbanization in the last thirty to forty years. The urban development pathway adopted by cities is a crucial factor in determining energy choice and measuring local emissions of air pollutants and greenhouse gases. Such roads also affect urban carbon sinks. It plays a significant role in determining the vulnerability of cities to the effects of climate change. The links between cities and climate change are complicated. Understanding the factors that explain such pathways is critical for finding appropriate solutions to problems. Above all, managing climate change at the city level and taking the necessary measures for climate change are very difficult tasks, given the fact that cities focus primarily on local issues. However, climate change is already happening; now cities need to demonstrate how they can contribute to reducing the causes and effects of climate change (Dhakal, 2008: 173).

The growing threat of climate change necessitates a comprehensive reassessment of development models and strategies to be developed and implemented at the global, regional, national, and local levels. For the solution of the climate problems, global, national, and regional strategies to mitigate/reduce greenhouse gas emissions and local policies aiming to eliminate the root causes of climate change (on a local scale) are required. Even in situations of inadequacy and/or inconsistency of national strategies, cities are seen as the most important actors in mitigating the damaging effects of climate change. All over the world, climate problems enter the agenda of urban policy and even urban planning. Cities are given a leading role in policies and strategies aimed at reducing greenhouse gas emissions (Galderisi and Colucci, 2018: xvii).

3. CLIMATE-SMART CITY

Today, it seems difficult for a plan, program, or initiative that does not regard the changing climate risks and only makes use of existing climate and weather information to be sustainable. Ignoring climate risks can only be explained by climate change not affecting the intended activity or by the lack of capacity or resources to take account of this issue (IFRC, 2020: 5).

Ideas or approaches aiming to be compatible with the environment and climate, to be prepared for the possible effects of climate change, and to mitigate its adverse effects are referred to by different names in the literature. Concepts such as climate-friendly, climate-sensitive, climate-aware, climate-conscious, and climate-resilient are frequently encountered in studies on climate change. In recent years, with the spread of smart applications in production, agriculture, urban development, and planning, the concept of climate-smart has been added to these. This study focuses on how to mitigate the negative effects of climate change in terms of cities or how cities will adapt to this change. For this reason, the mentioned concepts will be used in this study in relation to cities and urban development, when the occasion arises.

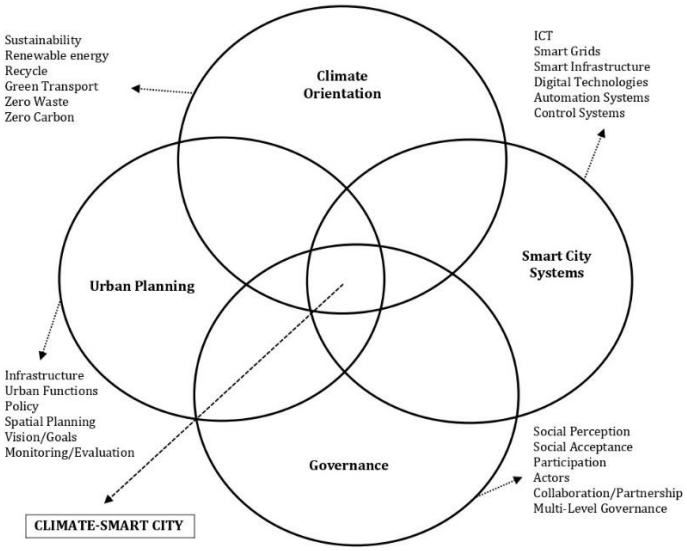
The concepts of climate and city are often used together with the concepts of an environmentally friendly, ecological, sustainable, and green city. A climate-oriented city refers to a city where urban development and planning, policies, services, and programs do not harm the environment, and the negative impacts of climate change are gradually decreasing. The widespread use of bicycles in urban transportation or the use of electric public transportation indicates a low-carbon lifestyle and a climate-friendly city.

Kim (2018) defines climate-oriented urban approaches as a kind of New Urbanism, such as sustainable urbanism and ecological urbanism, and uses the concept of Climate Urbanism. He accepts it as a new model of ecological urban planning and development, which pays special attention to the issues of climate change in cities. He uses the term "climate resilient and low carbon smart cities" as an alternative to the term "ecological cities" for resilience, efficiency, circularity, sustainability, and connectivity. This approach, in which the climate-resilient city is combined with the elements of the smart city, is called the climate-smart city in short. Climate-smart urban planning should be different from traditional urban planning. First, climate planning should be incorporated into city planning policy. This is only possible by creating the necessary planning conditions for integrating all the effects of climate change into the urban planning process. The basic principles of climate-smart cities are (Kim, 2018: xxvii):

- Consideration of the unique suitability of certain lands (through smart zoning),
- Creation of digitally connected smart urban form for resource and energy efficiency (with smart energy grid),

- Management of underground and surface water resources to achieve the right balance between the needs of society and the requirements of the environment (through integrated water resources management with smart water grid),
- Implementation of regional energy projects (with smart heat grid),
- Managing natural and man-made disasters, controlling flood-prone lands and flood risk to protect human health, natural environment, and resources,
- To prevent and control pollution, and to protect and improve air, soil, and water quality by applying the "polluter pays" principle,
- Reducing waste through waste reduction, reuse, recycling, and improved handling and disposal standards,
- Conservation and development of the natural, cultural, and historical value, landscapes, and biological diversity of the city for eco-tourism,
- Conservation, improvement, and promotion of coastal areas to protect coral reefs, use them for appropriate recreational purposes and present them to the public,
- Reducing Greenhouse Gas (GHG) emissions by taking climate change mitigation measures,
- Promoting green infrastructure development in an integrated way

Figure 1. The Basic Components of a Climate-Smart City



The use of smart applications and digital techniques has become a necessity in today's world for a city focused on sustainability, mitigating the damaging effects of climate change, and low carbon emissions. However, the way to combine the climate-oriented approach with the smart city approach is to integrate this idea with urban planning. Kim (2018: xxviii) described this issue as the three pillars of

the climate-smart city and explained it with a figure. However, in the practices and experiences of cities (e.g., Malmö), a fourth pillar seems necessary. In this equation, the understanding of climate orientation should be blended with smart city systems, and it should be included in urban planning. However, the approach of urban citizens to climate problems, the participation of users, their support for policies, and their desire to interact (partnership and collaboration) with other stakeholders are also effective. In this study, a model consisting of four components was developed in climate-smart urban planning and development (Figure 1).

