

GAZİANTEP BUILDING SECTOR DECARBONIZATION ACTION PLAN

EXTENDED SUMMARY

December, 2023



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Digital copies of the national road-map and local action plans prepared within the scope of the project can be accessed through the QR code.

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Design and Layout

YGG Consultancy

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ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
BEP	Building Energy Performance
BEP-TR	Building Energy Performance Application
BIM	Building Information Modeling
CEMR	Council of European Municipalities and Regions
CO ₂	Carbon Dioxide
CoM	Covenant of Mayors
EIA	Environmental Impact Assessment
EPC	Energy Performance Certificate
EPD	Environmental Product Declaration
GEF	Global Environment Facility
GIS	Geographic Information Systems
GMM	Gaziantep Metropolitan Municipality
HVAC	Heating, Ventilation, and Air Conditioning
LCA	Life Cycle Assessments
MoEUCC	Ministry of Environment, Urbanization and Climate Change
NZEB	Nearly Zero Energy Buildings
R&D	Research and Development
SuDS	Sustainable Urban Drainage Systems
TMMOB	Union of Chambers of Turkish Engineers and Architects
UNEP	United Nations Environment Program
WRI	World Resources Institute
YES-TR	Green Certificate for Buildings and Settlements
ZCBA	Zero Carbon Building Accelerator



FOREWORD

In recent years, the adverse effects of climate change are progressing more severely than anticipated, causing destruction to social, economic, and environmental systems globally. The current global climate crisis conditions urgently demand a rapid “transformation,” and it has been unequivocally proven that prompt action is required to mitigate greenhouse gas emissions resulting from human activities, particularly due to fossil fuel consumption. This imminent danger, prominently outlined by climate science, compels the world to take action.

At the local level, climate action has become one of the most engaging fields of scientific study today. The primary reason for this is that the majority of the world’s population resides in urban areas, and a significant portion of greenhouse gas emissions (approximately 70%) responsible for climate change originates from cities. The ever-increasing energy consumption makes cities, which are at the forefront of the problem’s sources, crucial for solving it. Therefore, local governments, cities, and regions worldwide have started creating their plans to contribute to the efforts of the states.

As Gaziantep Metropolitan Municipality, we have been developing various strategies and putting them into practice since 2011 to combat the climate crisis, contribute to national efforts to reduce greenhouse gas emissions, and build a more robust, fairer Gaziantep by reducing the current and expected impacts of climate change. Gaziantep Metropolitan Municipality has prioritized energy efficiency, renewable energy, and climate change for approximately 12 years, setting an example for other municipalities with its work. Our city and municipality are proud to be among the earliest cities and institutions in Türkiye to take these steps and continue to make progress by adding a new one to their efforts every day.

According to the Sustainable Energy and Climate Action Plan we developed in 2018, it has been revealed that the Buildings and Construction sector



in Gaziantep constitutes approximately 36% of the city’s CO₂ emissions related to energy. Thus, it is evident that the buildings of a net-zero carbon future cannot be achieved without decarbonizing them.

With the support of the Global Environment Facility (GEF) and the beneficiary of the Ministry of Environment, Urbanization, and Climate Change, Gaziantep is one of the two pilot cities selected from Türkiye within the scope of the Zero Carbon Building Accelerator Project. This project examines the current bottlenecks in taking measures for the decarbonization of the building sector and presents strategic actions to be implemented to both national and local policymakers.

This Action Plan created within the project provides a multi-layered framework that will guide building policies, including energy-efficient improvements, the use of high-performance equipment, and the promotion of renewable energy. Apart from decarbonizing the building sector, it brings numerous benefits, such as reducing energy bills for users, preventing air pollution, preserving human and environmental health, and creating green jobs.

I would like to express my gratitude to everyone who has contributed to this project, which we believe will make Gaziantep a more livable and climate-resilient city.

Fatma Şahin

Gaziantep Metropolitan Municipality Mayor

1. INTRODUCTION

Human-induced greenhouse gas emissions, when compared between the 2011-2020 period and the 1850-1900 period, have increased global surface temperatures by 1.1°C and are now widely accepted as one of the primary causes of global warming. Global greenhouse gas emissions continue to inequitably rise and meet the atmosphere, stemming from the use of traditional energy sources, unsustainable production and consumption methods by regions, countries, and individuals, and changes in land use [1]. These emissions lead to global warming and are rapidly triggering climate change and numerous extreme weather events worldwide. It is anticipated that an average temperature increase of 2°C compared to the pre-industrial era will lead to more severe and destructive changes on a global scale, adversely affecting the natural environment, human health, and well-being [2]. The Paris Agreement, to which Türkiye is also a party, establishes a global framework for limiting global warming to well below 2°C, with efforts to limit it to 1.5°C, aiming to prevent the dangerous effects of climate change [3].

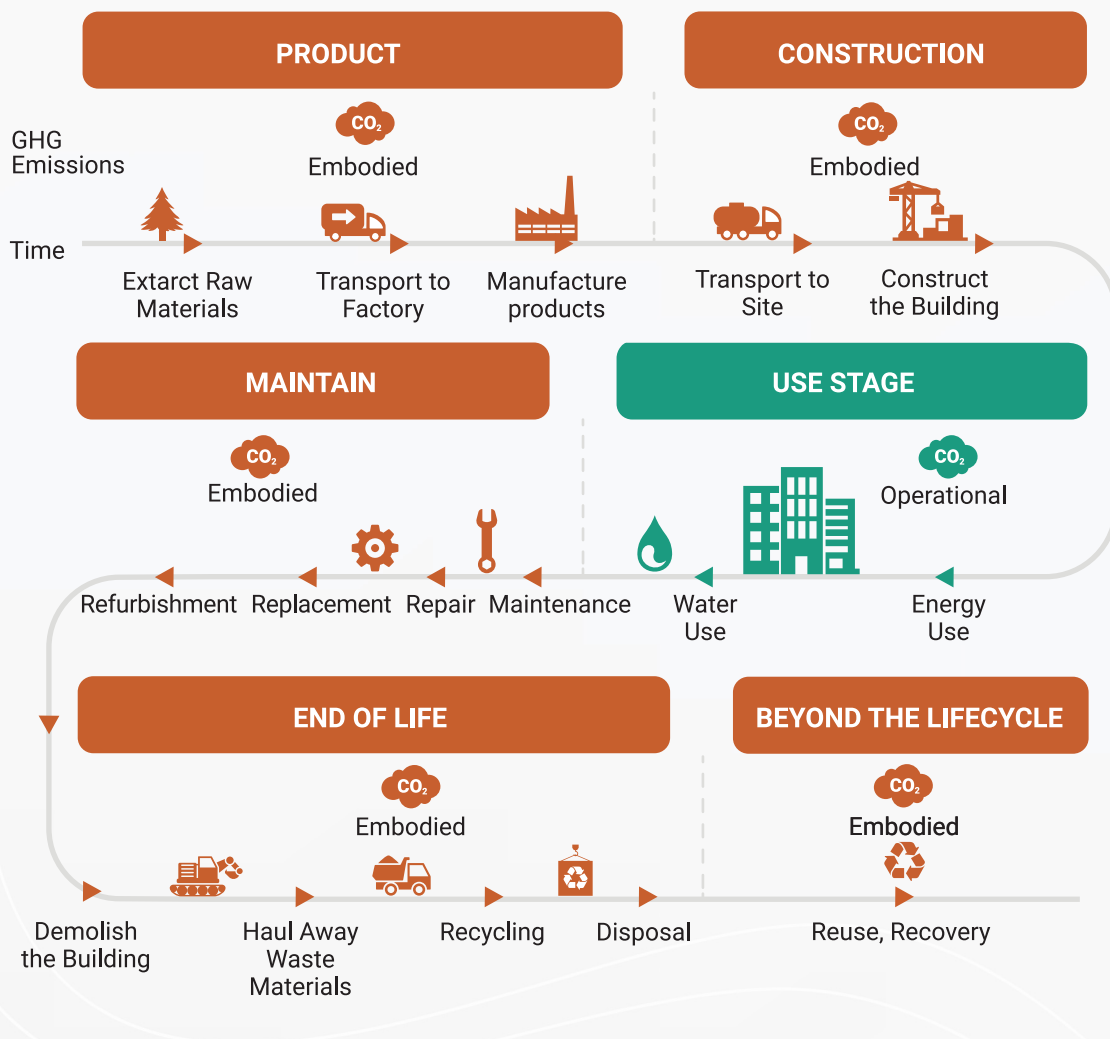
According to the International Energy Agency, the final energy consumption attributed to buildings' usage is responsible for approximately 30% of global values and contributes to 26% of global energy-related emissions. Out of this 26%, 8% directly

originates from buildings, while the remaining 18% results from indirect emissions associated with the production of electricity and heat energy needed by buildings [4]. A study conducted by the United Nations Environment Programme (UNEP) indicates that if countries do not take immediate action, energy consumption is projected to double by the year 2050 [5]. It is projected that approximately 70% of the world's population will live in cities by the year 2050. The increasing shift towards urban living implies a greater need for buildings in cities [6].

Building-related carbon emissions are categorized into two main types: operational carbon and embodied carbon. Operational carbon covers emissions generated during the use of buildings, resulting from energy consumption for heating, cooling, lighting, and the operation of appliances throughout the building's lifetime. Embodied carbon, on the other hand, encompasses emissions caused by building materials during their production and supply chain, including the extraction of raw materials, manufacturing of building materials, transportation, on-site assembly during construction, maintenance and repair activities during the use of building, and, finally, the demolition and disposal of buildings at the end of their life cycle. The carbon emissions throughout a building's life cycle are illustrated in Figure 1 [7].



Figure 1. Building Life Cycle.



A zero-carbon building is defined as a highly energy-efficient building, meeting the remaining energy needs from on-site or off-site renewable energy sources. These buildings minimize operational and embodied carbon emissions throughout their life cycle, and any unavoidable emissions are neutralized through carbon balancing. Additionally, it is crucial for Zero Carbon Buildings to be climate resilient [8]. These buildings offer users additional benefits such as improved indoor air quality, more comfortable living and working spaces, and lower energy bills. Today, there are architectural designs, construction practices, building materials, and sector-relevant technologies available to realize Zero Carbon Buildings.

The definitions and goals of zero-carbon buildings primarily reflect a strong commitment to

increasing efficiency. In cases where renewable energy is not available or feasible, terms like “zero-ready” or “near-zero” may be used to signify that the building has done its best to approach zero energy [7].

Buildings also represent the most cost-effective carbon reduction solution available to address climate change. Every investment in efficiency in buildings provides approximately double the cost savings in energy supply expenses. Despite its immense potential, the building sector has yet to tap into about 80% of global energy savings that are economically feasible. To achieve carbon emission reduction and climate resilience goals, the global building stock must reach net zero carbon by 2050 [9].

1.1 Vision and Objectives

In 2021, as part of the Zero Carbon Building Accelerator (ZCBA) project led by WRI and supported by the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP), Türkiye and Colombia, as beneficiary countries, have developed national roadmaps for decarbonizing the building sector. Furthermore, local action plans have been prepared for the implementation of net-zero carbon buildings, which includes local strategies and actions. Türkiye's cities, Gaziantep and Konya, have been part of the ZCBA project as pilot cities, and together with other pilot cities, they have worked to implement the necessary regulations and policies to achieve carbon-neutral buildings by 2050 [10].

This Local Action Plan, prepared with the aim of decarbonizing the Gaziantep building sector, aims to promote "Zero-Carbon-Ready Buildings" that significantly reduce energy consumption, are highly energy-efficient, source their energy needs from low-carbon sources, and are highly efficient and climate-resilient throughout their life cycle. The action plan covers the current status of the local building sector in Gaziantep, the actions developed for decarbonization, the scope and duration of these actions, and the responsibilities of relevant stakeholders. The action plan also proposes a pilot project along with a business model for decarbonizing the building sector.

