ISTANBUL METROPOLITAN MUNICIPALITY

DEPARTMENT OF ENVIRONMENTAL PROTECTION AND DEVELOPMENT

İSTANBUL SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN



Funded by the European Union

CPVA

SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN OF İSTANBUL

2030

Funded by the European Union

CPVA Central project management agency

ISTANBUL METROPOLITAN MUNICIPALITY

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ABBREVIATIONS

AFAD	Disaster and Emergency Management Presidency (DEMP)
AYEDAŞ	İstanbul Anatolian Side Electricity Distribution Inc. - İstanbul Anadolu Yakası Elektrik Dağıtım A.Ş.
BEDAŞ	Boğaziçi Electricity Distribution Inc. - Boğaziçi Elektrik Dağıtım A.Ş.
BEI	Baseline Emission Inventory
BİMTAŞ	Boğaziçi Landscape Construction Consultancy Technical Services Industry and Trade Inc. - Boğaziçi Peyzaj İnşaat Müşavirlik Teknik Hizmetler San. Tic. A.Ş.
CCAP	Climate Change Action Plan
CDP-ICLEI	CDP (formerly known as the Carbon Disclosure Project) and ICLEI (Local Governments for Sustainability)
CoM	Covenant of Mayors for Climate and Energy Initiative
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CPMA	Central Project Management Agency
DSİ	State Hydraulic Works - Devlet Su İşleri
EU	European Union
EU4ETTR	EU4 Energy Transition Project in Western Balkans and Türkiye
EMRA	Energy Market Regulatory Authority of Türkiye
EPC	Energy Performance Contract
ESCO	Energy Service Company
GCoM	Global Covenant of Mayors for Energy and Climate
GD	General Directorate
GDP	Gross Domestic Product
GHG	Greenhouse gas emission

GIS	Geographic Information System
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GWP	Global Warming Potential
HMI	Heat Mitigation Index
HVAC	Heating, Ventilation, and Air Conditioning
HRL	High-Resolution Layer
IBA	Important Bird Area
ICCAP	İstanbul Climate Change Action Plan
IEA	International Energy Agency
IPA	Important Plant Area
IPCC	International Panel on Climate Change
IMM	İstanbul Metropolitan Municipality
İETT	İstanbul Electric Tram and Tunnel Company - İstanbul Elektrik Tramvay ve Tünel İşletmeleri Genel Müdürlüğü
İHE	İstanbul People's Bread Inc.- İstanbul Halk Ekmek A.Ş.
İSKİ	İstanbul Water and Sewerage Administration - İstanbul Su ve Kanalizasyon İdaresi
İSFALT	İstanbul Asphalt Factories Industry and Trade Inc. - İstanbul Asfalt Fabrikaları Sanayi ve Ticaret A.Ş.
İSTAÇ	İstanbul Waste Management Industry and Trade Inc. - İstanbul Çevre Yönetimi Sanayi ve Ticaret A.Ş.
İTÜ	İstanbul Technical University
InVEST	Risk and Vulnerability Model
İSTAÇ	İstanbul Waste Management Industry and Trade Inc. - İstanbul Çevre Yönetimi Sanayi ve Ticaret A.Ş.
JRC	Joint Research Centre of EC
KİPTAŞ	İstanbul Housing Development Plan Tourism Inc. - İstanbul Konut İmar Plan Turizm A.Ş.
LGs	Local Governments
LULC	Land Use and Land Cover
MGM	Turkish State Meteorological Service - Devlet Meteoroloji İşleri Genel Müdürlüğü

MEI	Monitoring Emissions Inventory
MENR	Ministry of Energy and Natural Resources
MoAF	Ministry of Agriculture and Forestry
MoEUCC	Ministry of Environment, Urbanization and Climate Change
MoI	Ministry of Industry
MoTI	Ministry of Transport and Infrastructure
MMU	Marmara Municipalities Union
MW	Megawatt
MWhe	Million tons of oil equivalent
MWhfuel	Fuel in terms of megawatt hours
NCD	National Declaration of Contribution
NGO	Non-governmental organization
NZEB	Nearly Zero Energy Buildings
RCPs	Representative Concentration Pathways
SECAP	Sustainable Energy and Climate Action Plan
SUMP	Sustainable Urban Mobility Plan
PV	Photo Voltaic
RES	Renewable Energy Resources
TCDD	Turkish State Railways - Türkiye Cumhuriyeti Devlet Demiryolları
TEİAŞ	Turkish Electricity Transmission Corporation - Türkiye Elektrik İletim A.Ş.
TEP	Tons of equivalent petroleum
TMMOB	Union of Chambers of Turkish Engineers and Architects - Türk Mühendis ve Mimar Odaları Birliği
TOE	Tons of oil equivalent
TOKİ	Public Housing Administration - Toplu Konut İdaresi Başkanlığı
TurkStat - TUİK	Turkish Statistics Institute
UCLG-MEWA	United Cities and Local Governments Middle East and West Asia
UHI	Urban Heat Island
USDA	United States Department of Agriculture

CONTRIBUTORS TO THE REPORT

This report was prepared under the coordination of İstanbul Metropolitan Municipality (IMM) Environmental Protection and Control Department Climate Change Branch, in partnership with IMM Parks, Gardens and Green Areas Department, Energy Management and Lighting Branch, and with the technical support of the Central Project Management Agency (CPMA) of Lithuania.

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@2023

PREFACE OF THE MAYOR

Dear Residents of İstanbul,

Since the commencement of our tenure, we continue to work and produce with the goal of a fair, green and creative İstanbul, and to offer a better city life to İstanbul and its valuable residents. İstanbul is experiencing the era which stands as an unprecedented period of extensive investments in metro systems and infrastructural advancements within the city's history. We have undersigned the firsts in the history of IMM such as İstanbul Halk Dairy, Yuvamız İstanbul nurseries, student dormitories, Anne Card, Regional Employment Offices, City Restaurants, life centers and life valleys. It is with great satisfaction that we acknowledge the successful collaboration with local farmers and producers, facilitated by our support, ensuring efficient production unburdened by financial constraints.

Employing a participatory, transparent, people-oriented approach that values collective visdom, we have conceptualized and executed projects that safeguard the collective interests of 16 million İstanbul residents while preparing İstanbul for the future. We continued the 150 Projects in 150 Days, which started with the opening of the Basilica Cistern on July 22, 2022, with the 300 Projects in 300 Days marathon. This marathon has accelerated our investments, leading many works to İstanbul and laid the foundations of many projects. The foundation of the İçerenköy Sports Facility marked the initiation of our "New Investments, New Breakthroughs" marathon, which we eagerly anticipate.

Our efforts also extend to safeguarding İstanbul against environmental risks. The climate crisis threatens life around the world. The repercussions of this crisis, such as rising temperatures, forest fires, drought risks, and challenges pertaining to water and food security, necessitate a coordinated global response. Waste of no time, IMM has initiated concerted actions to address this exigent issue. We remain actively engaged in monitoring both local and global initiatives aimed at tackling this challenge.

Upon assuming office, we established the İstanbul Planning Agency to embark on the formulation of the Vision 2050 Strategy Document, a comprehensive roadmap for İstanbul's multifaceted future. The Vision 2050 Strategy Document was created as a result of data-based analysis with the ideas, efforts and contributions of thousands of

people. Throughout its development, the document has benefitted not only from our internal teams but also from the insights of nearly 2.000 representatives spanning academia, public entities, civil society organizations, private sector institutions, and almost 25 thousand citizens. One of the main themes of this document was the environment and the city adapting to the changing climate.

Under the umbrella of the İstanbul Metropolitan Municipality, we started to produce green energy with the solar energy systems we installed in IMM premises. We expanded green spaces in our city, we protected İstanbul's sea and water beds. We commenced environmental facilities, especially the Kemerburgaz Waste Incineration and Energy Production Facility, the largest in Europe, and the Silivri Seymen Landfill Gas Power Generation Facility. Our aspirations extend towards making İstanbul a carbon-neutral and climate-resilient global city by 2050. We will achieve this goal by decarbonizing the transportation system and improving the integration of public modes and fostering synergy with other transit options.

Presently, we possess the İstanbul Sustainable Energy and Climate Action Plan for 2023. In alignment with the İstanbul Metropolitan Municipality's resolute commitment to combatting climate change, IMM focuses on green energy transformation in buildings, equipment, urban transportation systems and recycling



of waste. We anticipate this endeavor will be beneficial and auspicious for our city and our fellow citizens. I extend my heartfelt gratitude to all contributors who have been instrumental in shaping this report, on behalf of 16 million İstanbulites.

This year we celebrate the 100th anniversary of our Republic. As we step into the second century of our Republic's existence, we remain devoted to work with the same faith and enthusiasm, adding value to İstanbul with the projects we will implement in the light of practical wisdom and scientific insights.

With profound regard and utmost esteem,

Ekrem İmamoğlu
Mayor of İstanbul Metropolitan Municipality



EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

İstanbul is the most populous city in Türkiye and Europe. It is located on both sides of the Bosphorus, the strait that connects the Black Sea to the Sea of Marmara. As of 2019, the population of İstanbul is 15.519.267 and it is estimated to be just over 17 million by 2030.

İstanbul the hub for the country's commercial, historical, and cultural activity. The city is a major hub for trade and commerce, banking and finance, manufacturing, media and entertainment, and tourism. It is home to many of the country's largest banks, as well as a large number of foreign banks.

As stated in the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports, Türkiye is in the Eastern Mediterranean Basin, which is one of the regions sensitive to climate change. According to the annual average temperature projections presented in the IPCC 5th Assessment Report, increases are predicted throughout Türkiye in all scenarios and throughout the entire period (2016 - 2100).

İstanbul Metropolitan Municipality (IMM) is the public institution responsible for municipal affairs of the province of İstanbul. 35% (1869 km²) of the total land area of İstanbul, which is within the jurisdiction of the İstanbul Metropolitan Municipality, is located on the Anatolian Side and 65% (3474 km²) is on the European side.[1]

Since İstanbul is a city that is acutely aware of the vulnerability created by climate change and being a signatory of Global Covenant of Mayors (GCoM), **IMM is committed to reduce GHG emissions 40% by 2030 from 2019 levels** and prepare and implement Sustainable Energy and Climate Action Plan (SECAP) in this respect. SECAP defines the activities and measures set up to achieve this target. For Climate Change mitigation, the main target sectors are buildings, equipment/facilities, urban transport, and waste.

As part of İstanbul Metropolitan Municipality's membership in the C40 Cities Climate Leadership Group, Mayor Mr. Ekrem İmamoğlu signed the Deadline 2020 Commitment, accepting the goal of making İstanbul a carbon-neutral and resilient city by 2050. In line with this new target, the

1 https://www.ibb.istanbul/icerik/yetki-alani

revision process of the CCAP (Climate Change Action Plan), which was initially prepared in 2018, commenced, and the Revised İstanbul Climate Change Action Plan was prepared and published in 2021[2]. This CCAP outlines the necessary steps for the entire city to take in order to combat climate change. The SECAP presented herein is designed to complement the CCAP and does not aim to reiterate the actions already identified for the city, but rather focus on the measures related to the IMM buildings, transport, facilities, and its affiliates/companies and intensify the sustainable energy and climate actions. The GHG inventory, risk and vulnerability assessment, targets and goals defined are relevant to the local conditions and reflect the specific activities, capacity and regulatory context of IMM.

IMM has created the institutional GHG inventory as an energy consumption inventoryresulting from all activities of the municipality. The institutional GHG emission inventory also includes municipal administrative buildings and activities, as well as the activities of subsidiaries/affiliates. The Baseline Emission Inventory (BEI) was developed for baseline year 2019 by calculating CO_2e emissions using an activity-based approach. Overall calculations of GHG emissions by sectors in the city level show that total GHG **emissions of İstanbul city** comprise about **50,89 $MtCO_2e$.** Stationary energy sector emissions comprise 63% of all emissions in İstanbul city. The majority of stationary energy sector emissions come from the residential buildings (44,17%). The transportation sector is responsible for 28,3% of total emissions, dominated by on-road transportation (99%). The waste and waste water sector, which is controlled and managed by IMM through companies İSTAÇ and İSKİ, represents the remaining 8,8% of emissions in İstanbul, with the vast majority (89%) of these coming from solid waste disposal. Analysis shows that **İstanbul's municipality insititutional emissions (1,54 $MtCO_2e$)** comprise about 3% of total citywide emissions. Main source of corporate emissions is commercial and institutional buildings and facilities of IMM affiliated companies and subsidiaries (54,13%).

As a summary of the works undertaken for risk and vulnerability assessment and determination of adaptation actions, a series of adaptation actions were prioritized for the identified vulnerabilities of the city of İstanbul. All of the problems arising from the vulnerability assessments may not be immediately resolved throughout İstanbul due to technical and budgetary

2 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

constraints. Therefore, the climate extremes, system vulnerability and the exposure of İstanbul, as explained in İstanbul Climate Change Action Report[3] were studied to determine the city vulnerability maps. The identification of the regions through these maps, where climate change impacts are concentrated, pointed out vulnerability hotspots. Based on these hotspots, the potentially applicable adaptation actions were identified, which were then narrowed down to the list of adaptation actions as per city's specificities.[4]

Through SECAP, energy efficiency measures are targeted at the sectors with the greatest potential for energy savings, such as the building, industry, transport, and waste sectors. IMM is responsible for public transportation, waste management, water supply, sewerage system and treatment, recreational areas, road paving, urban and zone planning. IMM is not involved in the production, transmission, distribution of electricity, or public street lighting for the city. However, it does operate several energy production plants, such as solar and waste-to-energy plants, to generate electricity for its own use.

The municipality's buildings will begin their energy efficiency journey by modernizing the largest and most energy-intensive buildings. 19 buildings have been identified and have undergone energy audits and are ready to start their modernization projects. The remaining buildings of the municipality will be grouped according to their energy consumption in order to prioritize their modernization, starting with the most energy-intensive buildings. A program, consisting of installing solar PV plants and using alternative energy sources to generate around 50% of the municipality's current electricity demand by 2030, is also planned.

IMM had 28 subsidiaries and 2 affiliated institutions under its control in 2019.

3 İstanbul Climate Change Action Plan https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

4 Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP), JRC112986, https://publications.jrc.ec.europa.eu/repository/handle/JRC112986

These companies are İETT General Directorate (public bus company), İSTAÇ A.Ş. (waste management company), İSTON A.Ş. (the concrete manufacturer), İSFALT A.Ş. (asphalt production company), İSKİ General Directorate (water and sewerage administration), İstanbul Halk Ekmek A.Ş. (İHE) (bread manufacturing company) and METRO İSTANBUL A.Ş. (subway operator).

İETT

İSTAÇ

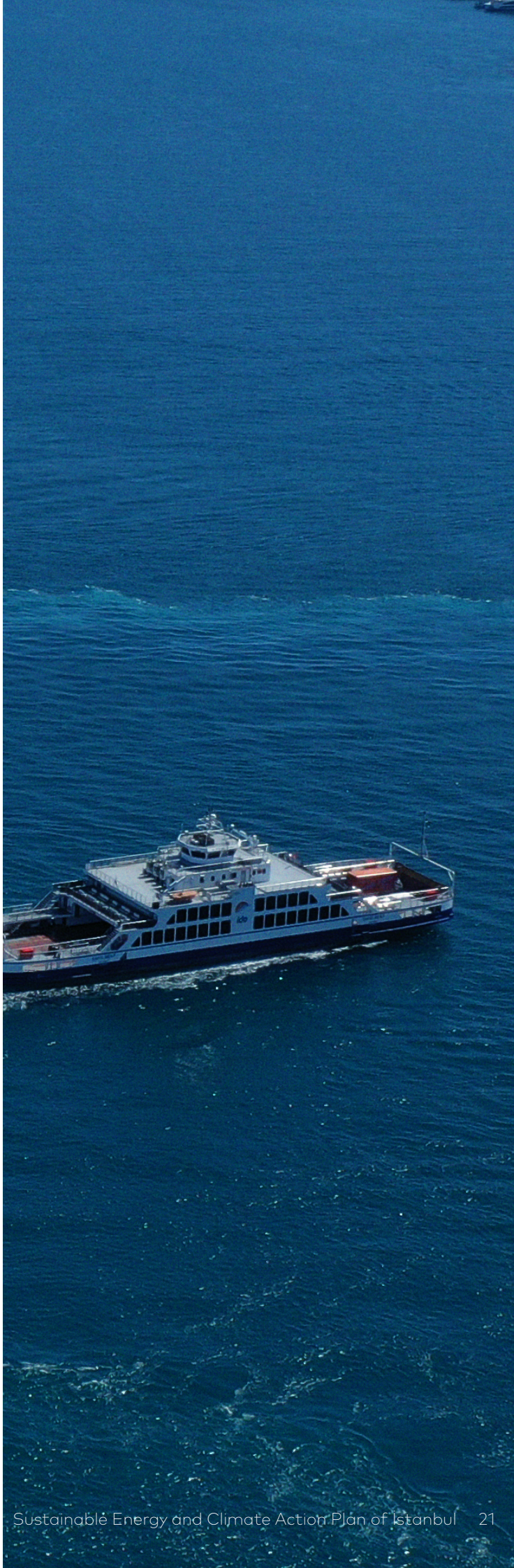
İSTON

İSFALT

İSKİ

İHE

METRO İSTANBUL



In order to meet their ambitious goals by 2030, the above-stated priority seven companies have conducted extensive research to identify the necessary actions. These include reducing energy consumption through efficiency investments and increasing renewable energy investments.





%40

İSKİ General Directorate will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

534.417,90 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***534.417,90 MWh/year***

İSKİ



%40

İETT General Directorate will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

36.998,10 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***36.998,10 MWh/year***



%40

İHE A.Ş. will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

29.045,30 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***29.045,30 MWh/year***

İSTANBUL HALK EKMEK



%40

İSFALT A.Ş. will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

29.123,50 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***29.123,50 MWh/year***

İSFALT



%40

İSTAÇ A.Ş. will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

6.432,50 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***6.432,50 MWh/year***

istaç



%40

İSTON A.Ş. will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

11.696,40 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***11.696,40 MWh/year***

İSTON



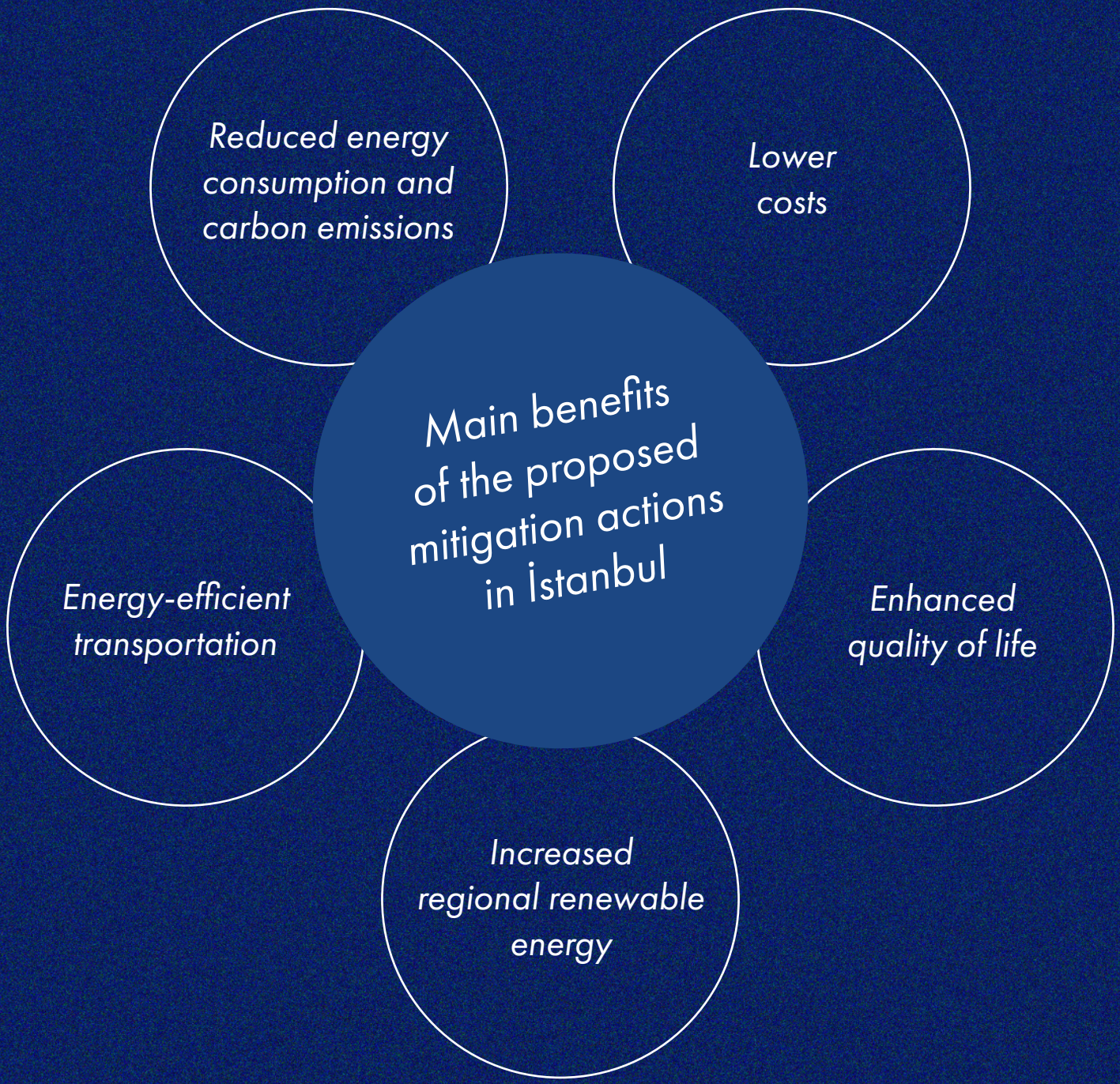
%40

METRO İSTANBUL A.Ş. will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030.

2.636,50 MWh/year

The total yearly amount of energy reduction in the buildings and facilities until 2030 will be: ***2.636,50 MWh/year***

METRO İSTANBUL


Reduced energy consumption and carbon emissions
Lower costs
Main benefits of the proposed mitigation actions in İstanbul
Energy-efficient transportation
Enhanced quality of life
Increased regional renewable energy

1. Reduced energy consumption and carbon emissions

Improving energy efficiency in buildings, ensuring lower energy consumption and therefore lower carbon emissions, will helpto mitigate climate change and improve air quality in İstanbul.

2. Lower costs

Implementing energy efficiency measures can help reduce natural gas and electricity costs, as well as maintenance costs for buildings, ultimately leading to lower overall expenses for citizens in İstanbul.

3. Enhanced quality of life

By reducing energy and carbon emissions, improving air quality both indoors and outdoors, and increasing energy efficiency, the quality of life for İstanbul citizens could be significantly enhanced. By reducing congestion and travel times, energy-efficient transportation could improve traffic flow and reduce the overall stress and frustration associated with transportation in İstanbul. By improving waste management practices and increasing waste recovery rates contributes to the development of the circular economy and creates cleaner city and environment. It is essential to decrease the rate of water losses and water usage and to improve waste water recovery and reuse to ensure water resources for all citizens.

4. Increased regional renewable energy

As renewable energy production increases, fossil fuel consumption decreases, digitalization in electrification and energy is implemented, and micro smart grids are established, both energy supply security and more suitable energy will be achieved. This will result in a more sustainable energy production and consumption system.

5. Energy-efficient transportation

Energy efficiency measures could also lead to lower fuel and maintenance costs for transport operators and individuals, helping to reduce the overall financial burden of transportation in İstanbul.

Overall, increased energy efficiency would be a beneficial move providing significant economic, social, and environmental benefits, making it a worthwhile investment for the city and its citizens.



1. INTRODUCTION

1. INTRODUCTION

1.1. INTRODUCTION TO SECAP AND EU4 ENERGY TRANSITION PROJECT

The Covenant of Mayors (CoM) is an EU based initiative, which began in 2008. The CoM later evolved in 2015 into the Covenant of Mayors for Climate and Energy, stepping up the mitigation target (from 20 % of CO_2 emissions reduction by 2020 to the 40 % by 2030) and integrating two more pillars in addition to mitigation: the adaptation and access to energy.

In 2017, the CoM developed into a global initiative, the Global Covenant of Mayors (GCoM), bringing together the EU Covenant of Mayors and the Compact of Mayors.

The Global Covenant of Mayors is now an international alliance of cities and local authorities with a shared long-term vision of promoting and supporting voluntary action to combat climate change and move to a low-emission resilient society.

Local authorities who have signed the EU CoM and GCoM have committed to submit a Sustainable Energy and Climate Action Plan (SECAP). SECAP is a key document for implementing goals and vision of city's energy policy. It defines the activities and measures set up to achieve the targets, together with time frames and assigned responsibilities.

EU4 Energy Transition: Covenant of Mayors in Western Balkans and Türkiye (Project) is a multi-donor action is jointly co-financed by the European Union and the German Federal Ministry for Economic Cooperation and Development and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Central Project Management Agency (CPMA).

Municipal authorities in the Western Balkans and Türkiye will share a vision for making cities decarbonised and resilient, where citizens have access to secure, sustainable and affordable energy and are prepared against the impacts of climate change. They will pledge to reduce CO_2 emissions by a share to be determined, equaling the level of ambition agreed at EU level (40% by 2030, and beyond, in line with

the EU's ambitious targets) and to increase their resilience to the impacts of climate change. This vision will build on the synergies between clean energy transition, GHG emission reductions and cleaner air in the urban context.

According to the Memorandum of Understanding signed with İstanbul Metropolitan Municipality (IMM) in 2021, CPMA provided support via the Project to IMM in preparation SECAP by CoM/GCoM requirements. IMM is the main implementing institution for SECAP preparation and submission via GCoM platform.

1.2. INTRODUCTION TO İSTANBUL

Once renowned as the 'capital of capitals', İstanbul is a city of immense historical and cultural significance. Situated between the Black and Marmara Seas, as well as the Bosphorus, İstanbul is one of the few cities in the world surrounded by water. This strategic geographical location has made it a bridge between Asia and Europe for centuries, allowing for the exchange of ideas, cultures, and traditions. İstanbul has been home to many civilizations, including the Roman, Latin, Eastern Roman, and Ottoman Empires, making it one of the oldest cities in the world. This rich history has endowed İstanbul with a unique cultural identity, making it a truly remarkable destination.

İstanbul is the hub for the country's commercial, historical, and cultural activity. It is a cosmopolitan city, with many foreigners living within its boundaries, and is the 10th most visited place in the world. The city is home to the third oldest subway in the world, the 573 meter long tunnel built in 1875, and the 23rd longest metro line in the world.

The city is a major center for finance and commerce, and it is a major port for goods coming in and out of the country. İstanbul is also a major center for tourism, and it is home to a wide variety of attractions, from historical sites to modern shopping malls. The city is a major hub for trade and commerce, banking and finance, manufacturing, media and entertainment, and tourism. It is home to many of the country's largest banks, as well as a large number of foreign banks. The city is also home to a number of stock exchanges, including the İstanbul Stock Exchange, the İstanbul Commodity Exchange, and the İstanbul Derivatives Exchange.

İstanbul is the most crowded city in Türkiye and also one of the crowdest cities in the world. It is located on both sides of the Bosphorus, the strait that

connects the Black Sea to the Sea of Marmara (Figure 1). As of 2019, the population of İstanbul was estimated to be a little up than 15 million, making it the most populous city in Türkiye and one of the most populous cities in the world. The population of İstanbul is diverse, with people from all over Türkiye and the world living in the city.

İstanbul is home to a wide variety of residential areas. The city is divided into 39 districts, each with its own unique character and attractions. The most popular residential areas in İstanbul are located in the European side of the city. The affluent districts of Beşiktaş, Nişantaşı, and Etiler are some of the most sought-after areas in the city. The Asian side of İstanbul is home to some of the city's oldest neighborhoods. Kadıköy is a popular residential area with a vibrant atmosphere and plenty of restaurants and cafes. Other popular areas include Üsküdar, Beylerbeyi, and Ümraniye. The city also has a number of areas which are popular with families and offer a more relaxed atmosphere than the city center.

İstanbul is a city with a breathtaking beauty, a vibrant culture, and a long and rich history. It is a city that will surely never cease to fascinate its residents.



Figure 1. İstanbul Location (Google Maps)

1.2.1. Population

The province of İstanbul is divided into 39 distinct districts, all of which are now part of the service area of the İstanbul Metropolitan Municipality, as per the law published in the Official Gazette on 22.07.2004. District map showing the general layout of the districts given in Figure 2.

İstanbul is the hub for the country's commercial, historical, and cultural activity. It is a cosmopolitan city, with many foreigners living within its boundaries, and is the 10th most visited place in the world. The city is home to the third oldest subway in the world, the 573 meter long tunnel built in 1875, and the 23rd longest metro line in the world.

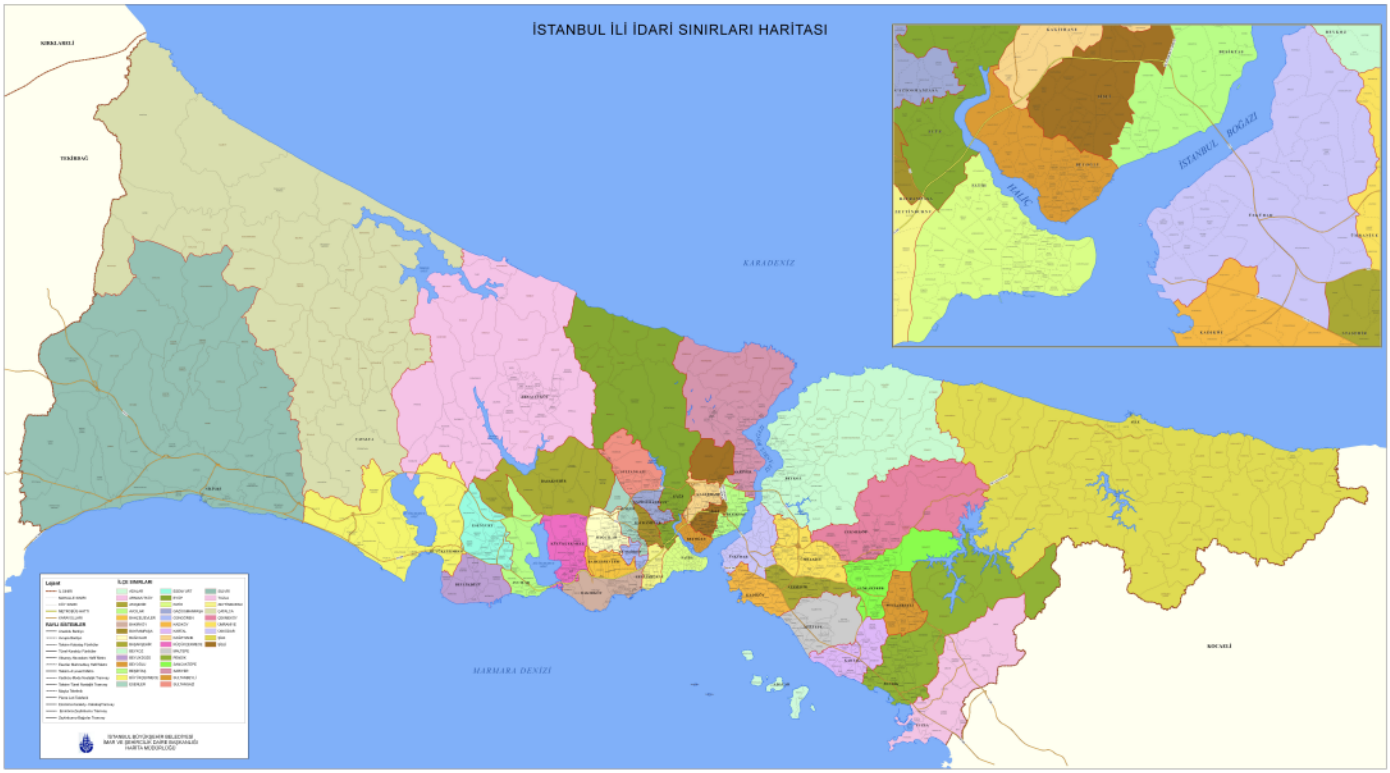


Figure 2. Map of İstanbul Districts [5]

İstanbul, divided into two sides: Europe and Anatolia, is a city with a huge population. Since the majority of the population is located on teh European side, the number of residential areas on this side is quite high.

The highest density of housing is in Bağcılar, Bahçelievler, Kadıköy, Pendik, Ümraniye and Küçükçekmece districts. In districts such as Fatih, Kadıköy and Bakırköy, which are located in the city center and are very dense, residential areas are nowadays replaced

5 http://www.ibb.gov.tr/tr-TR/SiteImages/Haber/ nisan2009/04052009idarisinirharitasi.jpp

with workplaces (offices and commercial centers). Districts such as Büyükçekmece, Silivri, Şile, Çekmeköy located outside the city center are among the districts with low housing density but rapidly developing.

According to the census results of the Address Based Population Registration System (ADNKS) prepared by the Turkish Statistical Institute (TurkStat), the total population of İstanbul in 2019 is 15.519.267. According to TurkStat official population figures for 2019, approximately 19% of Türkiye's population lives in İstanbul. The 3 districts with the highest population density are Güngören, Gaziosmanpaşa, Bahçelievler, and the lowest 3 districts are Silivri, Çatalca, Şile.[6] [7]

For centuries, İstanbul has been a major global hub, drawing people from all over the world to its vibrant and diverse culture. This influx of people has led to a rapid population growth in the city, making İstanbul the fastest growing city in Türkiye.

6 https://www.harita.gov.tr/images/urun/il_ilce_alanlari.pdf
7 https://biruni.tuik.gov.tr/medas/?kn=95&locale=tr

1.2.2. Climate

İstanbul is in a region where the transition from a Mediterranean climate with hot and dry summers and mild and rainy winters to a Black Sea climate with hot summers and mild winters but rainy in all seasons takes place. While the southern parts of the province, where the settlement is denser, have characteristics closer to the Mediterranean climate, the climate characteristics evolve towards the Black Sea climate as one goes to the north[8]. Because of these transitions, İstanbul's summers are hot and humid; winters are cold, rainy, and sometimes snowy. Average values and highest and lowest temperature values of climatic events that took place in İstanbul for the Period 1929 – 2019 is given in Table 1.

Table 1. Average values of climatic events that took place in İstanbul 1929-2019 [9]

Temperature	January	February	March	April	May	June	July	August	September	October	November	December	Yearly
Average Temperature (°C)	5,9	5,9	7,6	11,9	16,7	21,3	23,8	23,9	20,3	16,0	11,9	8,2	14,5
Average Maximum Temperature (°C)	8,8	9,3	11,6	16,7	21,7	26,3	28,7	28,9	25,2	20,3	15,5	11,2	18,7
Average Lowest Temperature (°C)	3,2	3,1	4,3	7,9	12,3	16,5	19,0	19,3	16,0	12,4	8,8	5,4	10,7
Average Sunbathing Time (hours)	2,4	3,2	4,4	6,1	8,3	10,2	10,9	10,1	8,1	5,5	3,6	2,5	75,3
Average Number of Rainy Days	15,2	13,2	11,7	8,9	6,6	4,7	3,0	3,4	5,5	9,0	11,2	14,5	106,9
Average Monthly Total Rainfall (mm)	86,8	72,1	62,3	44,1	31,3	24,8	22,6	27,7	44,1	70,0	86,1	105,3	677,2
Highest Temperature (°C)	22,4	24,6	29,3	33,6	36,4	40,2	41,5	40,5	39,6	34,2	27,8	25,5	41,5
Lowest Temperature (°C)	-13,9	-16,1	-11,1	-2,0	1,4	7,1	10,5	10,2	6,0	2,2	-7,2	-11,5	-16,1

8 https://www.iklim.istanbul/iklim/
9 https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=ISTANBUL

The annual average temperature of İstanbul is 14,5°C. As can be seen in Table 1, while the average temperature is around 6°C in January, the coldest month, it rises to around 24°C in August, the hottest month. In İstanbul, the highest temperature was measured as 41,5°C on 13.07.2000, and the lowest temperature was measured as -16,1°C on 09.02.1929[10].

İstanbul is a province with high precipitation variability in the north-south direction. While the total annual precipitation is around 650 mm in the south, it occasionally exceeds 1,000 mm in the middle parts. It decreases again towards the Black Sea coast and decreases to around 850 mm[11]. The annual average rainfall in İstanbul has been determined as 677,2 mm. The difference in precipitation between the driest and wettest months of the year is approximately 83 mm. The highest total precipitation amount in İstanbul was determined as 136,1 mm on 10.09.1981[12].

As stated in the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports, Türkiye is in the Eastern Mediterranean Basin, which is one of the regions sensitive to climate change. In the 6th Assessment Report of the IPCC, it is predicted that if the average temperature increase is 1.5 °C, the annual average temperature change in Türkiye will increase above the global average temperature change.

Climate change in İstanbul is expected to occur primarily with changes in temperature and precipitation regime. The İstanbul CCAP Climate Hazard Risk Assessment and the accompanying academic papers and Climate Scenarios report have comprehensively evaluated the different Representative Concentration Pathways (RCPs), namely the impact of radiative forcing in 2100 on future climate changes on a W/m2 scale. CCAP used downscaled global climate models and national data inputs and outputs from stations operated by the General Directorate of Meteorology (MGM) provided thirty years of city-specific climate data. This modeling approach considered possible future climate hazards according to four climate scenarios, namely RCP 2,6, RCP 4,5, RCP 6,0 and RCP 8,5, as defined in the IPCC's 5th Assessment Report published in 2013.