As seen in Figure 1, a climate-smart city consists of four basic components: Climate orientation, smart city systems, urban planning, and governance.

3.1. Climate Orientation

The first component of the climate-smart city is the climate-oriented approach. In order to be prepared for the negative effects of the climate change problem, the city administration must first have a sustainable urban approach. It is necessary to use resources efficiently, to protect the environment and to improve environmental values, to ensure energy efficiency, to reduce the use of fossil fuels as much as possible, and to expand renewable[1] and/or recycled energy[2] solutions. It is necessary to develop policies such as waste prevention, reduction, reuse, recycling, and zero waste in urban solid waste management, in addition to this reducing greenhouse gas emissions in all urban activities such as transportation, construction, and production. The city should be prepared for possible climatic disasters, floods, and adverse developments brought by extreme weather events.

3.2. Smart City Systems

The second component of the climate-smart city is the effective and efficient use of smart city systems in all activities, measurement, determination, control, evaluation, and planning stages. By establishing a smart infrastructure, information and communication technologies, control and automation systems, smart grids, and digital technologies should be used in the best way. Smart systems bring a user-friendly quality to urban activities and services. However, smart systems provide significant advantages in identifying and reporting environmental and climate problems, supporting planning with urban data, and ensuring the participation of citizens (users), beyond just running certain services in a digital environment.

Today, the internet is used more than ever before. Using social networks and links, information about everything is shared. Information and communication technologies (ICT) are also faster and more

[1] Renewable energy sources are accepted as solar, geothermal (ground water), wind, biomass (organic wastes such as plant residues, algae, fertilizer), hydro (rivers, water, and hydroxides), tide and wave (ocean and sea) (Özkaya, 2004).

[2] Recycled energy is obtained through methods such as generating electricity from landfill gas and incineration of waste for energy recovery.

advanced than ever before. These technological developments provide energy efficiency in sectors such as energy, industry, water, waste, land use, and housing. It helps to monitor the impact of energy use, resource efficiency, and emissions. When applied regularly with appropriate components, ICT can also facilitate monitoring and control of issues related to climate change. Climate-intelligent city planning includes not only the use of ICT infrastructure but also the past, present, and future knowledge bases for carbon reduction and disaster risk management to be developed holistically. The development of low-cost real-time digital technology, the internet, smart vehicles, and infrastructure offers new opportunities to combine existing smart city models with climate-driven city models. These technologies can be used to improve the efficiency, sustainability, circularity, resilience, and connectivity of tools such as policy, management, planning, technology, and economy designed for climate-driven cities. The use of smart city systems for climate-oriented cities will also enable strategic urban growth. Climate-smart urban planning will reduce greenhouse gas (GHG) emissions for green growth. It will help adapt to climate change, by means of the development of control and automation systems for measurement and evaluation purposes. Incorporating the smart city concept (using technologies such as ICT, smart grid, and smart infrastructure) into climate-oriented urban development constitutes the most significant pillar of the climate-smart city model (Kim, 2018: xxiii ff.).

3.3. Urban Planning

The third component of the climate-smart city is urban planning. If the climate-oriented city approach is to be supported by smart systems, this requires holistic and inclusive city design and planning. In order to fulfill the urban functions and services in the best way, it is necessary to use the land in the most efficient way and to establish a strong infrastructure that will prepare the city for the most negative developments and worst scenarios. The vision, goals, and growth principles of the city should be determined, and plans and policies should be developed by following these guiding principles. As in every planning, monitoring and evaluation are of great importance in urban planning.

Climate change, among other factors, has a significant impact on the city's vision, future, and competitiveness. Low-carbon, climate-resilient urban development is essential to create livable cities with clean air and green spaces, green transportation, a healthy and active urban lifestyle, well-managed waste and energy services, and safe, resilient, and green buildings. In addition, the investment potential of climate-smart urban infrastructure is enormous[3]. Major investments in climate-smart urban infrastructure are required in areas such as energy efficiency, renewable energy sources, clean water supply, waste management, public transport, and e-vehicle charging. It should not be forgotten that the urban population continues to increase. Realizing the investment potential of cities requires focusing on

[3] IFC's Climate Investment Opportunities in Cities report identified $29.4 trillion in investment opportunities in six urban sectors (renewable energy, public transport, climate-smart water, electric vehicles, and green buildings) in developing countries (IFC, 2018).

holistic urban planning and spatial plans that support low-carbon, compact urban development (Carter and Boukerche, 2020: 9).

Climate change problems, increasing extreme weather events and disaster risks bring about a significant change for cities. In order to keep up with this change, it is necessary to make significant changes in the planning and management of cities. A climate-oriented city planning is a good tool for achieving sustainable development goals and economic development. The structure of a city expresses the spatial model of its units and functions. It is important to plan the space so that there is a strong interaction between units and functions. However, the current city planning system cannot go beyond the effective and systematic coordination of sectoral plans with the sustainable development agenda (Kim, 2018: xxiii).

Multi-sectoral development-oriented zoning and planning allow governments and other stakeholders to consider possible land use options for different areas. It helps them choose the best options based on probabilities, limitations, and values. Spatial planning is a critical device for integrating climate and environmental policies and disaster measures into development plans. Environmental authorities, which provide environmental information and analysis that are fundamental to spatial planning, encourage spatial planning as a way to become more climate-focused, prevent environmental degradation, and protect ecosystems (UNEP, 2011: 27).

In contemporary planning practice, it is quite difficult to develop climate-smart and green cities. The reason for this difficulty is that the understanding of green infrastructure is not sufficiently adopted in urban planning. However, climate change issues have a significant impact on promoting green infrastructure in the strategic urban planning process. This is a result of the fact that green infrastructure promotes the implementation of ICT tools and using them in planning climate change mitigation measures (Crnčević, Tubić and Bakić, 2017: 40).

3.4. Governance

The fourth component of the climate-smart city is governance. As it is known, governance is a multi-layered (global, regional, national, local) approach in which all stakeholders, especially citizens, are involved in decision processes. Climate change, on the other hand, is a problem that has global consequences and that needs to be addressed and policy formed at the regional, national, and local levels. Cities must make climate-oriented plans and policies to reduce the negative effects of climate change and to prepare for extreme weather events. However, for these plans and policies to be successful, national, regional, and global climate policies should not be ignored. At the same time, these policies need to be adopted and supported by the inhabitants of the city. For example, in the gradual reduction of fossil fuel use and the spread of renewable energy; in the reduction, separation at source and reuse of domestic solid wastes; in choosing environmentally friendly, climate-sensitive, and/or recyclable

products; the perception and acceptance of the society are important in changing the lifestyle and consumer culture in this direction. In addition, the usefulness and efficiency of control and automation systems, information and communication technologies, and other digital systems depend on the support, information entry, and interaction of users (citizens).