The implementation of the Local Action Plan will contribute to the local and national policies and strategies developed to combat climate change, set an example for achieving the goal of zero-carbon-ready buildings, and provide guidance to cities and local governments aiming to decarbonize their buildings.

1.2 Local Objectives

Gaziantep is among the leading cities in Türkiye with its goals and efforts in the field of climate change. Gaziantep Metropolitan Municipality (GMM) has been working since 2011 to reduce local carbon emissions, increase energy efficiency, and develop renewable energy facilities. In 2014, the Energy Management Department, a first of its kind in Türkiye, was established within the Metropolitan Municipality to better manage energy. At the local level, the Gaziantep Climate Change Action Plan, prepared in 2011, aims to reduce per capita CO₂ emissions by 20% by 2023 [11]. In 2017, Gaziantep Metropolitan Municipality signed the Covenant of Mayors (COM), committing to a 40% reduction in greenhouse gas emissions by 2030. In 2018, the action plan was updated in line with COM, leading to the creation of the Sustainable Energy and Climate Action Plan. In 2021, the commitment made in COM was updated to pledge an 80% reduction in greenhouse gas emissions by 2050. In 2023, Gaziantep prepared the Climate Change Adaptation Action Plan to develop projects aimed at adapting to climate events and taking measures.

Due to the significant role of the building sector as one of the major sources of emissions, Gaziantep is also taking a pioneering role in decarbonization efforts in this area.

2. CURRENT STATE

2.1 Energy and Emission Profile

The population growth in Gaziantep, coupled with urbanization, increased industrial and commercial activities, has led to a rise in energy consumption and greenhouse gas emissions in the city. In 2020, the city's greenhouse gas emissions from various activities amounted to approximately 8.5 million tCO₂.eq, which is 34% higher than the total emissions in 2015. In 2020, the per capita greenhouse gas emissions in Gaziantep were 4.07 tCO₂.eq. According to the Sustainable Energy and Climate Action Plan developed by GMM, 32% of the emissions in the city are attributed to the residential building sector [12].

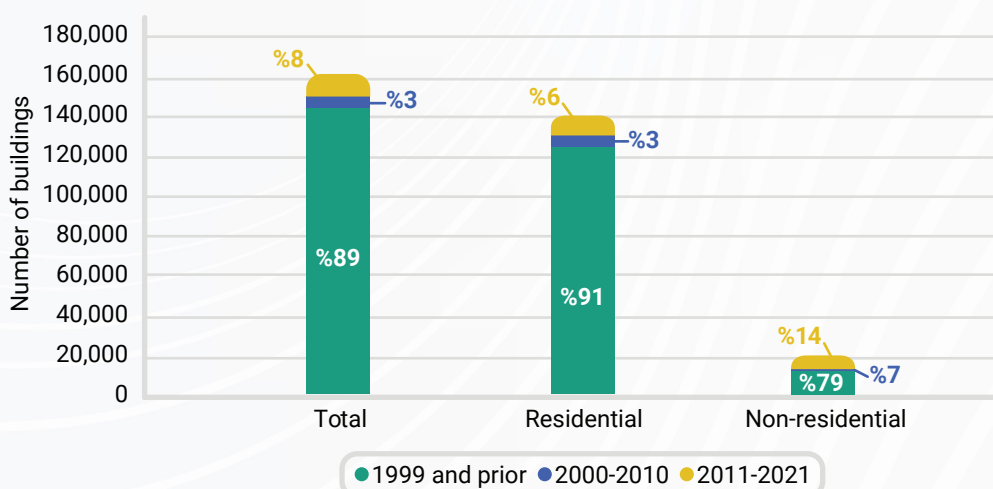
The emissions distribution for the prominent sectors, which account for 85% of the total emissions, is as follows:

- Emissions from electricity consumption in the industrial sector through transmission lines make up approximately 38% of total emissions,
- Emissions from diesel fuel consumption in road transportation activities constitute about 26% of total emissions,
- Emissions from energy consumption in buildings account for 28%, with residential energy consumption contributing 21% to this category [12].

2.2 City Building Stock

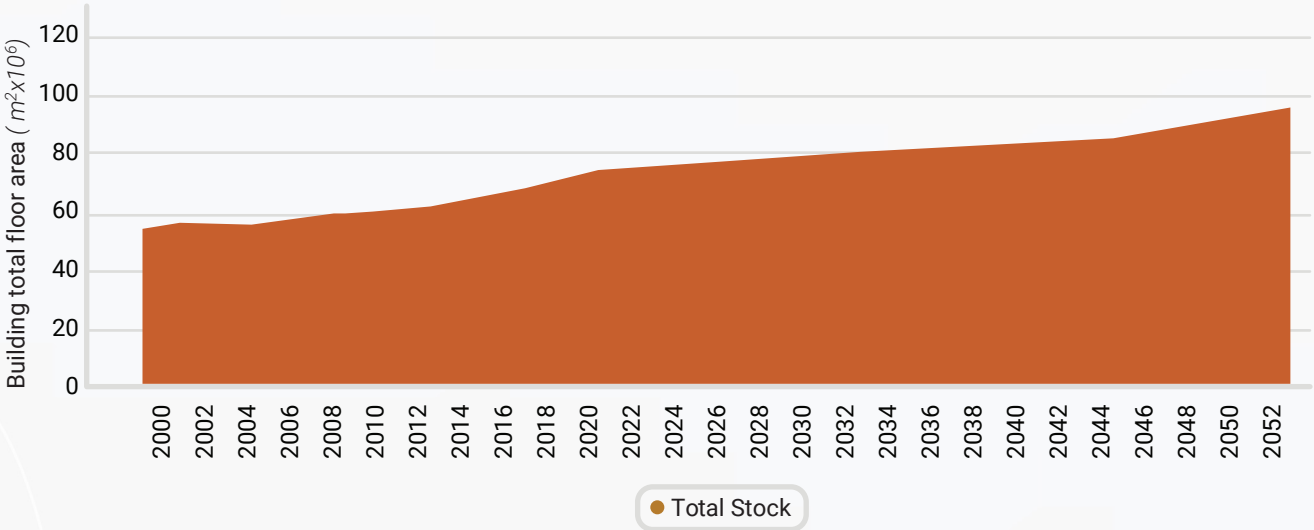
In light of the analyses conducted within the scope of the Gaziantep Building Sector Decarbonization Action Plan, it is projected that by the end of 2021, there were approximately 161,370 buildings in the Gaziantep province. Within this stock, 87% consists of residential buildings, while 13% is made up of non-residential buildings. The distribution of the building stock by year as of the end of 2021 is illustrated in Figure 2. Approximately 89% of the total stock was constructed before the year 2000, during a period when there were no national regulations governing energy performance in buildings. Between the years 2000 and 2010, about 3% of the stock was built when the thermal insulation requirements for buildings were defined according to the national standard TS825. After the introduction of the Building Energy Performance (BEP) Regulation in 2011, approximately 7% of the stock was constructed. Similar distributions are observed when examining the subcategories of residential and non-residential buildings.

Figure 2. Gaziantep building stock distribution by year and by building typology, 2022.



Based on the modeling and projections conducted in this study, it is estimated that the total floor area of the building stock will reach 95,300,799 square meters by the year of 2053. Figure 3 illustrates the development projection of the total floor area for the building stock from 2000 to 2053. In accordance with national urban renewal objectives, it is projected that structures built before the year 2000 will be systematically replaced with new constructions in the coming years.

Figure 3. The projection of the building stock total floor area.



2.3 Seismicity

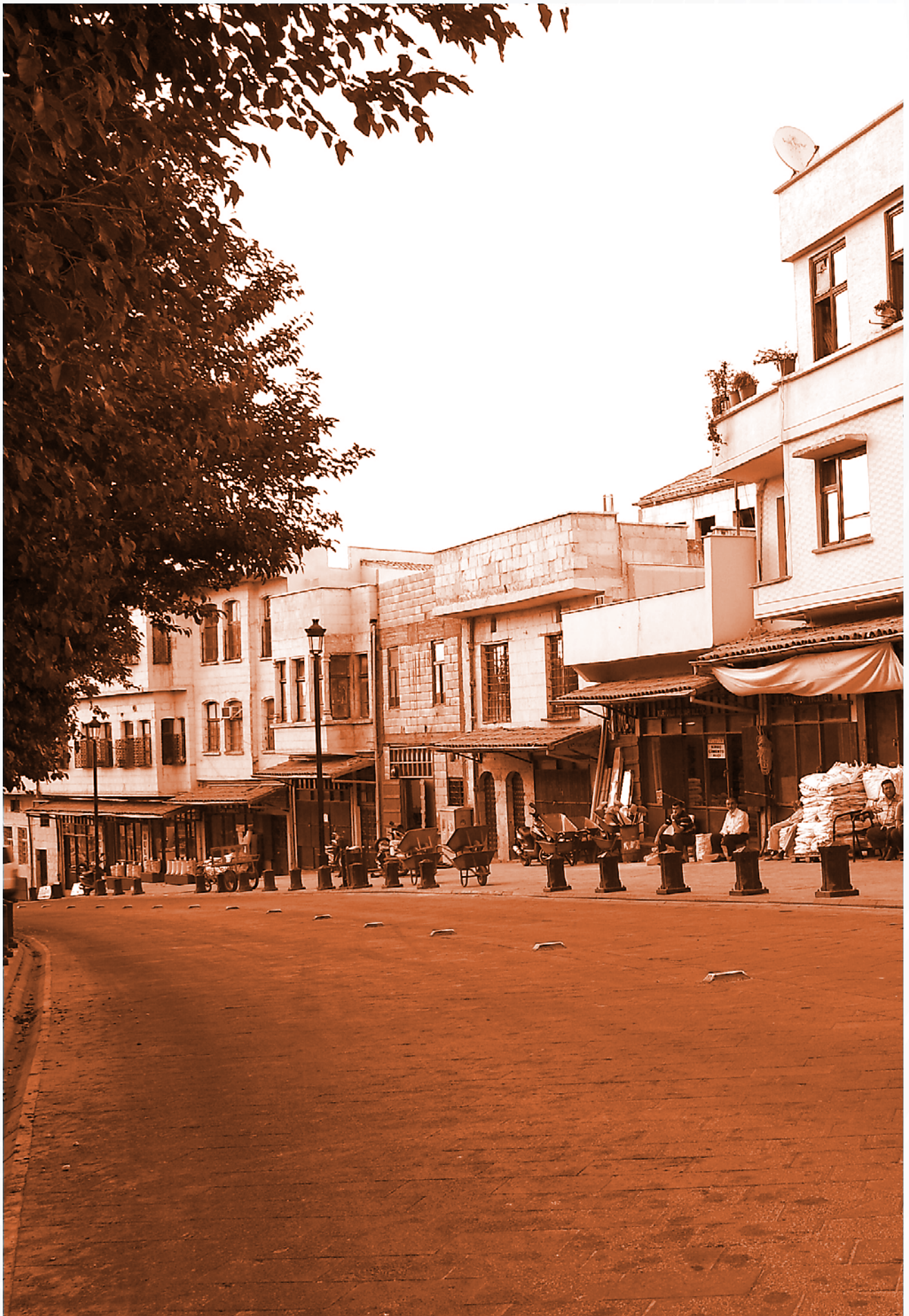
Türkiye is situated on the Anatolian Plate, which is highly active in terms of earthquakes, due to the convergence and interaction of the Eurasian, African, and Arabian plates, where severe earthquakes frequently occur. In the last century, Türkiye has experienced nearly 20 earthquakes with a magnitude of 7 or greater, some of which have resulted in severe effects classified as Violent-Extreme-Disastrous (IX-X-XI) on the Mercalli scale. This phenomenon places Türkiye at the top of the list of countries prone to earthquake damage in terms of tectonic activity and the risks posed by its building stock [13].