In 2017, the MGM compared the results of three different global climate models (HadGEM2-ES, MPIESMMR and GFDL-ESM2M) in order to obtain forecasts for regional climate changes in Türkiye according to RCP scenario 4,5-8,5 from 2016 to 2099. In all scenarios, İstanbul is expected to

10 https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=İSTANBUL
11 https://www.iklim.istanbul/iklim/
12 https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=İSTANBUL

experience higher average temperatures of between 1 and 4,5 °C per year (RCP 8.5) and a faster temperature increase in summer than in winter. It is estimated that at least 1 or even 2 degrees of this temperature increase may be directly related to the urban heat island effect.[13]

1.2.3. Ecosystems and Biodiversity

İstanbul has an extraordinary plant richness due to its soil diversity, geographical location between two seas and two continents (under the influence of the humid and cold climate from the Black Sea coast and the warmer Mediterranean climate of the Marmara Sea), topography and traditional land use dating back centuries. 270 plant species growing naturally within the provincial border of İstanbul are included in the "Türkiye's List of Rare and Endemic Plants in Danger. Among them, the richest populations of 40 species in the world are found in İstanbul. Based on the floristic studies conducted by the Wildlife Conservation Society and the İstanbul University Faculty of Pharmacy, Department of Pharmaceutical Botany, 7 important plant areas (IPAs) have been determined within the province of İstanbul.[14]

The importance of İstanbul's forests is not limited to its floristic (vegetative) feature, it is also interesting for its wildlife. Today, despite all the threats, deer, roe deer, wild cat, fox, jackal, wild boar, otter, badger and very few wolves continue to live in the forests of the city. As a result of the researches, fish species seen in the Strait ecosystem have largely disappeared in recent years due to the increasing pollution in the throat water. At the end of the 70s, the number of fish species living in the Bosphorus was 60, but today this number has decreased to 20. There are a total of 33 marine plants and animals in the Bosphorus, which are endangered in terms of biodiversity and need to be protected. Some areas in İstanbul, located on one of the important bird migration routes in the world, are defined as Important Bird Areas (IBAs). Birds, whose numbers are expressed in hundreds of thousands twice a year, migrate through İstanbul.[14]

1.2.4. Tourism and Culture

İstanbul is one of Türkiye's favorite tourism centers with its Bosphorus and many historical artifacts. It is possible to come across historical artifacts from various periods of history in almost every region of İstanbul, which has hosted different human communities for thousands of years. Among the thousands of historical artifacts registered in the inventory, there are city walls, palaces, mosques, churches, synagogues,

13 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf
14 https://webdosya.csb.gov.tr/db/ced/icerikler/-stanbul_2019_-cdr_son-20201015102245.pdf

fountains and mansions. Fatih district, which is the historical center of İstanbul (Historical Peninsula), settlements around the Golden Horn, Beyoğlu and Eyüp; Beşiktaş and Sarıyer on the Bosphorus; Kadıköy, Üsküdar and Adalar districts on the Anatolian side are among the rich centers of İstanbul in terms of historical tourism. Beykoz, Şile, Adalar and Sarıyer are interesting addresses for nature tourism.

There are a total of 1,796 historical places in İstanbul, including 28 palaces, 91 madrasahs, 517 mosques, 164 churches, 19 synagogues, 199 tombs, 595 fountains and 93 baths that host cultural tourism.[15]

The history of İstanbul, a world city located at the intersection of the European and Asian continents, dates to 8500 years ago with the Neolithic period settlement unearthed during the excavations at Yenikapı Theodosius Harbor. It has hosted different civilizations and cultures throughout the ages, has preserved its cosmopolitan and metropolitan structure where people from various religions, languages and races lived together for centuries, and has become a unique cultural mosaic in the historical process.[16]

İstanbul is a city that has been among the most important and largest metropolises of the world for about sixteen centuries from the 4th century to the 20th century and has managed to create significant effects in world history in this process. İstanbul for one thousand six hundred years from 330 to 1922; It is a city that served as the capital of 4 different empires: Roman Empire (330-395), Byzantine Empire (395-1204, 1261-1453), Latin Empire (1204-1261) and Ottoman Empire (1453-1922).

Bringing together different religions, cultures, communities and their heritage with its glorious past in a unique geography, İstanbul was included in the UNESCO World Heritage List in 1985 in 4 main topics: Archaeological Park, where the Hippodrome, Hagia Sophia, Hagia Irene, Little Hagia Sophia Mosque and Topkapi Palace are located; Suleymaniye Conservation Area, which includes the Suleymaniye Mosque and its surroundings; Zeyrek Conservation Area, which includes the Zeyrek Mosque and its surroundings, and the Historic Walls Conservation Area[17].

According to the data of the Ministry of Culture and Tourism of the Republic of Türkiye, the total number of foreign visitors to Türkiye in 2019 was 45.058.286; of which, 14.906.663 people, 33% of the total visitors, came to İstanbul[18].

15 http://www.istanbul.gov.tr/tarihi-ve-turistik-mekanlar
16 https://istanbul.ktb.gov.tr/TR-165066/tarihce.html
17 https://basin.ktb.gov.tr/TR-45517/istanbulun-tarihi-alanlari.html
18 https://istanbul.ktb.gov.tr/TR-243067/istanbul-turizm-istatistikleri---2019.html

1.2.5. Industry and Commerce

According to the values announced for 2019, the sectoral structure of the İstanbul's employment is approximately 32% industry, 67% services and 1% agriculture[19].

60% of the existing industry in Türkiye is located in the Marmara Region and İstanbul is a city where almost all kinds of industries are located. The fact that İstanbul received a significant share from the infrastructure investments, loans and incentives and public investments required for the industry, especially in transportation and energy, led to a very rapid development in the manufacturing industry. There are 8 organized industrial zones in İstanbul. There are 113 small industrial estates in İstanbul and 150.000 people are employed in 35.000 businesses located in these estates.

Apart from industrial sites, there are three free zones in İstanbul: Bakırköy, Çatalca and Tuzla. According to Turk-Stat data, while Türkiye exported 171,46 billion USD in 2019, a portion of 85,63 billion USD, which corresponds to 49,94% of this export, was provided by İstanbul. On the import side, while Türkiye realized 202,70 billion USD of imports in 2019, 105,26 billion USD of which corresponds to 52% of it was realized by İstanbul[20].



19 http://www.tuik.gov.tr/Labor Statistics
20 http://www.tuik.gov.tr/Foreign Trade Statistics

1.3. INTRODUCTION TO IMM AND ITS CLIMATE WORKS

1.3.1. National and International Framework

Among the many institutions and organizations in Türkiye, two stand out the most in energy efficiency and climate change actions, namely, Ministry of Energy and Natural Resources (MENR) and Climate Change Presidency, an affiliated institution of the Ministry of Environment, Urbanization and Climate Change (MoEUCC).

MENR is incharge of preparing the drafts of legislation, strategies and action plans related to energy efficiency together with regulatory impact analyses, monitoring and evaluating their implementation and planning remedial measures. It is also responsible for determining the energy saving potentials throughout the country and on the basis of sectors, carrying out the necessary studies, including the creation of alternative fuels, district heating and heat market, to make or have energy studies done.

Climate Change Presidency is responsible for determining policies, strategies, and actions at the national and international level, conducting negotiation processes, and ensuring coordination with institutions and organizations within the scope of Türkiye's climate change mitigation and adaptation efforts. In line with Türkiye's 2053 net zero emission and green development goals, it is in charge of carrying out all kinds of work necessary for adaptation and mitigation and raising awareness of climate change with a human and nature-friendly approach to all segments of society[21]. In Türkiye, a country that has many regulations in areas such as energy efficiency, renewable energy production, greenhouse gas measurement and reporting and almost all are harmonized with EU acquis, the strategies and plans most related to SECAP report are descibed below.

National Energy Efficiency Action Plan

Within the scope of the National Energy Efficiency Action Plan to be implemented between 2017-2023, it is aimed to reduce Türkiye's primary energy consumption by 14% in 2023 with 55 actions defined in 6 categories, including buildings and services, energy, transportation, industry and technology, agriculture and horizontal issues. It is envisaged to save 23,9 MTEP cumulatively by 2023 and to invest USD 10,9 billion for this saving. With 2017 prices, the cumulative savings to be achieved until 2033 is 30,2 billion USD, and the effect of some actions will continue until 2040[22].

21 https://iklim.gov.tr/en/about-us-i-75
22 https://enerji.gov.tr/bilgi-merkezi-enerji-verimliligi-ulusal-enerji-verimliligi-eylem-plani

National Energy Plan

The Turkish National Energy Plan includes the steps to be taken until 2035, based on Türkiye's target of achieving net zero emissions by 2053. According to the plan, Türkiye's energy consumption, which was 147,2 million tons of oil equivalent in 2020, is projected to reach 205,3 million tons of oil equivalent in 2035, meaning a 39,5% increase, in line with Türkiye's growth targets. Renewable energy sources, which had a 16.7% share in primary energy consumption in 2020, will increase to 23,7% in 2035. The country's installed power in electricity will reach 189.700 megawatts (MW), up from 95.900 MW in 2020. 74,3% of this capacity increase is expected to come from renewable energy sources, primarily solar and wind. In 2035, the solar installed power will reach 52.900 MW, while this number will be 29.600 MW for wind energy, 35.100 MW for hydroelectricity, and 5.100 MW for geothermal and biomass[23] energy.

MENR 2019-2023 Strategic Plan

According to the Strategic Plan of MENR covering the period of 2019-2023, following targets were set to prioritize and increase energy efficiency[24].

- **Target (2.1)**

Efforts to increase energy efficiency will be continued.

- **Target (2.2)**

A market infrastructure will be established for demand-side participation in electricity and natural gas.

- **Target (2.3)**

Studies will be carried out to increase public awareness of energy efficiency.

- **Target (2.4)**

Energy system planning for electric vehicles will be made.

National Climate Change Action Plan (CCAP)

Climate Change Action Plan of 2011-2023 is the main governmental strategy document which guides national climate change policies. It aims to increase energy efficiency and reduce greenhouse gas emissions in buildings, industry, transport and energy sectors[25]. CCAP's climate actions envisage their spread to the national level, emphasizing the importance of "local governments integrating this issue into their own strategic plans and programs in order to more effectively combat climate change at the local level and strengthen their adaptation capacity,

23 https://enerji.gov.tr/news-detay?id=21111
24 https://sp.enerji.gov.tr/ETKB_2019_2023_Stratejik_Plani.pdf
25 https://iklim.gov.tr/en/action-plans-i-121

and preparing local climate action plans".

National Climate Change Adaptation Strategy and Action Plan

National Climate Change Adaptation Strategy and Action Plan 2011–2023[26] is focused on five important fields:

- Water Resources Management
- Agricultural Sector and Food Security
- Ecosystem Services, Biodiversity and Forestry
- Natural Disaster Risk Management Public Health

Paris Agreement Nationally Determined Contribution

As part of the Paris Agreement signed by Türkiye on April 22, 2016 and ratified on October 7, 2021, the Ministry of Environment, Urbanization and Climate Change (MoEUCC), Türkiye's National Declaration of Contribution (NDC) towards the 1.5 degree reduction target from an increase of up to 21% by 2030 was updated and increased to 41%, thus it was announced that by 2030 there would be an emission reduction of approximately 500 million tons[27]. In addition, President of Türkiye announced the nation's zero emissions goal for 2053.

1.3.2. İstanbul Metropolitan Municipality

In Türkiye, metropolitan municipalities are upper-tier municipalities that were introduced to the Turkish local administration system in 1984. Metropolitan municipalities were established based on the provision "Special forms of administration can be established in large settlements" in article 127 of the 1982 constitution. With the Decree Law No. 195 on the Management of Metropolitan Municipalities, a two-stage metropolitan municipality system was introduced in three provincial centers in March 1984. With the Metropolitan Municipality Law No. 3030 and its implementing regulation, which was enacted in the same year, the institutional and legal foundations of the system were strengthened. With the law numbered 6360 enacted in 2012, the areas of responsibility of the metropolitan municipalities were extended to the provincial administrative borders, and all of the villages and districts were included in the metropolitan responsibility. Therefore, municipal service is carried out by both the metropolitan municipality and the district municipality at the same time.

İstanbul Metropolitan Municipality (IMM) is the state institution responsible for municipal affairs of the province of İstanbul. 35% (1869 km²) of the total land area of İstanbul, which is within the jurisdiction of

26 https://iklim.gov.tr/en/action-plans-i-121
27 https://iklim.gov.tr/turkiye-ulusal-katki-beyani-ni-cop27-de-acikladi-haber-84#:~:text=Paris%20Anla%C5%9Fmas%C4%B1%20%C3%A7er%C3%A7evesinde%202030%20y%C4%B1l%C4%B1,%C3%A7er%C3%A7evesinde%20y%C3%BCzde%2041'e%20y%C3%BCkseltilmi%C5%9Ftir.

the İstanbul Metropolitan Municipality, is located on the Anatolian Side and 65% (3474 km²) is on the European side[28].

İstanbul Metropolitan Municipality is divided into three main groups: İstanbul Metropolitan Municipality Mayor, İstanbul Metropolitan Municipality Council and İstanbul Metropolitan Municipality Committee.

According to the 26th article of the Metropolitan Municipality Law No. 5216 published in the Official Gazette dated 23.07.2004 and numbered 24431, the Metropolitan Municipality can establish capital companies in the fields of duty and service assigned to it, in accordance with the procedures specified in the relevant legislation. IMM carries many services through these special-purpose organizations, which have a separate legal personality and budget, are semi-commercial, but are subordinate to the local government and operate under the general control of the local government[29]. The İstanbul Metropolitan Municipality governs İstanbul with 30 affiliated companies and 2 subsidiaries.

Again, within the scope of Law No. 5216[30] Metropolitan Municipalities have been given the following duties, powers and responsibilities, which are related to sustainable energy and climate change actions:

To prepare, have it made and to approve and implement a master development plan in every scale between 1/5,000 and 1/25,000 within the boundaries of the metropolitan municipality, provided that it is in accordance with the environmental plan; to approve the implementation development plans to be prepared by the municipalities in the metropolitan area in accordance with the master plan, the changes to be made in these plans, the parceling plans and the development improvement plans as they are or by changing them, and to supervise their implementation;

To make or have and implement the metropolitan transportation master plan; planning and coordinating transportation and public transportation services;

To ensure the protection of the environment, agricultural areas and water basins in accordance with the principle of sustainable development; afforestation; to gather unsanitary workplaces, entertainment venues, and other workplaces that have an impact on public health and the environment in certain parts of the city; determining construction

28 https://www.ibb.istanbul/icerik/yetki-alani
29 https://www.ibb.istanbul/icerik/Belediye%20%C5%9Eirketler
30 https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5216.pdf

materials, scrap storage areas and sales places, excavation soil, rubble, sand and gravel storage areas, wood and coal sales and storage areas, and taking measures that will not cause environmental pollution in their transportation; to make and have the metropolitan solid waste management plan made; to perform services related to the reuse, storage and disposal of solid wastes and excavations, except for the collection of solid wastes at the source and transportation to the transfer station, to establish facilities for this purpose, to have them installed, to operate or to have them operated; to carry out services related to industrial and medical wastes, to establish the necessary facilities for this, to have them installed, to operate or to have them operated; collecting, collecting, treating the wastes of marine vehicles and making the necessary arrangements.

To carry out public transportation services within the metropolitan area and to establish, have them set up, operate or have them operated for this purpose, to give licenses to public transportation vehicles, including taxis and service vehicles, in the land and sea within the metropolitan borders.

Regarding the public transportation lines within the metropolitan area; To decide on the operation of public transportation services related to the lines to be determined based on the criteria of distance to the city center, population and number of people using the line.

To carry out water and sewerage services, to establish dams and other facilities necessary, to have them installed and operated; reclamation of streams; marketing spring water or water produced at the end of treatment.

To make plans and other preparations for natural disasters at the metropolitan scale in accordance with the plans made at the provincial level; providing tools, equipment and material support to other disaster areas when necessary; conducting fire and emergency services; to detect explosive and flammable material production and storage areas, to inspect residences, workplaces, entertainment venues, factories and industrial establishments and public institutions in terms of precautions to be taken against fire and other disasters, to issue permits and licenses required by the legislation in this regard.

Local governments are subject to the country's policies when it comes to energy resources such as electricity and natural gas consumed in the city. This is due to Law No 5216, which does not assign any duties to metropolitan municipalities in this regard.

1.3.3. IMM's Climate Resilience Activities

İstanbul Metropolitan Municipality is a member and/or active participant in some regional/inter-regional local governments climate networks related to climate change. Most notable of them are the Global Covenant of Mayors (GCoM), Large Cities Climate Leadership Group (C40) and UCLG-MEWA Environmental Committee. İstanbul Metropolitan Municipality is the first and only municipality from Türkiye to be a member of the C40 Cities Climate Leadership Group.

Since İstanbul is a city that is acutely aware of the vulnerability created by climate change, IMM can be considered one of the first local administrations in the world to start research on climate change adaptation. The strategy and action plan of the İstanbul International Financial Center, prepared in 2009, includes the goal of establishing a carbon exchange program for İstanbul. To achieve this goal, the plan includes actions by the İstanbul Metropolitan Municipality to implement low-emission projects and promote the creation of a local carbon market. Within that context, IMM prepared a greenhouse gas emission inventory in 2010.

Later, the Metropolitan Administration announced the amount of carbon dioxide emissions in accordance with international standards in April 2013. In 2015, the İstanbul Metropolitan Municipality revised its GHG inventory of electricity, transport, natural gas, waste and other fuels and took steps for the preparation of İstanbul Climate Change Action Plan (2015-2018). During this process, important studies were carried out, which are the basis and source of the İstanbul Climate Change Action Plan, the main ones being the Climate Scenarios and the Climate Change Risks, Opportunities and Vulnerabilities Analysis Report.

As of 2016, İstanbul Metropolitan Municipality is a member of the "Global Covenant of Mayors for Climate and Energy-GCoM", an international climate network committed to voluntarily reducing greenhouse gas emissions and becoming a resilient city. At the C40 Mayors Summit in Copenhagen in October 2019, IMM Mayor Mr. Ekrem İmamoğlu signed the "Deadline 2020" Commitment and the goal of making

İstanbul a "carbon neutral" and "resilient city" by 2050 has been accepted. With technical support from C40, İstanbul's Climate Change Action Plan was revised and shared with the public in 2021.

The highest share in the sectoral distribution of the greenhouse gas emission inventory prepared by IMM every year belongs to stationary energy. For this reason, IMM has started the SECAP preparation process, being aware of the need for İstanbul to focus on the stationary energy sector in order to reduce its greenhouse gas emissions.



1.3.4. Methodological Approach for SECAP Preparation

During the preparation of the SECAP, a process integration approach was employed to ensure that the project processes were considered holistically. Plan preparation and approval were synchronized and connected to capacity building activities, which were in turn synchronized and connected to coordination and communication activities. This approach allowed for the integration of individual tasks to improve the overall efficiency of the project. Figure 3 illustrates the key processes in the project design.

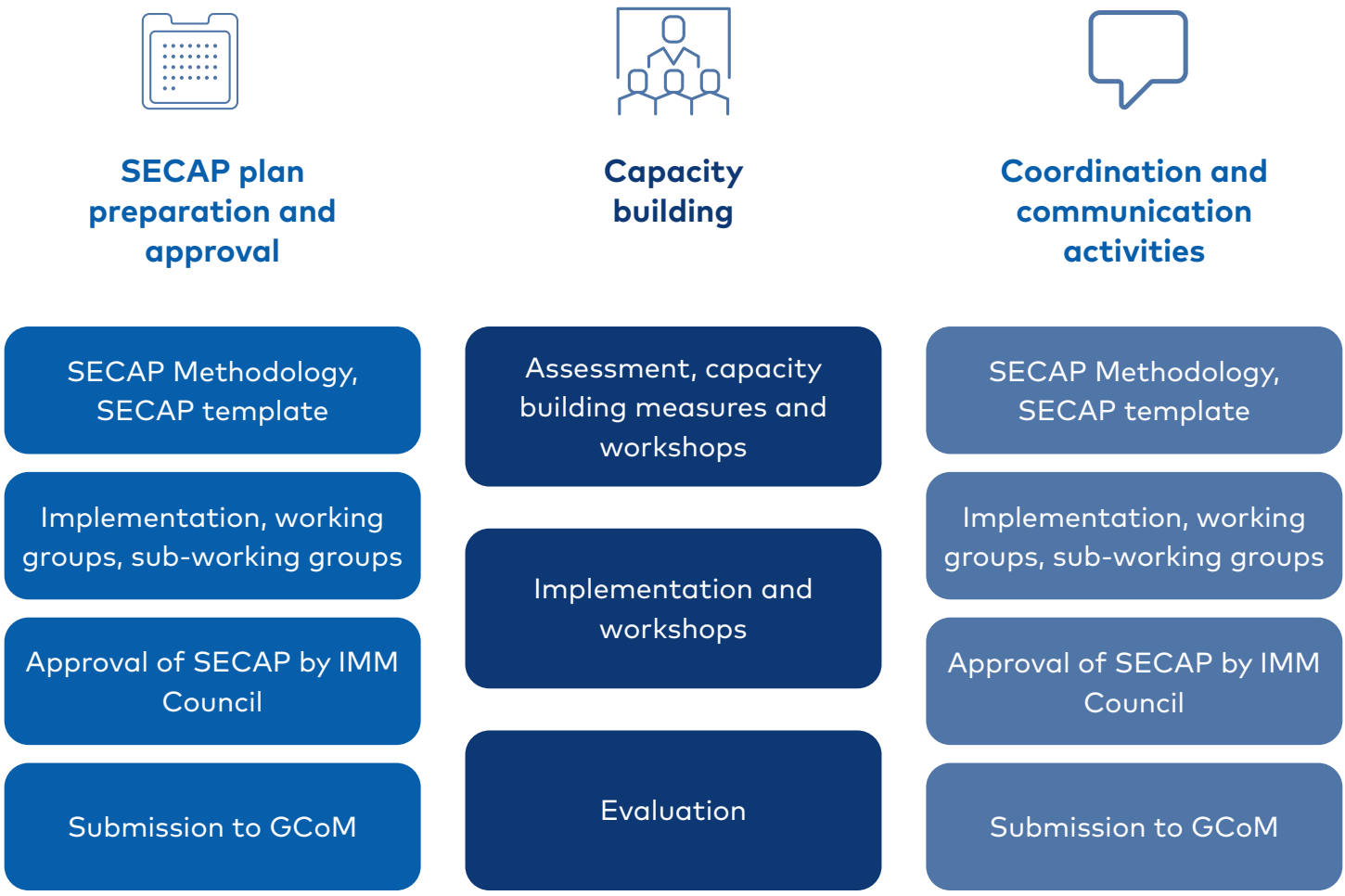


Figure 3. Key Processes Integration Approach

SECAPs have 3 fundamental targets (Chatelet, 2018[31]):

1. Mitigation (accelerating the transition to low carbon in the region), mitigating CO_2 emissions by minimum 40% by 2030 with the renewable energy and energy efficiency measures.

2. Adaptation (increasing the capacity of adaptation towards inevitable impacts of climate change), being prepared against the change that will be brought by global warming and creating a resilient structure.

3. Sustainable Energy (energy efficiency and renewable energy), developing cooperation with other local administrations in the region for access to reliable and suitably priced energy.

SECAP defines the activities and measures set up to achieve the targets, together with time frames and assigned responsibilities. Covenant Signatories are free to choose the format of their SECAP, as long as it is in line with the general principles set out in the Covenant of Mayors Office guidelines.

For Climate Change mitigation, the main target sectors are buildings, equipment/facilities and urban transport. The SECAP should concentrate on measures aimed to increase share of renewables reducing GHG emissions such as carbon dioxide (CO_2), and the final energy consumption by end users, as well as include adaptation actions in response to the impacts of Climate Change. The Covenant of Mayors for Climate and Energy (CoM) requires local authorities to take action to reduce their greenhouse gas emissions and to increase their energy efficiency. This commitment applies to the entire geographical area of the local authority, including both public and private sectors. As such, the Sustainable Energy and Climate Action Plan (SECAP) should include actions for both sectors. The local authority is expected to lead by example and take ambitious measures to reduce emissions from its own buildings, facilities, and vehicle fleet etc[32].

IMM already prepared and disclosed İstanbul Climate Change Action Plan (CCAP) in 2021 in line with C40 Cities[33]. This CCAP outlines the necessary steps for the entire city to take in order to combat climate change.

31 Chatelet, R. (2018). What is a Sustainable Energy Action Plan (SEAP) or Sustainable Energy and Climate Action Plan (SECAP)?.EU4Energy & Covenant of Mayors for Climate and Energy CoM East

32 JRC Guidebook'How to develop a Sustainable Energy and Climate Action Plan (SECAP) http://com-east.eu/en/faq3/itemlist/category/226-sustainable-energyaction-plan-seap-sustainable-energy-andclimate-action-plan-SECAP

33 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

The SECAP presented herein is designed to complement the CCAP and does not aim to reiterate the actions already identified for the city, but rather focus on the measures related to the IMM buildings, transport, facilities and its subsidiaries/affiliates and intensify the sustainable energy and climate actions.

The GHG inventory, risk and vulnerability assessment, targets and goals defined are relevant to the local conditions and reflect the specific activities, capacity and regulatory context of IMM.



As a local government participant to GCoM, IMM worked on identifying measures to[34]:

- Reduce/limit GHG emissions
- Get prepared for the impacts of climate change
- Increase access to sustainable energy,
- Track progress toward these objectives

The following sectors defined in Figure 4 were studied in IMM SECAP.



Municipal buildings, residential buildings, tertiary structure or groups of structures, surrounding spaces, permanently constructed or erected.



Includes road, rail, and water transport networks and related infrastructure.

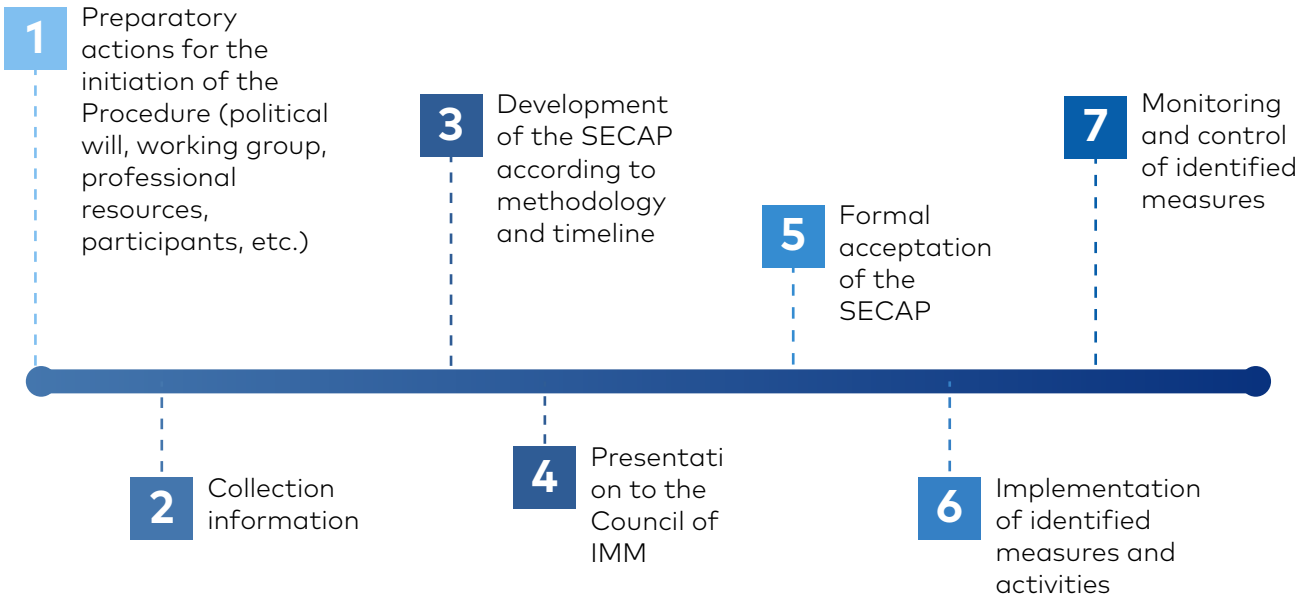


Includes activities related to the management (including collection, treatment and disposal) of various forms of waste.
It also covers water use, waste water, rainwater and water management system, that includes sewers, drainage and treatment.

Figure 4. Sectors Studied in IMM SECAP

34 GCoM, Common Reporting Framework, 2018. https://www.globalcovenantofmayors.org/our-initiatives/data4cities/common-global-reporting-framework/

The procedure of preparation, development, implementation and monitoring of the SECAP was divided into the following main steps:



The SECAP document comprises of six sub-reports which were developed as per sub-working group outputs and combined to form the full SECAP report. These sub-reports are namely BEI, RVA, buildings, transport, and waste/waste water sectors, and scenarios.

Sub-working groups were formed with appropriate and relevant units and institutions to work under these headings. The sub-working group, under the direction of the head, began the process of preparing the sub-reports by collecting data and information. During the workshops held, technical information and guidelines for drafting the sub-report were shared, in accordance with the SECAP format. The sub-reports included literature, current and calculation methods, and modelling (if applicable), as well as information and material that would be used in the mitigation, monitoring, and adaptation sections.

The sub-reports were distributed to the relevant stakeholders for their review and feedback. Upon completion of the review process, the sub-reports were consolidated to create a comprehensive SECAP report. The SECAP preparation spanned a period of 24 months, beginning in July 2021 and concluding in June 2023.

1.3.5. Stakeholders Participation

Workshop "The Covenant's Other Key Sectors: Transport, Waste and Water – Waste Water, including Adaptation Planning and Practice"

Workshop "The Covenant's Other Key Sectors: Transport, Waste and Water, including Adaptation Planning and Practice" was held on 23-24.05.2022 in İstanbul. 56 participants attended the first day of the event and 51 people attended the second day. Covenant's transport, waste and water – waste water sectors were presented to the participants with a focus on Climate Change mitigation and adaptation actions. Risks and vulnerabilities to climate change, identifying and discussing adaptation options were also assessed.

In the discussion part, the following topics were discussed:

1. What are the current climate risks and environmental problems in İstanbul due to global warming and what are the possible climate risks and environmental problems that may arise in the future, especially in the light of climate change? What can be done about these identified challenges?

2. If you examine a map showing the river drainage systems of İstanbul, where could be the most vulnerable areas and districts in terms of flooding and overland flows. What could be the possible reasons for this? What can be done to solve these challenges?

3. If you were given a mandate to solve environmental problems in İstanbul, which problem or problems would you like to start with first? And why? What can be done to solve these environmental challenges?

Consultations For Determination of Energy Efficiency Actions and Targets

IMM has subsidiaries/affiliated companies over which municipality administration has control over. During GHG inventory process, consumption data about energy, transportation and waste management was collected from these affiliates and subsidiaries.

Consultation with IMM affiliated companies and meeting for Determination of Energy Efficiency Actions and Targets was held on 2-3-4-5.08.2022. These meetings were planned as separate energy efficiency meetings with the representatives of IMM top GHG emitter companies to map their activities, consumption data and possible energy efficiency and mitigation measures. An average of 12 people participated in each of the meetings.

Consultation With Key Stakeholders and Meeting For Determination Of Climate Change Adaptation Options

Consultation with key stakeholders and meeting for Determination of Climate Change Adaptation Options for İstanbul was held on 19-20-21.09.2022. An average of 40 participants attended every day. The consultations aimed at supporting İstanbul Metropolitan Municipality, with its efforts to determine priority actions for adaptation to climate change that can address biodiversity loss, heat islands, city and coastal floods in an efficient and cost-effective way. The meeting was organized according to the SECAP methodology to define climate change adaptation actions and will discuss on the best possible adaptation actions together with the relevant stakeholders and decision-maker institutions. The target participants of the meetings were the key stakeholders from IMM's relevant units, related IMM-affiliated/ subsidiary companies, relevant district municipalities in İstanbul, and representatives of relevant central government institutions. The consultations were completed in a total of six sessions, one in the morning and one in the afternoon on each day. The "Multiple Criteria Analysis" method was used to determine the importance of the five adaptation measures determined as a result of the survey application. In order to perform multiple criteria analysis, a previously prepared "Multiple Criteria Determination Table" was distributed to the participants. In determining the order of importance, the contribution of the relevant adaptation methods to prevent life and economic losses, cost and applicability criteria were taken into consideration.

In the morning session of the first day (19.9.2022), various maps showing the vulnerability of İstanbul in terms of habitat and floods were introduced to the participants. Discussions with participants about the maps led to an attempt to recognize İstanbul's vulnerabilities. Following the map presentation, a presentation on urban flooding and the typical strategies adopted to prevent or lessen its effects was given during the second half of the morning session. A further presentation was also given on the possible adaptation methods to adapt to floods in coastal areas of İstanbul. In the afternoon session of the first day and based on the presentation, a group work was carried out with the same participants. This work involved participants to identify the five districts of İstanbul that are most susceptible to flooding as well as the names of the five best methods for these districts to adapt to flooding.

On the second day (20.9.2022), all of the activities focused on the quality and

degradation of biodiversity in İstanbul and its districts. A presentation on "Climate Change Adaptation Action Planning" was presented for this purpose. Following that, another presentation was given about the adaptation measures for biodiversity loss in İstanbul, as well as the advantages and disadvantages of each measure. After the presentations, a group work was carried out in order to identify the priority areas of İstanbul in terms of biodiversity loss. Within the scope of this group work, a survey was conducted to identify the five districts in İstanbul with the greatest loss of biodiversity (Habitat) and the five appropriate adaptation methods to minimize habitat destruction in these districts.

On the third day (21.9.2022), "Reducing Losses and Damages Caused by Heat Islands," on adaptation planning for the impacts of climate change and İstanbul's adaptation options to the heat island impact were presented. Then, heat islands and adaptation options and their advantages, disadvantages and suitability for İstanbul were discussed with participants. After the discussion session, a group work was conducted with the participants. A survey was carried out as part of this group study to identify the names of the five districts that experience the greatest heat island effect and to identify the names of the five most effective adaptation strategies from the adaptation table presented to them in order to mitigate the heat island effects in these districts.

Sustainable Urban Mobility Plan (SUMP) Stakeholder Engagement

One of the main policies to achieve the goal of the İstanbul Climate Change Action Plan to become a "carbon neutral and climate change resistant city" in 2050 is the İstanbul Sustainable Development Urban Mobility Plan (İstanbul SUMP).

İstanbul SUMP was prepared together with all stakeholders, with a new generation participatory planning approach and in line with the principles of inclusion, in order to "leave no one behind." Although it coincided with the Covid19 pandemic period, ahigh level of participation was achieved in the studies.

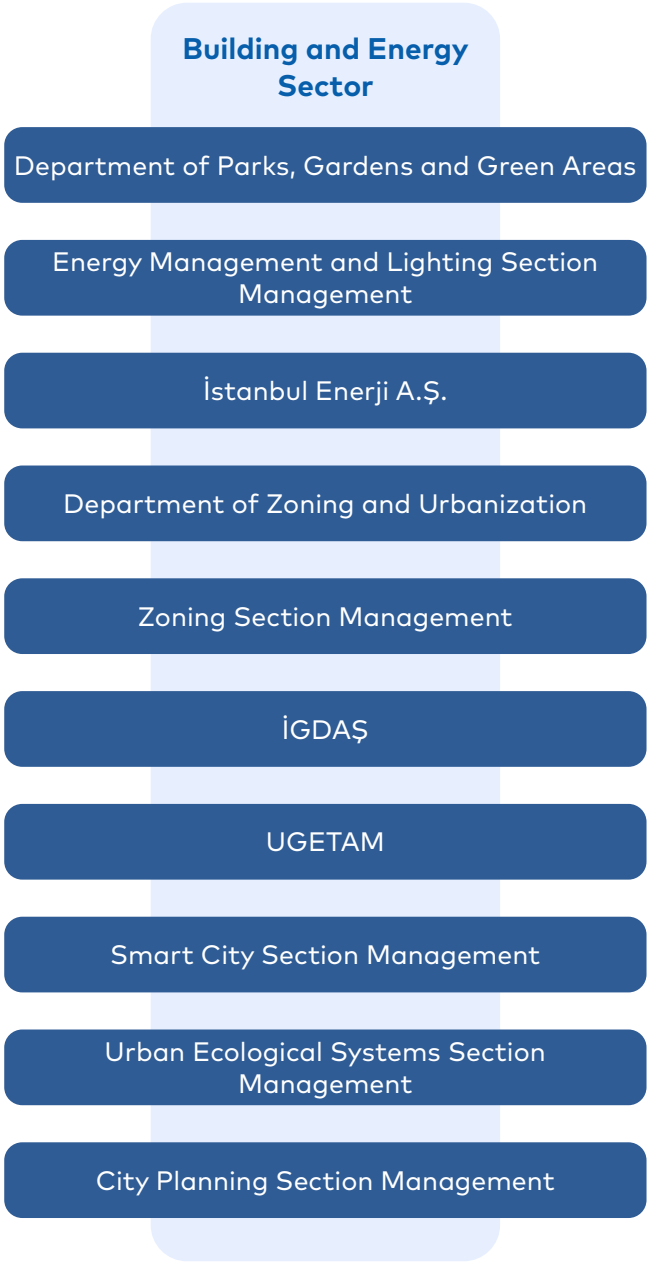
There are many activities that require stakeholder participation throughout the planning and implementation process of İstanbul SUMP. IMM Transportation Planning Branch Directorate, as the SUMP Management Unit, will also be responsible for ensuring and managing an effective stakeholder engagement. In order to ensure comprehensive stakeholder participation in the planning and implementation of the İstanbul SUMP, 255 stakeholders were identified, and many participation events were held with 134

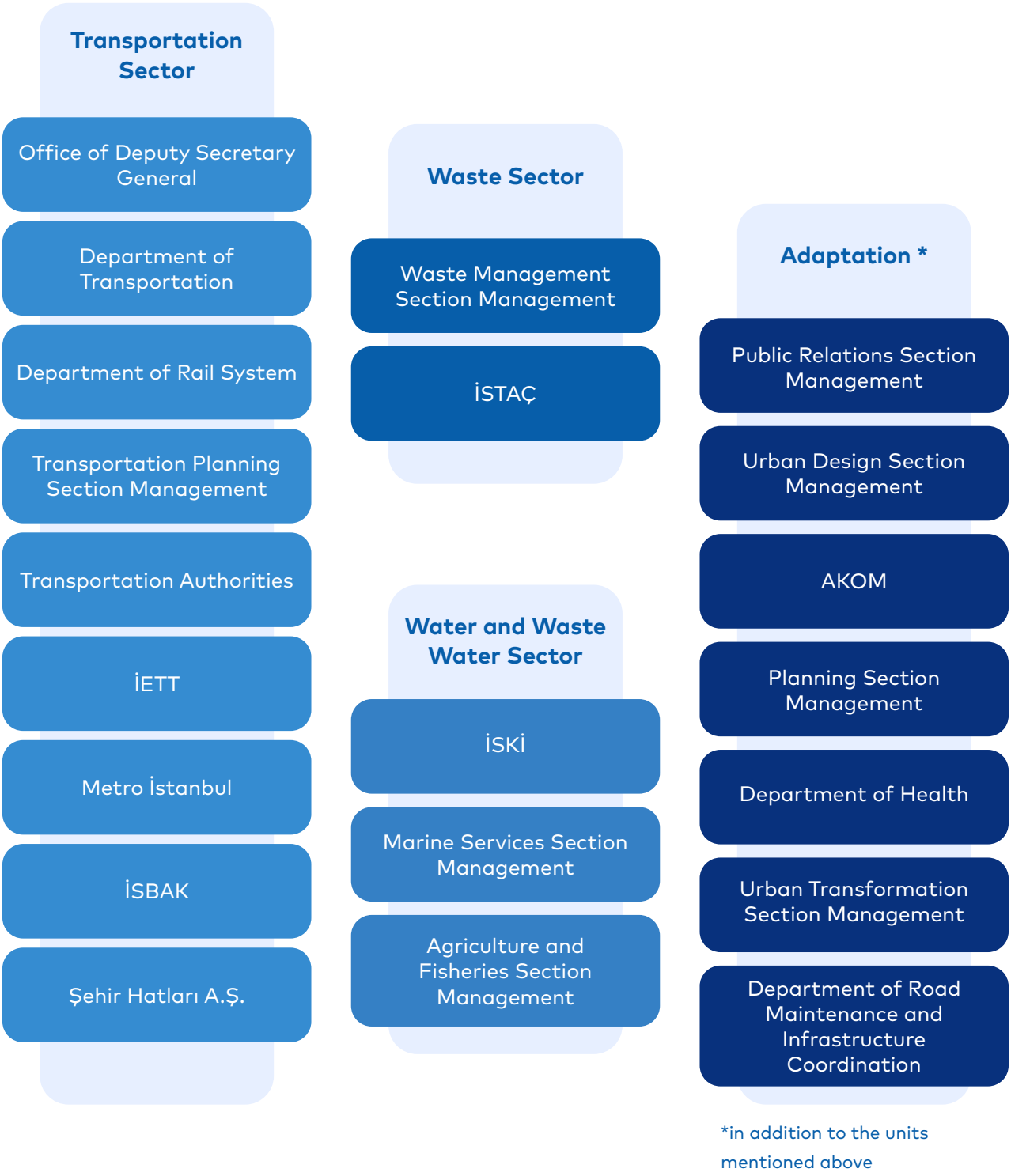
stakeholders. 134 stakeholders participated actively from the vision and scenario development stage of SKHP to the implementation process. Apart from IMM Units, District Municipalities, public institutions and organizations, these stakeholders mainly include NGOs, professional chambers, transportation operators and academicians who are experts in various fields such as urban planning, transportation planning and architecture, and this participatory approach will increasingly continue in the future.