For a climate-smart city, the social and political participation of stakeholders, that is, local governance is very important in the development, decision-making, and implementation processes of urban policies. The involvement of stakeholders only in the implementation processes will adversely affect their participation and support. Urban stakeholders will be more involved in and support the implementation of policies in which they are involved in co-development, planning, and decision-making.

The governance component also includes cooperation and partnerships in solving problems related to the city. The cooperation of public institutions with private sector organizations (PPP: public-private partnership) as well as the participation of the academy in this cooperation (triple helix) provides great advantages. The support of urban citizens and civil society will also strengthen this governance structure (quadruple helix).

4. CLIMATE-SMART HYLLIE EXAMPLE

Malmö, the largest city in Scania (Skåne) Province, is Sweden's third largest city. According to the statistics of 2022 (Statistics Sweden, 2022), 357,377 people live in Malmö, which has an area of 156.95 square kilometers. Since there are 2277 people per square kilometer, it can be said that the population density of the city is high. Located at the southern point of Sweden, Malmö is the closest Swedish city to Denmark. Affected by the oil crises of the 1970s, Malmö has moved from a production center with a strong focus on sustainable planning to the goal of becoming an information city. The Öresund Bridge, which was opened in 2000 and connects the cities of Malmö and Copenhagen, has increased the city's connections with Denmark and Europe by providing easy access to employment and settlement opportunities (Anderson, 2014: 10).

Located at the southern tip of Sweden, Malmö has a milder climate than Scandinavian cities with a cold climate. Due to the influence of the ocean current known as the North Atlantic Drift and the prevailing air currents, Sweden's average temperatures are higher than in similar northern countries further inland. Even, the average temperature and precipitation in the southern part of Sweden are higher than in the north of the country (McCoy, 2003: 516).

Malmö Municipality is the largest of 11 municipalities within the Malmö metropolitan area. Malmö has undergone a significant transformation after its decline in the 1970s, including architectural developments, sustainable planning projects, and attracting new international companies to the area. It

has launched quite ambitious urban and economic planning initiatives. In 2013 Malmö was divided into five major regions: east, west, north, south, and inner city. The planning and construction process was started by creating ten regions within these areas and dividing them into sub-areas and statistical areas (Anderson, 2014: 10-11). With the old port areas opening to settlement, areas such as Hyllie that had to be built from scratch emerged.

Hyllie is an urban area/neighborhood that connects southern Malmö to the Scania plain. Before the project started, this part of the city consisted of fertile arable farmland in a nearly empty state (Figure 2). Nowadays, the region has grown rapidly and has become a large and dense settlement with a focus on climate and sustainability. There are offices, schools, kindergartens, parks, and streets as well as residential areas in the rapidly developing Hyllie. Construction work continues with various detailed plans and comprehensive programs (Malmö Stad, 2021a).

Before moving on to Hyllie, one of Malmö's urban development policies, it is necessary to talk about the initiatives of the city administration that idealize the sustainable city approach. In 2009, Malmö Municipality adopted the Environment Program 2009-2020 and the Malmö Energy Strategy. The Environment Program's goal was for Malmö to be the world's best in sustainable urban development by 2020 (Malmö Stad, VA SYD and E-ON, 2011). The Environment Program (Miljöprogram) adopted by the Malmö city council on 17 December 2009 defined four overarching environmental targets (Malmö Stad, 2009a):

- *Malmö will be Sweden's most climate-smart city.* By 2020 Malmö Municipality's own organization should be climate neutral and by 2030 100% renewable energy should be supplied to all of Malmö. Energy should be used more efficiently, energy use in Malmö (based on the average annual use between 2001-2005) should be reduced by at least 20% per capita by 2020 and another 20% by 2030. More renewable energy should be used. Solar, wind, water, and biogas should be phased in, and fossil fuels should be phased out. By 2020, the proportion of renewable energy in Malmö Municipality's operations should be 100%. The aim is to produce as much of this energy locally as possible. Greenhouse gas emissions must be reduced. Greenhouse gas emissions in Malmö should be reduced by at least 40% compared to 1990. Transportation and travel habits should be adjusted. The development of rail and other electrically powered (green electricity) public transport, and the expansion of the cycle path network, will provide new options for local and regional travel. Opportunities for the transportation of goods by sea and rail should be improved. Adaptation strategies to climate change should be developed. For example, preparations must be made for changing temperatures, rising sea levels, and increased precipitation. Foresight and preparedness will deliver huge environmental benefits and lower costs.

- *The urban environment of the future will be in Malmö.* By 2020, Malmö should become a leading knowledge, promotion, and development center with a focus on sustainable urban development. Those

living in Malmö should experience a good urban environment with low noise levels and clean air. Malmö has a strong position on urban sustainability and should continue to develop as a driving force in this area. Resources should be used more wisely. Malmö should be a dense, mixed city, with housing, green spaces, services, and businesses close together. Land use should become more surface-efficient (for example, by reusing old industrial land). The city should be cleaner and quieter. Cycling, walking, and public transport should form the basis of the transport system. In Malmö, the traffic system should be designed to minimize air pollution and noise, with priority given to the city center. Green (trees, plants) and blue (water, lake, river, sea) qualities should be developed. Parks, green spaces, and aquatic environments in Malmö need to be expanded and protected. It should have high recreational and biological qualities. The urban environment can be beautified, for example, with vegetation-covered roofs and walls. Open rainwater management should be developed, and stone and concrete environments should be supported with greenery and water. A good living environment must be ensured for everyone in Malmö. Malmö residents must have access to healthy, safe, and secure housing. All children should have the opportunity to play outdoors in healthy and inspiring environments.

- *Natural resources should be used sustainably.* Malmö's natural resources (land, sea, limestone bedrock, groundwater, and biodiversity) must be well protected and used sustainably. Malmö should be a city that grows without neglecting its resource efficiency. First of all, the areas in the city, especially the land in the old business areas should be used. In this way, fertile arable land will not decrease. Agriculture in Malmö must be sustainable. Water resources, parks, and green spaces should be protected. By 2020 Malmö should have a leading role in all water councils that affect the municipality. Groundwater has the potential to be a future source of water for a variety of purposes. The nature of Malmö must be protected. Responsibility should be taken for rare and threatened species (biodiversity) living in and around the city. Malmö residents must increase their knowledge and commitment to nature.