During the development of the Gaziantep Building Sector Decarbonization Action Plan, a series of catastrophic earthquakes occurred on February 6, 2023, centered around the Pazarcık and Elbistan districts of Kahramanmaraş, with magnitudes of Mw7.7 and Mw7.6, respectively. Two weeks after the initial earthquakes, on February 20, 2023, a seismic event with a magnitude of Mw6.4 struck Yayladağı in Hatay. These earthquakes caused

devastating damage to 11 provinces, including Gaziantep, resulting in over 48,000 fatalities and damage to more than half a million buildings [13].

According to a report published by Presidency of Türkiye, Presidency of Strategy and Budget, in March 2023, approximately 94% of the surveyed buildings in Gaziantep had sustained damage. Among these structures, 29,155 had collapsed, were in urgent need of demolition, or suffered severe damage. Additionally, 20,251 buildings were categorized as having moderate damage, while 236,497 buildings were deemed to have minor damage. These statistics suggest that at least 16% of Gaziantep’s buildings had lost their functionality due to the earthquakes (either collapsed, requiring urgent demolition, heavily damaged, or moderately damaged) [13].

These seismic events have vividly illustrated the high seismic risk of Gaziantep and the vulnerability of its building stock.



3. DEVELOPING THE ACTION PLAN

The methodology employed for the development of the Local Action Plan for decarbonizing the building sector in Gaziantep involves a series of key steps, including literature review, stakeholder analysis, data collection and analysis, modeling and projections, needs assessment, action definition, and prioritization processes. Throughout the study, national and local regulations, national and local statistical data, as well as expert opinions obtained from GMM and local stakeholders, were utilized.

To identify stakeholders that can influence or be influenced by the policies and measures necessary for decarbonizing the building sector, a stakeholder map analysis was conducted.

Through collaborative efforts with stakeholders, an extensive survey and focus group meetings were conducted to evaluate several aspects of the building sector in Türkiye and Gaziantep. These aspects include the legal regulations governing the building

sector in Türkiye and Gaziantep, the technical capacities of building sector professionals, available sources of financing, the awareness levels of building sector stakeholders, and the technologies employed in building construction (including building materials, devices, and systems). These evaluations were carried out collectively and collaboratively. The current state of Gaziantep’s building sector was assessed, and the local needs and obstacles were identified. Recommendations for improvement were documented.

Following the evaluation of the research findings by experts, a draft action list was created for decarbonizing the building sector in Gaziantep. The potential impacts of these actions were assessed, and the draft action list was presented to stakeholders. Subsequently, specific actions to be included in the action plan were determined. Figure 4 illustrates the process and stages involved in the preparation of the action plan.

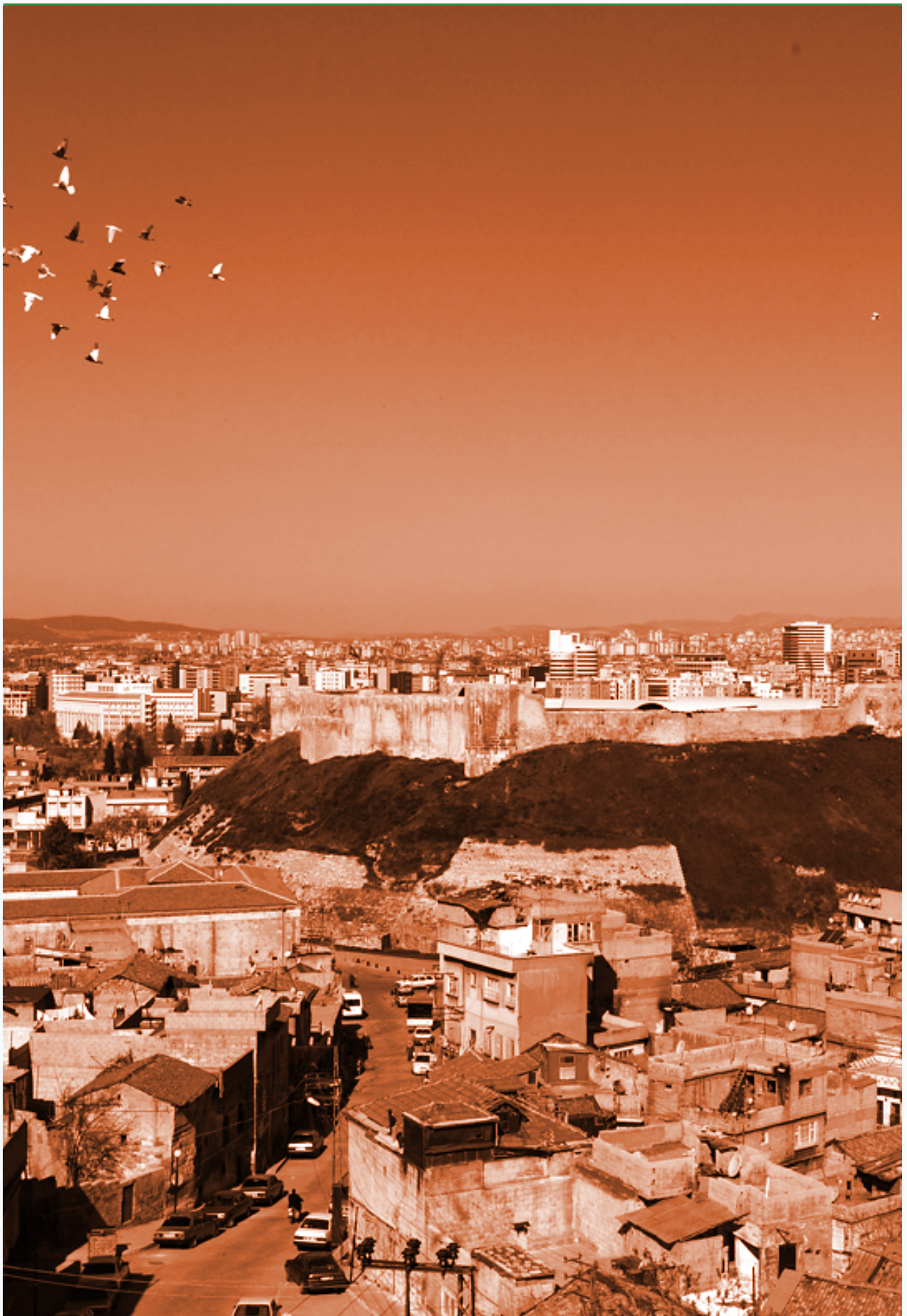
Figure 4. The process and stages of preparing the action plan.



The gaps and barriers for decarbonizing the building sector were identified through surveys, focus group meetings, and local stakeholder meetings under various categories. Some of the prioritized gaps and barriers, and recommendations provided by the participants, are tabulated below (Table 1).

Table 1. Gaps and barriers, and recommendations for the decarbonization of Gaziantep building sector.

✘ GAPS AND BARRIERS	✔ RECOMMENDATIONS
<p>Building materials:</p> <ul style="list-style-type: none"> Limited production and variety of local sustainable material, coupled with the high cost of these materials, making them less preferred by practitioners. Insufficient utilization of construction waste recycling that contributes to the production of low-carbon building materials. 	<p>Policy:</p> <ul style="list-style-type: none"> Strengthening the enforcement of existing regulations. Considering urban parameters influencing energy efficiency in buildings during the urban planning process and implementing sustainable planning at the neighborhood or district scale.
<p>Construction process:</p> <ul style="list-style-type: none"> Low compliance of constructions with regulations/standards. Inadequate competence of construction workers regarding implementation. 	<p>Finance:</p> <ul style="list-style-type: none"> Support for the production and use of domestic building materials. Developing financial mechanisms for the green building transformation of existing public buildings. Providing incentives for buildings seeking green certification during construction. Allowing urban renewal credits to be divided into longer terms.
<p>Building Design and Urban Planning:</p> <ul style="list-style-type: none"> Insufficient awareness and demand for sustainable green buildings by users, resulting in a lack of priority for green building construction by developers. Overemphasis on visual design in building design, neglecting sustainability and green building criteria. Inadequate construction of standards-compliant buildings in high-risk disaster-prone areas. Limited experience of site architects in preparing projects that are feasible for on-site implementation. 	<p>Technology:</p> <ul style="list-style-type: none"> Widespread adoption of building energy modeling during the building design phase. Conducting R&D work on lighting and heating technologies at local universities to develop domestic technologies and encourage their use in different building types. Promoting the widespread use of smart management systems in buildings
<p>Building operational phase:</p> <ul style="list-style-type: none"> Lack of awareness regarding energy and water efficiency by building users and managers. Continuation of coal use as an energy source for heating. Limited prevalence of central heating systems. 	<p>Technical capacity and awareness:</p> <ul style="list-style-type: none"> Providing capacity-building training on energy efficiency, sustainability, and decarbonization for all stakeholders. Developing mechanisms, incentives, and promoting ecological building transformations in high-performance sustainable buildings in urban renewal activities for buildings that have reached the end of their lifespan or have been damaged by earthquakes.
<p>Demolition and recycling:</p> <ul style="list-style-type: none"> Inadequate provision of construction waste recycling. High costs associated with demolition and recycling. 	



4.EMISSION MITIGATION MEASURES

Various emission mitigation measures have been developed for Gaziantep building sector, considering national regulations, national statistical data, official statements, expert opinions, and internationally accepted calculation methods in line with the baseline analysis. A mitigation portfolio has been created, consisting of nine mitigation measures aimed at effectively reducing emission during the building’s operational phase and embodied carbon emissions. The mitigation portfolio includes the following measures:

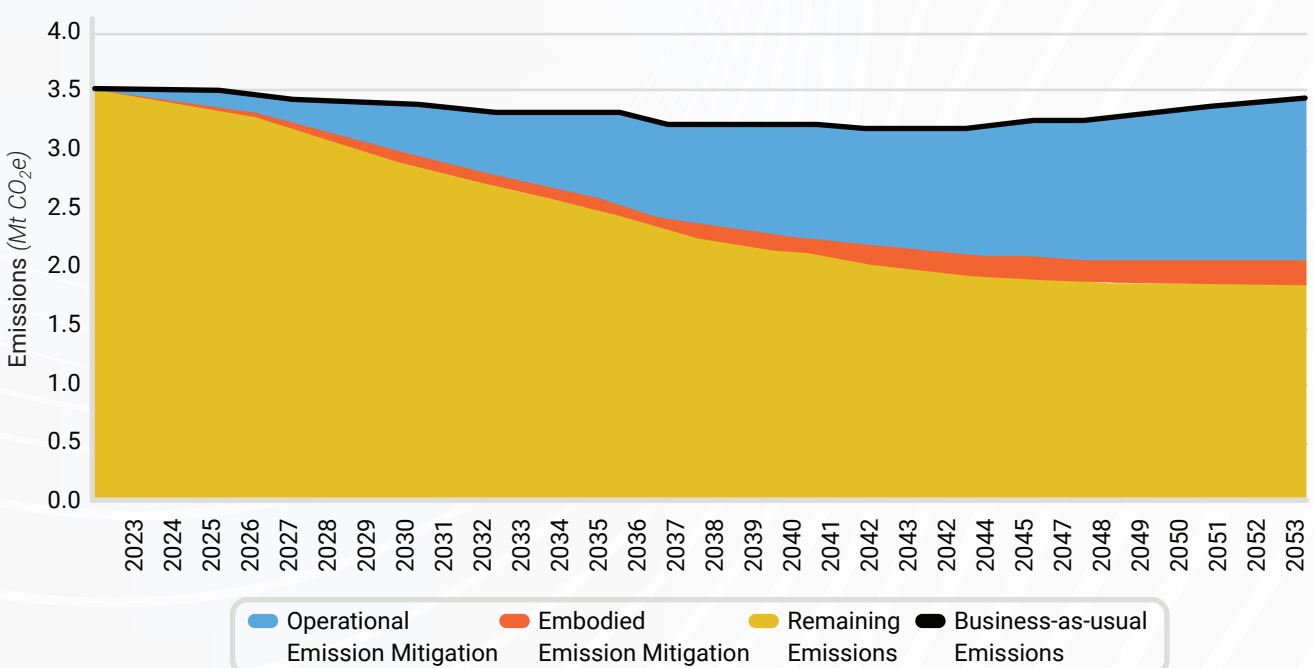
- Constructing new residential and non-residential buildings as Nearly Zero Energy Buildings (NZEB*) in the 2023-2032 period, building new residential and non-residential buildings as Class A buildings in the 2033-2042 period, building new residential and non-residential buildings as Constructing new residential and non-residential buildings between 2043-2053 to be Net Zero Operational Carbon Buildings** and gradually renewing the stock by demolishing pre-2000 buildings and improving the energy efficiency of 2000-2010 buildings by 5% annually (up to 2043) through comprehensive renovations to achieve NZEB status (Mitigation Measures for Operational Carbon).
- Replacing low-efficiency refrigerators/washing machines/dishwashers used in homes with up-to-date technology and energy-efficient appliances at an approximate rate of 10% annually starting from 2023 (up to 2033) status (Mitigation Measures for Operational Carbon).
- Using low-carbon concrete/steel in new residential and non-residential reinforced concrete buildings starting from 2023. Achieving a 30% reduction by 2033 and 100% reduction by 2053 compared to 2023 status (Mitigation Measures for Embodied Carbon).