İstanbul Climate Change Action Plan (İCCAP) Stakeholder Engagement

Since İstanbul's Climate Change Action Plan needs to be handled with an interdisciplinary approach, it is necessary to cooperate with different departments. These departments include working together with external stakeholders such as universities, public groups, professional chambers, non-governmental organizations, youth, as well as internal departments such as transportation, energy, waste water and waste.

In the process of revising the Climate Change Action Plan, an internal stakeholder workshop was held with the representatives of relevant units of IMM on "Building and Energy", "Transportation", "Waste", "Water and Waste water" reduction sectors and "Adaptation". In the workshop, goals and targets were evaluated, ambitious actions related to mitigation and adaptation were determined, these actions were prioritized, the feasibility of the actions and the obstacles to implementation were discussed.





*in addition to the units mentioned above

Four parallel sessions were held to prioritize actions in the Buildings and Energy, Transport, Waste and Water/Waste water sectors. After the second session, a third session was held in which additional stakeholders were invited to score the compliance actions. In each session, the participants scored the actions according to the criteria chosen through the online voting platform.

In total, 120 actions were voted according to the scoring criteria and 21 actions were prioritized for the Climate Change Action Plan. 42 key stakeholders from IMM's units and subsidiaries attended the workshops.

Prioritized mitigation and adaptation actions were also evaluated with academics after they were determined with their internal stakeholders. In the workshop, which was held with approximately 35 academicians from many universities in İstanbul, mitigation and adaptation actions were detailed and their adaptability to İstanbul was evaluated.

IMM Solid Waste Management Plan Stakeholder Engagement

On May 27, 2021, "İstanbul Waste Management Plan Academic Workshop" was held with the participation of Prof. Dr. Turgut ONAY from Boğaziçi University, Prof. Dr. Serdar AYDIN from İstanbul University, Prof. Dr. Barış ÇALLI from Marmara University, Prof. Dr. Osman Atilla Arıkan from İstanbul Technical University, and Prof. Dr. Mehmet Sinan BİLGİLİ from Yıldız Technical University. Waste Management Plan Strategies prepared with the motto of "2050 Carbon Neutral City İstanbul" were shared with academicians and discussed on scenarios. Opinions, suggestions and evaluations of each academician on issues such as the content of the İstanbul Waste Management Plan, suggested actions, scenario selection, investment planning were received.

"İstanbul Waste Management Plan Stakeholder Meeting" was held on 24 December 2021 with participants from the Environmental Protection, Cleaning and Zero Waste Directorates of 39 District Municipalities in the Kemerburgaz Domestic Waste Incineration and Energy Generation Facility conference hall. Head of Environmental Protection and Control Department, Prof. Dr. Ayşen ERDİNÇLER presented the scope of the plan and the most appropriate scenarios created for İstanbul in line with national/international targets. After the presentation, an online survey of 20 questions was made over the Mentimeter application to 52 participants, consisting of cleaning and environmental protection managers and staff of 33 district municipalities, and the results were shared with the participants instantly.






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2. BASELINE EMISSION INVENTORY

2. BASELINE EMISSION INVENTORY

2.1. INTRODUCTION

The Baseline Emissions Inventory (BEI) quantifies the amount of CO_2 emitted due to energy production and consumption, fuel/electricity consumption in transportation, waste and waste water management in the territory under the responsibility of the local authority in the baseline year selected. It is required for Global Covenant of Mayors (GCoM) and EU Covenant of Mayors (CoM) signatories to determine the relative emissions reduction target relative to baseline year. Elaborating a BEI is of critical importance as the inventory will be the instrument allowing the local authority to measure the impact of its actions related to climate change. The BEI will show where the local authority was at the beginning, and the successive monitoring of emission inventories will show the progress towards the objective. Emission inventories are very important elements to maintain the motivation of all parties willing to contribute to the local authority's CO_2 reduction objective, allowing them to see the results of their efforts.

The BEI will identify the principal human-caused (anthropogenic) sources of CO_2 emissions in the territory and indicate priorities to reduce them overall. If actions to reduce CO_2- equivalent greenhouse gases (GHGs) are covered by the SECAP, the inventory should also include methane (CH_4) and nitrous oxide (N_2O) emissions. These inventories are not only essential to develop SECAP targets; they are powerful motivators to all parties involved as evidence of the impacts of their efforts. The three main scopes of GHG emissions to be potentially included in the emission inventory are provided in Figure 5.

1 Direct emissions due to final energy consumption

The quantification of GHG emissions (mainly CO_2) due to energy consumption in both stationary and mobile sources is mandatory in the reporting.

2 **Indirect emissions related to consumption of grid-supplied energy (electricity and heating/cooling) within the local territory boundary**

The emissions from energy generation activities within the local territory boundaries are accounted for through the local emission factor for electricity and for heating/cooling.

3 **Non-energy related emissions that occur in the local territory**

It is mandatory to include in the emission inventory the waste and other non-energy related greenhouse gas emissions.

Figure 5. Main Scopes of GHG Inventory

The inventory is prepared in accordance with the JRC Guidelines[35] with a stepwise approach explained below.

2.2. SELECTION OF SECTORS INCLUDED

Local authorities may include all sectors relevant to their circumstances. However, local authorities shall report GHG emissions at least from three main sectors, namely buildings/stationary energy, transportation, and waste/other non-energy related. Table 2. SECAP Sectors Considered in the BEI Table 2 shows the sectors included in the BEI studies for IMM.

Table 2. SECAP Sectors Considered in the BEI

SECAP Sector	Scope	Status
Final energy consumption in buildings, equipment/facilities and industries		
Municipal buildings, equipment/-facilities	All final energy consumption and related GHG emissions occurring in buildings and facilities owned by the local authority are included under this sector. All final energy consumption (and related GHG emissions) due to operation of municipal water supply system, solid waste and waste water treatment and disposal facilities are also included here.	Mandatory
Tertiary (non-municipal buildings, equipment/facilities	All final energy consumption and GHG emissions occurring in buildings and facilities of the tertiary sector included here.	Mandatory
Residential Buildings	All final energy consumption and GHG emissions occurring in buildings that are primarily used as residential buildings for cooking, heating & cooling, lighting and appliances.	Mandatory
Municipal Public Lights	Electricity consumption due to public lighting is included here.	Mandatory
Industries	All GHG emissions from fuel combustion and use of grid supplied energy in buildings, facilities and machinery in industry include here. Energy generation industries should not be reported here.	Optional

SECAP Sector	Scope	Status
Final energy consumption in transportation		
Urban road transportation: municipal fleet	All GHG emissions from fuel combustion and use of grid supplied energy for transportation by municipal fleet included here	Mandatory
Urban road transportation: public transportation	All GHG emissions from fuel combustion and use of grid supplied energy for transportation by public transportation vehicles are reported here.	Mandatory
Urban road transportation: private and commercial transportation	All GHG emissions from fuel combustion and use of grid supplied energy for transportation by private and commercial transportation are included.	Mandatory
Other road transportation	This sector covers the road transportation on roads in the territory of the local authority not under its competence, for example highways. No measures planned as the sector is out of the municipality's responsibility.	
Urban rail transportation	This sector covers the urban rail transportation in the territory of the local authority, such as tram, metro and local trains. They are included as measures are planned.	
Other rail transportation	No measures planned as the sector is out of the municipality's responsibility.	
Aviation		Out of scope
Shipping/fluvial transportation		Out of scope
Local ferries	Local ferries are the ferries that serve as urban public transportation in the territory of the local authority. They are included as measures are planned.	
Off-road transport	No measures planned as the sector is out of the municipality's responsibility.	

SECAP Sector	Scope	Status
Other emission sources (not related to energy consumption)		
Fugitive emissions from production, transformation and distribution of fuels		Out of scope
Process emissions of industrial plants involved in EU ETS		Out of scope
Process emissions of industrial plants not involved in EU ETS		Out of scope
Use of products and fluorinated gases (refrigeration, air conditioning etc)		Out of scope
Agriculture (e.g. enteric fermentation, manure management, rice cultivation, fertilizer application, open burning of agricultural waste)		Out of scope
Land use, land use change and forestry		Out of scope
Waste water treatment	GHG emissions not related to energy consumption, such as CH_4 and N_2O from waste water treatment plants.	Mandatory
Solid waste treatment	GHG emissions not related to energy consumption, such as CH_4 from landfills.	Mandatory
Energy Supply		
Fuel consumption for electricity production		Optional
Fuel consumption for heating/cooling production		Optional

2.3. DATA COLLECTION AND EMISSION INVENTORY

In the compilation of BEI, the following concepts are of utmost importance:

1. **Baseline year,** is the year against which the achievements of the emission reductions in 2030 shall be compared. The EU has committed to reduce the emissions by 40% by 2030 compared to 1990, and 1990 is also the base year of the Kyoto Protocol. To be able to compare the emission reduction of the EU and the Covenant signatories, a common base year is needed, and therefore 1990 is the recommended baseline year of the BEI. However, if the local authority does not have data to compile an inventory for 1990, then it should choose the closest subsequent year for which the most comprehensive and reliable data can be collected.

İstanbul Metropolitan Municipality signed the Deadline 2020 commitment to be a Carbon Neutral city by 2050 in 2019 and revised the İstanbul Climate Change Action Plan according to the new targets of the Commitment. In the report shared with the public in 2021. 2019 was taken as the reference/base year and the Greenhouse Gas Inventory of İstanbul was prepared. Therefore, 2019 was taken as the reference year for the "Sustainable Energy and Climate Action Plan (SECAP) study."

2. **Activity data,** was used both in the province and in institutional inventory calculations. The amount of energy means the amount of fuel converted to MWh. Examples of activity data used are:

- Natural Gas used in residential buildings
- Electricity consumed in municipal buildings and in the province
- Fuel consumed by vehicles
- The amount of waste water treated by biological and physical means
- Amount of waste disposed of and/or recycled

3. **Emission factors,** are coefficients which quantify the emission per unit of activity. The emissions are estimated by multiplying the emission factor with corresponding activity data. Examples of emission factors are:

- Amount of CO_2 emitted per MWh of natural gas consumed
- Amount of CO_2 emitted per MWh electricity consumed
- Amount of CO_2 emitted per MWh fuel consumed

Data is collected at both municipality level and city level separately from the stakeholders indicated in Table 3. The selected sectors within the borders of IMM are buildings, transportation, waste management and waste water treatment sectors.

Table 3. Sectors and Stakeholders for Data Collection

Sectors	Stakeholder	Responsibility	Stakeholder	Responsibility
	Municipality Sections		City level	
Buildings	Support Services Department, Energy Management and Lighting Section Management, İGDAŞ	Energy and fuel consumption data for all buildings of the municipality (natural gas and electricity)	BEDAŞ, AYEDAŞ, TEİAŞ, EMRA	Energy and fuel consumption data for the city. Leaks from energy transmission and distribution
Transport	Energy Management and Lighting Section Management, Enerji A.Ş. İstanbul Transportation A.Ş., Department of Transportation, Department of Rail Systems Metro A.Ş., İETT, IMM Support Services Department, Marine Services Department, Şehir Hatları A.Ş.,	Municipality fuels consumption	EMRA, TCDD	Fuels consumption within the city Fuel and electricity consumption
Waste and Waste water	İSKİ	Treated waste water amount and characteristics	İSKİ	Waste water quantity and characteristics in the city
	IMM Waste Management Section, İSTAÇ A.Ş.	Amount of waste generated and characteristics within the Municipality, amount of waste disposed or recycled	IMM Waste Management Section, İSTAÇ A.Ş., MoEUCC	Solid waste and characteristics in the city. Amount of waste disposed or recycled

As part of İstanbul city GHG inventory[36] also the corporate GHG emissions of İstanbul Metropolitan Municipality (IMM) has been calculated for 2019 baseline year. IMM has created the GHG inventory as an institutional inventory, which includes municipality administrative buildings and their activities and as well relevant subsidiaries and affiliated companies activities. Thus IMM GHG emissions inventory consists of: İBB'nin sera gazı emisyon envanteri aşağıdakileri içermektedir:

- Emissions related to the local government own activities,

- Emissions from the municipality affiliated and subsidiary companies activities.

The analysis of corporate-scale GHG emissions representing local government activities include GHG emissions from all major organizations and services. All emissions as a result of local government activities and activities where subsidiaries/affiliate companies have operational control are included, regardless of where the emissions occur.
IMM had 28 subsidiaries and 2 affiliated companies in 2019 over which municipality administration has control over. During GHG inventory process consumption data about energy, transportation and waste management was collected from these companies and from this data 5 subsidiaries and 2 affiliated companies were identified as the ones that have the most impact on GHG emissions. These companies are İETT (the public bus company), İSTAÇ (the waste management company), ISTON (the concrete manufacturer), İSFALT (the asphalt production), İSKİ (water and sewerage administration), İHE (the bread manufacturer) and Metro A.Ş. (subway operator). Separate energy efficiency meetings were conducted with the representatives of these companies to map their activities, consumption data and possible mitigation measures.

IMM is responsible for public services such as public transportation, waste transportation and management, potable water supply, sewerage system and waste water treatment, green and recreational areas, road construction /maintenance/repair, urban and zone planning. IMM has energy production plants (generally solar and waste-to-energy) but is not responsible for city electricity generation, transmission, distribution or public street lighting.

36 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

2.4. EMISSION FACTORS

The GHG emission calculations within the determined responsibliities of IMM were performed using a formula shown below, adapted from the Intergovernmental Panel on Climate Change (IPCC) "Tier-1" and "Tier-2" methodology. It is consistent with the formula provided in the Guidebook "How to develop a Sustainable Energy and Climate Action Plan (SECAP)"[37], which is based on activity data on fuel consumption and emission factors:

$$\text{Carbon dioxide emissions } (t\ CO_2) =$$

$$= \Sigma_s \Sigma_f \{\text{fuel consumption}_{sf}\ (MWh) \times CO_2 \text{ emissions factor}_f\ (t\ CO_2/MWh),$$

s = sector

f = energy carrier

Fuel consumption data given as unit mass or volume are multiplied by net calorific values and converted to MWh.

Three greenhouse gases were included in the inventory: CO_2, NH_4 and N_2O. NH_4 and N_2O emissions sourcing from solid waste disposal activities were calculated separately. Global warming potentials of GHGs included in the inventory were taken from IPCC 5th Assessment Report (AR_5)[38]

The emission factors which are used in this SECAP were applied from IPCC Emission Factors except the national electricity grid emission factor calculated for Türkiye[39].

The average emission factor from electricity is taken from the Primary Energy and Greenhouse Gas Emission Coefficients of Electricity published by the Ministry of Energy and Natural Resources.

37 https://publications.jrc.ec.europa.eu/repository/handle/-JRC112986
38 https://www.ipcc.ch/assessment-report/ar5/
39 https://unfccc.int/documents/194818

2.5. CALCULATION APPROACH

GHG emission calculation approach for the baseline emissions inventory is performed according to Greenhouse Gas Protocol (GHG Protocol)[40] developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). In the GHG Protocol, release categories are classified as follows:

- **Scope 1 – direct greenhouse gas emissions:** Emissions from all fixed and mobile emission sources (Table 1.4) owned or directly controlled by the organization. These resources include assets owned, leased or financed. The scope limit is all controllable emission sources.

- **Scope 2 – indirect energy greenhouse gas emissions:** Emissions from energy purchased for the organization's activities, mainly electricity from the grid including electricity or other types of energy used for heating/cooling purposes.

- **Scope 3 – other indirect greenhouse gas emissions:** Indirect greenhouse gas emissions resulting from the activities of the organization but not directly under the control of the organization.

Like in the city inventory, as per GPC basic standards in IMM GHG inventory Scope 3 was also excluded and not calculated. Table 4 shows the difference between scopes at municipal and urban scale.

Table 4. GHG release categories (GHG Protocol)

	Municipal Scale	Urban Scale
Scope 1	Direct emissions (e.g. municipal vehicle fleet, municipality fossil fuel consumption for heating in buildings)	Direct emissions (e.g. from vehicles in the city)
Scope 2	Indirect emissions (e.g. consumed electricity in the municipality buildings)	Indirect emissions (e.g. electricity consumed in the city)

40 https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

2.6. STRUCTURE OF INVENTORY AND METHODOLOGICAL NOTES

İstanbul Metropolitan Municipality's Baseline emission inventory (BEI) was developed for 2019 and consists of two parts: **city inventory** and **corporate (municipality) inventory.** BEI mainly covers the following sectors:

- **Stationary energy:** municipal, tertiary, residential buildings, industry, public lighting;
- **Transport:** municipal fleet, public transport, private and commercial transport;
- **Waste:** solid waste, organic waste and waste water.

The baseline city-wide GHG inventory covers the stationary energy, transportation, and waste sectors, encompassing both city and municipal (corporate) areas of control. İstanbul's Greenhouse Gas Inventory for 2019 was calculated according to the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC) 'BASIC' Standard.

As part of İstanbul city GHG inventory also the **corporate** GHG emissions of İstanbul Metropolitan Municipality (IMM) has been calculated for 2019 baseline year. Baseline year is the year against which the achievements of the emission reductions in 2030 and 2050 will be compared.

2.7. EMISSION INVENTORY OF İSTANBUL CITY

Overall calculations of GHG emissions by sectors in the city level[41] are provided in the Table 5 which shows that total GHG emissions of İstanbul city in 2019 comprised about **50,89 $MtCO_2e$**

Five categories have been identified as the city-wide sources of GHG emissions related to stationary energy sector:

- Residential buildings
- Commercial and institutional buildings
- Manufacturing industries and construction
- Agriculture
- Non-specified sources
- Fugitive emissions

Generation of grid-supplied energy (electricity-only generation) is considered out of scope and was not included in the GHG inventory.

Three categories have been identified as the city-wide sources of GHG emissions related

41 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ ist_iklim_degisikligi_eylem_plani.pdf

to transportation:

- Transportation on road (private, commercial and municipal vehicles)
- Transportation on railways (commercial and public)
- Transportation waterborne navigation (commercial and public)

Four categories have been identified as the city-wide sources of GHG emissions related to waste and waste water:

- Solid waste disposal: treatment and disposal of solid waste in landfills generates significant amount of methane through anaerobic decomposition
- Biological treatment: biological treatment of organic waste, such as food waste, garden waste and sludge emit both nitrous oxide and methane. Composting and anaerobic digestion are included in this category
- Waste incineration: carbon in solid waste that is of non-biogenic origin generates carbon dioxide while burning
- Waste water treatment and discharge: organic material in domestic waste water generates methane due to anaerobic decomposition. Nitrous oxide
- emissions from waste water treatment can occur as direct emissions from treatment plants.

Stationary energy sector emissions comprise 62,9% of all GHG emissions in İstanbul city. The majority of stationary energy sector emissions come from the residential buildings (14,1 $MtCO_2e$), predominantly due to natural gas use in homes for cooking, hot water and heating. Commercial buildings and manufacturing industries generate 21,4 % and 12,9% of total GHG emissions of this sector respectively.

The **transportation** sector is responsible for 28,3% of total emissions and the single most significant source is on-road private and commercial transportation. This activity comes mostly from private cars and a significant number of buses. The 2019 inventory includes emissions from rail and water-borne navigation, but these represent less than 1% of total transportation emissions.

Waste sector, which is controlled and managed by IMM through company İSTAÇ, represents the remaining 8,8% of emissions in İstanbul, with the vast majority (89,4%) of these coming from solid waste disposal. The remaining 10,6% of waste emissions are allocated across waste water treatment (5,4%), industrial incineration (2,7%) and biological treatment (composting) (2,5%).

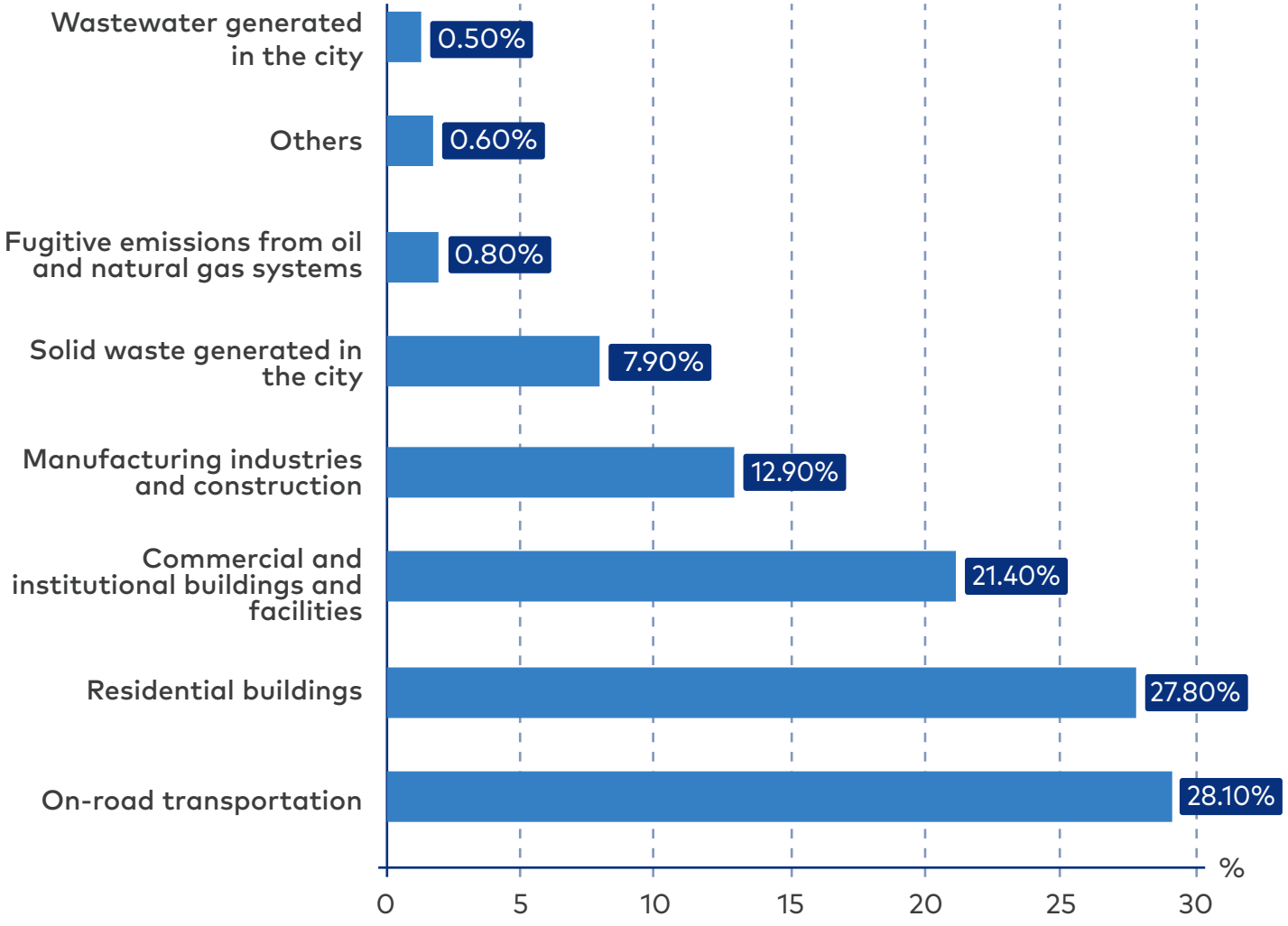
Table 5. İstanbul city GHG emissions in 2019 [42]

STATIONARY ENERGY			
	MWh	**tCO_2e**	**%**
Commercial & institutional buildings/facilities	29.491.282,48	10.891.905,00	21,4
Residential buildings	52.398.132,46	14.134.797,00	27,8
Manufacturing industries & construction	16.868.667,41	6.558.490,00	12,9
Agriculture	9.516,25	4.676,00	0,0
Non-specified sources	81.479,13	16.472,00	0,0
Fugitive emissions from oil and natural gas systems	68.677.083,33	383.617,00	0,8
Subtotal	**167.526.161,06**	**31.989.957,00**	**62,9**
TRANSPORT			
On-road transportation	53.623.578,68	14.311.579,00	28,1
Railways	98.452,00	47.470,00	0,1
Waterborne navigation	215.156,31	57.395,00	0,1
Subtotal	**53.937.186,99**	**14.416.444,00**	**28,3**
WASTE			
Solid waste	-	4.007.800,00	7,9
Biological waste	-	113.590,00	0,2
Incinerated and burned waste	-	119.861,00	0,2
Waste water	-	241.002,00	0,5
Subtotal	**-**	**4.482.252,00**	**8,8**
TOTAL	**221.463.348**	**50.888.653,00**	**100**

42 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

Shares of emissions among different sectors in İstanbul city are shown in Figure 6. Private, public and commercial on-road transportation (28,1%) together with residential (27,8%), commercial and institutional buildings (21,4%) and industry (12,9%) sectors are responsible for the largest part of city's emissions, followed by solid waste management sector (7,9%).

Figure 6. Share of sectors in total emissions of İstanbul city



2.8. CORPORATE GHG EMISSION INVENTORY OF İSTANBUL METROPOLITAN MUNICIPALITY

İstanbul SECAP focuses on municipality level and encompases climate change mitigation and adaptation measures targeted to areas of activity under control of IMM.

İstanbul's corporate greenhouse gas emission inventory includes municipal administrative buildings and their activities, as well as the activities of related subsidiaries and affiliates. Regardless of where the emissions occur, the emissions of all activities over which IMM has its own activities and operational control are included in the analysis.

Thus IMM GHG emissions inventory consists of:

- Emissions related to the local government own activities,

- Emissions from the municipal affiliated companies' and subsidiaries' activities.

IMM had 28 affiliated companies and 2 subsidiaries in 2019 over which municipality administration has control. During GHG inventory process initial consumption data about energy, transportation and waste management was collected from these affiliates/subsidiaries and from this data 7 afiliates/subsidiaries were selected which have the most impact on GHG emissions. These companies are İETT, İSTAÇ, İSTON, İSFALT, İSKİ, İHE and Metro İstanbul . Separate energy efficiency meetings were conducted with the representatives of these companies to map their activities, consumption data and possible mitigation measures. For the institutional inventory, it was decided to include the waste generated by IMM units, subsidiaries and affiliates.

The sectors studied in the institutional inventory are the same as the sectors studied in the city inventory.

Overall calculations of GHG emissions by sectors in the municipal corporate level are provided in Table 6, stemming from the activities of municipality and its affiliate companies. Information has been disaggregated into sub-sectors in line with CoM guidelines[43], which helps to identify key intervention areas and therefore facilitates decision-making processes when developing an action plan.

Table 6 shows that emissions in the **stationary energy** sector comprise almost 54,7% of all emissions in

43 https://www.covenantofmayors.eu/IMG/pdf/Reporting_Guidelines_SEAP_and_Monitoring_v2-0-2.pdf

municipality. The majority of stationary energy sector emissions (99%) come from commercial, institutional buildings (836.281 tCO_2e), predominantly due to natural gas use for heating and electricity use. Manufacturing industries (6.758 tCO_2e), agricultural activities (200 tCO_2e) and fugitive emissions from natural gas use (1.913 tCO_2e) generate 1% of stationary GHG emissions.

The **transportation** sector is responsible for nearly 43% of total emissions. Diesel oil (435.702 tCO_2e) is the dominant fuel source in the emissions of on-road municipal fleet compared to CNG (compressed natural gas) (12.953 tCO_2e) and gasoline (759 tCO_2e). The 2019 IMM institutional GHG emission inventory includes emissions from public railway transportation (169.448 tCO_2e) and water-borne navigation (38.434 tCO_2e).

Waste sector, which is controlled and managed by IMM through company İSTAÇ, represents the remaining 2,7% of emissions in IMM, with the majority of these coming from solid waste incineration (29.110 tCO2e) and disposal (11.252 tCO_2e). The remaining waste sector emissions are allocated across waste water treatment (1.984 tCO_2e) and biological treatment (113 tCO_2e).

Analysis shows that IMM corporate emissions (1.544.908 tCO_2e) comprised about 3% of total citywide emissions (50.888.653 tCO_2e) in 2019.

The mitigation commitment of IMM is related mainly to the emissions associated with energy consumption in sectors which can be influenced by the municipality (housing, services and urban transport). At this point, some sectors that are not under the control of IMM (e.g. industrial establishments) are excluded.

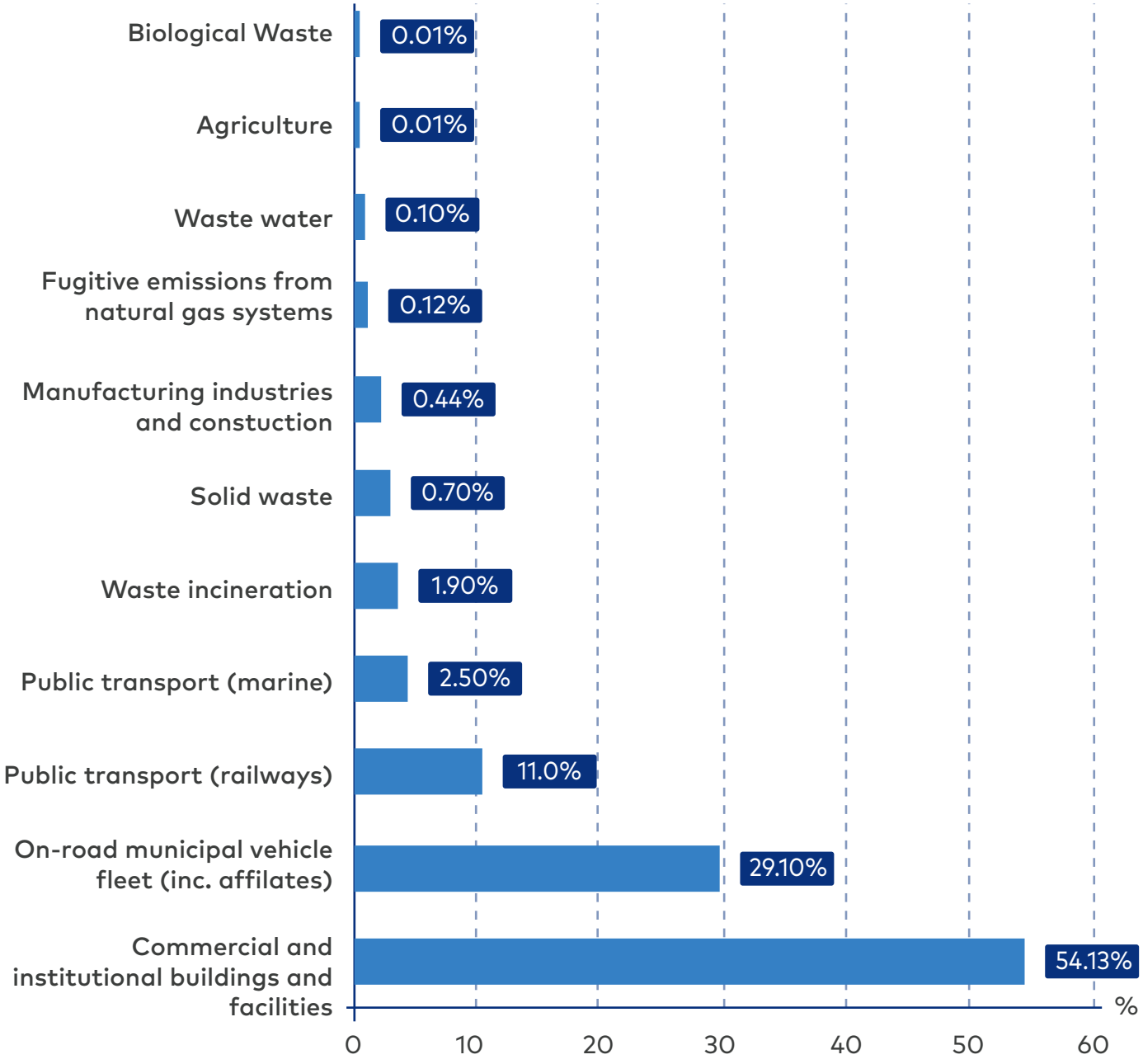
Table 6. IMM corporate greenhouse gas emissions, 2019

STATIONARY ENERGY			
	MWh	**tCO_2e**	**%**
Commercial and institutional buildings and facilities	2.037.343,64	836.281	54,13
Manufacturing industries and construction	14.877,65	6.758	0,44
Agriculture *	440,14	200	0,01
Fugitive emissions from natural gas systems	353.725,03	1.913	0,12
Subtotal	**2.406.386,46**	**845.152**	**54,7**
TRANSPORT			
On-road municipal vehicle fleet (incl. affiliates)	1.667.726,01	449.415	29,1
Public transportation (railways)	373.033,12	169.448	11,0
Public transport (marine)	144.076,88	38.434	2,5
Subtotal	**2.184.836,01**	**657.297**	**42,6**
WASTE			
Waste management (solid waste disposal)	-	11.252	0,7
Waste management (biological treatment)	-	113	<0,01
Waste incineration	-	29.110	1,9
Waste water treatment plant	-	1.984	0,1
Subtotal	**-**	**42.459**	**2,7**
TOTAL (IMM corporate GHG inventory)	**4.591.222,47**	**1.544.908**	**100**

* Electricity consumption resulting from agricultural irrigation as a result of the sampling growing activities in the facilities of Ağaç A.Ş., one of IMM affiliates

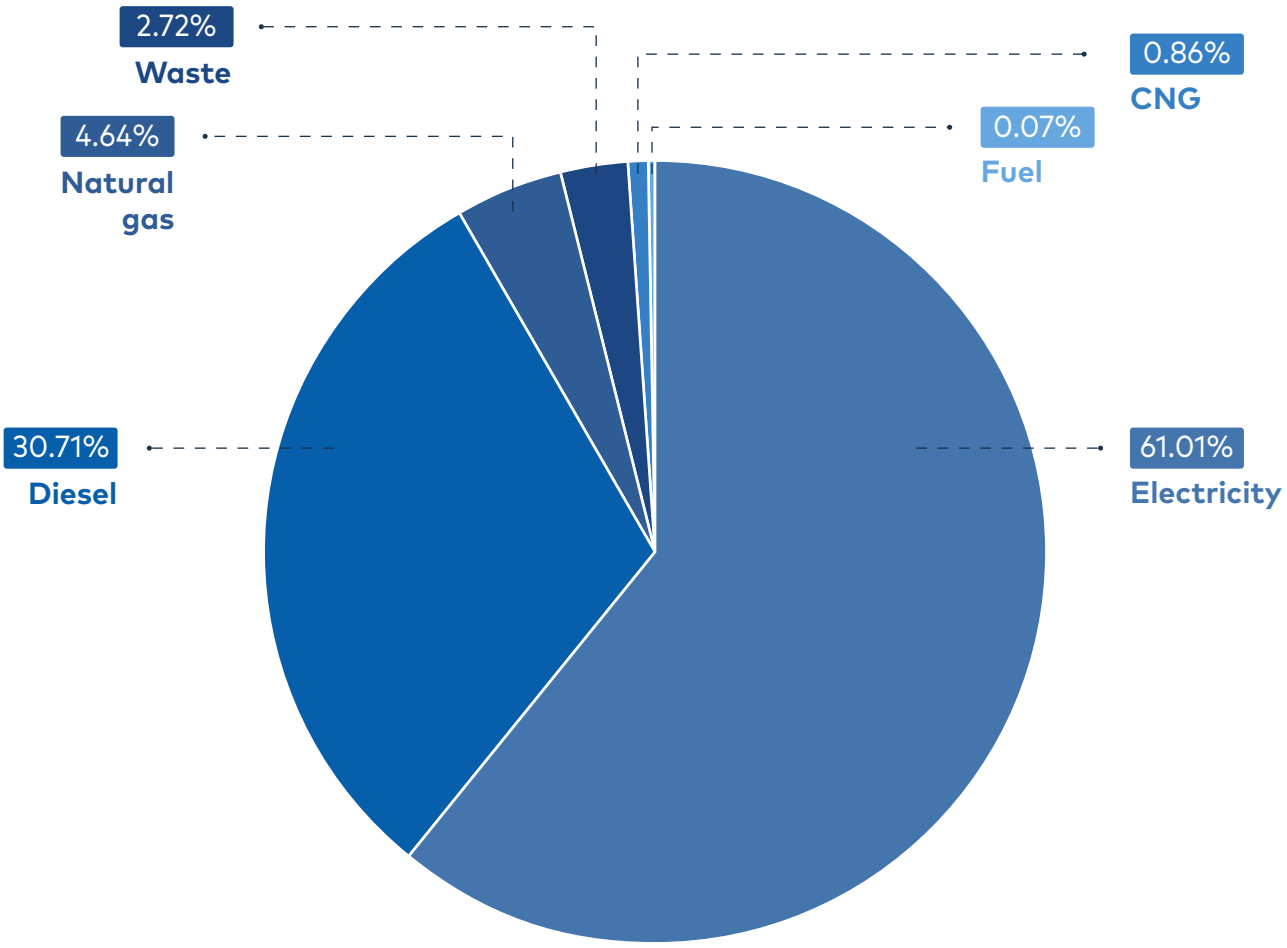
Figure 7 shows proportional shares of all identified GHG emission sectors of IMM. Commercial and institutional buildings and facilities dominate the list with 54% followed by on-road municipal fleet and railway transportation sector (trams and metro), comprising 29% and 11% of total municipal emissions respectively.