- *It's easy to do the right thing in Malmö.* In 2020, the use of resources will be characterized by "sustainable and long-term" expressions. Making sustainable choices in goods, services, energy, travel, and waste management should be easy for both the business community, the residents of Malmö, and the organization of the Municipality of Malmö. Sustainable supply approach should be adopted. The city of Malmö should review its procurement and purchasing routines as well as the resource consumption of its municipal organization. The market share of organic and locally produced food should increase in the city of Malmö. The use of harmful substances should be reduced. Hazardous substances should be phased out of the cycle through information, cooperation, and control. Malmö Municipality must disable goods that already contain such substances at the time of purchase. Sustainable material choices should be made in all sectors. Waste must be recycled. The ever-increasing trend of waste must be broken. The most effective way is to minimize waste generation. The separation (at source) and recycling policy should become simpler and more accessible. Malmö should be a city of

knowledge and innovation. Existing clean technology companies should be strengthened and attract new business ideas and new companies. Sustainable consumption and lifestyle should be promoted. It should be easy for Malmö residents to make environmentally friendly, sustainable, and non-toxic choices. Consumption and production must be more resource-efficient, smarter, and more focused on quality.

The Malmö Energy Strategy (Energistrategi för Malmö) adopted in 2009 also emphasizes similar basic ideas to the Environment Program. The strategy aims to contribute to central, regional, and local work in Sweden's energy transition, to form the basis of energy issues in other governing documents (such as the Environmental Program) in the city, and to set out general objectives and guidelines on energy issues. The Energy Strategy has identified three main problem areas in the energy sector: First, energy use pollutes the air, causing damaging environmental effects (carbon dioxide, sulfur, and nitrogen emissions). Nitrogen dioxide levels in some locations in Malmö exceed applicable environmental quality standards. This means a risk to public and environmental health. The second problem is uncertainty and interruptions in energy supplies (such as the oil crisis or power outages). The third problem is that the costs in the energy field are very high because of the partial lack of competition. Three general strategies have been identified to overcome these three problem areas and achieve energy targets in Malmö: Using energy more efficiently, switching to renewable forms of energy, and good management of planning, economy, security, and information (Malmö Stad, 2009b).

Again in 2009, the Environmental Building Program (Miljöbyggprogram SYD Version 1)[4], which aims to build ecological and sustainable buildings, was accepted by the Municipality of Malmö and the Municipality of Lund (assemblies). The Environmental Building Program was carried out as a joint effort between these municipalities and Lund University. The program is essentially a dialogue effort between municipalities, universities, and stakeholders from the construction industry to share experiences and discuss good practices. Dialogues were established with real estate builders and joint seminars were held on sustainable and environmentally friendly construction. It was emphasized that the housing and building sector constitutes an important material use, and at the same time, more than one-third of Sweden's energy use is used by this sector. It is emphasized that new buildings can be designed with significantly less resource use and less climatic and environmental impact. Together with the Environmental Construction Program, an internet-based platform was created for constructive and strategic cooperation between municipalities, construction companies, and other actors for ecologically sustainable development. The program, developed in cooperation between Malmö Municipality, Lund Municipality, and Lund University, was updated in 2012 (Miljöbyggprogram SYD Version 2). The

[4] Previously, the Municipality of Malmö implemented the construction programs called Ecologically Sustainable Construction in Malmö (Ekologiskt hållbart byggande i Malmö) and the Municipality of Lund Sustainable Construction and Management (Hållbart byggande och förvaltning). The new building program has replaced those programs (Malmö Stad, et al., 2009). However, the Environmental Building Program has also phased out after the Hyllie Environment Program was adopted in 2015.

program includes a set of measures to achieve sustainable construction, emphasizing different focus areas such as energy, humidity safety, indoor environment, urban biodiversity, building acoustics, and traffic noise (Malmö Stad, Lunds Kommun and Lunds Universitet, 2009; 2012).

Hyllie is the next development area from Malmö Municipality's West Harbor. In the city government's comprehensive plans, Hyllie had long appeared as an area south of the city. The area was home to a water tower and fields until the early 2000s (Figure 2). In 2000, the Öresund Bridge was built, connecting Malmö and Copenhagen by road and rail. The Swedish Government has decided to build a railway tunnel under Malmö that will shorten the journey between the two cities. The presence of the Hyllie Train Station in the plans for the tunnel (Figure 3) accelerated the plans for urban development in Hyllie. The first part of Hyllie to be developed was the train station, which opened in 2010, and a commercial center located around it. Between 2008 and 2012, a multi-purpose sports and performance area (Malmö Arena), a large shopping mall, a conference center, and office buildings were completed. The planning of the first residential neighborhood started in 2007 and the first buildings were ready in 2013. As of 2015, Malmö Municipality had planned that Hyllie would house 9,000 apartments by 2040 (Parks, 2020a). However, Hyllie is now Malmö's largest urban development area. It is estimated that there will be 15 thousand workplaces and 25 thousand residences in 2040 in Hyllie, which continues to grow (Malmö Stad, 2021a).

Figure 2. Hyllie in 2004

Source: Malmö Stad, 2015b

Figure 3. Hyllie in 2009

Source: Malmö Stad, 2015b

Malmö has been working towards the sustainability of urban planning since the 1990s when the West Harbor (Västra Hamnen) area began to be rebuilt. The city administration and planners worked on the construction and development of the region and other parts of the city with the principles of social and environmental sustainability. Malmö Municipality worked up Hyllie as a climate-smart urban space and a model for the rest of the city. This is a vision that combines smart city discourses with the city's environmental governance goals. Hyllie's vision brought about a large smart grid project financed by

the Swedish Energy Agency. With this project, smart city ideas are implemented in sustainable city planning (Parks, 2018: 3).