The implementation of the specified measures allows for a total reduction of 28,5 MtCO₂.eq in greenhouse gas emissions from 2023 to 2053. This corresponds to a 28% reduction compared to business-as-usual emissions. Moreover, 48% of emission reduction is achieved in the year 2053 (Figure 5).

*Buildings classified as NZEB (Nearly Zero Energy Building) must have an energy performance class of B or better in their Energy Performance Certificate, and at the same time, they should use at least 10% of the building’s primary energy demand from renewable energy sources. During the transition period between January 1, 2023, and January 1, 2025, the minimum renewable energy rate of “10%” will be reduced to “5%”, and the total building construction area specified as “2000 m²” will be applied as “5000 m²”.

** Net Zero Operational Carbon Buildings are considered buildings balancing their annual operational carbon emissions with renewable energy sources.

Figure 5. Operational and embodied carbon mitigation portfolio results.

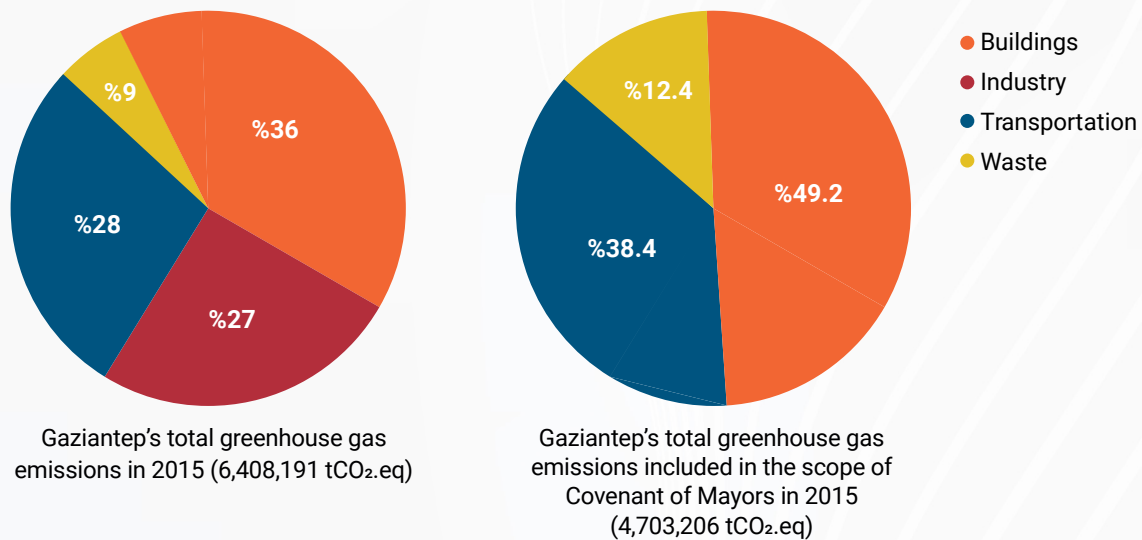


5. GAZIANTEP BUILDING SECTOR DECARBONIZATION ACTIONS

Carbon emissions from the building sector occur throughout the life cycle of buildings, due to activities such as raw material extraction and material production, transportation, construction activities, maintenance, repair, material renewal during the building's life cycle, energy and water consumption during building use, demolition, and end-of-life processes of building materials. Worldwide, carbon emissions from buildings are roughly equivalent to about 39% of the total carbon emissions from all sectors. More than a quarter of these emissions are related to greenhouse gases associated with the production of building materials and construction activities [14].

In 2018, GMM conducted an inventory based on 2015 data, as a voluntary member of the Covenant of Mayors (CoM) initiative. According to this inventory, greenhouse gas emissions from buildings constitute 32% of the total emissions. Among the three categories included in the Covenant of Mayors (Buildings, Transportation, and Waste), buildings have the highest emission rate, reaching up to 49.2%. This indicates a significant potential for reducing greenhouse gas emissions from buildings in Gaziantep. Similarly, GMM has committed to reducing the city's emissions by 40% by the year 2030 [15].

Figure 6. Gaziantep's greenhouse gas emissions based on 2015 data.



The Decarbonization Actions in the Building Sector have been prepared based on desktop studies, literature reviews, participatory workshop activities with stakeholders, online surveys, and one-on-one discussions with experts. Transformative actions are grouped under four main headings in the following sections: "Building Materials," "Existing Buildings," "New Buildings," and "Urban Planning and Resilience."

5.1 Building Materials

Embodied carbon in buildings accounts for 11% of global emissions [16]. This percentage corresponds to approximately 28% of the carbon emissions released throughout the life cycle of a building. Strategies to reduce embodied carbon, which has such a significant impact, should be addressed at the early stages of building projects. As a project progresses, making design and implementation changes to reduce embodied carbon becomes much more challenging and costly.

Gaziantep, an industrial city, holds a significant position in the region due to its production of construction

materials, construction activities, and machinery inventory in the construction sector. Gaziantep should collaborate with all stakeholders at both national and local levels to reduce the potential carbon emissions embodied in buildings. Within these collaborations, it is possible to promote the use of Life Cycle Assessment (LCA) and Environmental Product Declarations (EPD) analysis and documentation for commonly used construction materials, incorporate modular and precast systems into projects, and encourage the use of local materials to reduce transportation-related carbon emissions.

In the following sections, the proposed goals, targets, and transformative actions for Gaziantep related to decarbonizing building materials, are presented.

5.1.1 Goals and Targets

Building materials have been examined with a focus on three primary goals, and the proposed actions are aligned with the strategic targets defined for the years 2030, 2040, and 2050 in the national roadmapping effort.

GOAL #	GOAL DESCRIPTION
BM1	Promoting Life Cycle Assessment (LCA) for building materials
BM2	Expanding the use of Environmental Product Declarations (EPD) for building materials
BM3	Reducing embodied emissions from building materials

TARGET #	CURRENT STATE	2030 TARGET	2040 TARGET	2050 TARGET
BM.T1	Most building materials lack Life Cycle Assessment (LCA) analyses.	At least 40% of the main building materials used in construction projects have LCA.	At least 80% of commonly used building materials in construction projects have LCA.	At least 95% of all building materials used in construction projects have LCA.
BM.T2	Most building materials lack Environmental Product Declarations (EPD).	At least 40% of the main building materials used in construction projects have EPD.	At least 80% of the main building materials used in construction projects have EPD.	At least 95% of all building materials used in construction projects have EPD.
BM.T3	Adequate data on embodied emissions from building materials is not available.	40% reduction in embodied carbon emissions from building materials.	60% reduction in embodied carbon emissions from building materials.	Reducing embodied carbon emissions from building materials to net zero.



5.1.2 Actions

In this section, transformative actions to address carbon emissions resulting from building material use, as well as the target timeframe in years for completing these actions, are presented.

The main actions are examined under the category of “policy”, while supporting actions are provided under the categories of “finance,” “technology,” and “technical capacity and awareness”.

ACTION #	ACTION DESCRIPTION	TIMEFRAME
BM.PA1	Development of specifications for the use of materials with Environmental Product Declarations (EPD) in all municipal procurements and tenders.	5 years
BM.PA2	The use of materials with Environmental Product Declarations in new municipal public buildings, and the development of specifications.	5 years
BM.PA3	Utilization of materials with Environmental Product Declarations (EPD) in new buildings under the responsibility of Gaziantep Metropolitan Municipality.	5 years
BM.PA4	Incentivizing the use of materials with Environmental Product Declarations (EPD) in new buildings and renovations in Gaziantep province that are not under the responsibility of Gaziantep Metropolitan Municipality.	5 years
BM.PA5	Development of policies to prefer local materials in the procurement and tender processes for public buildings.	5 years
BM.PA6	Prevention of the demolition of existing buildings that can be economically extended through deep retrofit and structural reinforcement.	7 years
BM.PA7	Development of specifications for the use materials with Environmental Product Declarations (EPD) in municipal buildings that will be renewed through deep retrofit and structural reinforcement.	3 years
BM.PA8	Incentivizing the use of local and materials with Environmental Product Declarations (EPD) in all renewed buildings in Gaziantep through deep retrofit and structural reinforcement.	7 years
BM.PA9	Preparation and regular updating of inventories of local building materials produced in Gaziantep and neighboring provinces.	1 years
BM.PA10	Amendment of public building specifications to encourage the use of low clinker content cement and concrete.	5 years
BM.PA11	Regular acquisition of sustainability reports from the cement, concrete, and steel industries serving the building sector in Gaziantep and the encouragement of their environmentally friendly use.	5 years
BM.PA12	Inclusion of modular and precast systems in GMM's specifications for public buildings to incentivize their use.	7 years
BM.PA13	Incentivizing the use of the Green Certificate for Buildings and Settlements (YeS-TR) guide as a reference for material selection in buildings.	7 years
BM.PA14	Incentivizing the use of recycled and reused materials.	5 years

5.1.2.2 Finance Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
BM.FA1	Developing financial resources for local producers to increase the number of EPDs for local materials.	5 years
BM.FA2	Developing financial resources for research and development (R&D) to reduce the environmental impact of local materials.	7 years
BM.FA3	Developing financial resources for R&D efforts for the use of modular and precast systems in construction.	5 years
BM.FA4	Developing financial resources for local R&D projects related to the recycling and reuse of construction and demolition waste.	5 years

5.1.2.3 Technology Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
BM.TA1	Establishing a Building Information Modeling (BIM) library that includes construction materials commonly used in Gaziantep and surrounding provinces, along with their environmental impacts.	3 years
BM.TA2	Promoting and conducting R&D activities to reduce the adverse environmental effects associated with the production of local materials.	5 years
BM.TA3	Promoting and conducting R&D activities aimed at the use of modular and precast systems in construction.	5 years
BM.TA4	Promoting and conducting R&D activities related to the recycling and reuse of construction and demolition waste.	5 years
BM.TA5	Employing new technology and high-efficiency machinery and transport vehicles in construction and demolition processes.	5 years



5.1.2.4 Technical Capacity and Awareness Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
BM.TCA1	<p>Conducting technical capacity-building and awareness-raising initiatives for the municipality, industry representatives, and other stakeholders to enhance knowledge on sustainability in construction materials. This includes areas such as EPDs, green certification systems, national and international standards, best practice examples, and more.</p>	2 years
BM.TCA2	<p>Gaziantep Metropolitan Municipality and district municipalities to provide relevant departments with technical capacity-building training on Sustainable Practices in Building Materials, which should include the following topics and similar subjects:</p> <ul style="list-style-type: none"> • Building Information Modeling (<i>BIM</i>) • Material-related embodied carbon and calculation tools • Life cycle assessment • Sustainable architecture • Innovative methods, modular, and precast systems in construction • Green building certifications (e.g., <i>Green Building Certification for Buildings and Settlements - YeS-TR</i>) • Structural retrofit • Deep retrofit of energy efficient renovations 	2 years

5.2 Existing Buildings

Operational carbon emissions are the greenhouse gas emissions resulting from the total energy sources required for heating, cooling, ventilation, lighting, water consumption, and the operation of other mechanical and electrical appliances throughout the period of building use. These emissions constitute approximately 27% of the global and 72% of the total building-related emissions. Approximately one-third of these emissions are attributed to the use of fossil fuels within buildings, while two-thirds stem from electricity consumption [16].