Figure 7. Distribution of GHG emissions in sub-sectors of IMM corporate activities



Most of GHG emissions in IMM corporate activities stem from electricity consumption (61%) (Figure 8). More than 80% of this electricity is consumed in the stationery sector, mainly commercial and institutional buildings and facilities. The second largest GHG emission source (30,7%) is diesel consumption in municipal vehicle fleet encompassing all affiliated companies.

Figure 8. Distribution of IMM corporate GHG emissions according to energy carrier type

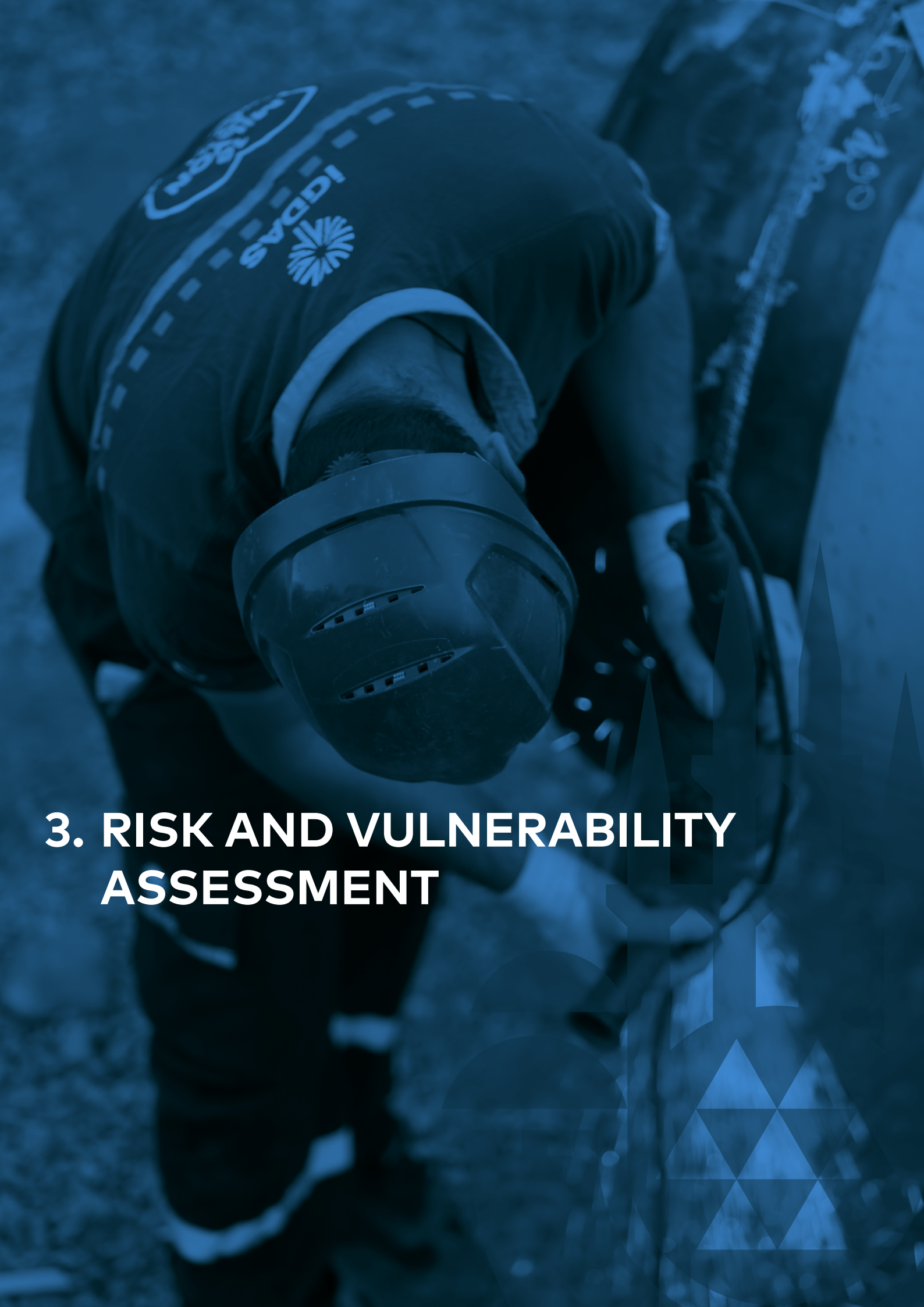


2.9. SUMMARY

The **BEI** was developed for baseline year 2019 by calculating CO_2e emissions using an activity-based approach. This SECAP focuses on the actions of IMM (not the whole city), therefore separate BEIs were developed for İstanbul city and İstanbul Metropolitan Municipality.

Overall calculations of GHG emissions by sectors in the city level show that total GHG **emissions of İstanbul city** comprise about **50,89 $MtCO_2e$.** Stationary energy sector emissions comprise more than half of all emissions in İstanbul city. The majority of stationary energy sector emissions come from residential buildings (44,1%). The transportation sector is responsible for 28,3% of total emissions, dominated by on-road transportation (99%). Waste sector, which is controlled and managed by IMM through company İSTAÇ, represents the remaining 8,8% of emissions in İstanbul, with the vast majority (89%) of these coming from solid waste disposal.

Analysis shows that **İstanbul's municipality institutional emissions (1,54 $MtCO_2e$)** comprise about 3% of total citywide emissions. Main source of corporate emissions is commercial and institutional buildings and facilities of IMM affiliated companies and subsidiaries (54,13%).



3. RISK AND VULNERABILITY ASSESSMENT

3.1. INTRODUCTION

Controlling climate change effects also requires an in-depth assessment of impacts, vulnerabilities, and solutions for disaster risk reduction, enhancing the resilience of human systems and ecosystems and developing nature-based solutions. From this perspective, two key concepts emerge the implementation of a circular economy and the increase of the resilience of cities and communities. The greater a system's ability to conserve its energy supply, the more adaptable it will be to internal and external events (such as climate change or other threats). a resilient approach considers Vulnerability and multiple-risk assessment in cities to define spatial policies. Resilient solutions are designed to address Adaptation to climate change by using nature-based solutions to achieve a measurable benefit of socio-economic health. Adaptation and risk management policies and practices will be more successful if they consider the dynamic nature of vulnerability and exposure.

According to a 2016 study conducted by Basque Center for Climate Change in Spain[44] , which ranks coastal cities in Europe based on their risks, İstanbul ranks first and İzmir third.

As claimed in the İstanbul Climate Change Action Plan Summary Report (2018) İstanbul is one of the European cities most vulnerable to climate change, thus adaptation activities have priority. In 2017, Türkiye experienced one of its driest years. In the summer of the same year, heavy rainfall and severe hail events have affected the transportation infrastructure and caused significant damage to homes and vehicles. According to a study that assesses the potential economic damages of extreme weather events in 15 European coastal cities, İstanbul ranks first[45] .

In the report, it is explicitly written that, despite minor uncertainties which depend on modeling gaps, İstanbul's climate will converge to a typical Mediterranean climate which means that it will become much warmer and drier. Moreover, the Mediterranean basin will become one of the most vulnerable to climate change due to the position, the number of coasts, and the exposure of people.

Particularly, the emerging issues for İstanbul are found to be the change in temperature and precipitation

44 L. M. Abadie, E. Sainz de Murieta and I. Galarraga, "Climate Risk Assessment under Uncertainty: An Application to Main European Coastal Cities," Frontiers in Marine Science, Volume 3, p. 265, 2016.

45 İstanbul Climate Change Action Plan Summary Report, Department of Environmental Protection and Development Directorate of Environmental Protection İBB Beyoğlu Ek Hizmet Binası Hacı Ahmet Mah. Kurtuluş Deresi Cad. Yeni Yol Zarif Sok. No: 22, 34440 Beyoğlu / İSTANBUL and İstanbul Environmental Management and Trade Inc. Paşa Mah. Piyalepaşa Blv. No: 74 34379 Şişli / İSTANBUL

patterns, drought, increased sea levels, and cross-cutting themes related to urban heat islands and air quality.

The average temperatures in İstanbul are expected to rise until the end of the century. This increase will be higher during summer months, which will be amplified significantly by the urban heat island effect and potential heat waves. While the total precipitation is expected to decrease slightly, heavy rainfall is expected in shorter periods of time, leading to potential flash floods. The severity and frequency of extreme climatic events are expected to increase. Some examples are already experienced in recent years in İstanbul in the form of floods, droughts, and hailstorms.

Four main changes in the normal pattern are identified: higher average temperatures, shift in wet and dry seasons, higher tides and erosion rates, variations in annual precipitation, excessive evaporation, and mean sea level rise (Figure 9). Therefore, the change in extreme patterns will include heat waves, excessive evapotranspiration, epidemics, droughts, floods and landslides, and storm surges.

According to these statements, the four ecosystem vulnerability maps should be interpreted as a baseline guide for the future Adaptation of the city. Changes in precipitation, temperature and pollutants will obviously affect the biodiversity, the erosion/inundation of the coastline, the diffusion of urban heat islands, and the possibility of being affected by pluvial floodings.



TEMPERATURE CHANGE

Increase in annual average temperature

1 - 4,5 °C

Warmest day temperature

40 + °C

Coldest day temperature

0 + °C



PRECIPITATION CHANGE

Decrease in total annual precipitation

maximum %12

Increase in the amount of precipitation on heavy rain days

maximum %59

Increase in rainfall intensity

maximum %13



DROUGHT

Longest droughty duration

maximum 57



SEA LEVEL RISE

45-75 cm



URBAN HEAT ISLAND

Additional increase in average temperature due to intense urbanization

1 - 2 °C

Figure 9. Expected climatic changes

(Source: Revised İstanbul Climate Change Action Plan, 2021)

3.2. METHODOLOGICAL NOTES

In order to model the ecosystem vulnerabilities of İstanbul city, InVEST model[46], which is a suite of free, open-source software models used to map and value the goods and services from nature that sustain and fulfill human life, was used. InVEST's versatile modular design feature has made it an important modular program used in different fields. InVEST assists decision makers in the quantitative evaluation of the areas where it is applied and provides advantages in establishing the planned regulations on more concrete foundations. The toolset includes distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems, as well as several "helper tools" to assist with locating and processing input data and with understanding and visualizing outputs.

InVEST models are spatially-explicit, using maps as information sources and producing maps as outputs. InVEST models are distributed as a standalone application independent of a GIS software. You need mapping software such as QGIS or ArcGIS to view results.

As an outcome of the İstanbul Climate Change Action Plan[47], four climate change risks were selected to be throughly studied for adaptation actions. These are:

1. Urban Floods
2. Coastal Floods
3. Habitat Degradation
4. Heat Islands

The InVEST model was used to determine and evaluate in which districts or regions of İstanbul the above-mentioned risk factors are concentrated, or rather their spatial distribution.

Habitat Quality

The InVEST Habitat Quality model uses habitat quality and rarity as proxies to represent the biodiversity of a landscape, estimating the extent of habitat and vegetation types across a landscape and their state of degradation. The model combines maps of land use land cover (LULC) with data on threats to habitats and habitat response. Modeling habitat quality alongside ecosystem services enables users to compare spatial patterns and identify areas where conservation will most benefit natural systems and protect threatened species. This model does not attempt to place a monetary value on biodiversity.

46 https://invest-userguide.readthedocs.io/en/latest/index.html
47 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

Urban Flood Risk Mitigation

Flood hazard comes from different sources, including riverine (or fluvial) flooding, stormwater (or urban) flooding, and coastal flooding. Natural infrastructure can play a role in each of these. Related to stormwater flooding - the focus of the InVEST flood risk mitigation model, natural infrastructure operates mainly by: reducing runoff production, slowing surface flows, and creating space for water (in floodplains or basins). The InVEST model calculates the runoff reduction, i.e. the amount of runoff retained per pixel compared to the storm volume. It also calculates, for each watershed, the potential economic damage by overlaying information on flood extent potential and built infrastructure.

Urban Cooling (Heat Islands)

Urban heat mitigation is a priority for many cities that have undergone heat waves in recent years. Vegetation can help reduce the urban heat island by providing shade, modifying the thermal properties of the urban fabric, and increasing cooling through evapotranspiration. This has consequences for the health and wellbeing of citizens through reduced mortality and morbidity, increased comfort and productivity, and reduced need for air conditioning. The InVEST urban cooling model calculates an index of heat mitigation based on shade, evapotranspiration, and albedo, as well as distance from cooling islands (e.g. parks).

Coastal Vulnerability

The InVEST Coastal Vulnerability model uses geophysical and natural habitat characteristics of coastal landscapes to compare their exposure to erosion and flooding in severe weather. When overlaid with data on coastal population density, the model's outputs can be used to identify where humans face higher risks of damage from storm waves and surge.

3.3. VULNERABILITIES OF İSTANBUL CITY

3.3.1. Urban Flood Risk

Cloudburst events represent one of the most potentially dangerous conditions for coastal cities worldwide. In fact, climate change is rapidly augmenting the number of extreme events while exposing the densely inhabited coastal areas to potential damage and dangerous situations. Besides, mountainous coastal cities have an idiosyncratic vulnerability to be flooded, which is intended as an urban system's propensity to be inundated during a cloudburst event. In particular, numerous high-density Mediterranean urban areas are developed on hillside terrains along the coastline, on poorly hydraulically conductible soils, with a limited capacity to drain the rainwater and little favorable terrain to create run-off streams.

The urban flood mitigation model represents one of the first explicitly designed tools for urban mapping vulnerabilities. The model assumes that flood-prone areas are impermeable material of artificial surfaces built upon low drainage soils. The model considers that the water on the impervious surface moves directly to the area next to it, contributing directly to surface flow accumulation. The exact biophysical estimation of the run-off in urban land can be significantly difficult to compute since the discharge volume during a cloudburst can be affected by many factors (quantity, quality, and surface of buildings, sewer systems capacity, the presence of dust/leaves in the ground).

The output calculates the run-off retention index (i.e., the percentage of run-off retained per pixel compared to the storm volume) and, on the contrary, the millimeters of water that undergoes the run-off process. The land use classification was entirely built around the United States Department of Agriculture (USDA) classes, employing the Imperviousness High-Resolution Layer (HRL) database[48].

The model produced the following results in Table 7 and in Figure 10.

48 available at https://land.copernicus.eu/pan-european/high-resolution-layers/imperviousness , accessed on 15 May 2021

Table 7. Biophysical output table with the run-off and retention parameters

Municipality	Run-Off Retention Index	Run-Off Retention (m³)	Flood Volume (m³)
GÜNGÖREN	0,47	167.544,74	189.025,26
GAZİOSMANPAŞA	0,47	275.031,13	309.108,88
BAHÇELİEVLER	0,48	401.568,71	433.866,27
BAĞCILAR	0,48	541.186,74	580.393,29
BAYRAMPAŞA	0.49	233.403,03	243.621,98
ZEYTİNBURNU	0.50	286.003,21	287.821,79
BEYOĞLU	0.50	225.198,38	222.466,62
ESENYURT	0,51	1.088.888,44	1.061.571,56
FATİH	0,51	399.572,80	383.057,21
ŞİŞLİ	0,51	273.537,95	261.977,05
KAĞITHANE	0,52	382.310.33	355.644,66
ATAŞEHİR	0,54	681.554,97	585.855.00
ÜMRANİYE	0,58	1.321.758,88	976.626.08
KADIKÖY	0,58	724.623,56	524.831,35
KÜÇÜKÇEKMECE	0,58	1.053.886,50	760.718,50
ESENLER	0,62	574.877,20	347.547,75
KARTAL	0,64	1.224.243,58	701.261,35
BAKIRKÖY	0,64	939.189.31	533.975,57
ÜSKÜDAR	0,64	1.133.478,86	638.906.03
BEYLİKDÜZÜ	0,64	1.211.933,90	681.686.02
SULTANBEYLİ	0,65	947.628,96	499.655,96
AVCILAR	0,66	1.292.799,91	674.564,97
SULTANGAZİ	0,68	1.197.724,42	572.920,49
MALTEPE	0,68	1.792.470,73	855.469.15
BEŞİKTAŞ	0,68	609.686,47	289.503,50
BÜYÜKÇEKMECE	0,69	5.212.635,42	2.333.348,84
SANCAKTEPE	0,69	2.115.323,83	932.456.01
TUZLA	0.70	4.356.541,63	1.825.657,89
BAŞAKŞEHİR	0,71	3.718.184,67	1.519.539,93
PENDİK	0,75	6.774.635,01	2.220.049,43
ŞİLE	0,78	85.90	24.10
ARNAVUTKÖY	0,79	16.937.233,61	4.480.634,38
EYÜPSULTAN	0.80	9.035.110,04	2.223.489,22
SİLİVRİ	0,81	34.511.597,12	8.002.120,32
SARIYER	0,83	7.251.436,96	1.534.392,70
ÇEKMEKÖY	0,83	6.213.852,90	1.228.301,83
BEYKOZ	0,85	13.097.619,74	2.364.439,61

The districts in İstanbul are listed according to their vulnerability level in Table 7, the most vulnerable districts being Güngören and Gaziosmanpaşa. When the flow retention index is high, the ability to contain and direct water increases, which can reduce the risk of flooding. A low flow detention index can cause water to accumulate rapidly and increase the risk of flooding. Accordingly, districts with low flow retention index in the table above can be described as vulnerable to flood risk.

In order to explain how the data Table 7 should be read, Bağcılar district is taken as an example. According to this data, Bağcılar district is the fourth most critical district in terms of run-off retention. According to the modelling output, only 48% of the rain volume (of a simulated single rain event of 50mm), can be retained by the soil. It means that most of the rain volume (52%) will undergo a run-off process. More specifically, the model calculated that in that specific flash flood event (50mm) the potential flood volume is 580.393,29 m^3.

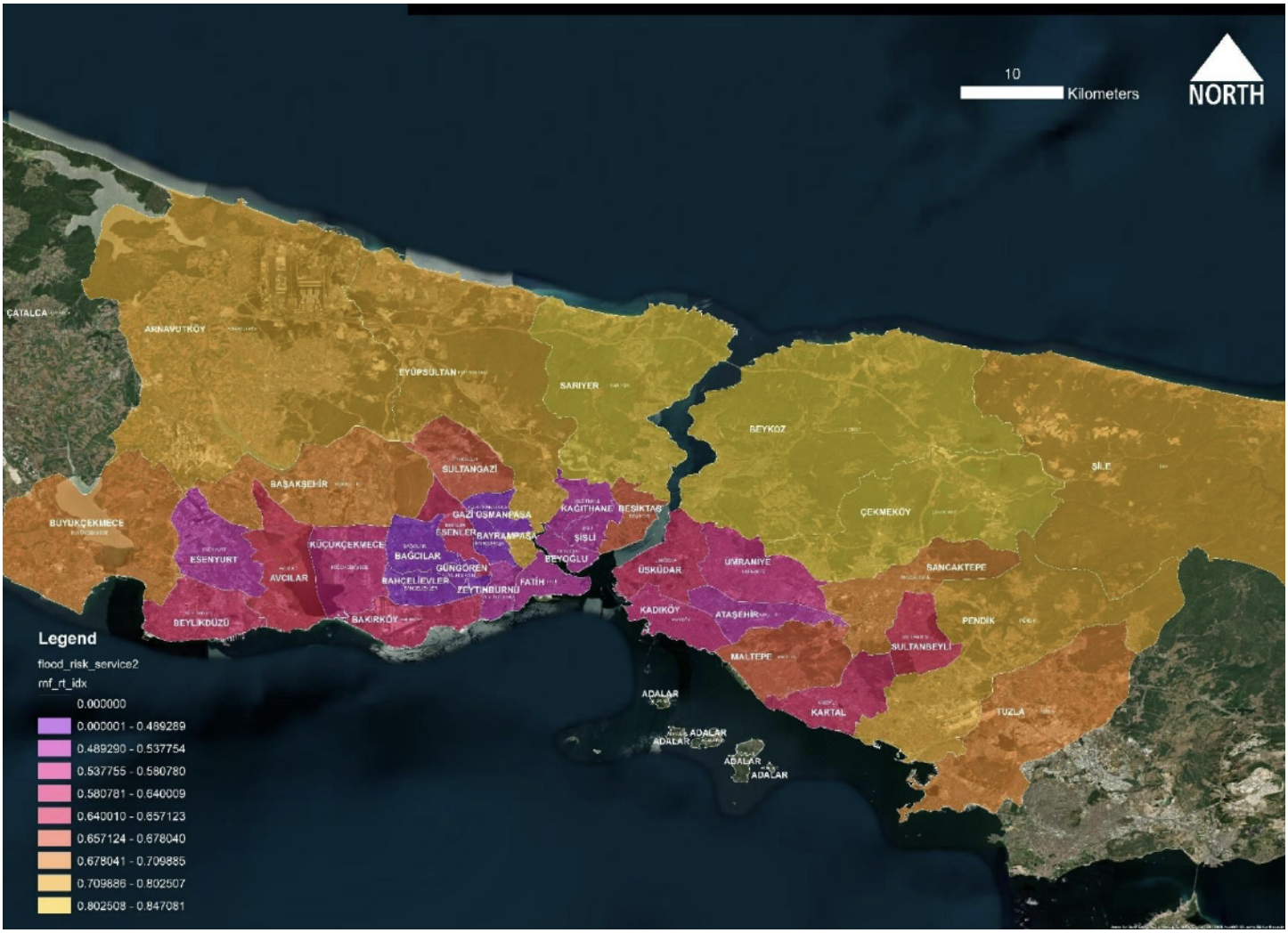
Then, to empirically measure if these results can be considered sustainable for the district, the discharge rainwater capacity of the channel in the district should be evaluated against the results to see if potential stormwater floods can occur during huge rain events in the city.

Figure 10 shows the pluvial flooding vulnerability levels in İstanbul. A low score in a grid cell (darker shade on the map) means urban flooding risk in the cell is high relative to other cells. If the southern parts of the basin sections where the population and settlement are intense are excluded, the rivers partially preserve their semi-natural characteristics in the northern regions that form the upper parts of the river basins. Stream bed patterns also show significant changes in the southern parts where urbanization and population are dense. In these areas, the riverbeds partially preserve their natural characteristics because they are semi-canalized by human intervention.

The more the riverbeds are changed by unconscious anthropogenic interventions, the more fragility of those rivers in terms of floods increases. In the case of flash floods, if the anthropic system has a failure, the probability of huge inundations is high. While considering how to adapt the system to this specific problem (pluvial flooding), it is important to give priority to all those areas that present a huge

vulnerability and then, once the critical areas for intervention are defined, check whether streams or upstreams cross these areas according to the flow accumulation analysis.

Figure 10. Pluvial Flooding Vulnerability of İstanbul City with the InVEST Model (Areas in reddish and purple color indicate districts with high vulnerability)



3.3.2. Coastal Vulnerability Model

Faced with an intensification of human activities and a changing climate, coastal communities need to better understand how modifications of the biological and physical environment (i.e. direct and indirect removal of natural habitats for coastal development) can affect their exposure to storm-induced erosion and flooding (inundation). The InVEST Coastal Vulnerability model produces a qualitative estimate of such exposure in terms of a vulnerability index, differentiating areas with relatively high or low exposure to erosion and inundation during storms. By coupling these results with global population information, the model can show areas along a given coastline where humans are most vulnerable to storm waves and storm surge. The model does not consider coastal processes that are unique to a region, nor does it predict long- or short-term changes in shoreline position or configuration. The results provide a qualitative representation of coastal hazard risks, rather than quantifying shoreline retreat or inundation limits.

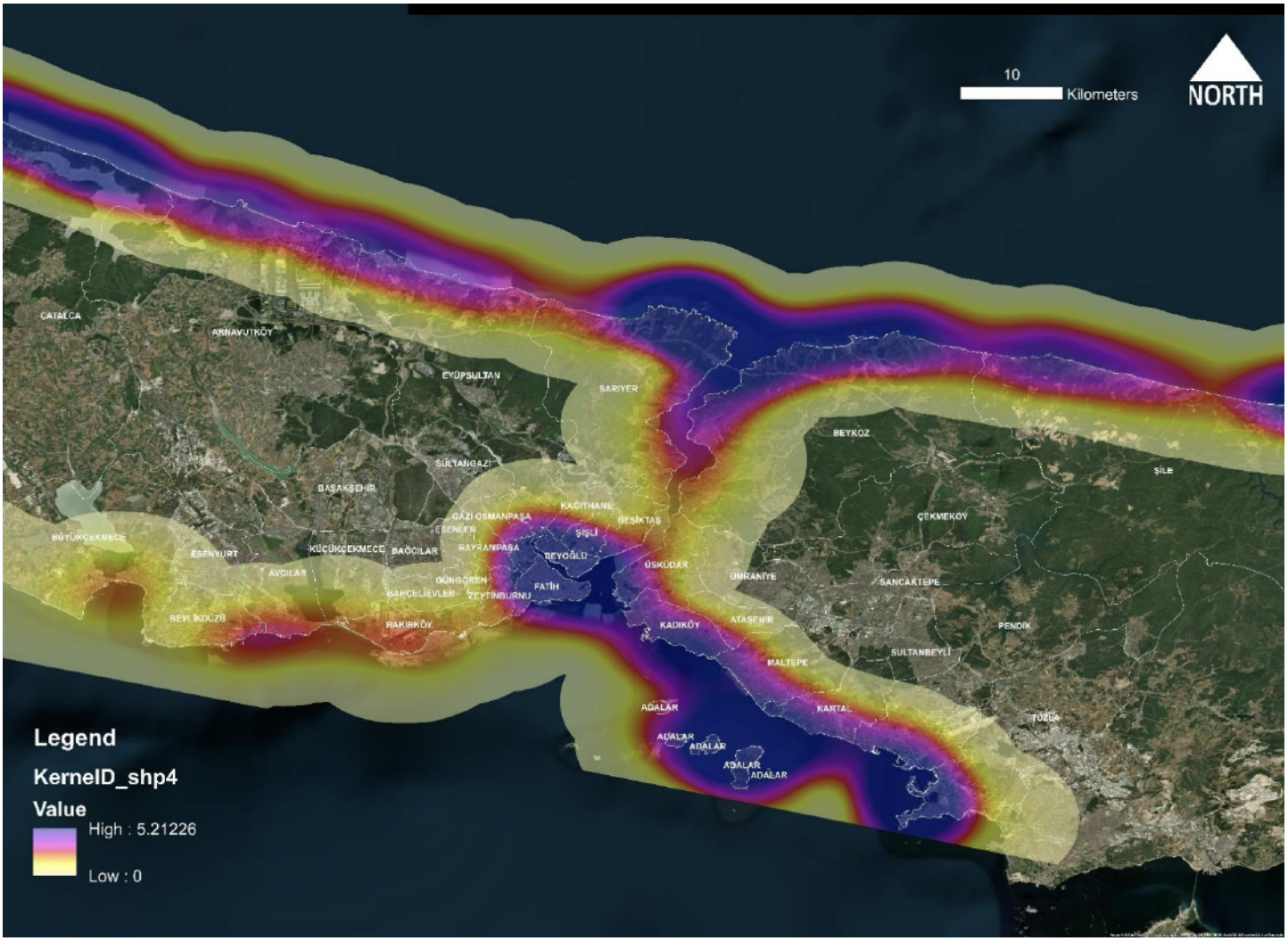
The model calculates the index of coastal exposure to storm-induced erosion and flooding. Figure 11 shows the final outputs of the model.

İstanbul has more than one type of coast. Two types of coasts can be seen, especially in İstanbul, divided into Ria and Lagoon-Port Coasts. The coastal type formed by the inundation of river valleys under sea water is called the Ria coastal type. It has the coast type of İstanbul-Çanakkale Strait and Golden Horn Ria. On the map, the coasts in Sarıyer, Beykoz, and Beyoğlu, Fatih, Zeytinburnu, Üsküdar districts, which are places with the Ria coastal type, show high coastal vulnerability distribution with the effect of the Black Sea, except Beşiktaş, while the south-western part of Beykoz and the northern part of Üsküdar, located in either side of the middle of the Bosphorus show low coastal vulnerability. The reason for this is that, since it is between two lands, the salt water inflow is less compared to its surroundings, and the coastal vulnerability such as erosion and storm waves is less than the environment. Kadıköy, Maltepe, Kartal, Pendik and Tuzla coasts running parallel to Heybeliada, Adalar, Büyükada, Kınalıada and Golden Horn have coastal vulnerability due to factors such as wind, distance, and depth of the Marmara Sea.

The other coastal type that is unique to İstanbul is coastal with Lagoon-Harbor. As in Büyükçekmece and Küçükçekmece

examples, when the waves accumulate alluvium in front of a bay, the mouth of the bay is partially or completely closed and lagoon shores are formed. These two coast types have a lower vulnerability index than the other coasts mentioned above. Considering future climate change, districts such as Bakırköy, Küçükçekmece, especially Avcılar and Beylikdüzü may be at higher risk of coastal vulnerability.

Figure 11. Coastal Vulnerability Mapping of İstanbul Cıty with the InVEST Model



As for coastal vulnerability, the sea level rise prediction of 75 cm has been used as a new input layer to map this specific vulnerability in the İstanbul metropolitan area. The model has been re-launched using only the scenario evaluation that considers the sea level rise hazard (Figure 12). Results indicate that two coastal hotspots will be threatened with higher intensity: all the Golden Horn coast, including the eastern coast facing the Bosphorus Strait, and the northern coastal areas of the Bosphorus Strait can be impacted by the seal level rise. Since the northern coast is less anthropized, the exposure of people, buildings and other aesthetic and historical values in this part of the metropolitan area is minimized. On the other hand, the extremely vulnerable situation due to sea-level rise in the city's most ancient, historical, dense and touristically attractive area represents a serious problem that should be faced by employing various technique of Adaptation through the re-design and re-develop of the waterfront.

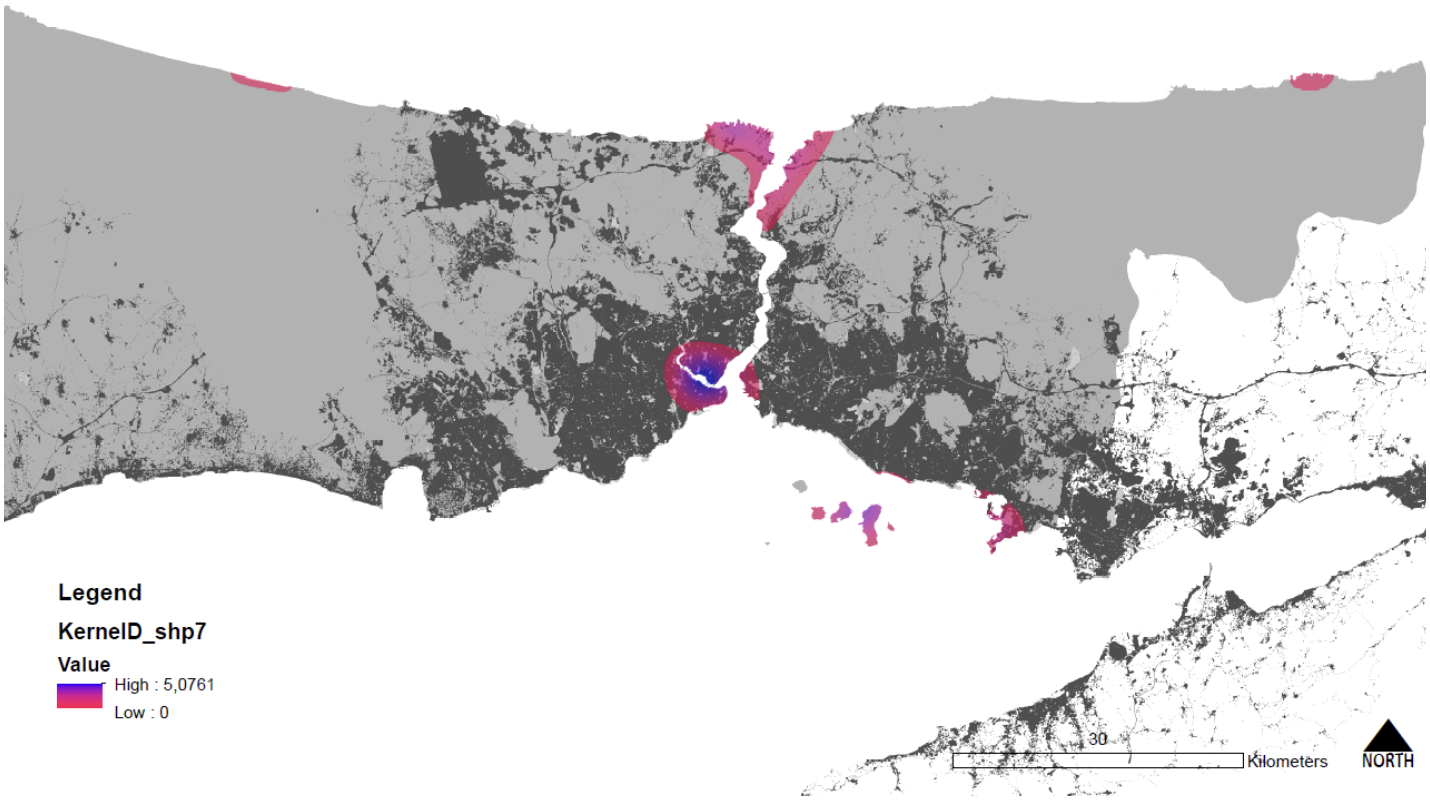


Figure 12. Sea Level Rise Vulnerability Map

3.3.3. Habitat Quality

InVEST's habitat quality model combines information on land use and land cover (LULC) and biodiversity threats to create habitat quality maps. The habitat degradation section of the model shows the extent and configuration of natural land cover types in the current or potential future landscape relative to the extent of similar natural land cover types at some reference time.

The first step to modeling consisted in selecting the borders of İstanbul. Then, imperviousness data was selected as a threat to habitat quality and has been clipped according to the study area boundary. The land use data to be used in the sensitivity table was downloaded from https://www.copernicus.eu/en for 2018.

Using the zonal statistic as table tool, min, max and mean values of imperviousness were calculated for each land use class, and the database was then post-processed in excel. The relative values of imperviousness were used as a proxy for the evaluation of habitat values (e.g. if dense urban settlements are impervious at 80% it means their degree of naturalness is the opposite – 20% thus selecting 0.2 as the input value for the Habitat in the sensitivity table of the InVEST model.

The model produced the relative level of habitat quality on the current landscape of İstanbul city as shown in Figure 13. Higher numbers (darker shade on the map) indicate better habitat quality vis-a-vis the distribution of habitat quality across the rest of the landscape. Areas on the landscape that are not habitats get a quality score of 0. This quality score is unitless and does not refer to any particular biodiversity measure.

Likewise, Figure 14 shows the relative level of habitat degradation on the current landscape. A high score in a grid cell (darker shade blue-reddish on the map) means habitat degradation in the cell is high relative to other cells. Grid cells with non-habitat land cover get a degradation score of 0.