Hyllie is Malmö's most important urban development area. Also, Malmö's most important urban development experiments were carried out in Hyllie. Hyllie has become a large-scale "testing ground" (pilot site) for sustainable solutions in energy, transportation, green buildings, and waste management. The biggest driving force behind this situation is the establishment of public-private partnerships with clear common goals. In addition, the goals set in the previous plans gave Hyllie very important missions. In 2011, Malmö Municipality, energy company E.ON, and the public water and sewerage company VA SYD signed a Climate Agreement for Hyllie (Klimatkontrakt för Hyllie). With this contract, guidelines and targets were set to make Hyllie the smartest climate-smart city district in the region. According to the convention, "Hyllie will become the most climate-smart region of the Öresund region and become a global model for sustainable urban development." Today, Hyllie uses 100% renewable or recycled energy for cooling and heating. Work is being done to provide 100% renewable electricity to the region (Malmö Stad, 2021b; Malmö Stad, 2023a). The targets set in the 2011 Hyllie Climate Convention are (Malmö Stad et. al., 2011):

- The energy supply in Hyllie should consist of 100% renewable or recycled energy by 2020. Updated numeric estimates should be available and reviewed regularly so that target work can be tracked.
- Integrated infrastructure systems for electricity, gas, heating, and cooling are being developed at Hyllie. The focus is on an optimized interaction between central and local production. To achieve a good balance between generation and consumption, energy flows in Hyllie must be based on smart infrastructure (smart grid).
- Buildings in Hyllie should be built in conditions that are effective, efficient, energy efficient, and able to take advantage of the opportunities provided by general smart systems.
- A significant proportion of energy demand should be met through locally produced renewable energy (such as solar and wind power).
- Transport in Hyllie should be largely by foot and bike, supplemented by good public transport. In addition to public transportation, smart solutions should be produced for gas and electric vehicles.
- Conditions must be provided in Hyllie to make appropriate choices for a climate-friendly lifestyle. Doing the right thing at Hyllie should be easy.
- Hyllie will become a world-leading model for climate-smart solutions.
- Targeted studies will be carried out by following this roadmap.

Hyllie's development direction, demands, and common goals are set out in this climate convention. In the climate agreement, it was emphasized that in order to achieve the ambitious targets in Malmö's environmental program and energy strategy, Hyllie must take important steps and direct development towards a sustainable city. Four general focus areas have been identified for the success of the joint strategy that the parties plan to follow (Malmö Stad et al., 2011):

- *Energy supply for electricity, heating, and cooling needs:* It is necessary to examine how the energy balance has developed over time at Hyllie. Next, the conditions for establishing a full supply through renewable or recycled energy should be explored. In addition to the supply situation for district heating and cooling, investigations should also include possibilities for local, renewable electricity generation, such as wind power. It should also be investigated how much local electricity and heat generation can be directly produced at the properties.
- *Infrastructure - distribution solutions and interaction between systems and properties:* A solution must be created at Hyllie that enables intelligent interaction between the energy system (as a whole) with efficient use of energy and energy consumption of buildings in Hyllie.
- *Transport solutions:* Hyllie is a network with extremely good opportunities for environmentally friendly transport. Links between different modes of transport should be improved. Conditions must be created for the establishment of new systems for sustainable transport in Hyllie, for example, the development of electric and biogas vehicles.
- *Consumption - control and regulation systems, behavior, and lifestyle issues:* In addition to the establishment of smart systems, citizens' support, information input, and interaction are required. For example, waste management and transportation are areas where behavior and lifestyle influence the outcome of a sustainable solution. Methods should be developed to adopt sustainable policies and encourage active choices among consumers.

In 2013, in addition to the first apartments ready for occupancy, E.ON's smart network platform went live and the real estate company Roth Fastigheter AB, which has built a large number of residences in Hyllie, is connected to this network. The "Flintrännan" biofuel plant was restarted by E.ON to provide renewable central heating. In 2014, MKB, a public housing company owned by the Municipality of Malmö, and Skanska, an international construction company, and Malmö Arena, were connected to E.ON's Customer Energy and System Optimization platform. In 2015, the Kretseum, an information and social activity center (near the water tower, Figure 4), the Hyllie Aquapark (Vattenparken), and the Malmö Arena were officially opened. A final negotiation was held for a smart grid project developed with the intent of establishing a sustainable energy system in Hyllie (Malmö Stad, VA SYD and E-ON: 2015).

Figure 4. Hyllie in 2015

Source: Malmö Stad, 2015b

Figure 5. Hyllie in 2022

Source: Malmö Stad, 2022

In the Hyllie Environment Program (Miljöprogram Hyllie) adopted in 2015, it is emphasized that investments made with sustainable and climate-smart urban principles will continue. The determined environmental targets indicate that the existing principles will not be compromised, and the vision will be preserved (Malmö Stad, 2015a):

- Buildings and facilities built in Hyllie are energy efficient, connected to smart networks, and benefit from the opportunities provided by smart homes.
- A significant part of Hyllie's energy needs is met by local production. The rate of renewable and recyclable energy is increasing gradually.
- Hyllie is climate resilient.
- In Hyllie there is a close dialogue between Malmö Municipality and the developers. Hyllie attracts actors with a high environmental profile. The land allocation policy provides a long-term quality and environmental profile for developers. The Municipality of Malmö assists with grant monitoring.
- Walking and cycling are easier than driving in Hyllie. Hyllie has advanced public transport. There is vehicle traffic in climate-smart city conditions.
- Separation at the source starts from where the waste generates. In Hyllie, waste collection points are close to residences and workplaces.
- At Hyllie, people are well-informed. People can see the results of their lifestyles and change their behavior.
- Hyllie is characterized as a network of green and blue structures. The green area factor ensures the formation of rich green and blue structures in the neighborhood land. A lifecycle perspective is applied to all constructions. Excellent interior environments are designed in the buildings.

The city of Malmö has made significant progress in Hyllie, even in 2015, to achieve its goal of being climate smart. Harmony and coordination between urban stakeholders have been ensured. External financing (such as E.ON, and Swedish Energy Agency) has been provided for the realization of plans and programs. Smart homes are designed in Hyllie. Thanks to the home energy management system (HEMS) and its interface, energy efficiency is supported by smart systems. Studies have been carried out so that people can understand, adopt, and adapt to these new ideas and practices. Intelligent buildings with a building management system (BMS) gateway have been built in Hyllie. To save energy, white goods are connected to the hot water network. Smart buildings have become a sector where new business and incentive models are formed. Infrastructure has been developed for the local generation of energy. For example, thanks to the solar panels on the roofs of the buildings, the buildings produce a significant part of their own electricity. The remote central heating system and smart thermal network are used energy-efficiently. Buildings are connected to a holistic smart grid system and interface. Automation in network stations has shown a significant increase. With the increase in users, customer relations have improved. Transportation in Hyllie is carried out by climate-smart and environmentally friendly methods. Biogas filling stations and electric vehicle charging points have become widespread. Energy balance modeling has been done in Hyllie and an interface has been developed for this. High-efficiency cooling solutions are applied. Core storage capacity has been established for the storage of energy in Hyllie. Integration of photovoltaic cells[5] and local battery storage is provided. Likewise, the thermal network and local heat accumulation are integrated (Malmö Stad, 2015b).