A portion of greenhouse gas emissions generated during the operational phase of buildings is also attributable to the release of refrigerants used in cooling systems and heat pumps into the atmosphere. Emissions stemming from leakages and uncontrolled releases during the use and disposal of refrigerants constitute approximately 2% of global greenhouse gases [17].

To accelerate the mitigation of greenhouse gas emissions from existing buildings and reach net zero, improvements in building envelope, enhanced efficiency of heating, cooling, and lighting systems to reduce consumption, expedited transition to electrification, and increased utilization of renewable energy are necessary. Conducting a comprehensive building inventory study at the city level urgently, and rapidly increasing Energy Performance Certificate (EPC) documentation will establish a fundamental framework, enabling the establishment of realistic goals and facilitating monitoring efforts.

In the following sections, the proposed goals, targets, and transformative actions for Gaziantep, related to decarbonizing existing buildings, are presented.

5.2.1 Goals and Targets

Existing Buildings have been examined with a focus on five primary goals, and the proposed actions are aligned with the strategic targets defined for the years 2030, 2040, and 2050 in the national roadmapping effort.

GOAL #	GOAL DESCRIPTION
EB1	Implementing energy-efficient transformation of existing buildings.
EB2	Increasing energy and water efficiency in buildings during their operational phase, reducing household waste production.
EB3	Minimizing energy consumption during demolition processes , ensuring the most efficient transportation and disposal of demolition waste.
EB4	Maximizing the recycling of construction material waste generated during demolition and renovation works.
EB5	Preventing leakage and ensuring controlled disposal of refrigerants used in HVAC systems and other equipment.

TARGET #	CURRENT STATE	2030 TARGET	2040 TARGET	2050 TARGET
EB.T1	10% of existing buildings are EPC-rated, in Gaziantep.	Expanding the EPC documentation to 50% of existing buildings.	Expanding the EPC documentation to 100% of existing buildings.	
EB.T2	There is no mandatory requirement for a minimum level of energy efficiency in existing buildings.	Retrofitting 40% of existing buildings to achieve the Nearly Zero-Energy Building (NZEB) target.	Retrofitting 70% of existing buildings to achieve the Nearly Zero-Energy Building (NZEB) target.	Retrofitting 100% of existing buildings to achieve the Nearly Zero-Energy Building (NZEB) target.
EB.T3	There is no mandatory requirement for using alternative water sources (e.g., rainwater, greywater) in existing buildings.	Retrofitting 40% of existing buildings for using alternative water sources.	Retrofitting 70% of existing buildings for using alternative water sources.	Retrofitting 100% of existing buildings for using alternative water sources.
EB.T3	The recycling rates for construction and demolition waste are considerably low.	Increasing the recycling rate of construction and demolition waste to 20%.	Increasing the recycling rate of construction and demolition waste to 40%.	Increasing the recycling rate of construction and demolition waste to 70%.

5.2.2 Actions

In this section, transformative actions to address carbon emissions resulting from existing buildings, as well as the target timeframe in years for completing these actions, are presented.

The main actions are examined under the category of “policy”, while supporting actions are provided under the categories of “finance,” “technology,” and “technical capacity and awareness.”

5.2.2.1 Policy Actions

ACTION #A	ACTION DESCRIPTION	TIMEFRAME
EB.PA1	Generating a building inventory to determine the current state of the building stock; the inventory to include, at a minimum, the construction year, floor area, purpose, structural/seismic performance, and energy performance rating.	2 years
EB.PA2	Identification and transformation of informal and abandoned buildings found during the inventory of the existing building stock.	5 years
EB.PA3	Completing the transition from high carbon-emission fuels (e.g., coal) to lower emission fuels (e.g., natural gas) for heating purposes in residential buildings.	2 years
EB.PA4	Expansion of energy monitoring in municipal building (e.g., EKOM - Energy Coordination Center initiatives).	3 years
EB.PA5	Expansion of energy monitoring in non-municipal buildings. (e.g., EKOM - Energy Coordination Center initiatives).	5 years
EB.PA6	Conducting energy audits and implementing efficiency-enhancing projects (EEP) in municipal buildings following energy monitoring efforts.	2 years
EB.PA7	Increasing the prevalence of energy audits and efficiency-enhancing projects (EEP) in non-municipal buildings following energy monitoring efforts.	5 years
EB.PA8	Developing deep retrofit programs for inefficient residential buildings (e.g., insulation, windows, airtightness, etc.).	5 years
EB.PA9	Increasing the use of photovoltaic and/or solar thermal systems in municipal buildings.	3 years
EB.PA10	Increasing the use of photovoltaic and/or solar thermal systems in non-municipal buildings.	5 years
EB.PA11	Incentivizing the use of energy-efficient devices in residences and offices (e.g., household appliances, office equipment, etc.).	5 years
EB.PA12	Incentivizing of rainwater harvesting and greywater recycling practices.	5 years
EB.PA13	Incentivizing of waste separation methods to reduce household mixed solid waste.	4 years
EB.PA14	In municipal buildings, replacing the use of refrigerants in climate control systems with next-generation and low-GWP (Global Warming Potential) refrigerants, and establishing regulations for the safe disposal of current gases without causing greenhouse gas effects.	2 years
EB.PA15	In non-municipal buildings, replacing the use of refrigerants in climate control systems with next-generation and low-GWP (Global Warming Potential) refrigerants, and establishing regulations for the safe disposal of current gases without causing greenhouse gas effects.	3 years
EB.PA16	Enhancing compliance with national regulations for the environmentally friendly management, recycling, and disposal of demolition and excavation waste, along with efforts to improve recycling processes.	1 year
EB.PA17	Replacing lighting fixtures used in public buildings with efficient luminaires (e.g., LED).	1 year
EB.PA18	Establishing educational teams within municipalities for technical training to create energy-efficient behavioral changes among building users.	1 year

5.2.2.2 Finance Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
EB.FA1	Establishing green financing and incentive programs (e.g., Green Incentive Program) in collaboration with financial institutions for comprehensive and energy-efficient renovations of existing buildings.	5 years
EB.FA2	Establishing local green financing programs for urban transformation	5 years
EB.FA3	Increasing Energy Performance Contracts (EPC) in energy efficiency applications.	5 years
EB.FA4	Developing financial resources for the comprehensive renovation of municipal buildings.	2 years
EB.FA5	Developing financial resources to enhance processes for recycling construction waste materials in support of a circular economy.	5 years

5.2.2.3 Technology Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
EB.TA1	Widespread utilization of energy modeling tools to support comprehensive renovations of existing buildings.	3 years
EB.TA2	Development of an assessment tool and mechanism within the Green Incentive Program for measuring building compliance (e.g., inclusion of the BEP-TR Building Energy Performance Application).	3 years
EB.TA3	Conducting R&D activities to devise innovative design and implementation methods tailored to local conditions in Gaziantep (social, cultural, geographic, climatic, etc.) for the comprehensive renovations of existing buildings.	3 years
EB.TA4	Integrating innovative technologies required for construction waste transformation and disposal into municipal solid waste disposal facilities.	3 years
EB.TA5	Developing a joint monitoring system with relevant service providers for tracking energy and water consumption in buildings.	3 years
EB.TA6	Developing smart applications for building users to monitor and improve domestic waste, energy, and water consumption.	3 years
EB.TA7	Utilizing innovative technologies (e.g., satellite imagery, drones, GIS tools, thermal cameras) to support current building stock surveying efforts.	2 years
EB.TA8	Encouraging the use of new technology and fuel-efficient, low-emission machinery and transportation vehicles in demolition and excavation operations.	2 years

5.2.2.4 Technical Capacity and Awareness Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
EB.TCA1	Developing national and international partnerships to leverage best practices for the decarbonization of existing buildings.	2 years
EB.TCA2	Conducting collaborative efforts with district municipalities and neighborhood councils to create awareness programs promoting energy-efficient behavior in the community (e.g., smartphone applications, practical training of building users by energy efficiency instructors, establishment of a consultation desk).	2 years
EB.TCA3	Conducting public communication campaigns on sustainability, energy efficiency, renewable energy, and other technologies (in municipal public spaces, public transportation vehicles, stations, screens, billboards, etc.).	2 years
EB.TCA4	Establishing a unit within the municipality responsible for managing and overseeing decarbonization efforts in buildings, along with the employment of technical personnel.	2 years

5.3 New Buildings

Every new building added to the building stock will have an impact on both operational carbon emissions resulting from energy and water consumption during the usage period, and embodied carbon emissions, throughout the life cycle of building materials. Taking measures during the planning, design, and construction phases and enhancing the effectiveness of inspection mechanisms are necessary to minimize these emissions.

Policies related to energy-efficient design, the use of renewable energy sources, and sustainable material usage should be implemented to minimize the impact of new buildings on greenhouse

gas emissions. Furthermore, building permit and inspection processes should be improved to reduce carbon emissions throughout the entire life cycle of buildings. The proliferation of documentation and certification systems, the increase in electrification rates in final energy usage, and the reduction of water consumption and waste generation in all processes should be targeted to reduce carbon emissions.

In the following sections, the proposed goals, targets, and transformative actions for Gaziantep, related to decarbonizing new buildings, are presented.

5.3.1 Goals and Targets

New Buildings have been examined with a focus on six primary goals, and the proposed actions are aligned with the strategic targets defined for the years 2030, 2040, and 2050 in the national roadmapping effort.

GOAL #	GOAL DESCRIPTION
NB1	The dissemination of integrated building design, construction, and management standards to increase resource efficiency and reduce carbon emissions throughout the entire life cycle of buildings.
NB2	Enhancement of energy efficiency, electrification, and the use of renewable energy in architectural and mechanical design.
NB3	The widespread adoption of green building certification systems.
NB4	Material selection in accordance with sustainability standards and the increased use of low-carbon structural systems.
NB5	Increasing the effectiveness of building permit processes and preventing unauthorized and non-compliant constructions.
NB6	Reduction of energy and water consumption and waste generation during the construction process.