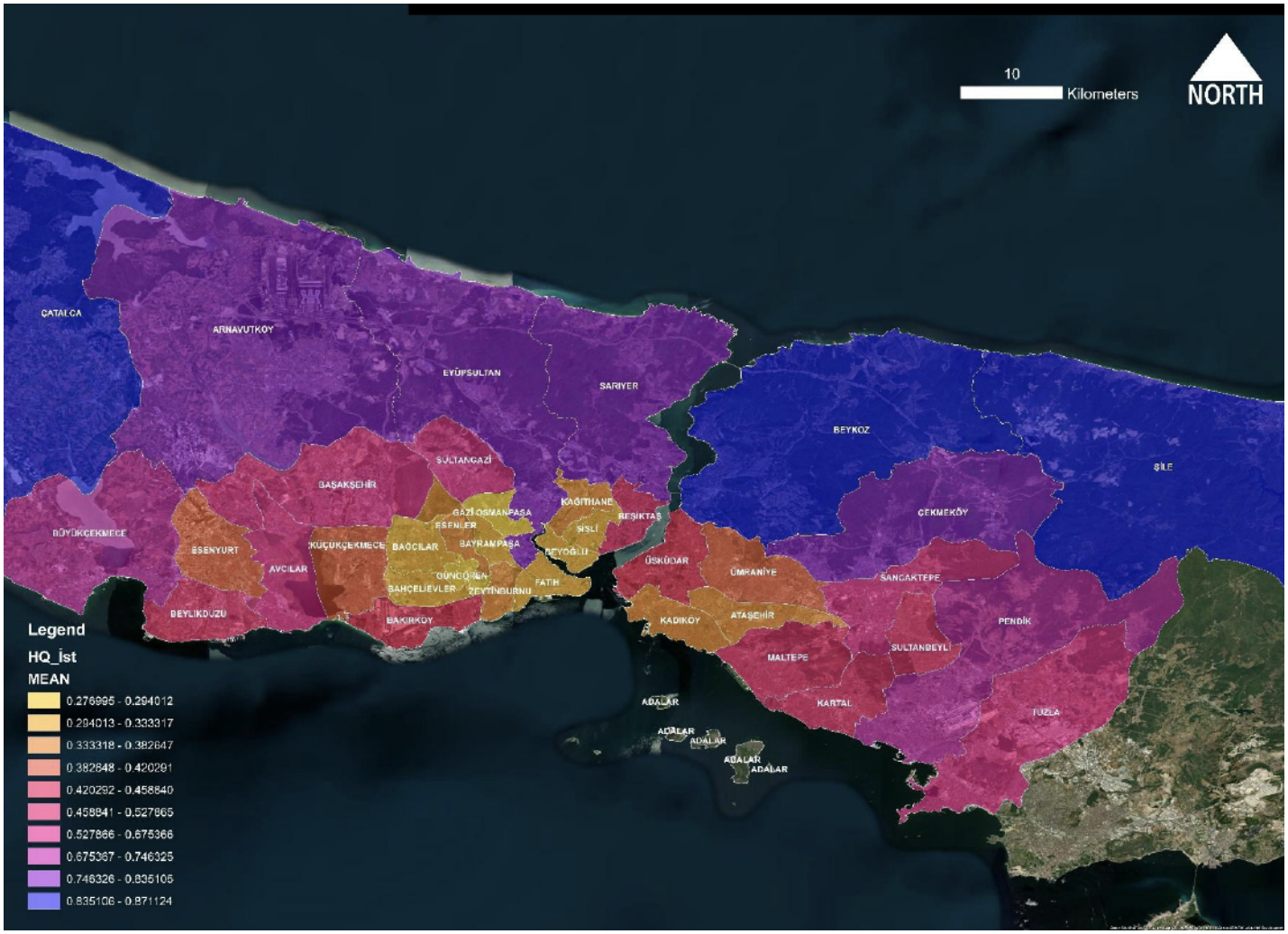


Figure 13. Habitat Quality Mapping of İstanbul City with the InVEST Model

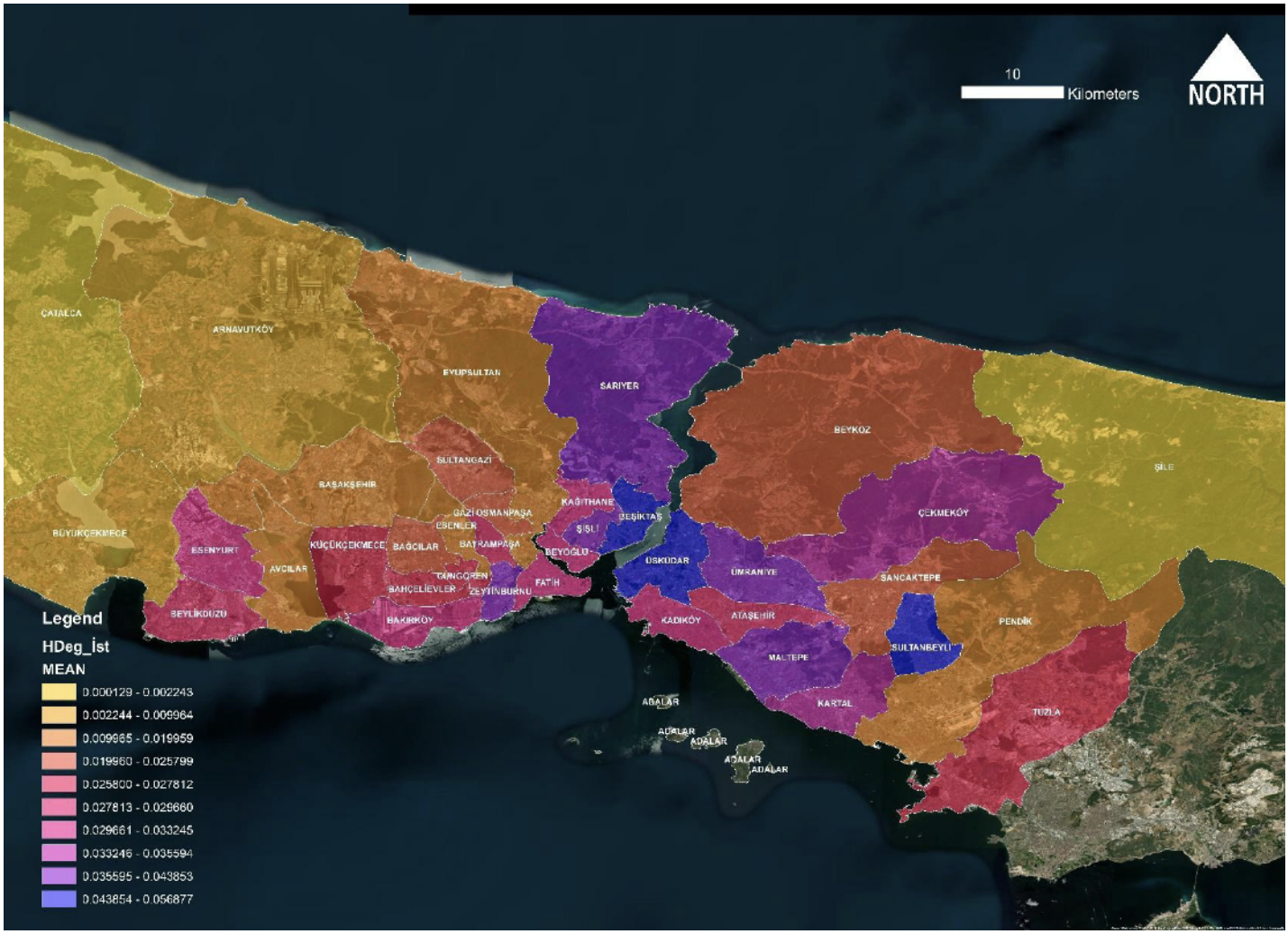


Figure 14. Habitat Degradation Mapping of İstanbul City with the InVEST Model

The Habitat Quality output layers represent the biophysical spatial distribution of the potential biodiversity of İstanbul and the spatial distribution of threat values for the same catchment (Figure 13). The lowest habitat quality values are continuous urban areas, discontinuous urban areas, construction areas, and industrial and commercial areas (with a value of 0,35). These areas are not susceptible to threats because they do not have any habitat value. Areas sensitive to threats; are broad-leaved forest, coniferous forest, mixed forest (with a value of 0,95), natural grasslands and transitional woodland shrubs (with a value of 0,85), pastures (with a value of 0,95), agricultural lands (with the value of 0,84). Since these areas contain high habitat values, they are the most sensitive land uses in the area.

In short, it is observed that there are no sensitive habitat values in the coastal areas of the province, namely Üsküdar, Kadıköy, Bakırköy, Avcılar, Zeytinburnu, Eminönü, Fatih, Bahçelievler, Güngören, Beyoğlu, Şişli, Beşiktaş, Sarıyer, Umraniye, Pendik, Kağıthane, Eyüp, Bağcılar and Bayrampaşa districts where urbanization is intense, and habitat quality values were observed to be 0,35 and below.

It is seen in the maps above that habitat values increase, and sensitive land uses increase as you go from the coastal part in the northeast and northwest directions. In the north of Pendik and Tuzla districts, the habitat quality value is 0,85 and above. Habitat quality value is 0,78 and above in the north and northeast of the Beykoz district. In the northwest of Sarıyer district, the value is 0,85 and above. It has been observed that the values increase from 0,78 to 0,95 towards the outer borders of Eyüp district. In addition, Aydos Forest, which is surrounded by the residential areas of Kartal, Pendik and Sultanbeyli districts, is one of the most sensitive areas in the middle of residential areas, with a value of 0,95.

The interaction between the habitats and the impervious surfaces shows how the distribution of habitat values is spatially clustered in İstanbul province in Figure 14. The highest degradation value (with the value of 0,80) is observed around the previously mentioned Aydos forest, which is located in the northernmost part of Kartal district. It is clear how urban areas affect habitat quality and fragment the landscape. The white areas in below figures clearly show how the quality of natural and seminatural areas decreases exponentially as they approach urban areas, emphasizing the edge effect. Degradation values were also observed to be high around two large forest areas in Maltepe district, west of Aydos forest,

with a value of 0,90. The sharpness of the edge effect and high degradation values were observed between urban areas and sensitive areas such as Alemdağ Forest, Polonezköy Nature Park, Sultançiftliği Taşlıtepe State Forest, 164th Year Police Memorial Forest, İstanbul Butterfly Farm in Beykoz and Ümraniye districts. Bentler Nature Park in Sarıyer district, Mehmet Akif Ersoy National Park, Ministry of Forestry Fatih Forest Recreation Area, Atatürk City Forest, Belgrad Forest, Kömürcü Bendi National Park and in Eyüpsultan district, Irmak Nature Park, Fatih Fountain Nature Park, Kurt Kemeri Recreation Area, Ayvat Bendi National Park. The deterioration between sensitive areas (where the degradation value is 0,008 and habitat quality value 0,95) and urban areas is clearly visible.

In short, the areas shown in blue, reddish and pinkish colors in the south of both peninsulas and on both sides of the Bosphorus (Figure 14) show the areas where habitat degradation is most intense and unsuitable for habitat development in İstanbul. Fragmentation and impermeability are concentrated in these areas while representing a barrier to the ecological continuity of İstanbul province. The visualization of habitat decay for some parts of the İstanbul city are presented from Figure 15 to Figure 18.





Figure 15. Visualization of Habitat Decay- A - General view, brown areas (*)

(*) (Brown areas indicate the most sensitive areas for habitat degradation. These areas form the transition areas between areas where the natural habitat has completely disappeared due to intense urbanization (light colored areas) and areas where the habitat is relatively good (green and light green)).

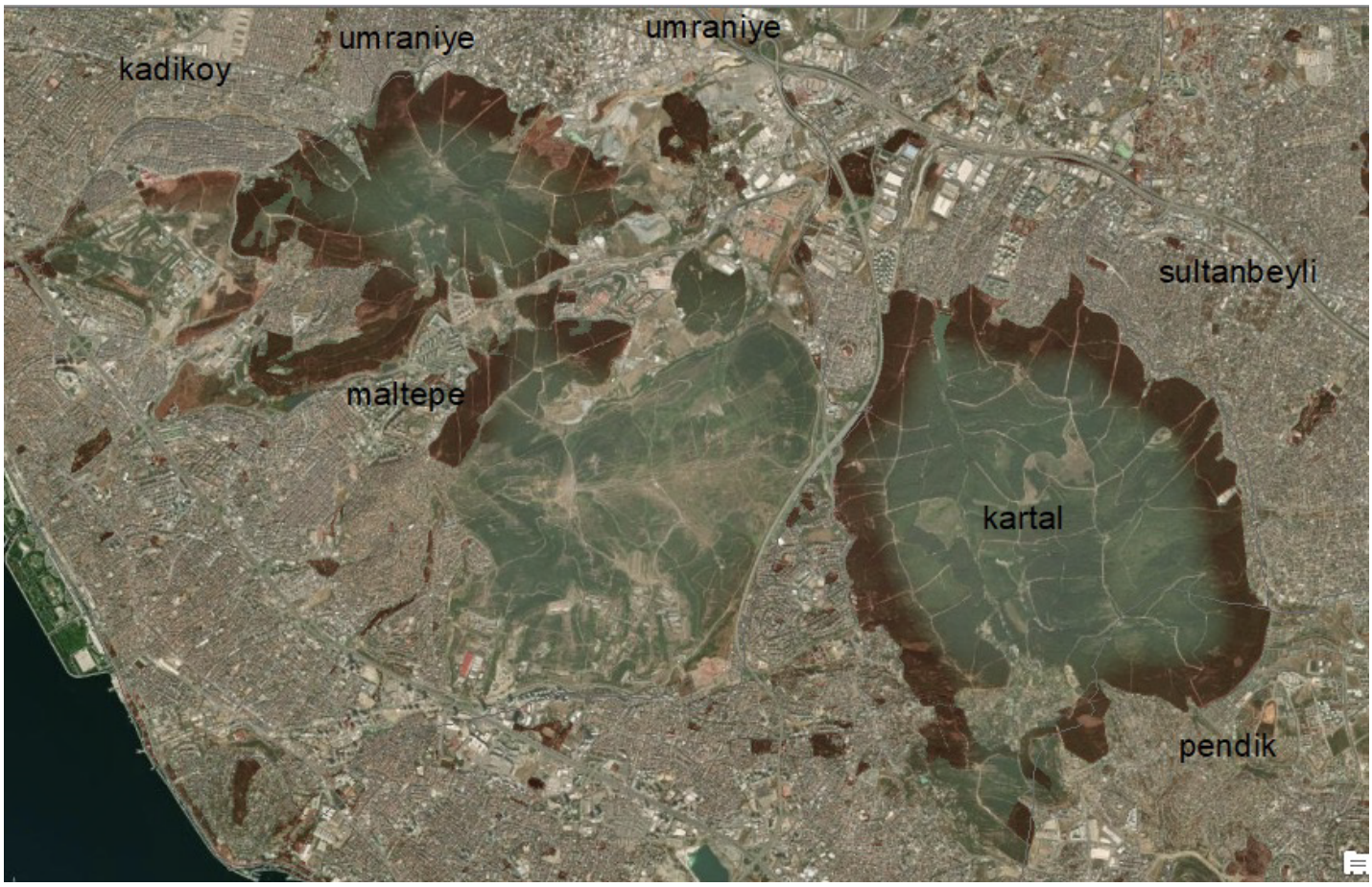


Figure 16. Visualization of Habitat Decay – B - particular view, brown areas



Figure 17. Visualization of Habitat Decay -C- particular view, brown areas



Figure 18. Visualization of Habitat Decay (D particular view, brown areas)

3.3.4. Urban Heat Island

The Urban Heat Island (UHI) phenomenon is mainly caused by the physical structure of the built environment, which absorbs solar radiation and releases more heat than the natural landscape. The urban microclimate is highly influenced by urban design due to the complex interactions between outdoor conditions (e.g., air temperature, humidity, wind speed, solar radiation) and the morphological parameters shaping cities (e.g., urban density, building form, roads, streets, and canopies geometry, building orientation). The impacts of UHI include the citizens' health (particularly children and the elderly) leading to respiratory and cardiovascular problems, dehydration, heat exhaustion, and potentially life-threatening heatstroke, more than exacerbating existing medical conditions, such as heart and kidney disease.

In the future, the UHI effect will be one of the major challenges to be managed in urban areas; it can be reduced by making planning decisions oriented towards the performance-based design of public and private spaces, for example, ensuring the permeability and the reflectance of paved materials, and introducing densely green planted areas and vegetation which could increase the cooling process due to evapotranspiration and shading surfaces, while absorbing short-wave radiation.

The model produces the following results as shown in Figure 19 and Figure 20. For the modelling, reference air temperature was inputted as 30°C; the difference between the rural reference temperature and the maximum temperature observed in the city was inputted as 3,5°C. In Figure 19, where the average temperature anomaly is shown, the tangible effect on urban comfort provided by the peri-urban open spaces of the northern seminatural land of the city is visible. While obviously, the internal part of the densely inhabited system presents critical values, showing a low cooling capacity. The InVEST urban cooling model calculates an index of heat mitigation (HMI) based on shade, evapotranspiration, and albedo, as well as distance from cooling islands (e.g. parks). The index is used to estimate temperature reduction by vegetation. Figure 20 is a map of the modelled HMI for İstanbul city, where the lighter colors show the cooling effect of green areas on temperature.

Figure 19. Average temperature anomaly of İstanbul City with the InVEST Model

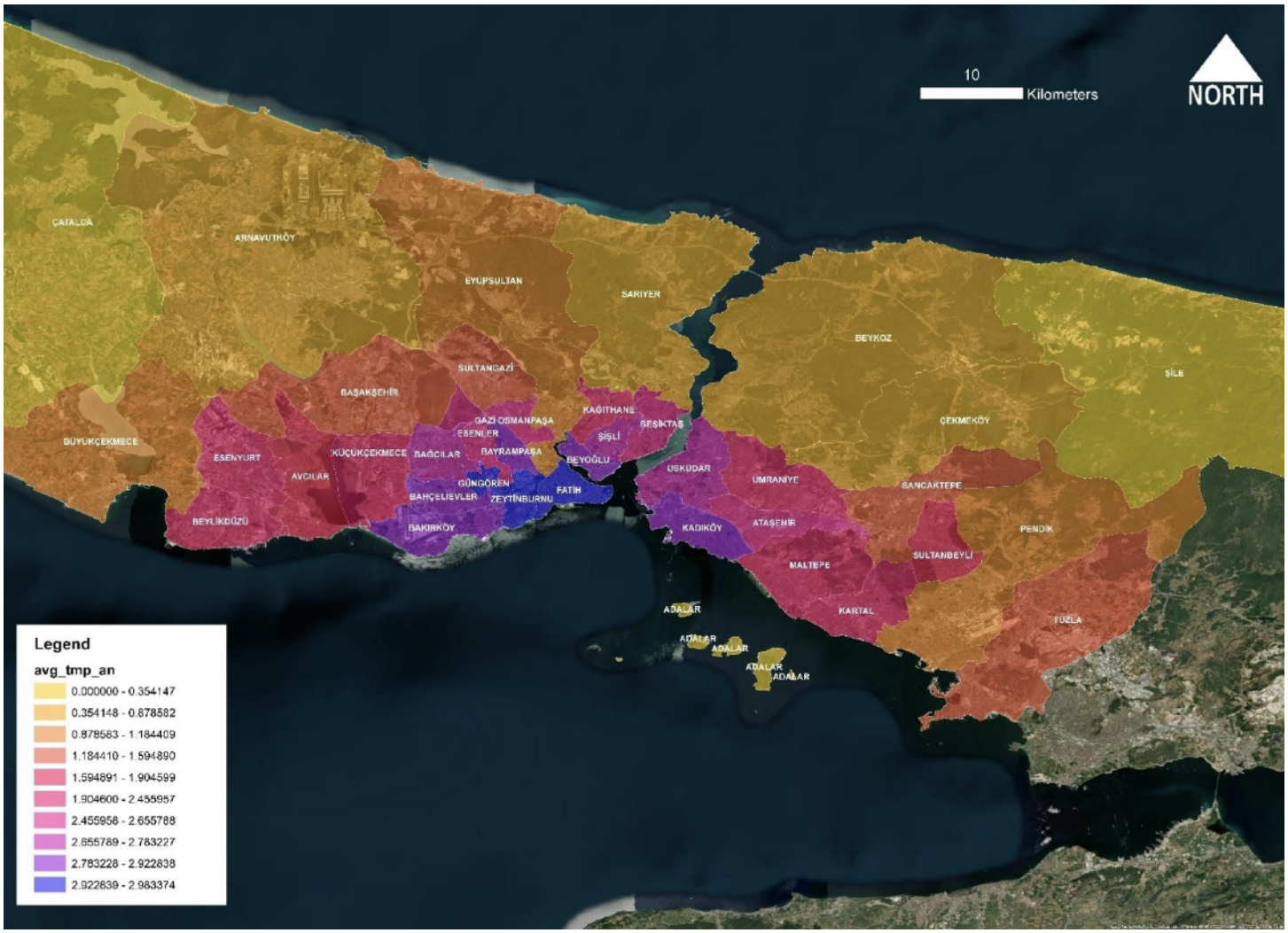
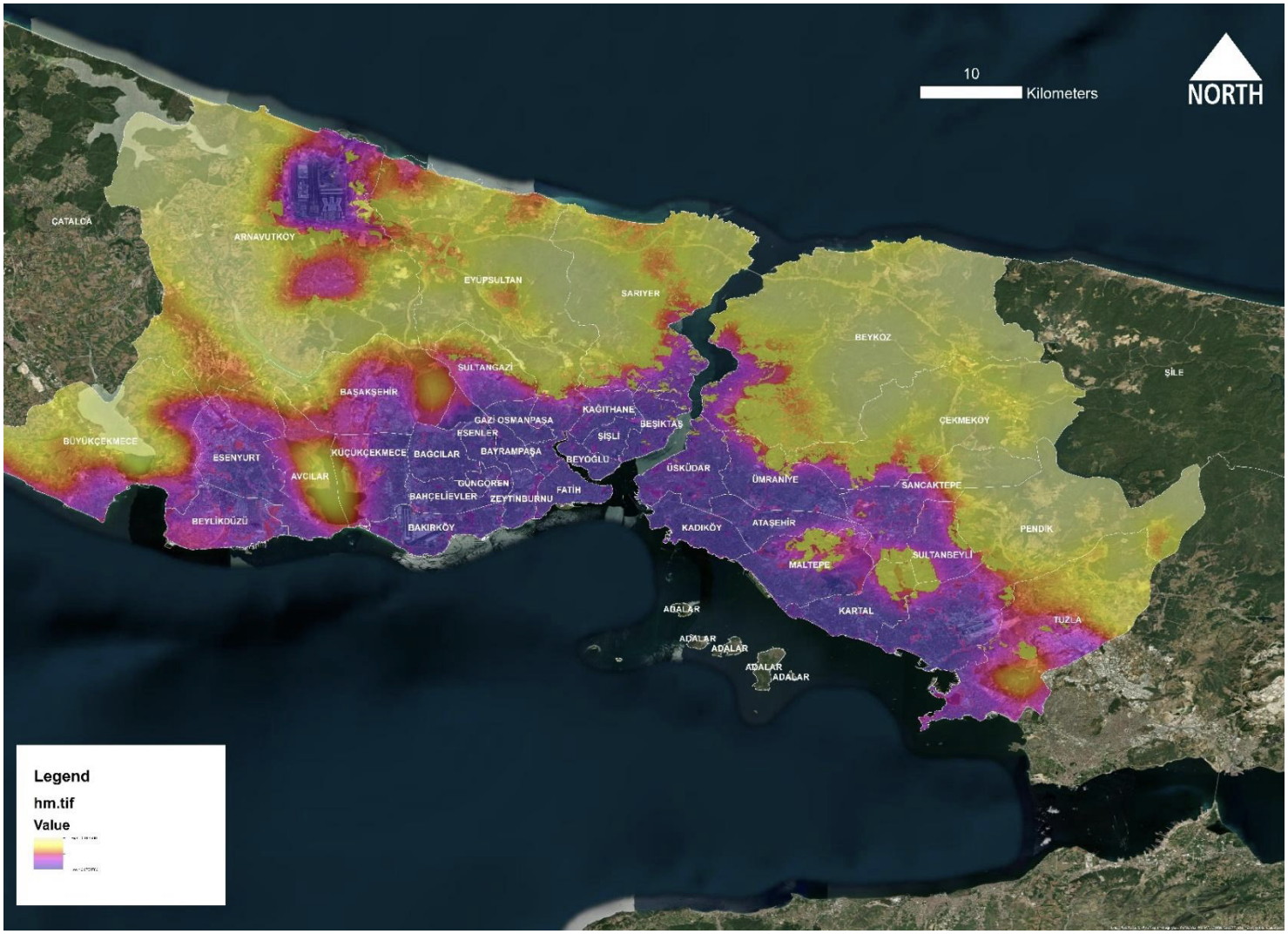


Figure 20. Heat Mitigation Index of İstanbul City with the InVEST Model



3.4. ADAPTATION ACTIONS

In general, the need to act for a rapid adaptation of the system is strictly necessary, considering that in the medium-term period, the scenarios can be even worse than the ones already predicted. Even if greenhouse gas emissions causing climate change is going to be hardly reduced today, the concentration of greenhouse gasses in the atmosphere will not be reduced to any significative effect, thus the effects of climate change will continue to impact the system. Adaptation is, therefore, necessary, which includes the capacity to alleviate the existing and expected risks while prioritizing the intervention on natural and anthropogenic systems with adequate models, techniques, and supports. As written in many recently published articles, the resilience of socio-economic systems and ecosystems needs to be improved in the light of knowledge of these vulnerabilities. These systems should be adopted where they are more vulnerable first.

Within the light of the scope presented above, adaptation for İstanbul will consist of systematic and coherently planned and designed application actions and policies, which should focus on minimizing the intensity of destructive impacts of potential hazards, while using a combined application of technological and nature-based solutions. These actions should keep in mind that in the long term, only the reduction of the anthropic footprint, in consumption, and in environmental degradation, can play an active role towards a more resilient system.

These actions include practical interventions such as improving existing infrastructure investments, planning new buildings, and the greening the city to adapt to the climate, but also include raising awareness and enhancing the preparedness of both institutions and people.

3.4.1. Methodology for Selection of Prioritized Adaptation Actions

A multistakeholder consultation approach which considers discussion of the topics by people from a variety of expert groups was utilized to make sure of the applicability and acceptability of potential adaptation actions. The experts from key institutions came together between 19-21 of September 2022 to discuss the possible adaptation options for each vulnerability and prioritize the most efficient and applicable ones based on their experiences. The meeting utilized Multi-Criteria-Analysis Methodology for determining and prioritizing the adaptation options for the list of adaptation actions. The results of the

consultation meetings are explained below.

3.4.2. Adaptation Actions for Each Vulnerability

3.4.2.1. Urban Floods

İstanbul is among the biggest 10 metropolitan areas in the world, in terms of population. Increased urbanization has led to changing or destruction of the natural systems, including the rivers and their basins in the city. After heavy precipitation, the riverbeds that are now a part of the urban areas are flooded causing both human and economic losses.

The climate adaptation options indicated in this report are selected based on the circumstances of the parts of İstanbul that are most vulnerable to floods. However, the actual implementation stage may be subject to several bottlenecks. It may be challenging to revive the rivers and riverbeds back to their full functions, which will be extremely costly and would require strong cooperation among key institutions. Moreover, such activities may take many years to implement. Therefore, the following climate adaptation options presented in Table 8 are suggested, considering the capacities of the city to change and adapt. Still, adaptation options such as "Sponge Cities" may require some level of change to İstanbul's infrastructure.

These climate change adaptation actions are the ones selected for the most vulnerable districts of İstanbul, namely, Bağcılar, Esenyurt, Güngören, Bahçelievler, Gaziosmanpaşa. However, they can be implemented in all parts of the city, where natural habitats are destroyed, urbanization prevails over the natural environment, and there is high density of population. Especially districts of İstanbul such as: Beylikdüzü, Şişli, Kağıthane, Fatih, Bayrampaşa, Arnavutköy on the European side, and Sultanbeyli, Maltepe, Tuzla, Pendik, Ataşehir, Ümraniye, Üsküdar, Kadıköy, Çekmeköy on the Asian side.

Table 8. Urban floods adaptation actions selected for the most vulnerable districts of İstanbul

	Permeable Pavements	Flood Planning & Management	Infiltration Trenches	Sponge City	Green Roofs
Selected areas	Bağcılar, Esenyurt, Güngören, Bahçelievler, Gaziosmanpaşa	Bağcılar, Esenyurt, Güngören, Bahçelievler, Gaziosmanpaşa	Bağcılar, Esenyurt, Güngören, Bahçelievler, Gaziosmanpaşa	Bağcılar, Esenyurt, Güngören, Bahçelievler, Gaziosmanpaşa	Bağcılar, Esenyurt, Güngören, Bahçelievler, Gaziosmanpaşa
Potential acceptability by local public	Highly acceptable		Highly acceptable		Requires local stakeholder polls for determination of acceptance
Time interval for implementation	Short-term (new pavements, mid-term (existing pavements)	Short-term, mid-term	Mid-term, long-term	Mid-term, long-term	Mid-term, long-term
Key stakeholders for implementation	• MoEUCC İstanbul Directorate	• State Hydraulic Works • AFAD	• MoEUCC, Infrastructure and Urban Transformation Services Directorate • State Hydraulic Works	• MoEUCC, Infrastructure and Urban Transformation Services Directorate • State Hydraulic Works	• MoEUCC İstanbul Directorate

However, the actions indicated here should also be combined with a set of other actions to ensure effectiveness and sustainability. Rivers and their basins should be protected through integrated river basin plans. In order to increase water permeability and avoid floods, green zones should be extended, green roofs and water harvesting systems should be installed to the extent that is feasible. Population under flood risk should be removed from this danger. Public awareness should be increased on climate change, floods, and the associated risks.

Permeable Pavements

Permeable paving surfaces are made of either a porous material that enables stormwater to flow through it, or nonporous blocks spaced so that water can flow between the gaps. Permeable paving can also include a variety of surfacing techniques for roads, parking lots, and pedestrian walkways. Permeable pavement surfaces may be composed of pervious concrete, porous asphalt, paving stones, or interlocking pavers. Unlike traditional impervious paving materials such as concrete and asphalt, permeable paving systems allow stormwater to percolate and infiltrate through the pavement and into the aggregate layers and/or soil below. In addition to reducing surface runoff, permeable paving systems can trap suspended solids, thereby filtering pollutants from stormwater.

Permeable pavement is commonly used on roads, paths and parking lots subject to light vehicular traffic, such as cycle-paths, service or emergency access lanes, road and airport shoulders, and residential sidewalks and driveways. Permeable pavement can be implemented in many zones in İstanbul, where it is not possible to relocate public that are at risk.

Advantages:

- Permeable paving surfaces are effective in managing runoff from paved surfaces and recharging groundwater aquifers. They can reduce downstream flooding and maintain base flows in rivers to keep ecosystems self-sustaining.

- They can control pollutants found in surface runoff, reducing suspended solids and harmful chemical concentrations within groundwater.

- Permeable pavements enable improved water retention in urban environments, which are more vulnerable to high temperatures due to the heat island effect. Permeable paving, as well as green roofs,

maintain water within the local microecosystem, which keeps temperatures cooler when compared to a non-permeable paving system.

Disadvantages:

- During the initial setup phase, it can be slightly more expensive than those made using traditional methods.
- They may not be durable for a long time in places where heavy vehicles pass in the city. Therefore, they may not be suitable for airports and main roads.
- Large storm events may cause the water table beneath the porous pavement to rise and prevent the precipitation from penetrating the ground.
- Special problems could arise in cold climates. Porous concrete pavements may be damaged due to wintertime salt treatment.
- Maintenance is necessary for permeable pavement systems, especially those with porous surfaces, to keep the pores free of fine particles and maintain the system's capacity to permit rainfall to permeate.

From an economic point of view, it can be difficult to compare cost impacts between conventional impervious surfaces and permeable surfaces given the variables such as: lifespan, geographic location, type of permeable paving system and site-specific factors. Therefore, the right type of pavement should be selected for İstanbul, and cost calculations should be made accordingly.

Flood Planning and Management

Flood management or planning should adopt a holistic approach that incorporates human and socioeconomic issues as well as scientific and engineering challenges such as precipitation, runoff, and flooding. Flood protection and damage minimization are the goals of flood management plans. To mitigate the consequences of flooding in the city, preventive measures taken before the flood, as well as structural and non-structural measures taken during and after the flood, should be regarded as a whole and implemented by authorized institutions. These methods serve as the foundation for flood management. Flood Risk Pre-Assessment, Flood Hazard Maps, and Flood Risk Maps comprise the three-stage Flood Management Plan.

In İstanbul, Flood Risk Maps are conducted by State Hydraulic Works

(DSİ). At this point, the following actions are suggested as adaptation options:

- Preparation of flood plans and managing floods in order to reduce the loss and damage in cooperation with DSİ

- Integration of Flood Risk Maps into city planning and zone planning practices for all vulnerable hotspots in order to avoid losses in the future.

- Cooperation with geomorphology experts while developing Flood Risk Maps[49]. Also, it would be suggested to involve the IMM in the map's preparation processes are recommended for the DSİ.

Five types of flood risk management strategies[50] can be considered for İstanbul:

1. Flood risk prevention: Decreasing the exposure of people/property, etc., via methods that prohibit or discourage development in areas at risk of flooding (e.g., spatial planning, reallotment policy, expropriation policy, etc.).

2. Flood defense: Aiming at decreasing the probability of flooding through infrastructural works, such as dikes, dams, embankments, and weirs, mostly referred to as "flood defense" or "structural measures" through measures that increase the capacity of the existing channels for water conveyance to increase space for water.

3. Flood risk mitigation: Focuses on decreasing the consequences of floods through measures inside the vulnerable area. They can be smart design of the flood-prone area, including spatial order, water retention within the protected area, or (regulations for) flood-proof building.

4. Flood preparation: Consequences of floods can also be mitigated by preparing for a flood event. Measures include developing flood warning systems, preparing disaster management and evacuation plans, and managing a flood when it occurs.

5. Flood recovery: This strategy facilitates a good and fast recovery after a flood event. Measures include reconstruction or rebuilding plans as well as compensation or insurance systems.

Advantages:

- If flood planning is done on a Basin basis, it can be extremely viable.

- The organizations formed will serve as an excellent model for disaster preparedness in general.

49 These maps are prepared by DSİ, therefore IMM is not addressed for this recommendation.
50 adopted from Hegger et al. 2014

Disadvantages

- It requires serious inter-agency cooperation. Some institutions may not have the necessary information about floods.
- The measures may require significant financial resources.
- There may be difficulties in finding personnel with technical and theoretical knowledge in the field.

Infiltration Trenches

Infiltration trenches are linear ditches that collect rainwater from adjacent surfaces, and their highly permeable soils allow the water to quickly seep into the ground. Because they are linear ditches, they are very practical to install parallel to roadsides, or around the perimeter of parking lots.

Advantages:

- The primary advantages of the infiltration trench are water quality treatment, reduction of peak flows in sewer systems, and groundwater recharge; so that the peak flow across the surface is reduced, and the amount of surface water entering waterways is slowed down. This reduces channel erosion.

Disadvantages

- Filtration systems such as this are prone to clogging with sediments suspended in the stormwater.

Sponge City

Sponge Cities are, as their name suggests, designed to soak up as much extra water as possible. These areas are designed, or in many cases redesigned, to use a combination of storage tunnels, permeable pavements, rain gardens, constructed ponds and wetlands to store as much water as possible.

Sponge city has several interchangeable building blocks. At a large scale, protecting or restoring forests and natural ground cover helps give water a chance to sink in. At smaller scales, there are several options. Permeable pavement can be used on roadways, sidewalks, and pathways to allow water to infiltrate the ground, rather than wash off into the local stormwater system. Retention ponds and constructed wetlands help catch and filter water, allowing it to slowly percolate into the local water table. Rain gardens perform a similar function at a smaller scale and can easily be incorporated into neighborhood green space.

Sponge City indicates a particular type of city that allows any water to filter

through the ground, but more like a sponge, actually absorbing the rain water, which is then naturally filtered by the soil and allowed to reach into the urban aquifers. This allows for the extraction of water from the ground through urban or peri-urban wells. This water can be easily treated and used for the city water supply.

Instead of causing floods, water can infiltrate through the soil, reducing the severeness and frequency of city floods, protecting lives and property.

Moving towards implementation of sponge city, however requires infrastructural changes in the city. An abundance of spaces that allow water to seep through them, instead of only impermeable concrete and asphalt, is the primary need.

The following applications are involved in sponge cities:

- Contiguous open green spaces, interconnected waterways, channels and ponds across neighborhoods that can naturally detain and filter water as well as foster urban ecosystems, boost biodiversity and create cultural and recreational opportunities.

- Green roofs can retain rainwater and naturally filter it before it is recycled or released into the ground.

- Porous design interventions across the city, including construction of bio-swales and bio-retention systems to detain run-off and allow for groundwater infiltration; porous roads and pavements, permeate and recharge groundwater; drainage systems that allow trickling of water into the ground or that direct storm water run-off into green spaces for natural absorption.

Advantages

- Reduction in flood risk as the city offers more permeable spaces for the natural retention and percolation of water.

- Replenished groundwater and thus greater water self-sufficiency

- Cleaner groundwater due to the increased volume of naturally filtered storm water.

- Lower burdens on drainage systems, water treatment plants, artificial channels and natural streams. This also entails lower costs for drainage and treatment infrastructure.

- Greener, healthier, more enjoyable urban spaces, improved quality of life, recreational areas, increased land values

- Enriched biodiversity around green open spaces, wetlands, urban gardens and green rooftops

Disadvantages

- Requirement for free spaces for sponge city applications

- Financial requirements for implementation and maintenance of the systems

Green Roofs

Green roofs serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, and helping to lower urban air temperatures and mitigate the heat island effect.

Green roofs, which are also known as "vegetated roofs" or "living roofs", consist of a waterproofing membrane, growing medium (soil) and vegetation (plants) overlying a traditional roof. Well-designed, engineered and maintained green roofs provide multiple environmental, social, economic, and aesthetic benefits.

Green roofs are suitable for retrofit or redevelopment projects, as well as for new buildings and can be installed on small garages or larger industrial, commercial and municipal buildings. They effectively use the natural functions of plants to filter water and treat air in urban and suburban landscapes.

With more than 1.5 million buildings in İstanbul, the city has a great potential to green its roofs, as a water retention measure to reduce the likeliness of floods.

Advantages

- Financial benefits that accompany green roofing, such as increased real estate value, and a reduction in energy use for heating and cooling. Green roofs allow buildings to better retain their heat during the cooler winter months while reflecting and absorbing solar radiation during the hotter summer months, allowing buildings to remain cooler.

- Green roofing can extend the lifespan of a roof due to covering the roof with waterproofing membrane and with growing medium and vegetation, which shields the membrane from ultra-violet radiation and physical damage.

Disadvantages

- The initial cost of installing a green roof can be higher than a normal roof.

- The additional mass of the soil substrate and retained water can cause a large pressure on the structural support of a building. This makes it unlikely for intensive green roofs to become widely implemented due to a lack of buildings that can support such a large amount of added weight as well as the added cost of reinforcing buildings to be able to support such weight. Some types of green roofs do have more demanding structural standards especially in seismic regions of the world.

- Green roofs may require significantly more maintenance and maintenance energy compared to a standard roof. Standard maintenance for green roofs includes removing debris, controlling weeds, deadhead trimming, checking moisture levels, and fertilizing. Maintenance costs depend on the type of green roof.

Considering the advantages and disadvantages of green roofs, İstanbul's old building stock can be considered as less likely to host such roofs. However, the city is growing rapidly, and considerations can focus on new buildings, preferably on public buildings as pilot projects.

3.4.2.2. Coastal floods

İstanbul is surrounded by the Black Sea from the north and the Marmara Sea from the south. The Bosphorus connects the two seas[51]. The bathymetry map clearly shows that on both the Black Sea and Marmara Sea coasts, the sea depth increases sharply over short distances from the coast to the open sea. This circumstance, particularly in severe weather, will cause wave breaking to occur near to the coast, and the breaking waves will attack the coast quickly, causing coastal flooding as well as significant erosion. The fact that the prevailing wind direction in and around İstanbul is generally northeast-southwest and southwest-northeast will also strengthen this situation.