However, the desired success in wind energy production envisaged in the Hyllie Climate Agreement has not been achieved. Company E.ON has promised to build wind turbines based on the contract vision. But when an area (land) was proposed for the installation of wind turbines, two groups objected. One is the land's neighbors, and the other is Malmö Municipality's Property Department. Malmö Municipality and E.ON were unable to resolve the disputes. The Real Estate Department wanted to maximize revenue from the sale of the city's land. At the same time, the land wasn't enough to generate the renewable energy Hyllie needed. If it was used for another purpose, it could bring in more income. Neighbors of the land, on the other hand, thought that the wind turbines would lower the value of the surrounding land. Therefore, they tried to prevent the attempts by legal means. At the end of the discussions, E.ON was able to obtain enough land for only one turbine. The company is exploring ways to comply with its commitments and the Climate Agreement by building turbines outside of Hyllie but perhaps in the Öresund region (Parks, 2020b).

[5] Photovoltaic cells are long-lasting electronic systems that can convert sunlight directly into electricity, have no moving mechanical parts, and are easy to maintain. Photovoltaic cells are semiconductor materials; they convert solar energy directly into electricity (Öztürk, 2017: 1).

As we approached the end of 2022, I emailed Malmö city officials about Hyllie's latest status. They stated that a report on Hyllie's latest condition is in the making. They sent a presentation from a meeting held in November 2022. The presentation also includes an overview of Hyllie (Figure 5) and photographs of the final state of the urban space projects. On 11 November 2022, Malmö City Property and Street Office (FGK - Fastighets- och gatukontoret), City Planning Office (SBK - Stadsbyggnadskontoret) and VA SYD held a non-detailed meeting about Hyllie's situation and future perspective. At the meeting, Hyllie's architectural quality, traffic problems, and metropolitan package issues were discussed. The upcoming milestones of Hyllie and the year 2022 were evaluated (Malmö Stad, 2022).

While the completed urban areas in Hyllie are inaugurated, new urban areas continue to be planned. After the Water Park (Vattenpark) opened in 2015, the construction of a new park (Hyllievångsparken) was started in 2021 for the development of green spaces, while another park (Aktivitetssparken) was opened in 2022.

In Hyllie, while designing homes and workplaces, transportation infrastructure, roads, parks, leisure and entertainment centers, the environment-friendly, sustainable, and climate-smart planning of urban spaces is not neglected. Urban and residential projects have climate-smart elements such as pedestrian and bicycle paths, green environments, energy efficiency, smart grids, solar cells, or roofs with plants (Figure 6). In some urban projects, a specific focus is chosen such as biophilic designs, functional architectural design, and social and environmental sustainability. Subareas and projects such as Hyllieäng/Söder om Badhuset, Solkvarteret, Härbärget, Hyllie allé, Söder om spåren, Parkside/Söder om Klipporna are examples.

Figure 6. Solar Panels/Green Roofs in Hyllie Allé

Source: Malmö Stad, 2022

Figure 7. Solar Panels/Green Roofs in Solkvarteren

Source: Malmö Stad, 2022

Regions, which were far from the negative effects of climate change in the past, have begun to be affected significantly today. The issue of how to manage heavy downpours is a new challenge for the

city of Malmö and other Swedish cities. On August 31, 2014, the heaviest downpour of the recent period, which affected Scania and especially Malmö very badly, was experienced. Parts of Malmö received 100 millimeters of rain in 24 hours. In places such as the underpass, cars and buses were flooded. Rainwater systems were unable to accommodate large volumes of water and many areas of the city were flooded. After this bitter experience, the city of Malmö started working to create long-term sustainable stormwater solutions in newly built areas. The extension of Bunkeflostrand and Gyllin's garden are two of several examples. The floods in recent years have made this work more important. The city of Malmö prepared a storm (downpour) plan (Skyfallsplan för Malmö) in 2017 with VA SYD[6]. This (Malmö Stad and VA SYD, 2017) is a long-term and concrete action plan on how the city should be equipped against torrential rain. According to the plan, the costs associated with torrential rain should be minimized. The security of important social functions should be increased in case of heavy rain. No citizen should be exposed to danger, or their habitat destroyed. Malmö's long-term ambition with its downpour plan is to make the city better equipped to deal with future downpours. The city of Malmö has also made progress in developing and implementing ways to deal with downpours (Malmö Stad, 2021e):

- *Planned flooding:* To deal with heavy rains, deliberate flooding of certain areas is a good solution. Because the entire city was not designed to handle large amounts of precipitation, special places in the city were adapted (designed) to handle the rain instead. Floods are diverted to places where they will not cause damage. Some parks and sports fields can be given as examples of such multifunctional spaces. When constructing new sites, it is a principle to consider possible torrential rains and the need for the site to be resistant to large amounts of water. For example, various retarding reservoirs are useful, where water is diverted before it descends into the rainwater pipes.

- *Avoiding hard surfaces:* Rainwater management is important even during normal rains. Urban citizens should contribute to long-term sustainable stormwater management. The city of Malmö, for example, adopts practices that make it easier for water to seep into the ground and delay its flow into rainwater pipes. However, individual property owners who choose grass and gravel instead of concrete and asphalt for their land also make a significant contribution.

- *Creating multifunctional surfaces:* In Malmö's work to prepare for heavy rains, the city is investing in above-ground solutions, followed by predominantly multifunctional spaces. Intentionally flooding certain areas is an example of a multifunctional solution for dealing with

[6] VA SYD already has many policies and practices regarding storm water. It has invested in stormwater management through the project "Together we make room for water (Plats för vattnet)", which it carries out with the municipalities of Malmö and Lund. It works to reduce the load of the city network and the risks of damage in floods. It provides suggestions and information for the participation and support of citizens in the fight against floods. It even gives a monetary reward to the citizens who separate the water flowing from the roof gutters from the city network (store it in a barrel or pool) and evaluate it in their garden (VA SYD, 2021).

heavy rains. Floods are directed to places where they will not harm (some multifunctional parks and sports fields). Collecting water in underground tanks is very costly, moreover, they take up a lot of space and serve no other function.