TARGET #	CURRENT STATE	2030 TARGET	2040 TARGET	2050 TARGET
NB.T1	GMM has the Ecological Urban Design Guide ruled in , providing an Ecological Incentive System for new buildings in Gaziantep.	40% of new buildings to be constructed according to the GMM Ecological Urban Design Guide criteria through incentives.	70% of new buildings to be constructed according to the GMM Ecological Urban Design Guide criteria through incentive	100% of new buildings to be constructed according to the GMM Ecological Urban Design Guide criteria through incentives.
NB.T2	Regulation or target related to electrification in buildings is not available.	40% of new buildings with 100% electrification capacity.	70% of new buildings with 100% electrification capacity.	100% of new buildings with 100% electrification capacity.
NB.T3	EPC rating requirements per total floor area: - EPC-C for buildings < 2000m ² and - EPC = NZEB for buildings > 2000m ² .	All new public buildings to be constructed in accordance with the current NZEB criteria.		
NB.T4	Green building certifications (e.g., YeS-TR) used on a voluntary basis.	New public buildings to be constructed in accordance with YeS-TR criteria.		
NB.T5	Regulations limiting emissions originating from building materials are not available.	20% of the building materials used in construction with low embodied carbon content	50% of the building materials used in construction with low embodied carbon content	80% of the building materials used in construction with low embodied carbon content

5.3.2 Actions

In this section, transformative actions to address carbon emissions resulting from new buildings, as well as the target years for completing these actions, are presented.

The main actions are examined under the category of “policy”, while supporting actions are provided under the categories of “finance,” “technology,” and “technical capacity and awareness.”

5.3.2.1 Policy Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
NB.PA1	Encouraging the use of life cycle assessment and energy modeling in new building projects	5 years
NB.PA2	Adopting green building standards for new buildings in urban renewal projects.	5 years
NB.PA3	Establishing a Green Incentive Program for promoting eco-friendly practices in new buildings, and ensuring the effective use of the existing programs (e.g., <i>Ecological Urban Design Guide</i>).	7 years
NB.PA4	Adopting "Green Procurement" criteria for public tenders, encouraging the use of sustainable materials with Environmental Product Declarations (<i>EPDs</i>).	5 years
NB.PA5	Encouraging the use of low-carbon structural systems (e.g., <i>wood, adobe, earth buildings, etc.</i>) in new public buildings owned by the municipality.	5 years
NB.PA6	Implementing Building Information Modeling (BIM) in new public buildings for integrated design.	5 years
NB.PA7	Encouraging the use of BIM-based integrated design in large-scale new constructions (e.g., <i>shopping centers, office buildings, residences, hospitals, schools, etc.</i>).	5 years
NB.PA8	Enhancing the effectiveness of existing inspection mechanisms to ensure compliance with the BEP Regulation for energy-efficient building design.	3 years
NB.PA9	Enhancing the effectiveness of existing inspection mechanisms to ensure that the construction process aligns with the design.	3 years
NB.PA10	Requiring that new public buildings owned by the municipality , with a floor area of 2,500m ² or more, be designed as Nearly Zero-Energy Buildings (<i>NZEB</i>) in accordance with the BEP Regulation.	2 years
NB.PA11	Designing new public buildings owned by the municipality according to YeS-TR (or equivalent) green building certification criteria.	5 years
NB.PA12	Ensuring that new public buildings owned by the municipality with a floor area of over 10,000m ² receive YeS-TR (or equivalent) certification.	5 years
NB.PA13	Promoting energy-efficient building design.	3 years
NB.PA14	Achieving 100% electrification in new public buildings owned by the municipality.	7 years
NB.PA15	Increasing the share of renewable energy in new public buildings owned by the municipality.	2 years
NB.PA16	Incentivizing the increase of the share of renewable energy in all new buildings in Gaziantep.	3 years
NB.PA17	Encouraging the integration of renewable energy sources (e.g., <i>Solar, Wind, Heat Pumps</i>) into integrated design.	5 years

ACTION #	ACTION DESCRIPTION	TIMEFRAME
NB.PA18	Using efficient lighting systems (e.g., LED) in new public buildings owned by the municipality.	
NB.PA19	Enhancing the selection of construction machinery and transport vehicles based on efficiency, fuel type, and carbon emissions, and enhancing legal regulations, including public tenders.	5 years
NB.PA20	Incentivizing reduced water usage during construction , encouraging the use of alternative water sources such as rainwater and treated water, and developing legal regulations.	3 years
NB.PA21	Ensuring effective collection and disposal of construction waste during construction.	2 years
NB.PA22	Ensuring effective collection and disposal of construction waste during construction.	5 years

5.3.2.2 Finance Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
NB.FA1	Utilizing existing national and international financial programs supporting the green economy.	2 years
NB.FA2	Prioritizing funding for sustainable, energy-efficient, and environmentally friendly designs in new municipal buildings.	2 years
NB.FA3	Developing incentive programs for sustainable buildings, emphasizing low environmental impact materials , renewable energy, and energy-efficient design.	5 years

5.3.2.3 Technology Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
NB.TA1	Promoting the widespread use of life cycle assessment tools for evaluating building sustainability.	5 years
NB.TA2	Encouraging the adoption of energy modeling tools in building design and construction.	5 years
NB.TA3	Developing an assessment tool within the Green Incentive Program to measure building compliance.	5 years
NB.TA4	Collaborating with academic institutions to conduct research and development (R&D) and practical implementation in the field of sustainable buildings , tailored to the Gaziantep region's specific geography (<i>Low-carbon material applications, smart buildings, efficient appliances, smart monitoring systems, advanced HVAC systems, renewable energy integration, etc.</i>)	5 years
NB.TA5	Utilizing thermal cameras during inspections to assess the thermal permeability of building envelopes.	5 years
NB.TA6	Increasing the use of innovative technology to monitor and enhance construction processes (<i>e.g. drone-based construction progress tracking</i>).	5 years
NB.TA7	Promoting the widespread adoption of Building Information Modeling (BIM) systems for construction planning, reducing application errors and delays.	5 years

5.3.2.4 Technical Capacity and Awareness Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
NB.TCA1	<p>Developing ecological building design guidelines specific to Gaziantep's climate, and updating existing guidelines</p> <ul style="list-style-type: none"> • Integrated building design • Sustainable materials • Sustainable architecture • Renewable energy systems and their integration into building systems • Electrification in buildings • Waste management <p><i>(Guidelines to include recommendations for project management, material selection, passive design methods, shading systems, heating and cooling, lighting, insulation, and the selection of mechanical systems.)</i></p>	2 years
NB.TCA2	<p>Raising awareness and provide training in the following areas, to enhance the capacity of municipal departments, industry representatives, and other stakeholders:</p> <ul style="list-style-type: none"> • Building Information Modeling (BIM) • Sustainable materials • Solid waste, construction waste disposal, and recycling • Circular economy • Life cycle assessment in buildings • Renewable energy and electrification • Sustainable architecture • Innovative construction methods • Green certifications 	2 years
NB.TCA3	<p>Conducting communication campaigns to raise awareness among citizens about sustainable buildings, energy efficiency, sustainable materials, smart buildings, and related topics.</p>	3 years
NB.TCA4	<p>Raising awareness within the municipal organizations regarding renewable energy, and innovative practices and materials in the National Construction and Installation Unit Price Catalog published by the Ministry of Environment, Urbanization and Climate Change (MoEUCC).</p>	2 years
NB.TCA5	<p>Providing training to professionals to incorporate water-efficient systems into building designs due to the high water consumption in Gaziantep's buildings.</p>	2 years

5.4 Urban Planning and Resilience

In recent times, urbanization is occurring at an unprecedented rate, with living spaces transforming into urban areas more rapidly than ever before. According to UN Habitat data, the global urbanization rate has increased fivefold between 1950 and 2011 [18]. Today, approximately 55% of the world's population resides in urban areas. By 2030, it is projected that this proportion will reach 70%, and by 2050, an estimated 2.5 billion more people will join the global population, leading to an anticipated urban population rate of 90% [19].

Buildings, which constitute a vital component of urban systems, already consume approximately 40% of global energy and are responsible for nearly one-third of global greenhouse gas emissions. Greenhouse gas emissions from transportation, on the other hand, make up around 25% of total emissions, and if current conditions persist, this percentage is expected to rise to 40% [20].

"Resilience" against climate change can be built through mitigation and adaptation actions, ensuring urban systems' robustness against climate impacts.

Increasing energy efficiency in all urban activities and transitioning from fossil fuels to alternative and renewable energy sources for the remaining energy consumption, support the mitigation strategies.

The development of “adaptation” strategies for new and changing conditions due to climate change is of significant importance in the fight against climate change. Adaptation methods refer to the adjustments made in ecological, social, or economic systems in response to existing or anticipated climatic events and their impacts, enhancing the systems’ resilience against climate effects.

Increasing the resilience of Gaziantep city and its buildings to the impacts of climate change through nature-based and sustainable methods will contribute equitably to demographic needs and societal development. Establishing an inclusive, flexible,

and disaster-prepared urban structure is possible through comprehensive efforts. To achieve this, local policies need to be developed enhancing urban resilience. All sector stakeholders must collaborate harmoniously. Climate risks and urban vulnerabilities should be considered in the planning of the city, including data on population density and projections, urban carbon sink areas, and their spatial distribution. Additionally, continuous monitoring of data through tools like geographic information systems (GIS) is essential. Early risk reduction measures should be implemented based on the insights derived from this continuous monitoring.

The following sections list the goals, targets, and transformative actions for Gaziantep proposed to enhance decarbonization and resilience in the areas where urban, natural, and building systems intersect.

5.4.1 Goals and Targets

Urban Planning and Resilience have been examined with a focus on seven primary goals, and the proposed actions are aligned with the strategic targets defined for the years 2030, 2040, and 2050 in the national road-mapping effort.

GOAL #	GOAL DESCRIPTION
UP-R1	Enhancing urban climate and disaster resilience
UP-R2	Increasing the climate and disaster resilience of existing and new buildings
UP-R3	Preserving green spaces and the main ecological structure while restoring degraded areas
UP-R4	Designing public spaces, urban infrastructure, and transportation systems in harmony with the ecological structure
UP-R5	Integrating regional alternative and renewable energy production facilities into urban planning
UP-R6	Ensuring maximum soil infiltration of rain and floodwaters through Sustainable Urban Drainage Systems (SuDS)
UP-R7	Eco-friendly and sustainable management of urban waste, contributing to a circular economy



TARGET #	CURRENT STATE	2030 TARGET	2040 TARGET	2050 TARGET
UP-R.T1	The Ecological Urban Design Guide is available also addressing climate risks, but its applications are not widespread. Urban resilience criteria are not included in the planning.	Developing a guide with criteria related to the preservation of green areas and the main ecological structure, incorporating these criteria into urban renewal and replanning processes. Increasing urban green spaces and implementing pilot projects to reduce heat island effects.	Restore and rehabilitate 50% of the main ecological structure. Designing urban green spaces in balance with carbon sequestration needs addressing urbanization-related carbon emissions. Introducing heat island and green space calculation criteria in new development projects.	Restore and rehabilitate 100% of the main ecological structure. Designing urban green spaces in balance with carbon sequestration needs addressing urbanization-related carbon emissions. Introducing heat island and green space calculation criteria in new development projects.
UP-R.T2	The Ecological Building Design Guide and incentive system supporting the construction of new buildings with climate resilience are available, but their implementation is not widespread. Local policies and regulations related to climate resilience are not in place.	Updating the Ecological Building Design Guide to reflect changing climate and economic conditions and promoting its widespread use. Ensuring that climate-resilient design criteria are used in 40% of new buildings through incentives.	Updating the Ecological Building Design Guide to reflect changing climate and economic conditions and promoting its widespread use. Ensuring that climate-resilient design criteria are used in 70% of new buildings through incentives.	Updating the Ecological Building Design Guide to reflect changing climate and economic conditions and promoting its widespread use. Ensuring that climate-resilient design criteria are used in 100% of new buildings through incentives.
UP-R.T3	Local policy and incentive system supporting the climate-resilient renovation of existing buildings are not available.	Developing climate-resilient renovation criteria for existing buildings and promoting climate resilience practices in earthquake strengthening projects. Renovating 40% of existing buildings to enhance climate resilience through maintenance and refurbishment efforts.	Renovating 70% of existing buildings to enhance climate resilience through maintenance and refurbishment efforts.	Ensuring 100% of existing buildings are climate-ready and resilient to climate change impacts.
UP-R.T4	Capacity-building efforts and action plans for climate-resilient planning in public spaces, infrastructure, and transportation activities exist but are not widely implemented. The city has existing bicycle usage and bike lanes. There are also examples of rail systems.	Developing regulations and pilot projects for enhancing urban resilience, promoting energy efficiency, using durable and low-carbon materials in public spaces, infrastructure, and transportation activities. Conducting pilot projects for transitioning to alternative fuel vehicles (such as electric or hydrogen) in public transportation. Expanding bicycle usage.	Developing regulations and pilot projects for enhancing urban resilience, promoting energy efficiency, using durable and low-carbon materials in public spaces, infrastructure, and transportation activities. Achieving a transition to alternative fuel vehicles in public transportation by 50%. Continuous expansion of bicycle usage.	Developing regulations and pilot projects for enhancing urban resilience, promoting energy efficiency, using durable and low-carbon materials in public spaces, infrastructure, and transportation activities. Achieving a transition to alternative fuel vehicles in public transportation by 100%. Continuous expansion of bicycle usage.