It should be noted that the whole of the floods occurring in the coastal part of the districts on the coast of the Marmara Sea are not related to the strong waves coming from the open sea. In fact, rivers flowing into the sea have either disappeared or had their natural flow paths considerably changed due to extensive urbanization in districts such as in Şişli, Avcılar, Bakırköy, Zeytinburnu, Kartal, Maltepe, Pendik, Göztepe, Kadıköy, Bostancı, and Eminönü. Particularly in these districts, the site-style residential areas have been transformed into some

51 Districts with coasts to the Sea of Marmara are: Silivri, Küçükçekmece and Büyükçekmece, Beylikdüzü, Avcılar, Bakırköy, Zeytinburnu, Kartal, Maltepe, Pendik, Göztepe, Kadıköy, Bostancı, Fatih. The districts bordering the Black Sea coast are the northern shores of: Çatalca, Arnavutköy, Eyüp, Sarıyer, Beykoz and Sarıyer districts' northern shores.

small local artificial basins. The reinforced concrete constructions in these basins have completely destroyed the ground's permeability. Particularly after severe downpours, rainwater collected in such small basins rushes to the shore without having time to soak into the earth, causing floods in the coastal districts as the waves from the sea are forced onshore. The climate adaptation actions indicated below can significantly reduce coastal floods and coastal erosion for the parts of the city such as Kadıköy, Üsküdar, Fatih, Zeytinburnu, Kartal, which suffer from coastal floods from time to time. Coastal areas in these districts generally represent low and flat coastal characteristics, which increases their vulnerability to storm surges.

The coasts in the specified coastal areas have low and flat coastal characteristics. Such low-lying coastal forms (like in Kadıköy, Üsküdar, Eminönü, and so on) are easily inundated by the sea as a result of sea swell, particularly during severe weather. If constructed in line with the defined adaption actions technique, the coastal structures defined will both considerably lessen the destructive effects of large waves on the shore in stormy weather and prevent the occurrence of events such as sea flooding on low-lying areas of the coastal zones. Additionally, these adaptation measures considerably minimize the rate and amount of erosion caused by waves and currents in coastal areas where they are applied, and they ensure that the shoreline is preserved. Thus, the chance of collapse or damage to the buildings located in the coastal area, especially the historical and aesthetic structures, is reduced.

These adaptation measures, particularly offshore breakwaters, can also greatly lessen the devastation caused by potential tsunami waves that can emerge from earthquakes that could occur in the Marmara and Black Sea regions.Although the above-mentioned adaptation activities were determined for the districts of Kadıköy, Üsküdar, Fatih, Zeytinburnu, and Kartal, they can be applied to any districts bordering the Black Sea, Marmara, and Bosphorus. The 5 actions explained below in Table 9 are particularly chosen for the districts indicated above.

Adaptation options such as Seawall, Rip-rap, Gabion and shore stabilized structures can be constructed in order to minimize the erosion caused by the waves on the shore in almost all vulnerable districts. However, offshore breakwater constructions may result in certain unexpected sea traffic risks, particularly in districts with dense populations and considerable busy sea traffic. They can be implemented in the less dense and less populated districts located on the Black Sea coast.

Table 9. Coastal floods adaptation actions selected for the most vulnerable districts of İstanbul

	Offshore Breakwaters	Seawalls	Gabions	Rip-raps	Cliff Stabilization
Selected towns	Kadıköy, Üsküdar, Fatih, Zeytinburnu, Kartal[52]	Kadıköy, Üsküdar, Fatih, Zeytinburnu, Kartal	Kadıköy, Üsküdar, Fatih, Zeytinburnu, Kartal	Kadıköy, Üsküdar, Fatih, Zeytinburnu, Kartal	Kadıköy, Üsküdar, Fatih, Zeytinburnu, Kartal
Potential acceptability by local public	Requires local stakeholder polls for determination of acceptance				
Time interval for implementation	Short-term or mid-term	Short-term or mid-term	Short-term or mid-term	Short-term or mid-term	Short-term or mid-term
Key stakeholders for implementation	• MoTI, GD of Shipyards and Coastal Structures • MoI • Special Provincial Administration • İstanbul Governorship • MoEUCC • Academia • Local government	• MoTI, GD of Shipyards and Coastal Structures • MoI • Special Provincial Administration • İstanbul Governorship • MoEUCC • Academia • Local government	• MoTI, GD of Shipyards and Coastal Structures • MoI • Special Provincial Administration • İstanbul Governorship • MoEUCC • Academia • Local government	• MoTI, GD of Shipyards and Coastal Structures • MoI • Special Provincial Administration • İstanbul Governorship • MoEUCC • Academia • Local government	• MoTI, GD of Shipyards and Coastal Structures • MoI • Special Provincial Administration • İstanbul Governorship • MoEUCC • Academia • Local government

52 Offshore Breakwater technique can also be applied in districts located on the southern shores of Black Sea (Çatalca, Arnavutköy, Eyüp, Sarıyer, Beykoz and Sarıyer districts), and on the northern shore of Marmara Sea, such as Silivri, Büyük Çekmece, Küçük Çekmece, Beylikdüzü, Avcılar, Bakırköy, Zeytinburnu, Tuzla, Pendik, Maltepe, Kartal and Adalar. Because these districts are located away from the Bosphorus, where there is heavy sea traffic, and are directly exposed to sea storms created by the northeast-southwest Poyraz winds in Blacksea and south-westerly destructive Lodos winds blowing from the Marmara Sea, especially in winter and spring seasons.

Offshore Breakwater

An Offshore breakwater is an offshore parallel structure that breaks waves, reducing the wave energy reaching the beach and fostering sediment accretion between the beach and the breakwater. Made of rock, concrete, or oyster shell, these structures can be floating or fixed on the sea floor and can be continuous or segmented. Breakwaters structures can be placed attached to the shoreline as headlands or submerged near the shoreline as sills. Breakwaters reduce the intensity of wave action in inshore waters and thereby provide safe harborage. Breakwaters may also be small structures designed to protect a gently sloping beach to reduce coastal erosion; they are placed 30–90 m offshore in relatively shallow water.

Advantages of offshore breakwaters are that they cause sand accumulation on the beach due to the decrease in wave energy. Due to these structures, waves break further offshore and therefore their erosive power is significantly reduced. Disadvantages of these structures are that they can be destroyed in severe storms and may be difficult to reinstall.

Offshore breakwater structures should be built in the districts located on the Marmara and Black Sea coasts to prevent coastal flooding and erosion that may occur on the coast due to strong waves coming from the open sea during storms.

However, the application of offshore breakwater structures may not be appropriate, especially in districts that have a coast on the Bosphorus (Fatih, Üsküdar, Beşiktaş, Beyoğlu, Beykoz, Sarıyer coasts). Because the Bosphorus is one of the areas in the world with its great maritime traffic and such structures may pose significant hazards to maritime traffic in the Bosphorus. Since the Bosphorus does not have a coast to open seas, there are strong currents rather than strong waves here. These strong strait currents only cause erosion rather than coastal flooding on the coasts.

As these structures require offshore construction, a feasibility needs to be made with care for their costs and benefits. Also, an assessment of acceptability can be conducted with the local residents.

Seawalls

A seawall is a type of coastal defense built where the sea and associated coastal processes have a direct impact on the landforms of the shore. A seawall's objective is to protect areas of human residence, conservation, and recreational activities from the damaging impact of waves. Because a seawall is a static feature, it will interfere with the dynamic nature of the shoreline and limit sediment exchange between land and sea. These structures are already in place in many parts of İstanbul for many years.

Advantages

- They provide great defense in areas with significant wave energy.
- During storms, they protect the coast from destructive wave impacts.
- They have a lengthy lifespan.
- They divert hazardous and destructive waves to other locations.

Disadvantages

- Scours form at the bottom of eroding beaches, disturbing the natural balance of the beach.
- Must be constructed along the entire coastline; otherwise, the nearby shoreline will erode.
- They can be quite expensive to build.
- They produce an unsightly appearance on the beach.
- It can make access to beaches difficult.

Gabions

Gabions also protect beaches from waves and current erosion. They resemble baskets packed with crushed rock or stones composed of cobbles or wire mesh. They are typically filled on-site with materials that are easily available in the area, making them potentially inexpensive. In close proximity to inclined "mattresses" or vertical cubic baskets, gabions can be used. Secondly, it is often not appropriate for usage on all kinds of shorelines, and they are built for stabilizing cliffs or the beach.

Advantages

- Cheaper than other forms of coastal defense
- Rock cages absorb wave energy
- As they are flexible and porous, they can absorb wave energy, reducing the scour problems associated with impermeable man-made sea structures such as concrete seawalls.
- Gabions offer an easy-to-use method of reducing water velocity on to the shore and protecting slopes from erosion.

Disadvantages

- Wire cages can break, and they need to be securely tied down securely
- They do not offer a good view of the coast.
- They are vulnerable to very strong waves.
- Difficult to install, generally requires large equipment.

Rip-raps

Rip-rap, also known as, rock armour or rubble, is human-placed rock or other material used to protect shoreline structures against scour and highly destructive wave impact. Rip-raps are used to armour shorelines, streambeds, bridge abutments, foundational infrastructure supports, and other shoreline structures against erosion.

Advantages

- They are relatively cost-efficient compared to other adaptation actions in terms of cost.
- They reduce the destructive effect of strong waves and currents on the coast and significantly slow down erosion.

- They prevent flooding in the coastal area.

Disadvantages

- They make the coastline look unsightly.
- They impede and can endanger people's access to the beach.

Like any other project which requires construction, rip-raps also come with a cost which need to be considered through a cost-benefit analysis. Also, the acceptability of such structures needs to be assessed among local residents.

Cliff Stabilization

Cliffs can fail due to several different factors, such as their composition or rock type, geological structure (faults, joints, etc.), climate and wave energy. There are soft and loose cliffs made up of sand, silt, clay, marl or chalk which are more prone to erosion and landslides, and hard cliffs made up of limestone, granite or sandstone. Erosion of cliffs in coastal areas results in the retreat of the coastline because the amount of material which is eroded exceeds that which is deposited.

Cliff stabilization techniques are applied to reduce the amount of erosion, landslide, collapse and rockfall potential of the cliffs. One of the cliff stabilization techniques can be terracing the steepness of the cliff using various engineering techniques or increasing the stability of the cliff by planting plants on or on the cliff slope. Planting vegetation strengthens the structure of the cliff and increases the adhesion of the material forming the cliff to each other, thereby preventing landslides, slips, etc. prevent it from collapsing for reasons such as: Another method is to drain the excess water in the cliff. This practice prevents water from seeping through weak surfaces (cracks) in the cliff, thus preventing the rocks and sediment from slipping or falling to the bottom of the cliff along these weak surfaces. This will also limit the possibility of liquefaction which can cause sludge flows. In İstanbul, this harmonization measure can be applied to protect coastlines with eroded cliffs.

Advantages

- Reduces risk of injury to beach users by slumping or sliding of cliff material.
- Enables the development of buildings and facilities on the cliff top with a reduced risk of collapse and failure.

- The stability of the cliffs will encourage tourism in coastal resorts and will have economic benefits for the area.
- Planting vegetation on cliff tops will increase the biodiversity of the area as it will act as a food source or habitat for wildlife.
- It slows the occurrence of landslides in the coast's cliffs (steep slopes).
- It reduces the rate of the cliff's retreat.

Disadvantages

- Vegetation growth is not immediate and will take time - therefore this may be more of a medium-long term solution.



3.4.2.3. Habitat Degradation

Cities cause erosion of biodiversity all around the world. Urban expansion leads to soil sealing and destruction of habitats, and the consumption patterns of habitants cause pollution and environmental degradation. İstanbul is no different than other metropolitan areas in the world when it comes to threats to its biodiversity. Rapid urbanization, which rarely considers natural assets combined with increasing pollution, and population threaten all natural habitats of the city.

Trees play an important role in reducing pollution in cities. Green infrastructure can cool down the temperature around it. Planting noise buffers made of trees and shrubs has proven to be an effective method to reduce urban noise. Also, connection to nature is proven to be beneficial for mental health. Planting trees can prevent landslides and flooding, and green infrastructure can also be used to manage rainwaters flows and enhance groundwater reserves. Therefore, loss of biodiversity will mean that we may suffer from several consequences in cities.

Cities do not have a homogenous distribution of urbanization and natural habitat zones. In İstanbul, there are parts where urbanization prevails over natural habitats in highly populated areas, as well as the parts that are mostly covered with a natural environment. And finally, there are border areas between highly urbanized areas and habitat zones. As vulnerability studies show us, the most endangered habitat zones are the border areas where urban zones expand towards the habitat zones. A variety of climate adaptation options have been selected below in Table 10 for the 3 zones indicated. However, it should be noted that the majority of biodiversity loss happens due to urbanization and pollution, rather than from climate change. Climate change exacerbates biodiversity loss with the impact of urbanization and associated pollution.

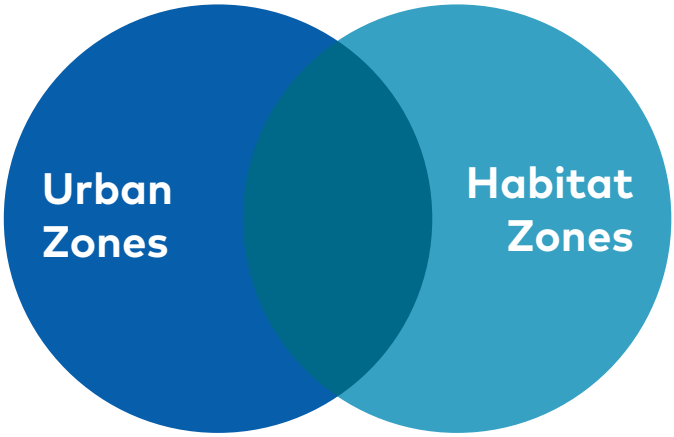


Table 10. Habitat degradation adaptation actions selected for İstanbul

	Enhancing Cooperation with Local Actors	National Efforts for Preventing Biodiversity Loss	Capacity Building in Local Governments	Restoration and Rehabilitation in Urban Zones	Monitoring and Control in Natural Habitat Areas	Integrating Biodiversity Conservation in Municipal Activities	Green Spaces
Relevant zones	All zones	Urban-habitat interface & habitat zones	All zones	Urban zones	Habitat zones	Urban Zones & Urban-habitat interface	Urban zones
Potential acceptability to local public	Highly acceptable	Highly acceptable	Highly acceptable	Highly acceptable	Highly acceptable	Highly acceptable	Highly acceptable, but particular cases may require public opinion polls
Time interval for implementation	Short to long-term	Mid-term long-term	Short to long-term	Short to long-term	Short to long-term	Short-term, mid-term	Short to long-term
Key stakeholders for implementation	• Academia • NGOs • Local governments • Local businesses • Relevant Units of IMM	• MoEUCC • MoAF • Climate Change and Adaptation Coordination Board • Union of Municipalities	• Academia • Relevant Units of IMM	• Academia • MoEUCC	• MoEUCC • MoAF • Relevant Units of IMM	• Academia • NGOs • Local governments Relevant Units of IMM	• MoEUCC • Relevant Units of IMM • State Hydraulic Works

Enhancing Cooperation with Local Actors on Biodiversity Loss

Local governments' cooperation with local actors with all kinds of semi-public and private actors in the local area for the protection of biodiversity and to raise awareness in the society is very important. IMM and district municipalities have access and potential communication opportunities with local actors such as local businesses, NGOs, academia, as well as residents in neighborhoods. Enhanced cooperation with such actors for preserving biodiversity can support IMM and district municipalities to increase the effectiveness of their actions.

An example is cooperation regarding data gathering with NGOs and academia on health and/or quantity of particular species in the city and its towns. Similarly monitoring activities regarding the impacts of actions of the IMM can be supported by relevant local actors. Such activities can be discussed, agreed and mainstreamed through multistakeholder events in the city.

Like many other "environmental measures" this climate adaptation option will include cooperation, communication activities with local stakeholders through workshops and events. They may also include activities that include more public engagement such as public surveys. Therefore, such a measure is expected to have high acceptability by the public.

The bottlenecks of this action may involve increased efforts and communication for engaging with a variety of stakeholders which need to be coordinated carefully.

Participation in National Efforts for Preventing Biodiversity Loss

Local governments have a unique role in public governance through their mandate of serving residents in cooperation with national institutes that are represented locally. This enables the local governments to have local solutions with the help of national institutions. Just like for many other responsibilities that the local governments have, preventing biodiversity loss exacerbated by climate change can only be done with the cooperation of local governments with national institutions.

This climate adaptation option is considered as a "soft measure" as it does not particularly involve "tangible" actions such as installations or construction. İstanbul Metropolitan Municipality's potential cooperation with national efforts to prevent biodiversity loss can be implemented through participation to

implementation of national policies and measures that are implemented in Türkiye. Possible synergies between national efforts and IMM's efforts to prevent biodiversity loss can within the framework of national policies and measures in the subject, such as Türkiye's National Climate Change Adaptation Strategy and Action Plan[53] (2010-2023), and the National Action Plan for Biodiversity[54] (2018-2028). There are several points in these documents where local governments are indicated to have responsibilities. Examples are monitoring the areas which are converted from forest areas to urban areas, implementing all activities on coastal zones in a manner to give the least harm to coastal ecosystems. Such activities require cooperation with the Ministry of Environment, Urbanization and Climate Changes, as well as the Ministry of Agriculture and Forestry and their local branches in İstanbul.

Combining the national capacities of the ministries with the local capacities of IMM can create synergies in developing cooperation with the local branches of the line ministries of the Metropolitan Municipality. Collaboration areas may include (but may be limited to) a variety of activities such as data collection, planning, strategy development and project development.

Such measures including enhanced cooperation among state institutions always have high levels of acceptability by the public. However, they come with bottlenecks of potential risks around cooperation and coordination and working cultures and the mandates of each institution.

53 https://webdosya.csb.gov.tr/db/iklim/editordosya/file/eylem%20planlari/uyum_stratejisi_eylem_plani_EN_Final.pdf
54 https://www.cbd.int/doc/world/tr/tr-nbsap-v3-en.pdf

Capacity Building in Local Governments

Knowledge on climate change and the prevention of biodiversity loss are key topics which need to be known not only by the Municipal department that are dealing with the issue daily. It is not enough that only the strategy developers or planners work on it. Staff with a variety of roles such as city planners, zone planners, field workers and even cleaners should at least have the minimum understanding on these key topics, so that they can continue their work considering climate and biodiversity in their daily actions.

Capacity building activities can include several topics besides climate change itself, such as ecosystem services, natural conservation, protection of biodiversity, etc. combined with how they can integrate them in their work. There are no particular bottlenecks for capacity building activities, and a high level of acceptability among the public can be expected. What needs to be considered for increased engagement is a clear explanation of why these activities are organized and how participants can benefit from them.

Restoration and Rehabilitation in Urban Zones

Degraded ecosystems in cities are mainly the areas where urbanization overcomes the natural habitats. Environmental conditions and species composition of most urban ecosystems are highly modified. Due to the lack of (semi-) natural reference systems available for defining restoration targets and assessing restoration success in urban areas, it is difficult to design and implement ecological restoration in cities. However, this is exactly where local non-state actors can step in and support the IMM to define and implement biodiversity restoration targets in İstanbul and monitor progress.

Examples of restoration and rehabilitation of biodiversity includes the introduction of native plant species, allowing regrowth of natural bank vegetation, development of wild urban woodlands with native species. Urban restoration approaches must consider local history and site conditions, as well as citizens' needs.

From the acceptability point of view, it is important that each restoration and rehabilitation action has some level of acceptability by the residents of İstanbul. From an economic point of

view, restoration and rehabilitation activities can be affordable or expensive depending on the choices of methods. It should also include integrating practices and making choices in a way to preserve the ecosystem, rather than taking new measures which are new to Municipality's activities, which can reduce the potential costs of implementing a new measure.

There are no particular disadvantages of this climate adaptation measure, as long as it is implemented with general consent in a way to prevent biodiversity loss and contribute to restoration and rehabilitation of the city's biodiversity.

Monitoring and Control in Natural Habitat Areas

Areas where natural habitat areas are relatively better protected in İstanbul are mainly natural parks and other protected areas. Some of the city parks are under the jurisdiction of the IMM, while the protected areas are under the jurisdiction of state institutions at national level such as the Ministry of Agriculture and Forestry. This situation gives limited opportunities to the IMM to plan and implement measures to protect biodiversity in İstanbul. However, the IMM can take measures in the areas under its control, such as city parks, through monitoring the health of habitats, implemented activities for habitat protection and their results. Data gathering and monitoring are important activities for management of any system, and biodiversity is no different. For this action, the IMM can seek support from academia and NGOs as needed.

This activity is already being implemented partially by the IMM. The extent of monitoring and stakeholder engagement can be enhanced in order to increase the efficiency and effectiveness of the measure. A roadmap can be developed for building upon existing systems instead of developing a new mechanism, which will ensure cost saving for this action.

The advantages of this adaptation option are that it can enhance cooperation between the IMM and non-state actors; it increases public engagement; increases the effectiveness and efficiency of the IMM's existing actions preventing biodiversity loss. There is no particular disadvantage to this adaptation action.

Integrating Biodiversity Conservation in all Municipal Activities

Biodiversity conservation is a cross-cutting adaptation option that can be integrated in several activities of the Municipality. This mainly includes all physical activities that are or are not related to climate change, nor nature conservation. Examples include actions such as choosing pesticides that do not give harm to birds and other animals than the pests. Other examples include caring for the bird nests when pruning off the trees.

The advantages of this adaptation option is that it can have direct positive impacts on the existing biodiversity in highly urbanized areas. Also, this measure is a soft measure, that does not require physical actions such as construction or implementation, but rather requires changes in planning and approach to implementation of the existing activities of the Municipalities.

However, there is a need to change the practices of the Municipality in all actions that directly or indirectly have an impact on the nature. That may require a range of plans and practices to change, including documentation such as technical specifications of purchased material for the activities. Therefore, thorough planning is required for implementing this measure.

Green Spaces

İstanbul is a continuously growing city both physically, economically, and population-wise. Inevitably, urban zones are growing into natural habitats, causing pollution and biodiversity loss. However, it is possible to protect the biodiversity to some extent through leaving "green spaces" when making zoning plans, spatial plans and other planning for the new urban areas.

Urban green spaces can be defined as outdoor places with significant amounts of vegetation and exist mainly as semi-natural areas. Urban areas can contain rich flora that contribute significantly to biodiversity, but loss and isolation of habitats due to urban sprawl threaten biodiversity and warrant limits on development. The connectivity provided by urban green spaces offers habitats and corridors that help to conserve biodiversity. Many cities develop

green space networks and increase connectivity to preserve and restore biodiversity.

In sustainable urban development, urban greening is a key element, but biodiversity must be an integral component of this greening. Consequently, preserving habitat and dispersal routes and developing a green space network that can maintain landscape-scale connectivity is crucial in urban biodiversity conservation.

The development of urban green space networks includes the protection of existing green spaces, creation of new spatial forms, and restoration and maintenance of connectivity among diverse green spaces.

Zoning plans is a critical area where the IMM has the opportunity to make decisions in a way to protect the biodiversity in İstanbul. Making the zoning plans in a way to leave enough natural habitat areas to avoid biodiversity loss is the essence of this climate adaptation action. Green space networks can provide a solution to the problems of intensified land use and fragmentation, enabling natural populations of species and threatened habitats to survive. The EU's 2030 biodiversity strategy encourages bringing nature back into cities by creating biodiverse and accessible green infrastructure.

3.4.2.4. Heat Islands

Heat islands contribute to higher daytime temperatures, reduced night-time cooling, and higher air-pollution levels. These, in turn, contribute to heat-related deaths and heat-related illnesses such as general discomfort, respiratory difficulties, heat cramps, heat exhaustion, and non-fatal heat stroke.

Heat islands can also exacerbate the impact of naturally occurring heat waves, which are periods of abnormally hot, and often humid, weather. Sensitive populations are particularly at risk during these events.

Older adults are among the most vulnerable to extreme heat events. Many physiological, psychological, and socioeconomic factors contribute to this danger. Older adults are more likely to be in poor health, to be less mobile and more isolated, to be more sensitive to high heat. People in poor health, including people with chronic conditions, disabilities, mobility constraints, and those taking certain medications, are vulnerable to extreme temperatures. İstanbul hosts a significant elderly population who should be careful in extreme heat conditions.

Populations with low-income are at greater risk of heat-related illnesses due to poor housing conditions, including lack of air conditioning and small living spaces, and inadequate resources to find alternative shelter during a heat wave.

People who spend their working hours outdoors are more prone to conditions such as heat exhaustion and heat stroke. They have higher exposures to ozone air pollution and heat stress, especially if work tasks involve heavy exertion. A significant population's occupation requires them to work outdoors in İstanbul. Therefore, it is important to implement adaptation options (Table 11) at least in the hotspots of the city.

There are no particular districts that suffer more than the others in İstanbul city. However, almost every town has its "hotspots" which are mainly the town center, that needs an intervention.

Table 11. Heat islands adaptation actions selected for İstanbul

	From Grey to Green	Shades in the City	Green Infrastructure	Light Colors	Green Roofs and Walls
Selected areas	Applicable in all İstanbul at hotspots for heat island effect (e.g. city centers)				
Potential acceptability to the local public	Highly acceptable	Acceptable in major parts, but local public opinion polls can be considered	Local public opinion polls can be considered	Acceptable in major parts, but local public opinion polls can be considered	Acceptable in major parts, but local public opinion polls can be considered
Time interval for implementation	Short to long-term	Short-term	Mid-term, long-term	Short-term	Mid-term (walls), long term (roofs)
Key stakeholders for implementation	• District municipalities	• MoEUCC İstanbul Directorate • District municipalities	• MoEUCC İstanbul Directorate • State Hydraulic Works • District municipalities	• District municipalities	• MoEUCC İstanbul Directorate • District municipalities

From Grey to Green

İstanbul, being a big metropolitan area, has several grey spaces such as squares and other public areas which are mostly covered with cement. Changing the cement areas with "green" ones by extending plant areas with planting trees and other plant species which do not require much water. Trees significantly reduce the temperatures in their shadow, creating a cool ambient for the city. Other plant species on the ground can absorb the heat and radiation from the sun preventing the heat island effect at their local environment.

Other advantages of greening the green areas besides reducing the ambient temperatures and heat island effect is to increase public health by reducing the impact of increased temperatures and heat waves. Also, green areas provide recreational areas within the city, increasing the life quality of the public.

Also changing public areas from grey to green provides additional green zones which can support increased connectivity and decrease fragmentation between green spaces, to preserve biodiversity.

This climate adaptation option is significantly beneficial for all İstanbul and its grey spaces due to low investment cost and high potential immediate impacts. İstanbul can embrace this option though changing several big grey public areas, into greener areas in a manner not reducing public access to the spaces.

What needs to be taken care is that the types of plants and trees should be selected among the ones which do not need much maintenance and irrigation, considering water scarcity issues in the city.

No particular disadvantage of this adaptation option is considered for İstanbul. Therefore, this option can bring positive results in all regions of İstanbul. Naturally from an economic point of view, application of this adaptation measure in highly populated areas can be beneficial. And from a public health point of view, this measure can be applied focusing on regions where socio-economic development is relatively low in order to create resilience against heat waves for elderly people.

This measure is expected to be highly welcomed by the public, thus having increased acceptability. Therefore, a major bottleneck in its implementation is not expected.

Shades in the City

İstanbul has so many open spaces where the ground is cement or asphalt, which exacerbates the heat island effect and increases the local temperatures, causing public health problems. Providing shade in the city at locations where possible can significantly reduce local temperatures creating cooler spaces for people. Also, the cost of cooling shops and closed areas may be significantly decreased.

This measure is already applied by people in places like marketplaces and open space shopping malls successfully for many years. Similar applications can be done at places where greening grey areas are not feasible. Examples are narrow streets where there is high pedestrian traffic, such as İstiklal Street or Kadıköy Bahariye Street. In such locations, canopies or shades made of a variety of materials such as textile or hard materials can be implemented for the summer season.

The installation of these materials will not require construction, which may be costly. It only requires the installation of systems that can be easily dismantled in the off-season.

The only downside of these systems might be the requirement of installation at the beginning of summer and disassembling at the end of summer.

Implementation of this adaptation measure is regardless of the towns of İstanbul, as the heat island effect is observed in all highly populated areas of the city. The measure can be considered for the most populated parts of each town with high pedestrian traffic.

No disadvantage of this adaptation option is considered for İstanbul. Therefore, this option can bring positive results in all regions of İstanbul. And from a public health point of view, this measure can be applied focusing on regions where socio-economic development is relatively low in order to create resilience against heat waves for elderly people.

This measure is expected to be highly welcomed by the public, thus having increased acceptability. Therefore, a major bottleneck in its implementation is not expected.

Green Infrastructure

İstanbul is a dynamic and growing city with constant need of maintenance and modifications in the built environment. Investing in green infrastructure can address several societal challenges such as water security and public health while protecting nature in cities. Green infrastructures are mainly "nature-based solutions" which have been highly in focus over the recent years in the international fight against climate change.

Green infrastructure includes several applications, such as open storm water systems, which store access water in water canals and ponds in case of heavy rain, where water is later on used for irrigation of green areas in the city. Another example is integrating wide areas made of cement or asphalt with the canals, so the water gathers in the canals without causing inland floods. Also, such examples include changing material on the ground from asphalt to permeable cement (with holes, for example) providing space for water to reach the ground, without compromising functionality. Such an application cannot be done on roads, but they can be easily applied to parking areas.

Green infrastructure is in principle extending the green and blue areas of the city through integrating nature-based solutions into the infrastructure and built environment. Because of the dynamic nature of İstanbul's built environment and urbanization, integrating green infrastructure in existing process may have short-term results in neighborhoods.

As the heat island effect is not focused on particular towns, but rather in hot spots where there is high urbanization, therefore this adaptation measure is not limited to any particular towns of İstanbul.

However, there may be some barriers to implementation of green infrastructure. These are mainly due to the already densely populated and tightly built nature of İstanbul. In many parts of the city, the existing built environment may not allow water canals or water ponds. However, a careful design considering the existing circumstances in neighborhoods may help to overcome such barriers. This will require case by case design of such systems, customized for each town/area.

Light Colors in Streets, Pavements and Roofs

Apart from the adaptation options that may require changes in the infrastructure, application of light colors in the built environment to the extent possible is a low-cost alternative. It is simply utilizing light colors in streets, pavements and roofs which can reflect light back to the atmosphere, providing some level of albedo effect in the cities.

This adaptation measure can be distinguished from others with its low-cost nature. However, there is not data available as to how much it can support reducing temperatures in hot spots in the cities especially when they are used on the ground. They may have a different impact on the roofs, as they have potential of reducing cooling costs for buildings in summer. However similarly, they may tend to reduce the heating effect of the sun during wintertime. Therefore, the choice of implementing this measure should be well thought and considered.

There is no bottleneck in terms of applying this measure in İstanbul. However, the willingness of residents needs to be assessed before implementing this measure, like many others.

Green roofs and walls

İstanbul, with its population which exceeds 16 million people, and with more than 1.5 million buildings inevitably suffers from the heat island effect. And reducing the heat island effect involves interventions to buildings to the extent possible.

To create green surfaces on existing and new roofs and walls is a way to reclaim nature and at the same time achieve other benefits. A green roof is created by sowing or planting directly on a layer of soil on the roofs.

Green roofs and walls have a direct reducing impact on the heat island effect in cities, as the green surfaces absorb the heat and radiation from the sun unlike many artificial surfaces that are widely used in cities. Besides supporting the city with the reduction of the heat island effect, green roofs can provide insulation for the buildings, reducing heating and cooling costs, support biodiversity conservation in the cities, help rainwater harvesting, support preventing city floods and also sequester carbon. Similarly, green walls can reduce the reflection of radiation from walls, significantly contributing to reduced local temperatures in cities. Also, green roofs have longer lifetimes compared to conventional roofs.

Despite the variety of positive impacts that the green roofs and walls can bring, depending on the type of green roof used, they can be high-maintenance structures. Therefore, comprehensive cost and benefit calculations should be made before planning such structures. Several parameters will be involved in such calculations, such as construction cost, maintenance cost per year, energy savings, water retention, etc. It is possible to say that such structures could be more cost efficient in buildings with wide rooftop areas. Currently, as there are not so many examples of green roofs in Türkiye, it is difficult to make benchmarking and make decisions. However, pilot cases implemented by public institutions such as İstanbul Metropolitan Municipality can become a role model for future private investments. This is a way of promoting private climate financing for the whole city and perhaps for the other metropolitans in Türkiye.

Like the other climate adaptation options for heat islands, this measure can be implemented anywhere in the city. However, the effectiveness would be higher in densely urbanized parts of the city. This measure is expected to be highly welcomed by the public, thus having increased acceptability. Therefore, a major bottleneck in its implementation is not expected.

3.5. MONITORING FOR ADAPTATION ACTIONS

Monitoring the level of implementation and progress of achievements is a key to overcoming the barriers to success of these actions and will further enhance the effectiveness of results. Below are the matrices for monitoring the implementation of actions for each vulnerability and adaptation action (Table 12 to Table 15).

Table 12. Urban floods adaptation actions monitoring

	Permeable Pavements	Flood Planning	Infiltration Trenches	Sponge Cities	Green Roofs
Key stakeholders / institutions for data gathering	MoEUCC State Hydraulic Works İstanbul Governorship MoI, Special Provincial Administration, Zoning and Improvement Department IMM and Related İnstitutions District Municipalities	• State Hydraulic Works • AFAD • IMM and Related İnstitutions • District Municipalities	• MoEUCC, Infrastructure and Urban Transformation Services Directorate • State Hydraulic Works • IMM and Related İnstitutions • District Municipalities	• MoEUCC, Infrastructure and Urban Transformation Services Directorate • IMM and Related İnstitutions • District Municipalities	• MoEUCC, Provincial zoning directorate • IMM and Related İnstitutions • District Municipalities
Indicators for monitoring	• Number of floods in each district (annually) • Number of flooded households (annually) • Number of flooded shops/businesses (annually)				

Table 13. Coastal floods adaptation actions monitoring

	Offshore Breakwaters	Seawalls	Gabions	Rip-raps	Cliff Stabilisation
Key stakeholders / institutions for data gathering	• MoEUCC, GD of Environmental Management • MoTI, GD of Shipyards and Coastal Structures • MoTI, GD of Coastal Safety • MoI, Special Provincial Administration • İstanbul Governorship • IMM and district municipalities				
Indicators for monitoring	• Number of floods and overland flows in coastal towns (annually) • Number of flooded households (annually) • Number of flooded shops/businesses (annually) • Erosion on shorelines (annually)				

Table 14. Heat islands adaptation actions monitoring

	From Grey to Green	Shades in the City	Green Infrastructure	Light Colours	Green Roofs and Walls
Key stakeholders / institutions for data colletion	• IMM • District municipalities • Local NGOs • Volunteers (shops, individuals)				
Indicators for monitoring (at observations spots)	• Local temperatures o monthly average o monthly max				

Table 15. Habitat degradation adaptation actions monitoring

	From Grey to Green	Shades in the City	Green Infrastructure	Light Colours	Green Roofs and Waals
Key stakeholders / institutions for data gathering	• Academia • IMM related İnstitutions • District municipalities				
Indicators for monitoring	• InVEST Urban biodiversity indicator indexes*[55]				

55 As part of SECAP workshops, IMM staff were given detailed information on the use of the InWEST modeling program. In addition, a map of İstanbul's biodiversity and habitat degradation areas was produced using the InWEST program and the relevant indexes were presented in a table. The free discount website of the InWEST (Integrated Valuation of Ecosystem Services and Tradeoffs) program: https://invest.readthedocs.io/en/latest/ There are explanations about what the indexes mean in the usage section of this program.

3.6. SUMMARY

All of the problems arising from the vulnerability assessments may not be immediately resolved throughout İstanbul due to technical and budgetary constraints. Therefore, the climate extremes, system vulnerability and the exposure of İstanbul, as explained in Climate Change Action Report were studied to determine the city vulnerability maps. The identification of the regions through these maps, where climate change impacts are concentrated, pointed out vulnerability hotspots. Based on these hotspots, the potentially applicable adaptation actions were identified, which were then narrowed down to the list of adaptation actions as per city's specificities. Multi-Criteria Analysis and key stakeholder consultations were carried out to ensure support adaptation planning.

As a summary of the works undertaken for risk and vulnerability assessment and determination of adaptation actions, a series of adaptation actions were prioritized for the identified vulnerabilities of the city of İstanbul.





4. IMM BUILDING ENERGY ACTIONS AND MITIGATION PLANS

4.1. INTRODUCTION TO STATIONARY SOURCES AND BUILDINGS

Through SECAP, energy efficiency measures are targeted at the sectors with the greatest potential for energy savings, such as the building, industry, transport, and waste sectors. By implementing energy efficiency measures in buildings, citizens can reap a multitude of benefits. Lower energy bills, improved quality of life, reduced reliance on external suppliers of oil and gas, and support for the sustainable growth of the economy are just some of the advantages. Although there may be costs associated with renovations, the benefits of energy savings far outweigh them.

Renovating both public and private buildings is an essential action and has been singled out in the European Green Deal as a key initiative to drive energy efficiency in the sector and deliver on objectives. A long-term renovation strategy to support the renovation of buildings into highly energy efficient and decarbonised buildings stock by 2050 is also essential to meet Türkiye's 2053 zero-emission target. Making buildings more energy efficient will also contribute significantly to İstanbul city in achieving its energy and climate goals. In this regard, renovating the IMM buildings will improve energy efficiency while driving the clean energy transition for the whole city.

This section describes the IMM building stocks and energy efficiency activities that will be used as the basis for making the investments in the renovation of IMM buildings, its affiliates and companies and insights for private residential buildings in İstanbul in order to achieve energy efficiency to the relevant extent.

4.2. COMPLIANCE OF THE ENERGY SAVING ACTION PLANS FOR BUILDINGS and FACILITIES WITH NATIONAL POLICY DOCUMENTS

Considering the future consumption projections made by the International Energy Agency (IEA) considering technological developments, economic growth rate, population growth rate, energy prices, continued energy policies and consumer movements, it is projected that world energy consumption will increase by 40% on average until 2035.