The Rainwater Park (Dagvattenparken), which was opened in November 2020, is one of the important "multifunctional parks" in terms of combating the negative consequences of climate change. The Rainwater Park is approximately 23 thousand square meters in size and is located south of the Hyllie Water Park and the trail area. The park is green but can also act as a rainwater reservoir during heavy downpours. It can hold up to 6,600 cubic meters of water. This corresponds to 50 years of rain. Therefore, the entire surface is bowl-shaped; this gave the park a wavy look with elevation differences. The water taken to the Rainwater Park comes from the buildings that span the south of the park, and the need for the reservoir increases as more housing is built. Rainwater from houses and streets flows into a pipe in Hyllie Vattenpark street, and when full, the water overflows into the park. When the pressure in the pipe drops, the water flows back slowly again, meaning there is never more than a few days of water left in the park. There is a pond in the deepest pit of the park. A bridge has been built over the pond that allows you to pass without getting your feet wet. The bridge moves above the surface, which is filled with water during heavy rains and therefore never flooded. Apart from that, the Rainwater Park is green with large areas of grass, meadows, and forests. The vegetation is adapted to cope with temporary floods, with plants that can withstand wetting at the bottom towards the pond and more drought-tolerant species in the upper reaches. Surrounding the Rainwater Park is the Solkvarteren district with residential buildings, a kindergarten, offices, and mobility houses, all with a special focus on solar energy. This focus will also be seen in the park, as the road-facing noise screen will be equipped with solar cells to provide electricity for the park's lighting (Malmö Stad, 2021c).

The residential project, which started in 2021 in the Solkvarteren district, has been the focus of solar energy from the very beginning (Figure 7). There are approximately 470 houses, a kindergarten, and workplaces in the district, which is expected to be completed in 2023. A comprehensive solar system is installed on almost all roof surfaces with proper orientation. It should meet 35% of the facility's total annual energy needs. Any surplus can be sold on the public grid. Another environmental effort in the Solkvarteren district is a green mobility package. Preparations are being made for a simple daily life where there will be no need for a car. Residents have access to an electric bike pool, a large bike room, and expanded maintenance and wash facilities to care for their bikes. For when the bike is not enough, there is a shared car sharing. In addition, every household that moves to the newly built house receives a grant for the purchase of a public transport card. An information campaign is being conducted to help residents gain sustainable travel habits (Malmö Stad, 2021d; Malmö Stad, 2022; Skanska, 2022).

In Malmö Municipality's urban planning studies for Hyllie, sustainability, climate change, climate-smart applications, energy efficiency, smart energy systems, solar energy, urban biodiversity,

water, and waste management, flood, and stormwater management, air quality, smart-traffic, and green transportation solutions are always included as important topics and targets. In fact, it is emphasized in the mainline plans and plan programs that the area is within the scope of the Hyllie Climate Convention and the Hyllie Environment Program (Malmö Stad, 2019a; Malmö Stad, 2019b). For this reason, it can be said that in Hyllie, smart systems and climate-oriented vision are among the important topics and targets of urban planning.

The city of Malmö seeks the opinions of all relevant stakeholders in the preparation, consultation, design, and decision-making stages of urban planning. For example, a consultation process was initiated before the Southern Hyllie Outline Plan (Översiktsplan för Södra Hyllie) was prepared. Consultation for the comprehensive master plan took place between February and May 2014. In addition to turning to boards, organizations, companies, citizens, and authorities, the city has also turned to "professionals" for critical advice. The consultation document was sent to 180 institutions. The document has been sent to Malmö municipal councils and boards, as well as to state and territory authorities, neighboring municipalities in Scania, companies operating in the area, interest organizations, and research institutes. 40 opinions, 35 from institutions, were received via mail. During the consultation process, five public meetings and three general assemblies were held with small groups, companies, and private individuals (Malmö Stad, 2014: 4).

The South Hyllie Outline Plan was on display for review in the entrance hall of Malmö town hall from 29 September 2015 to 1 January 2016. The offer was also featured on a dedicated website. The plan proposal was sent to the committees of the municipality, neighboring municipalities and regional organizations, authorities, companies, political parties, interest associations, landowners, and others (Malmö Stad, 2018a: 4). It has been continuously published on other city-related websites, particularly Malmö Municipality (malmö.se) and Hyllie (hyllie.com), where the plan is open for consultation and contributions. The plan proposal was published in newspapers and magazines, even on social media and blogs. It has been exhibited in libraries, public houses, health centers, and fairgrounds (Malmö Stad, 2014: 4). After the opinions and critical recommendations, the changes made in the plan were counted one by one (Malmö Stad, 2018a: 4). Environmental Impact Assessment for the Outline Plan was announced in June 2018; again, the suggestions received during the consultation process were not ignored (Malmö Stad, 2018b).

Stakeholders and their views were transparently disclosed to the public in the Southern Hyllie Mainline Plan consultation report and in the statement released after the plan was exhibited. The actors taking part in this process, which is carried out with the understanding of participation and governance, and expressing opinions are as follows (Malmö Stad, 2014; Malmö Stad, 2018a):

- *Government Agencies:* Scania Provincial Administrative Board (Länsstyrelsen Skåne), Scania Regional Administrative Board (Regionstyrelsen Skåne), Swedish Civil Contingencies Agency (Myndigheten för samhällsskydd och beredskap), Regional Growth Board (Regionala Tillväxtnämnden)
- *State-owned technical institutions:* Swedish Geotechnical Institute (Statens Geotekniska Institut), Swedish Electricity Network (Svenska Kraftnät), Swedish Traffic Administration (Trafikverket)
- *Nearby cities:* (Burlöv, Lomma, Lund, Staffanstorp, Svedala, and Vellinge Municipalities)
- *Malmö Municipality administrative units:* City Office, Municipal Boards (such as environment, culture, education, service, social resources, leisure committees), Councils (Malmö City Council for the Disabled - Malmö stads funktionshinderråd; Central Pensioners' Council - Centrala pensionärsrådet)
- *Local Public Corporations:* Southern Water and Sewage South (Vatten och Avlopp Syd - VA SYD), Southern Scania Waste Company (Sydskånes avfallsaktiebolag - SYSAV), real estate company MKB Fastighets AB
- *Non-governmental organizations:* Bicycle Promotion Movement (Cykelfrämjandet), Pedestrians Association (Fotgängarnas Förening), Swedish Pensioners' Association (Sveriges Pensionärsförbund), Malmö Sports Associations Association (Malmö Idrottsföreningars Samorganisation)
- *Private enterprises:* energy company (E.ON Sverige AB), real estate company (Josefssons Fastigheter Limhamn AB), real estate and project development company (JM AB - Region Syd Malmö)
- *Urban citizens:* Citizens living in Malmö also attended these planning consultation meetings or provided written comments. They spoke at meetings and criticized the plan proposal by criticizing conflicts of interest related to the plan, for example, "an efficient traffic solution" or "noise level". They expressed what kind of a city and living space they wanted with their suggestions such as "More green spaces, less asphalt!", "More flats should be built", and "Hyllie should have more colour, painting, art, and sculpture.". They said that there should be diversity in city buildings and those constructions in the city should not be given to the same big companies.