TARGET #	CURRENT STATE	2030 TARGET	2040 TARGET	2050 TARGET
UP-R.T5	Renewable energy projects associated with the GMM exist but are not widely implemented at the city level.	Conducting pilot projects in urban planning efforts to facilitate and promote renewable energy generation and district heating and cooling systems.	Introducing regulations containing criteria for renewable energy generation and district heating and cooling systems in urban planning efforts and implementing these criteria in new settlements.	Achieving a complete transition to renewable energy and district heating and cooling systems in all settlements.
UP-R.T6	Limited infiltration of rainwater due to impermeable hard surfaces, creating flood risks, inadequately replenishing groundwater sources, and ongoing drought risks.	Increasing infiltration of rainwater by creating more permeable surfaces through sustainable urban drainage systems (SuDS). Conducting pilot projects to achieve a 40% rate of rainwater reaching the ground through SuDS.	Implementing regulations for the use of SuDS, rehabilitating existing impermeable areas within the city, and achieving a 50% rate of rainwater reaching the ground through SuDS.	The rehabilitation of all existing drainage systems, making the use of SuDS mandatory through regulations, and achieving a 60% rate of rainwater reaching the ground through SuDS.
UP-R.T7	Limited recycling of urban waste and building demolition waste. Insufficient capacity for disposal and recycling in case of sudden rise of demolition waste (e.g. natural disasters, earthquakes).	Achieve a 40% recycling and reuse rate for urban waste by establishing appropriate collection and separation areas and facilities, and by improving the existing ones.	Achieving a 60% recycling and reuse rate for urban waste and increasing the capacity for biomass energy production.	Achieving an 80% recycling and reuse rate for urban waste and maximizing biomass energy production capacity.

5.4.2 Actions

In this section, transformative actions proposed for decarbonization in the Urban Planning and Resilience processes, as well as the target years for completing these actions, are presented.

The main actions are examined under the category of “policy”, while supporting actions are provided under the categories of “finance,” “technology,” and “technical capacity and awareness.”



5.4.2.1 Policy Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
UP-R.PA1	Increasing carbon sink areas in the city center and implementing these practices in harmony with urban regeneration projects.	7 years
UP-R.PA2	Handling urban planning in a way that supports the building energy performance criteria specified in the BEP regulation aiming "Energy-Efficient Urban Planning" (e.g., evaluating building orientation, form, height, inter-building gaps, etc.)	7 years
UP-R.PA3	Introducing urban planning regulations enforcing balanced design of carbon emission sources and carbon sink areas	7 years
UP-R.PA4	Integrating urban transportation systems for reducing vehicle traffic and congestion to lower carbon emissions, enhancing infrastructure for rail systems and bicycle usage.	7 years
UP-R.PA5	Introducing regulations to support the integration of urban renewable energy generation systems into urban planning practices.	7 years
UP-R.PA6	Introducing regulations to support the integration of district heating and cooling into urban planning practices.	7 years
UP-R.PA7	Selecting vegetation, trees, and landscaping elements based on climate and regional characteristics , and enhancing the effectiveness of inspection mechanisms in urban landscaping projects.	3 years

5.4.2.2 Finance Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
UP-R.FA1	Establishing green financing programs for alternative and renewable energy, district heating and cooling systems, integrated rail transportation, bicycle usage, and energy-efficient lighting projects through collaboration with financial institutions (Multilateral Development Banks, Ministries, and other financial organizations).	7 years
UP-R.FA2	Allocating institutional resources to expedite energy-efficient urban planning practices.	7 years

5.4.2.3 Technology Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
UP-R.TA1	Collaborating with academia on R&D efforts related to the widespread adoption of carbon capture technologies in urban areas .	7 years
UP-R.TA2	Developing a monitoring and reporting system for tracking urban carbon emissions .	7 years
UP-R.TA3	Conducting mapping, risk management, and climate change vulnerability assessments with the support of Geographic Information Systems (GIS) .	7 years

5.4.2.4 Technical Capacity and Awareness Actions

ACTION #	ACTION DESCRIPTION	TIMEFRAME
UP-R.TCA1	Collaborating with local and foreign cities and municipalities conducting similar projects, including partnerships, protocols, and reciprocal site visits. Organizing training and capacity-building initiatives for municipal staff to enhance their knowledge in innovative, environmentally friendly, and climate-resilient urban planning.	7 years
UP-R.TCA2	Providing technical training for urban planning experts on urban carbon sources and carbon sinks planning and management.	7 years
UP-R.TCA3	Increasing the capacity within the municipalities for energy-efficient and ecological urban planning and conducting workshops with universities.	7 years
UP-R.TCA4	Providing emission monitoring training for units responsible for emission tracking.	7 years
UP-R.TCA5	Providing training for relevant departments on Geographic Information Systems (GIS) usage.	7 years

5.5 Cross-Cutting Topics

5.5.1 Gender Equality

Gaziantep Metropolitan Municipality is one of the six metropolitan municipalities in Türkiye that signed the European Charter for Equality of Women and Men in Local Life, adopted by the Council of European Municipalities and Regions (CEMR) in May 2006. This charter represents a commitment by local and regional governments in Europe to use their powers and develop partnerships to ensure greater equality for their citizens in terms of gender [21].

One of the 17 Sustainable Development Goals developed by the United Nations, addressing environmental protection, climate crisis action, fair wealth distribution and peace, is “Gender Equality” (Goal 5) aiming to achieve gender equality and empower all women and girls. Additionally, Goal 10 “Reduced Inequalities” aims to reduce inequalities within and among countries [22].

This action plan for decarbonizing the building sector in Gaziantep has been developed with consideration for gender equality. Efforts should be made to ensure the involvement of women leaders, managers, and technical experts in the responsible stakeholder groups for implementing these actions. Additionally, it is of great importance to consider and

monitor gender and social equality within the beneficiary group in the employment processes, workforce participation, technical capacity development, and awareness-raising efforts that will be conducted throughout the implementation activities. Improving gender and social equality, which is currently relatively insufficient in the construction sector, requires fair support for all relevant stakeholder groups.

Recommended actions that institutions and organizations can implement to promote gender equality in the sector are presented below:

- Promoting diversity in the recruitment process.
- Ensuring equal pay and benefits for all employees.
- Providing comprehensive training and professional development programs.
- Facilitating active participation of all genders.
- Supporting businesses owned by women.
- Advocating for both gender and social equality.

5.5.2 Stakeholders and Institutional Structure

The decarbonization of the building sector relies greatly on the roles, responsibilities, and possible collaborations that all stakeholders in the sector will undertake to achieve Gaziantep's and consequently Türkiye's emission reduction targets. Some key stakeholders in the Gaziantep building sector are presented below:

- Governorship of Gaziantep
- Ministry of Environment, Urban Planning, and Climate Change Provincial Directorate
- Gaziantep District Municipalities
- GMM Energy Inc. (GMM Subsidiary Company)
- Gaziulaş - Gaziantep Transportation and Information Services Inc. (GMM Subsidiary Company)
- Gazi Consulting A.Ş. (GMM Subsidiary Company)
- GASKİ – Gaziantep Water and Sewerage Administration
- Toroslar Electricity Distribution Inc.
- GAZDAŞ- Gaziantep Gas Distribution Inc.
- (TMMOB) Union of Chambers of Turkish Engineers and Architects, Chamber of Architects Gaziantep Branch
- TMMOB Chamber of Civil Engineers Gaziantep Branch
- TMMOB Chamber of Urban Planners Gaziantep Branch
- TMMOB Electrical Engineers Association Gaziantep Branch
- TMMOB Chamber of Mechanical Engineers Gaziantep Branch
- TMMOB Chamber of Environmental Engineers Gaziantep Branch
- Gaziantep Chamber of Industry
- Gaziantep Chamber of Commerce
- Universities in Gaziantep Province
- National and International Financial Institutions
- The Scientific and Technological Research Council of Türkiye (TÜBİTAK)
- Silkroad Development Agency
- Gaziantep Contractors Association
- Local Material Producers
- Building Sector Associations

In Gaziantep Metropolitan Municipality, climate change-related activities are conducted by the Environmental Protection, Zero Waste and Climate Change Department. Figure 7 illustrates the organizational structure that will be directly involved in the action plan implementation activities [23].

Figure 7. Organizational structure of the municipal departments and offices involved in Gaziantep Building Sector Decarbonization Action Plan.



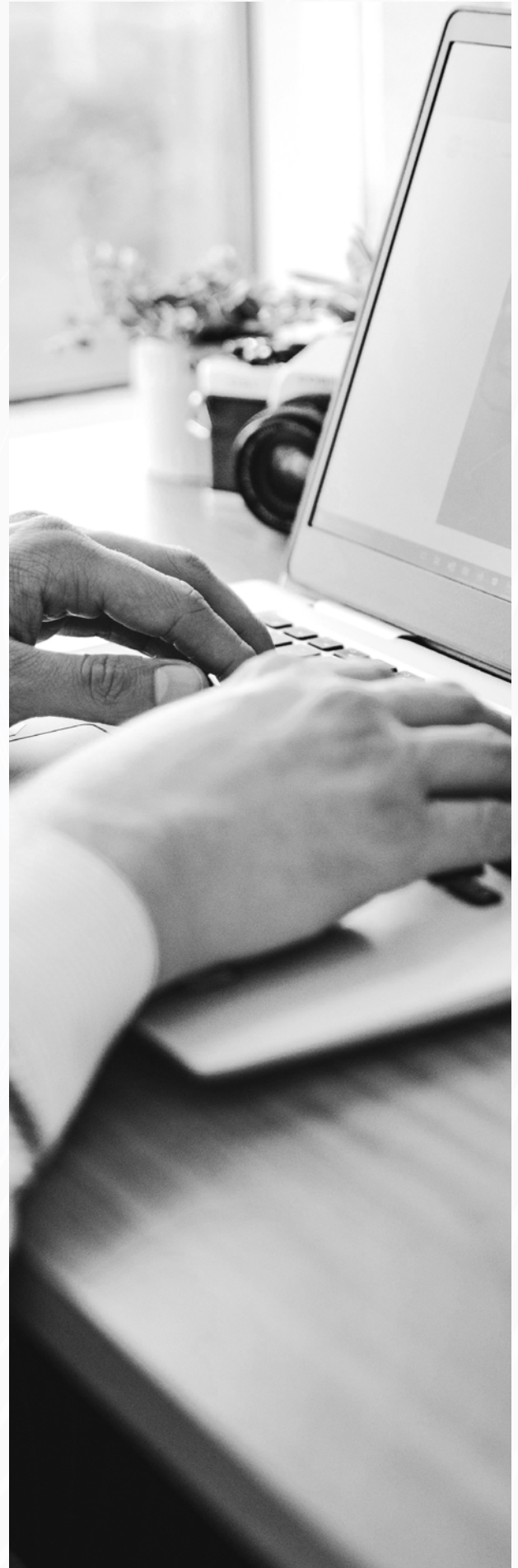
6. IMPLEMENTATION OF THE ACTION PLAN

The building sector, being one of the highest energy-consuming sectors, is considered a priority area in national and local climate change mitigation efforts. The successful implementation of the recommendations presented in this action plan for decarbonizing the building sector in Gaziantep, is of utmost importance.