A series of measures have been taken and policies have been determined to combat climate change and protect the global climate system. Some countries, especially Türkiye, have become party to the United Nations Framework Convention on Climate Change and the Kyoto Protocol, which tackle climate

change mitigation measures. Türkiye, which is a candidate country in the EU membership process, continues to work on aligning with the policies implemented by the EU member states to comply with the EU acquis. In this context, studies are carried out in line with the directives to successfully complete the Environment chapter, which is among the most important chapters in the EU harmonization process. **The National Energy Action Plan 2024-2030** was prepared and submitted to the European Union Commission. Incentives have been provided in order to increase the use of renewable energy resources in Türkiye during the harmonization process.

In addition, The Ministry of Energy and Natural Resources' **Strategy Plan for 2017-2023** has set a goal of achieving a 15% electricity saving by 2023, the 100th year of the Republic. In the national **11th Development Plan**, it is foreseen to encourage the necessary planning and investments in order to increase the energy efficiency in existing buildings, to establish the National Green Building Certification System and to expand unlicensed solar energy investments to meet own electricity needs.

The following laws and regulations are the backbone of national energy efficiency legislation:

- Energy Efficiency Law No. 5627 published on April 18, 2007.
- Regulation on the Distribution of Heating and Sanitary Hot Water Expenses in Central Heating and Sanitary Hot Water Systems
- Regulation on Procedures and Principles for Increasing Energy Efficiency in Transportation
- Regulation on Increasing Efficiency in the Use of Energy Resources and Energy
- Energy Performance Regulation in Buildings (BEP Regulation)
- Regulation on Environmentally Responsible Design of Energy-Related Products
- Energy Efficiency Inspection Regulation

In addition, the Government of Türkiye has taken steps to ensure energy efficiency with the publication of the "Energy Efficiency Strategy Document 2012-2023" on February 25, 2012 and the "National Energy Efficiency Action

Plan 2017-2023" on January 2, 2018. These documents set out clear targets, methods and implementation plans to ensure the country's energy efficiency.

On the other hand, the Presidential Circular on "15% Energy Savings in the Public" published on August 16, 2019, and the "Energy Performance Agreements in the Public Service" published on August 21, 2020, have both been instrumental in driving energy efficiency in the public sector. These two initiatives have provided the necessary guidance and support to public sector entities to identify and implement energy-saving measures, resulting in significant cost savings and environmental benefits.

Regulation on Increasing Efficiency in the Use of Energy Resources and Energy (Energy Efficiency Regulation):

It has been prepared for the implementation of the Energy Efficiency Law No. 5627, which consists of 39 articles, 15 temporary articles, and has been amended 4 times, the last of which was on March 14, 2020.

Energy Performance Regulation in Buildings (BEP Regulation):

It is published in order to regulate the procedures and principles regarding the effective and efficient use of energy and energy resources in buildings, the prevention of energy waste and the protection of the environment and is applied in new buildings and important renovations of existing buildings that require project change. With the BEP Regulation, the following topics are regulated: architectural, mechanical and electrical projects of buildings, thermal insulation, mechanical installation, heating and cooling system, ventilation and air conditioning systems, sanitary hot water preparation and distribution systems, automatic control, electrical installation and lighting systems, renewable energy sources, heat pump and cogeneration systems design and implementation, operation, periodical maintenance and inspection, and Energy Identity Certificate. For the buildings to be built to obtain a "building occupancy permit", their projects and construction must comply with at least C class defined in the regulation.

The concept of "Nearly Zero Energy Building (NZEB)" was introduced to the legislation by the Ministry of Environment, Urbanization and Climate Change. The aim was to create buildings with high energy performance that incorporate a certain amount of

renewable energy sources. With the regulation, as of January 1, 2025, all buildings with a total construction area of more than 2,000 m² must be constructed according to NZEB principles and at least 10% of the primary energy needs of these buildings must be met from renewable energy sources. In addition, NZEB buildings shall have energy performance class B or better in the Energy Performance Certificate. However, with the two temporary articles added to the regulation, stipulating that the building construction area required for NZEB projects would be 5,000 m² between January 1, 2023 and January 1, 2025, and the renewable energy usage rate would be 5%.

Public buildings with an annual total energy consumption of 250 TEP or a total construction area of more than 10,000 m² are considered "obligatory" and this responsibility is given to the "building management". If there is more than one independent building in a building group or campus, the sum of the construction areas of the individual buildings is considered as the total construction area.

The management of public sector buildings with a total construction area of at least 10,000 m² or an annual total energy consumption of 250 TOE or more, assigns an employee with an energy manager certificate among the employees in their buildings as an energy manager (with the exceptions specified in the 36th article of the relevant Regulation). TS EN ISO 50001 Energy Management System must be established and documented in obliged buildings until the end of 2023. Relevant institutions, organizations and businesses are responsible for keeping the energy management system up to date. It is necessary to have an audit done every seven years in the obliged buildings.

Presidential Circular dated 6 August 2019 and numbered 2019/18:

According to the Presidential Circular, a minimum of 15% energy efficiency until the end of 2023 in public buildings, with an annual total energy consumption of 250 TOE or more, or a total construction area of 10,000 m² or more, shall be achieved.

By the end of 2023, savings less than 14% are classified as "unsuccessful", savings between 14% and 16% are classified as "successful", and savings more than 16% are classified as "super successful". The unsuccessful ones shall submit their reasoned reports to the Ministry until the end of 2024.

4.3. BUILDINGS ENERGY ACTION AND MITIGATION PLANS OF İSTANBUL CITY

4.3.1. İstanbul City Buildings Outlook

İstanbul is home to a vast and ancient building stock, with a much higher proportion of energy inefficient buildings than in other EU countries (75% or more). This has resulted in significantly higher carbon emissions and energy consumption than in other cities. GHG amounts originating from İstanbul city buildings are given in Table 16.

Table 16. 2019 GHG Emissions from Stationary Sources in İstanbul City

STATIONARY SOURCES		
	MWh	**tCO_2e**
Commercial and institutional buildings/facilities	29.491.282,48	10.891.905,00
Residential buildings	52.398.132,46	14.134.797,00
Subtotal	**81.889.414,94**	**25.026.702,00**

In the İstanbul Climate Change Action Plan[56], strategies and reduction plans and targets for the reduction of these large amounts of buildings emissions have been established and published for 2030 (Table 17 and Table 18). These tables have been updated within the scope of 2023 legislation and developments.

56 https://cevre.İBB.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

Table 17. Building Energy Efficiency Strategies (with 2023 legislation updates)

Sector	Theme	Strategy
Buildings	New buildings - construction standards	Net zero buildings, Nearly zero buildings
	New buildings-construction standards	YES-TR certificate and smart buildings
	Existing buildings - retrofits	YES-TR certificate and smart buildings
	Existing buildings-retrofits	Net zero buildings, Nearly zero buildings
	Existing building-fuel switch	Fuel change to use renewable energy, switch to heat pump and electrification instead of natural gas
	Space cooling - efficiency	Energy efficient space cooling, switch to heat pump and electricification
	Space heating - fuel switch	Fuel switch for space heating, switch to heat pump and electricification
	Space heating - efficiency	Energy efficient space heating, switch to heat pump and electricification
	Water heating - fuel switch	Fuel switch for water heating, solar panel and collector
	Water heating - efficiency	Energy efficient water heating, heat recovery, use of solar collector
	Cooking - fuel switch	Fuel switch for cooking, electrification
	Lighting - efficiency	Energy efficient lighting, LED
	Appliance Equipment - efficiency	Energy efficient appliances
Energy	Street Lighting	Street Lighting LED conversion and efficient lighting automation
	Park, Garden and Tunnel Lighting	LED conversion and efficient lighting automation
	Grid decarbonisation	Long-term decrease and exit in natural gas for electricity generation, electrification
		Decrease and exit in coal for electricity generation
		Demand side management and digitalization, smart meters, IoT energy monitoring and management system
		Increasing renewable electricity and energy

Table 18. Building Energy Efficiency Target Until 2030 (with 2023 legislation updates)

Sector	Theme	Strategy	Target	2030
Buildings	New buildings - construction standards	Net zero emissions buildings	New buildings have net-zero emissions	100%
	Existing buildings - retrofits	Net zero emissions buildings	All buildings have net-zero emissions	10%
	Space cooling - efficiency	Energy efficient space cooling	High-efficiency chillers	100%
			Ground-source heat pumps	-
	Space heating - fuel switch	Fuel switch for space heating	Exit from coal for heating	50%
	Space heating - efficiency	Energy efficient space heating	High-efficiency gas boilers	100%
			Heat pumps	20%
	Water heating - fuel switch	Fuel switch for water heating	LPG water heating	-
			Residential solar hot water	-
			Commercial heat pumps	20%
	Water heating - efficiency	Energy efficient water heating	Low-flow water fixtures	100%
	Cooking - fuel switch	Fuel switch for cooking	LPG cooking	-
			Electric cooking	20%
	Lighting - efficiency	Energy efficient lighting	CFL	0%
			LED	100%
	Appliance Equipment - efficiency	Energy efficient appliances	High-efficiency appliances	100%

Sector	Theme	Strategy	Target	2030
Energy	Street lighting	Street lighting efficiency	LED	100%
	Grid decarbonisation	Natural gas use for electricity generation	Proportion of mix	24%
		Decrease in coal for electricity generation	Proportion of mix	23%
		Increasing renewable electricity	Proportion of mix	75%

4.3.2. Energy Action Plans of İstanbul Buildings, Houses and IMM Affiliates/Subsidiaries

İstanbul Metropolitan Municipality (IMM) has limited authority to impose regulations on buildings in İstanbul City to meet its 2030 carbon reduction targets. All residential, commercial, and industrial structures, including IMM's own buildings and facilities, are subject to the control and legislation established by the central government. As such, IMM is obliged to make its own buildings and facilities energy efficient, increasing renewable energy production, and constructing its new buildings that are nearly zero-emissions. Promoting usage of renewables and energy efficiency in residential buildings and assisting district municipalities to create building permits that adhere to energy efficiency standards are key actions that can be taken by IMM to help reduce energy consumption. By encouraging the public to use energy-saving practices and providing guidance to district municipalities on how to create energy-efficient building permits, IMM can help to reduce energy consumption and create a more sustainable future.

Within this context, IMM has determined the following actions and reductions in the İstanbul Climate Action Plan, as summarized in Table 19 and Table 20. These tables have been updated within the scope of 2023 legislation and developments.

Table 19. Action for İstanbul City Buildings[57] (with 2023 legislation updates)

Sector	Buildings
Strategy	Net Zero buildings
Action	Encouragement of measures to increase energy efficiency in all buildings
Duration	Short (<5 year) Period
Adaptation Capacity	5 – very relevant
Responsible Main Institutions That May Be a Stakeholder of IMM in Practice	Ministry of Environment, Urbanization and Climate Change; District Municipalities; TMMOB
Measurable Key Indicators	Smart Energy Monitoring and Management System. Carbon and Energy Footprint. GHG EmissionCalculations. Energy Performance Certificates. Net-Nearly Zero Emission Building Certification Monitoring and Management of Energy and Water Consumption in Public Buildings; Carbon Footprint Tracking of Industrial Organizations. Monitoring and Managing the Energy Consumption of Buildings with Smart Meters
Main Obstacles	Financial and Economic; Political and Social; Legal and Corporate
Financial Source	National Government; Municipality and Public Sector, International finance institutions, EU funds

57 https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

Table 20. Actions for İstanbul City Energy Sector (with 2023 legislation updates)

Sector	Energy
Strategy	Increasing the use of renewable electricity
Action	Generating new clean energy at regional scale (heating/cooling/power) – microgrid (PV, green hydrogen fuel cell, other)
Duration	Medium (5-10 year) Period
Adaptation Capacity	5 – very relevant
Responsible Main Institutions That May Be a Stakeholder of IMM in Practice	Energy and Natural Resources Ministry; Ministry of Environment, Urbanization and Climate Change; İSTAÇ; District Municipalities; Universities; İstanbul Energy AŞ.; Electricity distribution companies, Governor's Provincial Energy Management Office
Measurable Key Indicators	Ratio of Renewable Energy Used; Energy Consumption Data; GHG Emission Calculations; Number of Buildings/Households Benefiting from Heating, Cooling and Power Systems Connected to Renewable Energy Systems; Number of Buildings/Households Benefiting from Micro Grid; If Renewable Energy Cannot Be Installed on Building Roofs or Parking Lot, Evaluation of Renewable Energy Purchase Options and Changes in Related Purchase Specifications
Main Obstacles	Financial and Economical, Renewable Energy and Energy Cooperatives Legislation
Financial Source	National Government, Private Sector

Sector	Energy
Strategy	Increasing the use of renewable electricity
Action	Taking additional measures for renewable energy generation, energy and water saving in projects planned by KİPTAŞ and BİMTAŞ
Duration	Short (<5 year) Period
Adaptation Capacity	5 – very relevant
Responsible Main Institutions That May Be a Stakeholder of IMM in Practice	Ministry of Environment, Urbanization and Climate Change; Professional Chambers; TMMOB; Energy AŞ.; TOKİ; District Municipalities; Energy and Natural Resources Ministry Governorate Energy Management Unit, Distribution and Transmission Companies
Measurable Key Indicators	Energy Efficiency Measurements in All Buildings, Emission Reduction Amount, Number of Workshops Held, Amount of Energy Used in Buildings, Periodic Reports
Main Obstacles	Financial and Economic, Lack of Legislation, Control and Sanctions
Financial Source	National Government, Private Sector

4.3.3. Additional Actions for Residential Buildings

In addition to the energy conversion and emission reductions that the IMM will implement in its own buildings and facilities, IMM will also launch separate campaigns, actions and supports to further to promote energy efficiency and reduce GHG emissions in all residences, commercial buildings and industrial facilities. These initiatives will serve as an additional and indirect form of support. Additional mitigation measures for buildings are presented in Table 21. These tables have been updated within the scope of 2023 legislation and developments.

Table 21. Additional Energy Efficiency and GHG Reduction Mitigation Measures for Residential Buildings (with 2023 legislation updates)

Action	Insulation of Buildings
Current Situation/Purpose	At least 50% of residential buildings is not insulated.
Relationship to Existing Plans	Energy Efficiency Improvement Action Plan 2024-2030 and Energy Identity Certificate
Priority Level	High
Action Steps	Having Energy Advisory Tables in İstanbul
Action Type	Education and technical support
Savings Amount	Till 2030, 30-40% heating and cooling energy will be saved in these buildings.
Responsible	Ministry of Environment, Urbanization and Climate Change and Ministry of Energy and Natural Resources
Stakeholders	IMM
Contribution of the Municipality	Supervision and project support
Estimated Cost	5 million Euro
Timing	2024-2030
Risks	No direct support for adaption of regulation or motivation system, insufficient income,

Action	Renewable Energy for Buildings
Current Situation/Purpose	None of the residential housed rooftop PV systems or remote renewable energy systems.
Relationship to Existing Plans	Energy Efficiency Improvement Action Plan 2024-2030 and Nearly Zero Energy Buildings Regulation
Priority Level	High
Action Steps	Having Energy Advisory Tables in İstanbul
Action Type	Education and technical support
Savings Amount	Till 2030, 10% renewable energy will be produced and saved in these buildings.
Responsible	Ministry of Energy and Natural Resources
Stakeholders	IMM
Contribution of the Municipality	Supervision and project support
Estimated Cost	5 million Euro
Timing	2024-2030
Risks	No direct support for adaption of regulation or motivation system, insufficient income,

Action	Increase awareness of people for energy efficiency and less energy use
Current Situation/Purpose	Public awareness of energy efficiency is not at the desired level
Relationship to Existing Plans	2024-2030 Energy Efficiency Improvement Action Plan
Priority Level	High
Action Steps	To start information and education campaign for citizens.
Action Type	Regulation
Savings Amount	-
Responsible	IMM
Stakeholders	Ministry of Energy and Natural Resources
Contribution of the Municipality	Organization of awareness campaign
Estimated Cost	5 million EUR
Timing	2024-2030
Risks	Not enough financing for awareness campaign

4.4. ENERGY ACTION AND MITIGATION PLANS OF IMM'S INSTITUTIONAL BUILDINGS, FACILITIES and SUBSIDIARIES/AFFILIATE COMPANIES

4.4.1. Energy Consumption and Targets Outlook

In 2019, İstanbul Metropolitan Municipality (IMM) conducted an inventory of greenhouse gas (GHG) emissions and energy consumption in İstanbul City, including corporate GHG emissions and corporate energy consumption of stationary energy sources (such as IMM institutional buildings and facilities). This baseline inventory serves as a reference point for future GHG emissions and energy consumption reduction efforts. Table 22 provides information on GHG emissions from IMM institutional stationary sources.

Table 22. 2019 GHG Emissions from Stationary Sources in IMM Institutional Buildings

STATIONARY SOURCES		
	MWh	**tCO_2e**
Commercial and institutional buildings and facilities	1.945.092,75	794.377
Municipal public lighting	92.250,89	41.904
Subtotal	**2.037.343,64**	**836.281**

IMM has created the GHG inventory as an institutional energy consumption inventory, which includes municipality administrative buildings and their activities and as well relevant subsidiaries/affiliate companies' activities.

The energy consumption of subsidiaries/affiliates and their shares in 40% energy reduction target by 2030 is presented in Table 23.

Table 23. Energy Of 28 Subsidiaries/Affiliate Companies Commercial, Institutional Buildings And Facilities Energy Consumption (2019) With 40% Energy Reduction Target By 2030.

ALL IMM	ENERGY CONSUMPTION IN 2019 (MWh)	% SHARE	% SHARE IN 40% ENERGY REDUCTION TARGET	REDUCTION AMOUNT IN 2030 ACCORDING TO 40% REDUCTION TARGET (MWh)
İBB DEPT.S	463.194,44	10,93	4,37	185.277,77
İSKİ	1.359.821,96	32,09	12,84	543.928,79
İETT	1.305.962,49	30,82	12,33	522.385,00
İSTANBUL AĞAÇ VE PEYZAJ	10.219,19	0,24	0,10	4.087,67
BELBİM	1.877,90	0,04	0,02	751,16
BELTUR	17.741,64	0,42	0,17	7.096,66
BİMTAŞ	2.473,47	0,06	0,02	989,39
BOĞAZİÇİ YÖNETİM	958,65	0,02	0,01	383,46
İSTANBUL ENERJİ	5.754,82	0,14	0,05	2.301,93
HALK EKMEK	69.504,85	1,64	0,66	27.801,94
GÜVEN SU	1.202,69	0,03	0,01	481,08
HAMİDİYE	9.773,86	0,23	0,09	3.909,54
İSTTELKOM	357,92	0,01	0,00	143,17
İGDAŞ	18.057,15	0,43	0,17	7.222,86
İSBAK	5.719,40	0,13	0,05	2.287,76
İSFALT	72.704,63	1,72	0,69	29.081,85
İSTGÜVEN	1.192,59	0,03	0,01	477,04
İSPARK	19.739,07	0,47	0,19	7.895,63
İSTANBUL İMAR	131,30	0,00	0,00	52,52
İSTAÇ	269.115,43	6,35	2,54	107.646,17
İSTON	35.104,76	0,83	0,33	14.041,90
İSYÖN	8.275,24	0,20	0,08	3.310,10
KİPTAŞ	872,20	0,02	0,01	348,88
KÜLTÜR	4.192,78	0,10	0,04	1.677,11
MEDYA	693,02	0,02	0,01	277,21
METRO İSTANBUL	382.312,17	9,02	3,61	152.924,87
İSTANBUL ULAŞIM	870,40	0,02	0,01	348,16
ŞEHİR HATLARI	144.314,96	3,41	1,36	57.725,98
İSPER	19.887,51	0,47	0,19	7.955,00
SPOR İSTANBUL	4.035,27	0,10	0,04	1.614,11
UGETAM	1.435,69	0,03	0,01	574,28
TOTAL	**4.237.497,43**	**100**	**40**	**1.694.998,97**

The analysis of energy consumption at the corporate level for local government activities includes the quantification of Greenhouse Gas (GHG) emissions from all major organizations and services. This includes emissions resulting from energy consumption activities and activities where local government institutions have operational control, regardless of the location of the emissions.

IMM is responsible for public transportation, waste management, water supply, sewerage system and treatment, recreational areas, road paving, urban and zone planning. IMM is not involved in the production, transmission, distribution of electricity, or public street lighting for the city. However, it does operate a few energy production plants, such as solar and waste-to-energy plants, to generate electricity for its own use.

As of 2023, IMM has 30 subsidiaries and 2 affiliated companies. However, in 2019, which was taken as a basis for the emission inventory, IMM had 28 subsidiaries and 2 affiliated companies. During the energy consumption assessment process, data on energy consumption was collected from these companies. From this data, seven companies were identified as having the most significant impact on energy consumption and as having energy efficiency plans and targets for energy-using and emission-emitting activities. These companies are İETT, İSTAÇ, İSTON, İSFALT, İSKİ, İHE and METRO İSTANBUL.

The 2019 data for total energy consumption, renewable energy production and 2030 energy targets of the above named subsidiaries/affiliates are provided in Table 24.

Table 24. 2019 Energy Data of Selected Subsidiaries/Affiliate Companies With Energy Reduction Target By 2030

IMM Affiliates/ Subsidiaries	Total Energy Consumption in 2019 (MWh)	Total Renewable Energy Production in 2019 (MWh)	Reduction Amount According to 40% Reduction Target (MWh)	Building electricity consumption (MWh)	Buildings natural gas consumption (MWh)	Buildings total energy consumption (MWh)	Institutional buildings and facilities reduction amount according to 40% reduction target (MWh)
İSKİ	1.359.821,96	1.414,56	543.928,79	1.314.382,50	21.662,11	1.336.044,61	534.417,844
İETT	1.305.962,49	158,46	522.385,00	16.230,05	71.868,68	88.098,73	35.239,492
İHE	69.504,85	0,00	27.801,94	9.879,82	59.117,06	68.996,88	27.598,752
İSFALT	72.704,63	0,00	29.081,85	4.660,77	64.219,36	68.880,13	27.552,052
İSTAÇ	269.115,43	809.494,00	107.646,17	12.708,92	3.178,08	15.887,00	6.354,80
İSTON	35.104,76	0,00	14.041,90	4.411,21	23.398,46	27.809,67	11.123,868
METRO İSTANBUL	382.312,17	18,00	152.924,87	0,00	6.211,34	6.211,34	2.484,536
TOTAL	3.494.526,29	811.085,02	1.397.810,52	1.362.273,27	249.655,09	1.611.928,36	644.771,344

In Table 24, the blue numbers indicates the total energy consumption used only in the buildings and facilities of these 7 subsidiaries/affiliate companies and red numbers indicate their 40% energy reduction targets in 2030, compared to 2019.

In order to meet their ambitious goals by 2030, the seven companies have conducted extensive long-term research to identify the necessary actions. These include reducing energy consumption through efficiency investments and increasing renewable energy investments. The specifics of these actions are outlined in Annex 1 in detail. Apart from these targeted and planned actions, other energy efficiency and renewable energy investments may also be required for 40% reduction by 2030 which will be planned and implemented over the years according to the SECAP monitoring results. These actions will be planned and implemented over the years with studies such as energy efficiency and renewable energy, innovation, technological improvements, renewals, system optimizations.

İSKİ will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **534,417.844 MWh/year.**

İETT will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **35,239.492 MWh/year.**

İHE will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **27,598.752 MWh/year.**

İSFALT will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **27,552.052 MWh/year.**

İSTAÇ will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and

investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **6,354.80 MWh/year.**

İSTON will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **11,123.868 MWh/year.**

METRO İSTANBUL will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. The total amount of energy reduction in the buildings and facilities until 2030 will be: **2,484.536 MWh/year.**

4.4.2. IMM Buildings Energy Efficiency Actions

The municipality's buildings will begin their energy efficiency journey by modernizing the largest and most energy-intensive buildings. 19 buildings have been identified and have undergone energy audits and are ready to start their modernization projects. The total investment required for the implementation of the planned measures in these 19 buildings is estimated to be around 3.7 million EUR. The modernization projects are expected to result in savings of around 17.000 MWh/year or 1,1 million EUR per year at current energy prices. The simple payback period of investments is 3 years.

The remaining buildings of the municipality will be grouped according to their energy consumption in order to prioritize their modernization, starting with the most energy-intensive buildings. An accompanying building modernization plan for each year up to 2030 must be developed, including the modernization of all remaining municipal buildings. Financial requirements for implementing the measures must be estimated and presented with each year's plan. The total investment for the implementation of the simple energy efficiency measures in the remaining municipal buildings is estimated to be around 1,75 million EUR.

The modernization projects of remaining municipal buildings are expected to result in savings of around 8.000 MWh/year or 0,5 million EUR per year at current energy prices. A simple payback period of investments estimated is 3 years.

A program, consisting of installing solar PV plants and using alternative energy sources to generate around 50% of the municipality's current electricity demand by 2030, is planned in two phases.

In the first phase of the program, measures will be taken to ensure that 18% of the municipality's current electricity demand is met through renewable sources by 2024. These measures will be primarily focused on the above-mentioned 19 buildings of the municipality.

In order to generate 28,800 MWh of electricity per year, it is planned to install a several solar PV plant with a capacity of about 20 MWe. The total investment requirement for the installation of the solar PV plants is provisionally estimated at around 16 million EUR. The estimated simple payback period of investments is 4 to 5 years. The first phase is planned to be implemented in two steps, each including installation of a 10 MWe solar PV plant with 8 million EUR investment requirement.

The second phase will aim that 50% of the municipality's buildings total electricity demand will be generated by solar PV plants. To achieve this, the municipality plans to install an additional 60 MWe of solar PV plant. The total investment requirement for the installation of the solar PV plants is provisionally estimated at around 45 million EUR. Estimated simple payback period of investments is 4 to 5 years. This phase will be implemented in three steps, each including installation of a 20 MWe solar PV plant with 15 million EUR investment requirement.

4.4.3. IMM Subsidiaries/Affiliate Companies Energy Efficiency Actions

Separate energy efficiency meetings were held with representatives of the aforementioned companies to analyze their activities, energy consumption data, and possible energy-saving measures. As part of the SECAP, short-term and medium-term objectives were established. To begin with, the national legislation, IMM's and its subsidiaries'/affiliates' obligations, and the 2023 energy reduction goals were identified. For the medium-term objectives, action plans for 2030 energy reduction were established to align with the 40% GHG emission reduction target, focusing solely on buildings and facilities. Furthermore, as part of IMM's net zero carbon targets for 2050, an advanced renewable energy action plan aiming to achieve a minimum of 50% energy consumption of 2019 from

renewable sources by 2030 for the seven aforementioned subsidiaries and affiliates were developed.

In the IMM SECAP Report detailed and comprehensive studies were conducted on the seven largest energy-using and emission-emitting companies in order to achieve both the national goals in the short term and the SECAP 2030 targets in the medium term. Commonly, SECAP Reports provide general targets and action-mitigation plans for the city and municipality. IMM SECAP Report provides a unique approach to energy efficiency and emissions reduction that is tailored to the specific needs and targets of the municipality.

Total energy efficiency mitigation actions and renewable energy targets of 7 IMM affiliates/subsidiaries are provided in Table 25-Table 31. The detailed energy reduction targets for IMM buildings and facilities are listed in Annex 1.

Table 25. Energy Transition Actions of İETT A.Ş. in Buildings and Facilities until 2030.

Action	Energy efficiency in buildings
Current Situation/Purpose	Buildings and HVAC, Lighting Systems etc. are inefficient
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Insulation of buildings Changing of Lighting with LED and Automation Systems Changing of Pumps, Motors, HVAC Systems Application of Energy Monitoring System and ISO 50001 EnMS
Action Type	Financial, Energy Audit and ESCO-EPS
Savings Amount	Till 2030, 2000 MWh/year will be saved.
Responsible	İETT-İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision, application, and additional financing
Estimated Cost	1.060.000 EUR
Timing	2023-2030
Risks	Inability to allocate enough financing for purchasing and energy efficiency application for systems, buildings

Action	Increase the use of renewable energy
Current Situation/Purpose	Not enough renewable energy production and use exist
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	PV Systems
Action Type	Financial and application
Savings Amount	Till 2030, 15.000 MWh/year will be produced.
Responsible	İETT, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	7.750.000 EUR
Timing	2023-2030
Risks	Insufficient financing

İETT 2030 Advanced Renewable Energy Action Plan Proposal	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	Transport and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy Wind energy systems
Action Type	Finance and implementation
Savings Amount	In 2030, 46.000 MWh/year renewable energy generation will be planned.
Responsible	İETT, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	20.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

Table 26. Energy Transition Actions of İSKİ A.Ş. in Buildings and Facilities Until 2030

Action	Energy efficiency in treatment plants and pump stations
Current Situation/Purpose	Existing pumps, motors, blowers, dryers are inefficient
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	SCADA systems Energy Monitoring and ISO50001 EnMS Efficient pumps, motors, blowers and dryers Energy Audit
Action Type	Financial and ESCO-EPS Applications.
Savings Amount	Till 2030, 250.000 MWh/year will be saved.
Responsible	İSKİ, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision, application, and additional financing
Estimated Cost	200.000.000 EUR
Timing	2023-2030
Risks	Inability to allocate enough financing for purchasing systems

Action	Increase the use of renewable energy
Current Situation/Purpose	Treatment plants comprise of 70% electricity of IMM consumption. Renewable energy production is important for reduction of emissions.
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	PV Systems Pump Energy and Hydro Energy
Action Type	Financial
Savings Amount	Till 2030, 300 MWh/year will be saved.
Responsible	İSKİ, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	300.000.000 EUR
Timing	2024-2030
Risks	Insufficient financing

İSKİ 2030 Advanced Renewable Energy Action Plan Proposal	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	Transport and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy Wind energy systems
Action Type	Finance and implementation
Savings Amount	By 2030, 600.000 MWh/year renewable energy generation will be planned.
Responsible	İSKİ, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	300.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

Table 27. Energy Conversion Actions of İSFALT A.Ş. in Buildings and Facilities Until 2030

Action	Energy efficiency in asphalt plants
Current Situation/Purpose	Asphalt Plants are very old and inefficient, aiming to be energy efficient
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Changing pumps, motors, drying, boiler, compressors New production methods and machinery ISO 50001 EnMS and Energy Monitoring Systems Energy Audit
Action Type	Financial
Savings Amount	Till 2030, 20.000 MWh/year will be saved.
Responsible	İSFALT-İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision, application, and additional financing
Estimated Cost	30.000.000 EUR
Timing	2023-2030
Risks	Inability to allocate enough financing for purchasing

Action	Increase the use of renewable energy
Current Situation/Purpose	Decreasing energy consumption and carbon emissions
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Heat recovery PV Systems
Action Type	Financial
Savings Amount	Till 2030, 2.500 MWh/year will be produced.
Responsible	İSFALT, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	2.000.000 EUR
Timing	2024-2030
Risks	Insufficient financing

İSFALT 2030 Advanced Renewable Energy Action Plan Proposal	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	Transport and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy Wind energy systems
Action Type	Finance and implementation
Savings Amount	In 2030, 36.000 MWh/year renewable energy generation will be planned.
Responsible	İSFALT, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	20.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

Table 28. Energy Transition Actions of İSTAÇ A.Ş. in Buildings and Facilities Until 2030

Action	Energy efficiency in facilities and buildings
Current Situation/Purpose	Decreasing energy consumption and carbon emissions
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	New Scada and automation systems Pumps, motors and HVAC renovations Process Renovations ISO 50001 EnMS and Energy Monitoring Systems
Action Type	Financial
Savings Amount	Till 2030, 17.600 MWh/year will be saved.
Responsible	İSTAÇ-İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	not determined yet
Estimated Cost	11.016.000 EUR
Timing	2023-2030
Risks	Inability to allocate financing for purchasing systems

Action	Increase the use of renewable energy
Current Situation/Purpose	Decreasing energy consumption and carbon emissions
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	PV systems Bioenergy Heat recovery
Action Type	Financial
Savings Amount	Till 2030, 2.090 MWh/year will be produced.
Responsible	İSTAÇ, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	1.650.000 EUR
Timing	2024-2030
Risks	Insufficient financing

İSTAÇ Advanced Renewable Energy Action Plan Proposal for 2030	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	Transport and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Biogas, Wind energy Wind energy systems
Action Type	Finance and implementation
Savings Amount	In 2030, 8.000 MWh/year renewable energy generation will be planned.
Responsible	İSTAÇ, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	5.000.000 EUR
Timing	2023-2030
Risks	Insufficient self-financing

Table 29. Energy Transition Actions of İSTON A.Ş. in Buildings and Facilities Until 2030

Action	Increase the energy efficiency
Current Situation/Purpose	Decreasing energy consumption and carbon emissions
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Increase the steam generators efficiency, Burner Adjustments SCADA ISO 50001 EnMS and Energy Monitoring Systems
Action Type	Financial
Savings Amount	Till 2030, 2.000 MWh/year will be saved.
Responsible	İSTON, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	286.000 EUR
Timing	2023-2030
Risks	Insufficient financing

Action	Increasing Renewable Energy Production
Current Situation/Purpose	Decreasing energy consumption and carbon emissions
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	PV Systems
Action Type	Financial
Savings Amount	Till 2030, 5.000 MWh/year will be produced.
Responsible	İSTON-İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision, application and additional financing
Estimated Cost	4.000.000 EUR
Timing	2024-2030
Risks	Inability to allocate financing for purchasing systems

İSTON 2030 Advanced Renewable Energy Action Plan Proposal	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	Transport and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy Wind energy systems
Action Type	Finance and implementation
Savings Amount	By 2030, 15.000 MWh/year renewable energy generation will be planned.
Responsible	ISTON, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	10.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

Table 30. Energy Transition Actions of İHE A.Ş. in Buildings and Facilities until 2030

Action	Increase energy efficiency
Current Situation/Purpose	Manufacturing systems are very old and inefficient
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Changing Boilers, HVAC and Process
Action Type	Financial
Savings Amount	Till 2030, 7.819 MWh/year will be saved.
Responsible	İHE, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	500.000 EUR
Timing	2024-2030
Risks	Insufficient financing

Action	Renewable energy production
Current Situation/Purpose	Manufacturing systems are inefficient
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Heat Recovery Cogeneration PV Systems
Action Type	Financial
Savings Amount	Till 2030, 5.000 MWh will be produced.
Responsible	İHE-İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision, application, and additional financing
Estimated Cost	4.500.000 EUR
Timing	2024-2030
Risks	Inability to allocate enough financing for purchasing systems

İHE Proposal for the Advanced Renewable Energy Action Plan for 2030	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy and Waste Recovery Systems
Action Type	Finance and implementation
Savings Amount	In 2030, 36.000 MWh/year renewable energy generation will be planned.
Responsible	İHE, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	20.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

Table 31. Energy Transition Actions of METRO İSTANBUL in Buildings and Facilities Until 2030

Action	Increase the use of renewable energy
Current Situation/Purpose	İstanbul Metro is a railway system consisting of 189 stations. Efficiency will be achieved with renewable energy at stations and maintenance centers.
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Photovoltaic Systems. It is aimed to use 13 million kWh/year green energy with the installation of 8.6 MWp Solar Power Plant in the campuses.
Action Type	Financial
Savings Amount	Till 2030, 13.000 MWh/year will be produced.
Responsible	Metro İstanbul, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	7.700.000,00 EUR
Timing	2024-2030
Risks	Insufficient financing

Action	Increase the energy efficiency
Current Situation/Purpose	The İstanbul Metro is a railway the system which includes 189 stations, Buildings and HVAC, Lighting Systems etc. are inefficient
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053, Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Insulation of buildings With the use of LEDs and smart lighting technologies in lighting consumption, an annual 16.2 million kWh consumption improvement is aimed at 55%. Changing of Pumps, Motors, HVAC Systems Application of Energy Monitoring System and ISO 50001 EnMS
Action Type	Financial
Savings Amount	Till 2030, 16.200 MWh/year will be saved.
Responsible	Metro İstanbul, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Supervision- application and additional financing
Estimated Cost	Only with the use of LEDs in lighting consumption and smart lighting technologies, it is aimed to improve an annual consumption of 16.2 million kWh with 55%. (2.150.000 EUR). Other investments 1.500.000 EUR. Total 3.650.000 EUR.
Timing	2024-2030
Risks	Insufficient financing

METRO İSTANBUL 2030 Advanced Renewable Energy Action Plan Proposal	
Action	**Providing 50% of 2019 Building and Facility Electricity Consumption from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	Transport and Logistics Master Plan 2023-2053, National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy Wind energy systems
Action Type	Finance and implementation
Savings Amount	In 2030, 4.000 MWh/year renewable energy generation will be planned.
Responsible	METRO İstanbul and IMM
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, İlbank
Contribution of the Municipality	Project, site-land development, project, inspection-implementation, and additional financing
Estimated Cost	3.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

Table 32. Supplementary Energy Transition Actions of IMM and Other Affiliates/Companies

2030 Advanced Renewable Energy Action Plan Proposal of IMM and its 21 Affiliates	
Action	**To provide 50% of 2019 Building and Facility Electricity Consumption of IMM's 21 affiliates other than these 7 subsidiaries and affiliates from renewable energy in 2030**
Current Situation/Purpose	Not enough renewable energy generation and use
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High and long term.
Action Steps	Photovoltaic, Wind energy Wind energy systems
Action Type	Finance
Savings Amount	Until 2030, 13.000 MWh/year energy will be generated.
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Project, site-land development, project, inspection-implementation and additional financing
Estimated Cost	600.000.000 EUR
Timing	2024-2030
Risks	Insufficient self-financing

In order to achieve SECAP 40% emission reduction targets by 2030, as well as to produce 50% of the energy used in 2019 from renewable energy in 2030 as an advanced scenario, and to ensure greater energy efficiency, IMM will need a resource of approximately 2 Billion EUR. In order to achieve and manage these targets quickly and sustainably, it will also be planned to strengthen and increase the capacity of the unit that will monitor and manage these targets, results, and develop capacity, projects, mechanisms and models, financing, funds within IMM.

4.4.4. Additional Measures

In order to reduce energy consumption and promote the use of renewable energy sources, additional measures will be implemented (Table 33). These measures will include training and awareness-raising activities. Training will be conducted to educate people on the importance of energy conservation and the use of renewable energy sources. The training will cover topics such as energy efficiency, renewable energy technologies, and energy conservation practices. Awareness raising activities will also be conducted to inform people about the benefits of using renewable energy sources and the importance of energy conservation. These activities will include public campaigns, workshops, and seminars. The implementation of these additional measures will help to reduce energy consumption and promote the use of renewable energy sources.