A triple helix structure has been developed to develop a conceptual framework and a tool for the prediction of current and future energy balance in the Hyllie region. This structure consists of the relevant units of Malmö Municipality, the public water and sewerage company VA SYD, the energy company E.ON and members of the academy. An academic reference group has been established to provide the project with realistic data on current and future processes regarding the energy balance in

the Hyllie region. Since the Climate Convention concerns areas such as sustainable urban development, energy efficiency, and the waste sector, researchers from different fields were included in the study. Researchers working in the field of social anthropology also participated to understand the aspects of social perception and behavior of the subject (Saraiva Schott et al., 2013: 80). However, it is seen that Malmö Municipality, while creating a climate-smart urban area in Hyllie, has created a quadruple helix structure by involving citizens, non-governmental organizations and all relevant stakeholders in the consultation, planning, and implementation processes. This quadruple structure consists of public institutions, private sector organizations, academia, and civil society.

5.CONCLUSION

Malmö Municipality has applied very well especially urban environmental governance in the climate-smart development of Hyllie as an urban area. In addition, the understanding of sustainability and smart city ideas are the subjects that the city of Malmö adopted and made progress on before Hyllie. Of course, the experience gained from previous projects provides a great advantage in better planning and implementation of new projects. Experience and achievements in sustainability, urban environmental governance, smart city ideas, and sustainable urban planning make the climate-smart city vision more accessible.

Malmö Municipality's climate smart Hyllie project has not yet been completed. Already, targets for 2020, 2030, and 2040 were set at the beginning. As a climate-smart urban development project started from scratch, Hyllie has not been completed yet, but the following developments can be mentioned at the point reached today:

- As of 2023, 7200 people live in Hyllie. There are 3900 residences and an equivalent number of workplaces[7]. It is expected that there will be 4500 houses by the end of the year, including those whose construction will be completed (Hyllie, b.t.)
- Significant progress has been made in the target of zero carbon emissions in the city of Malmö. As with the greenhouse gas emissions originating from the Malmö geographic area, there has been a significant reduction in per capita emissions and greenhouse gas emissions from consumption, central heating, and municipal activities (Malmö Stad, 2023b). Hyllie uses 100% renewable or recycled energy for cooling and heating. Work is being done to provide 100% renewable electricity to the region (Malmö Stad, 2023a).
- The buildings in Hyllie are constructed in accordance with the Environmental Building Program as well as the Swedish Green Building Council's criteria for environmental friendliness, sustainability, health, and zero carbon impact (Sweden Green Building Council, 2023).

[7] As it is an urban development area, information about Hyllie's population and number of buildings was obtained via e-mail from Malmö Municipality officials.

- Transportation in Hyllie is carried out by climate-smart and environmentally friendly methods. Biogas filling stations and electric vehicle charging points have become widespread (Malmö Stad, 2015b).
- All buildings in Hyllie have indoor bike storage. Citizens are offered free membership in a shared vehicle to reduce car ownership. A public transport card is issued to every family that has just moved into the house (Malmö Stad, 2023a).
- To ensure energy efficiency in Hyllie, buildings are equipped with smart systems (HMES, BMS, smart grids). Infrastructure has been developed for the local generation of energy. Infrastructure has been established to store the energy produced by methods such as solar cells. As with residences in the Solkvarteren district, solar energy supplies 35% of the facility's annual energy needs. Cooling solutions such as biophilic designs and green roofs are implemented (Malmö Stad, 2015b; Malmö Stad, 2021d; Malmö Stad, 2022; Skanska, 2022).
- The desired success has not yet been achieved in generating energy with wind turbines. The efforts of the contractor firm in this regard continue (Parks, 2020b).
- A storm plan (Skyfallsplan för Malmö) has been prepared to deal with torrential rains in Hyllie (Malmö Stad and VA SYD, 2017). The natural environment and arable lands have been preserved and green areas have been increased. Large, multifunctional, and themed park areas were built in 2015, 2020 and 2022. Among these, the Rainwater Park (Dagvattenparken) stands out in the fight against floods. This multifunctional park provides the storage of a large amount of rainwater. With an area of 23,000 square meters, the park can hold up to 6,600 cubic meters of water, equivalent to 50 years of rain (Malmö Stad, 2021c).

It is necessary to wait for the completion of the project to reach more definite judgments about Hyllie. The report prepared by the Environmental Management Office regarding the current status of the project is under construction. However, it is possible to say that significant progress has been made in realizing Hyllie's climate-smart city vision since 2011. Combining the basic components of the climate-smart city has been effective in this. After all, this is the point that should be especially emphasized as a result of this study. The ideas in the Hyllie Climate Agreement, which combines the climate-oriented vision with smart city systems, did not remain on paper. These ideas have become the principles that guide the urban planning process. In the urban planning process, the idea of participation and governance was included in the process, in consultation with the stakeholders.

When developing Hyllie, Malmö Municipality combined climate orientation and smart systems in urban planning. At the same time, it has introduced the fourth component of the climate-smart city, governance, by involving citizens and stakeholders in the planning and decision processes. It has taken a governance approach to co-develop Hyllie and create a climate-smart urban space. This understanding has allowed negotiation, common sense, co-development, cooperation, and partnerships at Hyllie.

The understanding of participation and governance in urban development policies should not be ignored. Cities should be developed together with the citizens of the city, and they should not be technical and mechanical living spaces devoid of social and cultural values, art, and aesthetics. Climate orientation, smart systems, and urban planning stages involve intensive technical efforts. With these efforts to be appreciated, human values such as art, culture, history, and aesthetics that feed the urban spirit and urban identity should be blended.

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