Several key steps need to be taken to effectively implement the Action Plan and achieve decarbonization in the building sector. Firstly, a coordination team will be established within Gaziantep Metropolitan Municipality to monitor and report on the progress of the action plan. Subsequently, efforts will be accelerated to create a detailed building inventory in the city, with a focus on prioritizing technical capacity-building actions within the first two years.

Collaborations with international financial institutions will be developed to create incentive programs in line with Gaziantep's vision and strategic goals. Furthermore, projects will be developed, and pilot initiatives will be conducted to expedite the transformative impact of the actions.

This action plan, developed under the Zero Carbon Building Accelerator Project, serves as a local complement to Türkiye Building Sector Decarbonization Roadmap. The short, medium, and long-term actions outlined in this document will promote an environmentally friendly, climate-resilient, and adaptive urban and societal transformation, aligning with national goals and target, facilitating the dissemination of the city- and country-wide transformation.



7. MONITORING AND EVALUATION

The monitoring and evaluation activities will be overseen by a dedicated coordination team within the Gaziantep Metropolitan Municipality. This team will be responsible for the systematic collection of data and the management of a standardized reporting process concerning the efficacy of reduction measures and actions. An effective communication plan will be developed to facilitate data collection through robust engagement with internal municipal departments and external sector stakeholders. As the need arises, formal protocols will be employed between stakeholders.

The monitoring and evaluation activities will be conducted within the framework of two principal categories:

1. Monitoring of Mitigation Measures

This category will encompass the continuous monitoring of the performance of reduction measures and the evaluation of their influence on carbon emissions. Annual updates to emission calculations will be executed, and carbon emissions derived from both operational and embodied sources within the building stock will be periodically reported via a monitoring tool developed as part of the project. This tool will serve to compare the current state with the future projections.

2. Monitoring of Decarbonization Actions

A direct linkage exists between decarbonization actions and mitigation measures, as many of these actions manifest as numerical reflections of the implemented mitigation measures. Under this monitoring category, the progress of decarbonization actions will be tracked across 4 stages, namely "Initiation," "Planning," "Implementation," and "Completion". Percentage completion of the actions will be continually monitored and periodically reported. This methodology will facilitate an evaluation of the individual impact of each action, the pace of overall progress, and the prospect of attaining the predefined targets.

Monitoring and evaluation activities will be built upon the following key steps:

1. Determination of Performance Indicators
2. Data Collection and Monitoring
3. Establishment of a Baseline
4. Progress Reports
5. Evaluation and Improvement
6. Stakeholder Feedback

The monitoring and evaluation processes will serve as a critical tool to measure the success of the action plan and to take corrective measures when necessary, ensuring transparent progress toward the decarbonization goals and targets of the building sector.



8. PILOT PROJECT PROPOSAL

To ensure the success of decarbonization strategies in buildings, it is essential to address urban systems and societal dynamics together. Successful urban renewal projects consider multiple layers, such as energy and water efficiency, infrastructure, transportation systems, environmental sustainability, social equity, economic development, and social progress, beyond just building transformation, resilience, and decarbonization.

After the earthquakes in Gaziantep on February 6, 2023, a need for multi-layered transformation at the city scale has emerged. In this context, a model is required that prioritizes the transformation of the building stock, especially in areas affected by the earthquake, with strategies for resilience, decarbonization, renewable energy use, economic opportunities, reduction of social inequalities, and socioeconomic development. Within this framework, a pilot project is proposed to create a model in Sazgın Neighborhood within the boundaries of Gaziantep that respects the cycles of nature, uses energy resources efficiently, is environmentally friendly, sustainable and resilient to disasters.

Pilot Project: ECOLOGICAL TRANSFORMATION OF SAZGIN NEIGHBORHOOD

General Characteristics and Objectives:

Sazgın is located 15 kilometers from the city center and 7 kilometers from the Oğuzeli district to which it is affiliated. Its climate is similar to that of the main city center. The total population of the neighborhood is 270, distributed among 64 households. The residents of the neighborhood have voluntarily participated in the ecological village project.

The transformation project to be implemented in Sazgın by the Gaziantep Metropolitan Municipality aims to create more resilient, healthier, eco-friendly, and peaceful living spaces following the earthquakes of February 6, 2023. This investment will contribute to the municipality’s goals of decarbonization and sustainable development, positioning Gaziantep as an environmentally friendly city from ecological, economic, and social perspectives.

Recommended Actions for the Project:

The project aims to implement various approaches on both the building and neighborhood scale are aimed at achieving the project’s objectives, including Ecological Design, Green Production, Ecological Architecture, Alternative Energy, Energy Efficiency, Green Transportation, Zero Waste, and Water Conservation. In this context, the following actions are proposed as a priority to meet the project’s objectives:

At the Building Scale;	At the Neighborhood Scale;
<ul style="list-style-type: none"> • Energy-efficient building envelope • Low-emission building materials • High-efficiency heating, cooling, and ventilation systems • High-efficiency lighting • Integration of renewable energy • Rainwater collection and storage • Greywater treatment and reuse 	<ul style="list-style-type: none"> • Waste management and zero waste target • High-efficiency and renewable energy-supported street lighting • Installation of a biomass heating facility • Installation of a microalgae pool for heating • Establishment of a district heating system • Integration of renewable energy • Rainwater collection and storage • Greywater treatment and reuse • Bicycle stations • Sustainable landscaping efforts

Project Implementation:

Implementation of the project will involve the use of national or international green certification systems that provide criteria at both the building and settlement scales (e.g., Yes-TR). The analyses to be conducted may include Suitability for Settlement and Sustainable Land Use Study, Disaster Risk Report, Wastewater Management Plan, Transportation and Mobility Analyses, Urban Design, and Social and Economic Sustainability Studies, as well as analyses related to Heat Islands, Noise, Sound, and Light Pollution.

To meet the criteria designed in alignment with the United Nations Sustainable Development Goals, interdisciplinary planning is essential. This planning phase will embrace a team-based approach, involving professionals from various fields of expertise, such as urban planners, landscape architects, environmental engineers, architects, sociologists, economists, biologists, mechanical engineers, civil engineers, electrical engineers, and energy engineers.

Connection with the Business Model:

The project's activities at the building and settlement levels need to be certified and traceable. For instance, the energy performance of buildings should be certified according to the EPC system, and the targeted EPC classes should aim to exceed national criteria (e.g., ECP B class - Nearly Zero-Energy Building). At the settlement scale, it is recommended to use certification systems that define criteria at the national or international level as a guide (e.g., Yes-TR). Financial support for sustainable, certified, and traceable practices can be obtained from national and international development banks, private sector organizations, and their financial support programs.

Intended Outcomes:

This ecological transformation project aims to serve as an inspiration to public institutions and companies seeking solutions to environmental and social issues by representing a seismic-resistant, eco-friendly, energy-producing living model in Gaziantep and other regions. Additionally, the project emphasizes the importance of social benefit and community empowerment in creating sustainable living spaces. With these features, it is aimed for this initiative, which begins in Sazgın, to expand to surrounding neighborhoods, and then across Gaziantep and ultimately throughout Türkiye.





REFERENCES

- [1] IPCC, «Climate Change 2023 Synthesis Report,» 2023.
- [2] European Commission, «Causes of climate change,» 2020. [Online]. Available: https://climate.ec.europa.eu/climate-change/causes-climate-change_en.
- [3] United Nations Climate Change, «The Paris Agreement,» 2015.
- [4] International Energy Agency, 01 02 2022. [Online]. Available: <https://www.iea.org/topics/buildings>.
- [5] UNEP, «Why Buildings? Day at COP21,» Buildings Day at COP21, Paris, 2015.
- [6] UN Habitat, «World Cities Report,» 2022.
- [7] Global Alliance for Buildings and Construction (GlobalABC), «Regional Roadmap for Buildings and Construction in Latin America 2020-2050,» United Nations Environment Programme, IEA, 2020.
- [8] International Energy Agency, «All countries targeted for zero-carbon-ready codes for new buildings by 2030,» 9 2022. [Online]. Available: <https://www.iea.org/reports/all-countries-targeted-for-zero-carbon-ready-codes-for-new-buildings-by-2030-2>. [Accessed: 1 10 2022].
- [9] WRI, «Accelerating Building Efficiency: Eight Actions for Urban Leaders,» Washington DC., 2016.
- [10] WRI, «Building Efficiency Accelerator,» 2020. [Online]. Available: <https://buildingefficiencyaccelerator.org/zero-carbon-building-accelerator>.
- [11] Gaziantep Büyükşehir Belediyesi, «Gaziantep İklim Değişikliği Eylem Planı,» Gaziantep Büyükşehir Belediyesi, <https://www.gaziantep.bel.tr/uploads/2020/07/gaziantep-ccap-tr-final-20111102>, 2016.
- [12] Gaziantep Büyükşehir Belediyesi Sıfır Atık ve Çevre Koruma Kontrol Daire Başkanlığı & GTE Karbon Sürdürülebilir Enerji Eğitim Danışmanlık ve Ticaret, «Sürdürülebilir Enerji İklim Eylem Planı Mevcut Durum ve İzleme Raporu,» Gaziantep Büyükşehir Belediyesi, Gaziantep, 2022.
- [13] Türkiye Cumhuriyeti Cumhurbaşkanlığı, Strateji ve Bütçe Başkanlığı, «2023 Kahramanmaraş ve Hatay Depremleri Raporu,» 2023.
- [14] New Buildings Institute, «Lifecycle GHG Impacts in Building Codes,» Portland, 2022.
- [15] Gaziantep Büyükşehir Belediyesi, «Sürdürülebilir Enerji ve İklim Eylem Planı,» 2018.
- [16] Global Alliance for Buildings and Construction (GlobalABC), «2018 Global Status Report,» 2018.
- [17] Environmental Protection Agency, «2021 Global Greenhouse Gas Emissions Database,» 2021.
- [18] UN Habitat, «Cities and Climate Change: Policy Directions,» 2011.
- [19] UN Department of Economic and Social Affairs, «68% of the world population projected to live in urban areas by 2050, says UN,» 2018. [Online]. Available: <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>. [Accessed: 01 03 2023].
- [20] WRI, «Urban Efficiency and Climate,» 2020. [Online]. Available: <https://www.wri.org/cities/urban-efficiency-climate>.
- [21] CEMR, «Equality of women and men in local life,» 2006.
- [22] United Nations, 2023. [Online]. Available: <https://turkiye.un.org/tr/sdgs>.
- [23] Gaziantep Büyükşehir Belediyesi, «Teşkilat Şeması,» [Online]. Available: <https://www.gaziantep.bel.tr/tr/teskilat-semasi>. [Accessed: 21 05 2023].

BÜYÜKŞEHİR
GAZİANTEP

GAZİANTEP
BUILDING SECTOR
DECARBONIZATION
ACTION PLAN

EXTENDED SUMMARY

December, 2023



global
environment
facility
INVESTING IN OUR PLANET



WRI TURKEY
— ROSS CENTER



WORLD
RESOURCES
INSTITUTE | ROSS
INSTITUTE | CENTER