Energy literacy training will be provided to IMM personnel to ensure the effective and efficient use of energy in buildings and facilities. Through these trainings, personnel will gain an awareness of energy efficiency and management, enabling them to apply these learnings to their own homes and neighborhoods. As a result, they will be more conscious of energy conservation and sustainability.

Table 33. Additional Energy Mitigation Measures for Buildings

Action	Increase awareness of staff for energy efficiency and less energy usage in IMM Buildings
Current Situation/Purpose	Staff awareness of energy efficiency is not at the desired level
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	To start information and education campaign for stuff of IMM for IMM's buildings and facilities
Action Type	Awareness and behavior change
Savings Amount	-
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural Resources, Governorate Energy Management Unit
Contribution of the Municipality	Organization of information campaign
Estimated Cost	10.000.000 EUR
Timing	2024-2030
Risks	Not enough financing for information campaign

4.5. MONITORING OF MITIGATION ACTIONS FOR BUILDINGS

Establishing a monitoring process is an important part of the implementation of the SECAP. This process allows for the measurement of progress towards the targets. It is essential to identify measurable and observable indicators that can be used to track progress and make timely decisions to ensure the implementation of measures and the achievement of results. These indicators must be easily understood and accounted for, and the responsible persons or institutions for the collection and presentation of data must be identified. Monitoring should include feedback from stakeholders, such as other local authorities, businesses, and citizens.

The suggested KPIs for monitoring the building related mitigation measures are given in Table 34.

Table 34. Suggested KPIs for Building Related Mitigation Measures

Measure	KPI	Indicator	Timeline	Responsible
Energy Management	ISO 50001 EnMS	Number of Buildings-Facilities	2023	IMM - Energy Management and Lighting Management Section
Energy Management	Energy Manager	Number of Buildings-Facilities	2023	IMM - Energy Management and Lighting Management Section
Energy Measurement and Management Sytems	Energy Monitoring and SCADA Systems	Number of Buildings-Facilities	2030	IMM - Energy Management and Lighting Management Section
Energy Efficiency	Energy Audit	Number of Buildings-Facilities	Every 7 years	IMM - Energy Management and Lighting Management Section

Measure	KPI	Indicator	Timeline	Responsible
Energy Efficiency	Decrease in Energy Consumption.	15% in Buildings	2023	IMM - Energy Management and Lighting Management Section
Energy Efficiency	Decrease in Energy Consumption.	40% in Buildings	2030	IMM - Energy Management and Lighting Management Section
Renewable Energy	Increase in Energy Production	10% in new Buildings	2025	IMM - Energy Management and Lighting Management Section
Renewable Energy	Increase in Energy Produc-tion	55%	2030	IMM - Energy Management and Lighting Management Section
Nearly Zero Building	Renewable Energy Usage	5%	2023	IMM - Energy Management and Lighting Management Section
Nearly Zero Building	Renewable Energy Usage	10%	2025	IMM - Energy Management and Lighting Management Section
Nearly Zero Building	Renewable Energy Usage	50%	2030	IMM - Energy Management and Lighting Management Section
Increase awareness of people for energy use mode shift to insulation, renovation and renewable energy usage	Number of awareness of campaigns	Number of people	Number/year	IMM, - Energy Management and Lighting Management SectionSubsidiaries/Affiliate Companies, NGOs and campaign providers

According to the above-mentioned KPIs, monitoring of energy consumption will be carried out in accordance with the actions specified in Table 35.

Table 35. Monitoring of Prioritized Mitigation Actions

Actions	Monitoring Frequency	Responsible Department
Promoting measures to improve energy efficiency in all buildings and demand side management	Yearly	IMM Energy Management and Lighting Management Section, Ministry of Energy and Natural Resources
District-scale new clean energy development (heating, cooling, power) - microgrid (PV, RES, Biomass, hydrogen fuel cell, other)	Monthly and Yearly	IMM Energy Management and Lighting Management Section
Taking additional measures towards renewable energy generation, energy and water saving in the projects planned by KIPTAS and BIMTAS	Yearly	IMM Energy Management and Lighting Management Section
Establishment of Energy Monitoring Center	Monthly and Yearly	IMM Energy Management and Lighting Management Section

4.6. ENERGY ACCESS AND POVERTY ASSESSMENT

IMM is primarily making plans to switch and access renewable energy for its buildings and facilities. In 2022, PV roof applications with an installed capacity of 3,3 MWe were carried out in 19 facilities.

In this context, efforts will be made to facilitate the production of sustainable, accessible, and affordable electricity for all citizens with suitable roofs and residential, industrial and commercial facilities. Technical support and municipal approvals will be expedited to enable citizens to establish energy cooperatives and to promote community-oriented energy production. Technical project supervision and monitoring services will be provided to ensure that these initiatives are successful.

In 2020-2021 pandemic, IMM launched campaigns to pay the electricity and natural gas bills of citizens who were unable to pay their energy bills, particularly during the pandemic. Through these campaigns, tens of thousands of citizens' bills were successfully paid.

IMM is committed to tackling energy poverty, recognizing the connection between lack of access to affordable energy, poverty, inequality, and environmental issues. Inefficient building insulation and heating systems can lead to higher energy bills, creating a financial and health burden for many households. This can also cause health risks due to mold, cold, and low indoor air quality, further deepening the poverty of the most vulnerable population groups and widening the social inequality gap in cities. Additionally, inefficient buildings with high energy demands from fossil fuels contribute to higher greenhouse gas emissions than efficient dwellings. IMM is determined to address these issues and reduce energy poverty.

IMM is planning to join forces with TMMOB, Yıldız Technical University and İstanbul Technical University (İTÜ) and other universities to combat energy poverty in İstanbul. Through this partnership, university students will receive training from TMMOB to carry out simple energy audits in households that are struggling to pay their energy bills and to implement low-cost energy improvements. More than 4 million households in İstanbul are having difficulty in paying their energy bills. IMM is keen on taking action to eradicate energy poverty. This partnership between the IMM and TMMOB, sectoral associations, Yıldız Technical University and İTÜ will be an important step towards achieving this goal.

This project proposed in this context has three main objectives: mapping energy-poor households, implementing low-cost energy-efficiency measures, and providing advice on how to reduce energy use. The 4th grade students in a university program will be engaged to help vulnerable households in İstanbul reduce their energy consumption.

During the initial mapping and training phase, a group of hundred students, researchers, and university teachers will be trained by experts and TMMOB as well as sectoral associations to carry out social field research and energy audits. As energy poverty is not part of the engineering curriculum, IMM will choose vulnerable households to target and will invite them to participate in the project. Students will then conduct field visits to implement simple, low-cost energy efficiency interventions and gather data through surveys.

Over the course of five years, 1000 households will be visited and provided with low-cost energy-efficiency measures such as LED bulbs, draught-proofing of windows and doors, water-saving aerators, rooftop solar PV and timers for electric boilers. These measures, installed by students at no cost, will result in improved living conditions and long-term benefits.

By utilizing standard calculations, households can save up to 200 kg of CO2 and more than 1000 kWh of electricity and heat annually. As part of the program, students will advise households on the most cost-effective and energy-efficient measures based on a model for wall-retrofitting investments. This model demonstrates that wall-retrofitting investments with external thermal insulation are cost-effective for 30-50% of households (depending on heating systems and wall materials) with a payback period of 6-8 years or less, and other ancillary benefits such as improved human health due to better living conditions.

This multi-stakeholder collaboration provides simple, low-cost energy-efficiency measures to energy-poor households. Furthermore, university students experience carrying out simple energy audits and implement field research methods and become agents for a fair energy transition. Table 36 provides an overview of the activity.



Table 36. Project Proposal for Combating Energy Poverty and Deprivation of Households

Action	Konutlarda enerji verimliliği ve daha az enerji kullanımı için saha uygulamalarının başlatılması, teknik destek sağlanması
Current Situation/Purpose	Low-income households need to increase their access to energy and use of efficient affordable energy.
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Energy audits, energy monitoring and some improvement works in 1000 low-income houses
Action Type	Training 100 Engineering Faculty students on energy efficiency and energy Management, and then providing measurement, monitoring and implementation in 1000 residences.
Savings Amount	Electricity reduction of 1000 kWh/year per household
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural resources, Ministry of Environment, Urbanization and Climate Change, Governorate Energy Management Unit, TMMOB, Universities, sectoral associations
Contribution of the Municipality	Organization of trainings, selection of low-income households, logistics and technique in the execution of the process, energy measurement and change-transformation-improvement material support, etc.
Estimated Cost	10.000.000 EUR
Timing	2024-2028
Risks	Not enough financing for campaign

Other projects suggested are explained in Table 37 and Table 38.

Table 37. Project Proposal for Combating Energy Poverty and Deprivation of Households

Action	Establishment of an Energy Cooperative for the residences to produce their own electricity and to make "citizen's solar power plant" (YES)
Current Situation/Purpose	Low-income households need to increase their access to clean energy and use of affordable energy.
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Feasibility, project and cooperative implementation of installing rooftop or remote solar energy in 1000 low-income houses
Action Type	Training of 100 Engineering Faculty students on renewable energy feasibility and application by TMMOB and solar energy associations, and then providing measurement, project and application in 1000 residences
Savings Amount	Electricity reduction of 1000 kWh/year per household
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, Governorate Energy Management Unit, sectoral associations
Contribution of the Municipality	Organization of trainings, selection of low-income households, logistics and technique in the execution of the process, energy measurement and change-transformation-improvement material support, etc.
Estimated Cost	10.000.000 EUR
Timing	2023-2030
Risks	Insufficient funding for the campaign

Table 38. Project Proposal for Combating Energy Poverty and Deprivation of Households

Action	Establishment of "Alo Energy Advisory Desk" (AEDM) to manage the energy efficiency transformation and renewable energy awareness and demands of the residences.
Current Situation/Purpose	It is necessary to accelerate the energy efficiency conversions of low-income households and their transitions to insulation and heat pumps, and to increase their access to clean energy and their use of low-priced energy.
Relationship to Existing Plans	National Energy Efficiency Improvement Action Plan 2024-2030
Priority Level	High
Action Steps	Establishing 4 energy desks in different centers of IMM (2 on the European and 2 on the Anatolian Side),
Action Type	100 Engineering Faculty students are trained on energy efficiency and renewable energy feasibility and application by TMMOB, Energy Efficiency and Management Association, sector solar energy associations, and then detailed information given on grant, support, access to credit, survey, project and post-implementation control to those who demand.
Savings Amount	1000 kWh/year electricity reduction and 2000 m^3 natural gas reduction per household
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Energy and Natural Resources, Ministry of Environment, Urbanization and Climate Change, Governorate Energy Management Unit, Universities, TMMOB, Sectoral Associations etc.
Contribution of the Municipality	Establishment of desks and organization of trainers and volunteer experts, primarily announcing and reaching low-income households, logistics and technical, measurement and application-improvement material consultancy etc. provided in the execution of the process.
Estimated Cost	3.500.000 EUR
Timing	2023-2030
Risks	Insufficient funding to set up and maintain this desk

4.7. SUMMARY

The energy consumption and GHG emissions for the baseline year 2019 were determined through an activity-based approach. This approach enabled the development of comprehensive data on energy consumption, allowing for a more accurate assessment of energy use.

SECAP focuses exclusively on the actions of the İstanbul Metropolitan Municipality, so separate Building Energy Improvement and Energy Action and Mitigation Plans have been created for both the İstanbul City and the İstanbul Metropolitan Municipality (IMM).

Main benefits of the proposed mitigation actions in İstanbul will be:

1. Reduced energy consumption and carbon emissions: improving energy efficiency in building would lead to lower energy consumption and carbon emissions, helping to mitigate climate change and improve air quality in İstanbul.

2. Lower costs: Implementing energy efficiency measures can help reduce natural gas and electricity costs, as well as maintenance costs for buildings, ultimately leading to lower overall expenses for citizens in İstanbul.

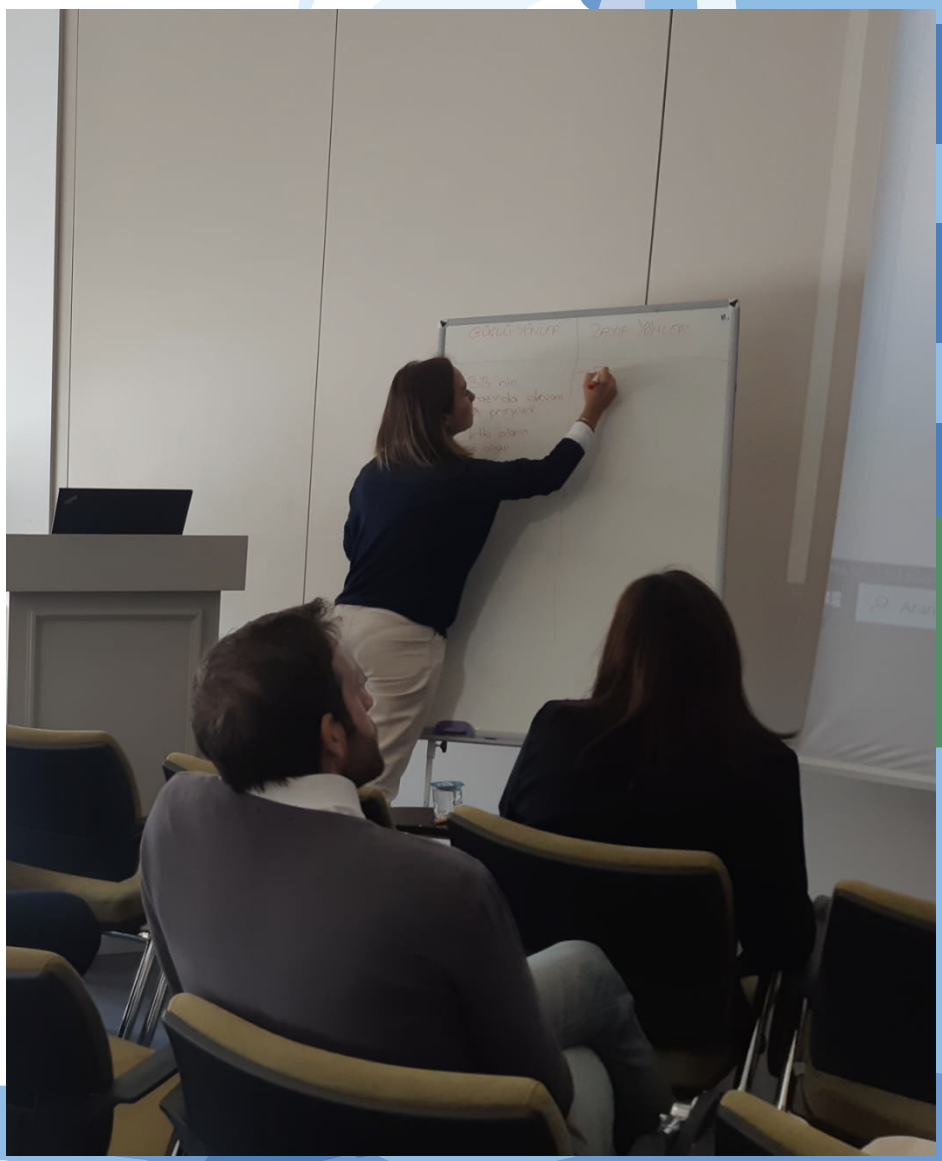
3. Enhanced quality of life: By reducing energy and carbon emissions, improving air quality both indoors and outdoors, and increasing energy efficiency, the quality of life for İstanbul citizens could be significantly enhanced.

4. Increased regional renewable energy: As renewable energy production increases, fossil fuel consumption decreases, digitalization in electrification and energy is implemented, and micro smart grids are established, both energy supply security and more suitable energy will be achieved. This will result in a more sustainable energy system.

Overall, increased energy efficiency in the building sector in İstanbul would be a beneficial move providing significant economic, social, and environmental benefits, making it a worthwhile investment for the city and its citizens.





















5. TRANSPORT SECTOR

5.1. INTRODUCTION

Connecting Europe and Asia, İstanbul is a city famous for its rich history, vibrant culture and stunning architecture. As of 2023, the population of İstanbul has reached 15.907.951[58] and its urban area has reached 125.000 hectares. It hosts a diverse population with a rich demographic structure and various transportation options that serve its visitors every day. Over 12 million foreign visitors come to İstanbul each year. From the traditional modes of transport like ferries and trams to the modern options like buses and metro lines, İstanbul has a transport system that is constantly evolving to meet the needs of its people and visitors.

As of 2022, there are 26.482.847 motor land vehicles with an average age of 14,8 in Türkiye. The high average age is disadvantageous both in respect of fuel economy and environment. However, according to the latest available data from the İstanbul Metropolitan Municipality, there were 4.940.010 registered motor vehicles in İstanbul as of the end of 2022.

Buses

Buses are the most common form of public transportation in İstanbul. There are 6.470 buses as of 2022 in İstanbul that provide transportation to millions of passengers every day. These buses are operated by İETT and cover different routes throughout the city. The average age of buses is 9,5 years as of the end of 2022, with the newest models renewed with modern technology and amenities such as air conditioning, free Wi-Fi, and USB charging ports. The buses of İETT provide transportation for over 1 billion passengers annually. However, the main challenges faced by the bus system in İstanbul are traffic congestion, insufficient bus lanes, and insufficient capacity during peak hours. The main targets for the bus system in İstanbul is to shorten travel times with separated bus lanes, ensure the continuity of line optimization studies, integrate smart transportation systems, increase accessibility, safety and security for all, and increase service quality by minimizing environmental negative effects.

58 https://data.tuik.gov.tr/Bulten/Index?p=49685#:~:text=T%C3%BCrkiye'de%202021%20y%C4%B1l%C4%B1nda%20%93,6%2C6'ya%20d%C3%BC%C5%9Ft%C3%BC.&text=%C4%B0stanbul'un%20n%C3%BCfusu%2C%20bir%20%C3%B6nceki,907%20bin%20951%20ki%C5%9Fi%20oldu

Trams

Trams are another popular form of public transportation in İstanbul. The trams cover several routes across the city, including the historic and tourist areas. These trams are operated by İstanbul Electricity, Tramway, and Tunnel Company (İETT) and offer transportation for millions of passengers every year. In terms of journeys per year, the trams provide transportation for over 150 million passengers. The main challenge faced by the tram system in İstanbul is the limited capacity during peak hours.

Metro

The metro is a rapid transit system that provides transportation to millions of passengers in İstanbul. There are currently eleven metro lines with 133 stations in İstanbul, with more under construction or in the planning stage. The metro lines cover different parts of the city and are operated by METRO İstanbul. The fleet size of the metro trains is significant, with the newest models accommodating up to 1.200 passengers. In terms of journeys per year, the metro provides transportation for over 757 million passengers. However, the main challenge faced by the metro system in İstanbul is the high construction costs and long construction times for new lines. The target for the metro system in İstanbul is to expand the network to connect more areas of the city and reduce the reliance on private cars.

Nevertheless, the transportation sector plays an important role for preparation of IMM SECAP, as it is one of the main macro-sectors that should be described in SECAP, according to the Reporting guidance of the Covenant of Mayors for Climate and Energy (CoM). The transportation sector in İstanbul is responsible for 28% of total emissions and the single most significant source, on-road transportation.

In order to change the situation and to prevent increasement of vehicles and CO_2 emissions it is needed to increase energy efficiency and usage of renewables, to build a sustainable transport system in country, increase transport modes and integration between modes, reduce unit fuel consumption of vehicles, and develop policies and strategies that minimizes damage to the environment.

5.2. THE MAIN LEGISLATION

Main legal acts for increasing energy efficiency and reducing CO_2 emissions in transport sector are as follows:

The Energy Efficiency Strategy, a major document which addresses energy efficiency in transport in our country, aims to reduce unit fossil fuel consumption of motor vehicles, increase the share of railroads in passenger and freight transport and of urban public transport, prevent unnecessary fuel consumption in urban transport, and reduce emissions harmful to the environment.

The Climate Change Action Plan 2011-2023 aims, among other things, to use transport modes in a balanced way for passenger and freight transport, restructure urban transport in line with sustainable transport principles, scale up the use of alternative fuels and clean car technologies, and improve energy efficiency in the sector.

In addition, there are measures for the transport sector in the **National Intelligent Transport Systems Strategy** (2014-2023) of the Ministry of Transport, Maritime Affairs and Communications which aims to adapt information and communication technologies to the transport sector.

The Energy Efficiency Law No. 5627 enforced in 2007 defines its fundamental purpose as to use energy effectively, avoid waste, ease the burden of energy costs on the economy, and improve efficiency in using energy resources and energy to protect the environment.

The National Climate Change Strategy of 2010-2023 aims to increase energy efficiency and reduce greenhouse gas emissions in buildings, industry, transport and energy sectors.

The National Energy Efficiency Action Plan (2017-2023) sets measures to be taken regarding the transportation sector to increase energy efficiency and reduce CO2 emissions. Below there are the general actions of the plan regarding the transport sector:

- Promoting energy efficient vehicles by introducing tax advantages for highly energy efficient, low emission, environment-friendly, small motor volume vehicles including fuel-cell, electric and hybrid vehicles.

- Develop benchmarking on alternative fuels and new technologies which will scale up vehicles that use alternative fuels and/or new technologies.

- Develop and improve bicycle and pedestrian transport to scale up

zero-emission transport to ensure sustainable urban and regional transport.

- Reduce traffic density in cities: Discourage use of automobiles. Implement effective control of street-parking of vehicles, dissuasive parking fee system, and establish smart parking area systems in order to reduce traffic density in urban centers.

- Promote public transport. Develop infrastructure and mobility plans to promote public transport systems.

- Develop and implement institutional restructuring for urban transport: Support the institutional restructuring of local organizations which will prepare national and local transport master plans to ensure sustainable transport.

- Strengthen maritime transport. Improve current technology, infrastructure and relevant legislative framework including energy efficiency to strengthen maritime transport.

- Strengthen rail transport. Transfer a part of cargo and passenger transport from road to railways on account of high-capacity rail infrastructure.

The Transportation and Logistics Master Plan 2023-2053

Main objects of the plan are to reduce logistics costs and increase service/response speed in line with sustainable mobility, to carry out efficient logistics activities on a regional basis.

- In cooperation with non-governmental organizations representing the sector, maintenance, and repair services of transportation and logistics infrastructure, vehicles and equipment will be developed to spread the freight traffic over time by using the flexibility in loading and delivery times and to realize optimizations that will benefit from the logistics infrastructure at the highest level.

- Efficiency and productivity will be increased in transportation.

- Efficiency, productivity, and service quality will be increased in logistics centers.

- Cooperation will be made with relevant institutions in order to increase efficiency and productivity in customs.

- The quality and competency of transportation and logistics services will be increased, and costs will be reduced.

İstanbul has a well-developed complex transport system, with the provision of multiple modes of public transport, with extensive walking and cycling and private car use. As the most economically prosperous region within Türkiye it also has extensive transport networks and connections to the rest of the country.

Reducing emissions from energy consumption in buildings and transportation largely coincides with the strategy and activities of IMM till 2050. In addition, due to the city's high population, traffic density and energy costs, citizens' knowledge, and willingness to reduce emissions such as public transportation, clean energy and energy efficiency will support the work of IMM in these areas.

5.3. TRANSPORT SECTOR IN IMM

In İstanbul, where more than 30 million journeys are made daily, the public transportation system plays a vital role in supporting the economy and providing citizens with access to basic services such as jobs, health, and education with healthy and environmentally sustainable options. In recent years, heavy investment has been made in the city's public transport system. 74% of public transport journeys are made by rubber-tyre types (bus and minibus). If the expansion of İstanbul's rail system network is completed as planned, the share of the rail system in public transport will nearly double from 24% to 47%. The rail system network is growing gradually, and the public transportation system is developing in parallel with the widespread use of smart transportation technologies.

İstanbul has a total rail system network of 262,15 km and a rail system project with a total length of 208,90 km is under construction (Figure 21). 103,30 km of these projects are carried out by the Ministry of Transport and Infrastructure. Metrobus, Marmaray and other rail system lines have been put into service in the city in recent years. Public transport projects have increased social inclusion and improved access to economic, social, and cultural opportunities for people living in the periphery of the city.

Another issue that needs to be addressed in terms of the public transportation system in İstanbul is sea transportation. The city has four different coasts, in the north and south, in addition to the Bosphorus and Golden Horn coasts. With a coastline longer than 500 km, İstanbul has a great potential in terms of sea transportation.

The share of sea transportation in daily public transportation journeys in İstanbul is approximately 2,5%. Seaside crossings are at the forefront of the journeys where sea transportation can be used more effectively in İstanbul.



Figure 21. İstanbul Railway Network Map

Active modes of transportation (walking and cycling) play a very important role in reducing the environmental impacts of transportation and contributing to a healthy life. It is very important to plan and design streets in a way that supports and encourages walking and cycling, thereby improving the quality of life of the citizens. However, walking on city streets is not safe and enjoyable due to low infrastructure standards, street crowds (trash cans, street lamps, signs, temporary barriers, etc.), occupation of sidewalks by automobiles and shopkeepers (shops, cafes). On the other hand, the awareness of the citizens about the benefits of walking is also low. Although the proportion of trips made on foot is high (around 40% of total trips), İstanbul cannot be described as a walkable city in terms of the opportunities it offers to pedestrians.

In İstanbul, the bicycle is used for sports and recreation activities rather than being a means of transportation. Despite some recent institutional developments, planning and infrastructure works, there is a need for significant breakthroughs in issues such as a holistic and safe bicycle network and bicycle parking. As of the end of 2022, there are 451,85 km of bicycle paths in İstanbul. In addition, a bicycle sharing program is implemented throughout the city. Cycling plays an important role in the first and last kilometer journeys in İstanbul. To this end, feeder bike routes need to be created to connect public transport stops and hubs with important services such as housing, work, and education.

Micro-mobility options such as electric bikes and electric scooters are becoming increasingly popular these days. Although they are not seen as active mobility, micro-mobility options are technologies that cannot be ignored. It is very important to implement electric sharing services as this service is getting more popular also in other big cities.

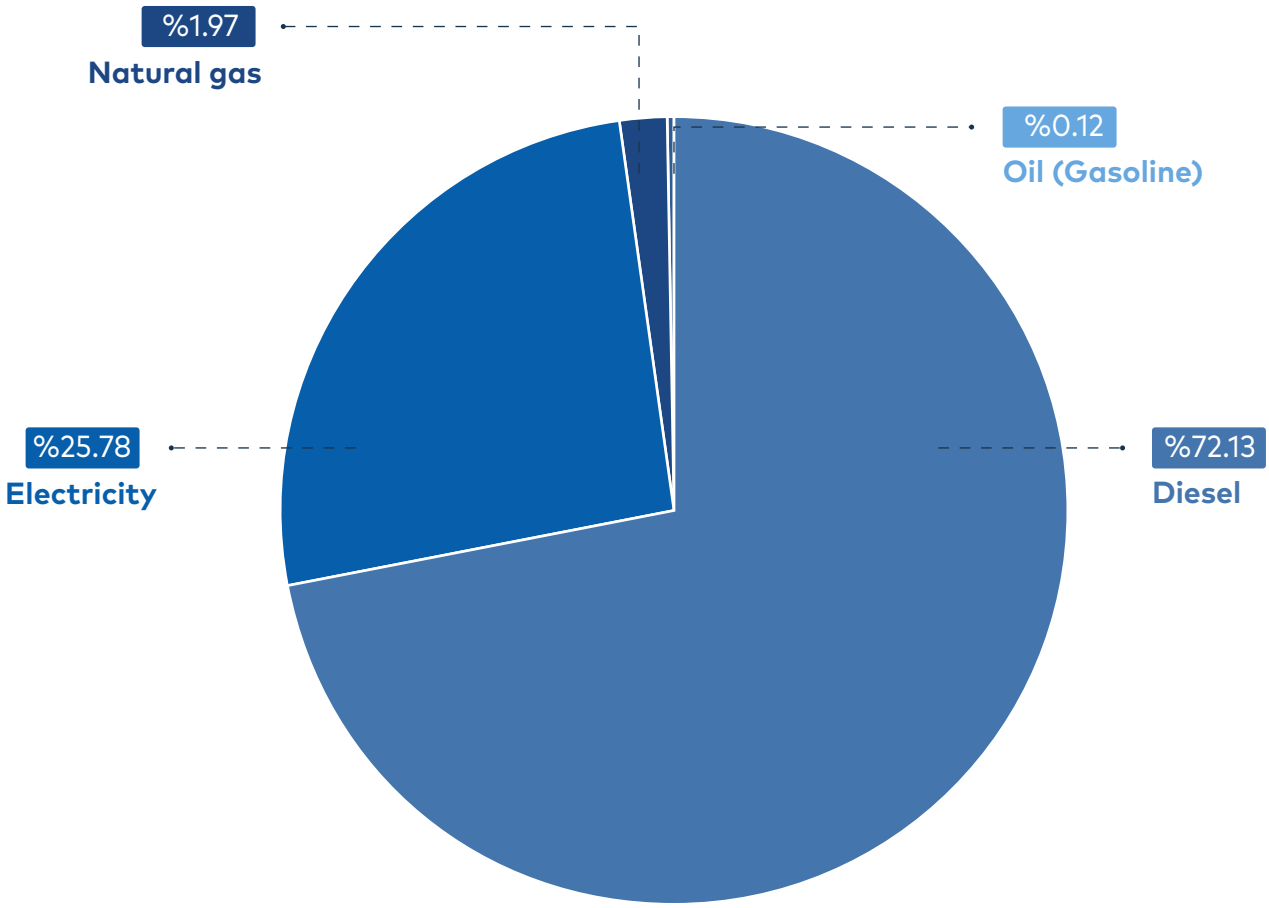
In 2019, the transportation sector in İstanbul covers 28% of the total GHG emissions. Road transport is the most important source of GHG emissions in the transport sector. This activity comes mostly from private cars and a significant number of buses. The 2019 inventory presented in Baseline Emission Inventory Section includes emissions from rail and water-borne navigation, but these represent less than 1% of total transportation emissions[59].

The biggest share in greenhouse gas emissions related to transportation comes from diesel consumption. Respectively, gasoline, LPG and public transportation electric are the sources that make up the other transportation greenhouse gas inventory (Figure 22).

59 İstanbul Climate Change Action Plan, 2021 https//cevre.ibb.istanbul/wp-content-uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

CO_2 EMISSIONS BY FUEL TYPE

Figure 22. Sources of Transportation GHG Inventory



The population of İstanbul is forecast (Figure 23) to increase by 22% to 17,9 million in 2030, by 35% to 19,7 million in 2040 and by 46% to 21,3 million in 2050 compared to 2015.

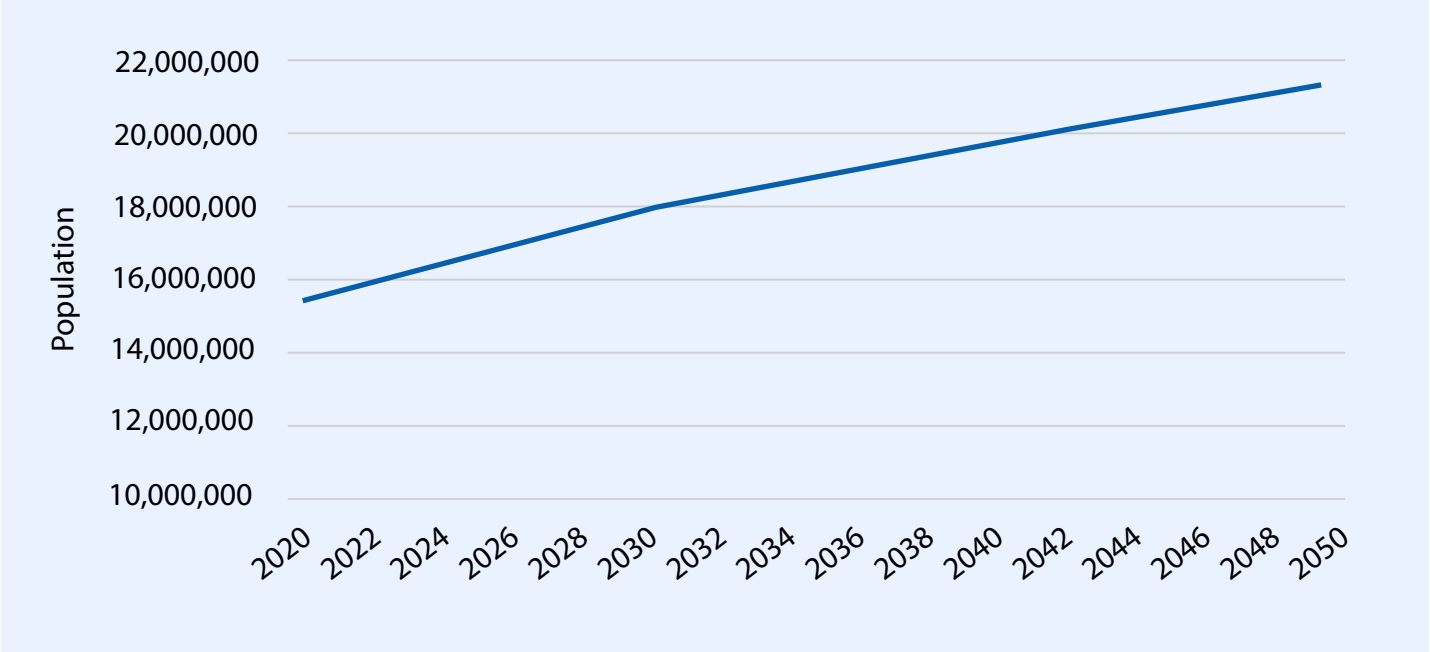


Figure 23. Population Forecast for İstanbul

In 2040, it is expected that the total number of daily trips will increase to 38,1 million, the total number of daily public transportation trips will increase to 11,1 million, and the share of the rail system in public transportation trips from 24,6% in 2020 to 47,2%. In 2020, there are 191 cars per 1.000 people in İstanbul. Considering the current number of registered motor vehicles in the city, it has been determined that if policies to reduce private vehicle use are not implemented, car ownership will increase by 39% between 2020-2040 and traffic congestion problems will continue.

The density of heavy vehicles in the road network causes serious road safety problems as well as carbon emissions and air pollution. In particular, for the problems caused by the circulation of construction materials in the city necessitates the production of safe, environmentally friendly, low-cost and smart logistic solutions.

This means that vehicles fleet also increase together with the other types of public transportation such as railways and buses. It is important for İstanbul to act on this matter considering that it is a coastal city rapid urbanization that is highly vulnerable

to climate change induced hazards including flooding, drought, and urban heat island effect. If İstanbul does not act now, it will feel the effects of climate change in the future. Strategic vision is that with integrated and efficient solutions, increasing public transportation for the transportation sector, pedestrianization by increasing the rate of bicycle use, replacement of municipality and service vehicles with low-carbon alternatives, smart signaling and optimization studies, smart parking, etc. It can be said that additional work on shared vehicle use and electric vehicle incentives with applications, the change of public transportation in energy efficient vehicles, and providing a behavioral change in reducing fuel consumption by providing training to drivers who actively use vehicles on economical driving techniques is needed.

Three categories have been identified as the sources of GHG emissions related with transportation:

- Transportation on road – municipal vehicle fleet, including affiliate companies;

- Transportation on railways (trams and subway);

- Transportation waterborne navigation (public marine transport).

The transportation sector of affiliate companies is responsible for 42,6% of energy consumption of all companies' consumption. So, this is a very important sector and much effort of public institutions and investments to the infrastructure will be needed.

For example, to increase the share of electric vehicles increasement of charging infrastructure is necessary and additional charging should be foreseen in public places, public institutions, companies, buildings and private houses. Together with that the security and reliability of the electricity grid should remain at the same level.

5.4. TRANSPORT SECTOR MITIGATION ACTIONS OF IMM AND ITS SUBSIDIARIES/AFFILIATE COMPANIES

The strategic aim of the transport sector is to promote sustainable modes of transport such as walking, cycling, using public transport, increasing urban rail systems, encouraging the increase in the use of sea and rail transport instead of road transport in both freight and passenger transport.

Strategic targets for transport are set in the İstanbul Climate Change Action Plan for all types of transports are provided in Table 39.

Table 39. İstanbul City Strategic Targets for Emission Reduction in Transport[60]

Theme	Strategy	Target	2030	2040	2050
Mod shift – cycling	Increased bicycle use	Proportional journeys by bicycle	1%	5%	--
Mod shift – from passenger cars	Reduced vehicle use	Passenger automobile use	15%	14%	--
		Use of mini/microbus	--	1%	--
Mode shift –transport	Shift to public transportation	Ratio of journeys by metro	8%	13%	--
		Ratio of journeys by Light Rail	3%	5%	--
		Ratio of journeys by Commuter rail	--	1%	--
Passenger car – fuel switch	Electrification of cars and taxis	Electric cars and taxis	65%	80%	100%
	Electrification of trucks	Electric trucks	30%	50%	100%
	Electrification of motorcycles		30%	50%	100%

60 İstanbul Climate Change Action Plan, 2021. Table 11. Targets for Emission Reduction.

Theme	Strategy	Target	2030	2040	2050
Passenger car – efficiency	Increasingly efficient vehicles	Improvement in km/liter of all vehicles	8%	14%	20%
Public transport – fuel switch	Electric minibuses/ minibuses	Electric mini/micro buses	100%	--	--
	Electric buses	Electric standard bus	30%	--	--
		Electric metrobus	30%	100%	--
	Electric commuter train	Diesel	--	0%	--
		Electric	--	100%	--
	Electrification of ferry boats	Electric ferries	10%	30%	100%

As transport sector consumes 2.184.836,01 MWh of energy, all measures will lead to reduction of energy consumption by 40% or 873.934,4 MWh till 2030.

During energy consumptions process initial consumption data about energy, was collected from the 28 affiliates/subsidiaries and from this data 7 subsidiaries/affiliate companies were identified as the ones that have the most impact on energy consumptions and who has their energy efficiency plans and targets of energy-using and emission-emitting. These companies are İETT, İSTAÇ, İSTON, İSFALT, İSKİ, İHE and Metro İstanbul (see Section 4).

In order to reach these targets, the actions they will take measures until 2023 and 2030 as a result of the long-term studies of the 7 subsidiaries/affiliate companies, the reductions they can achieve with their energy efficiency investments and renewable energy investments.

Apart from these targeted and planned actions, other energy efficiency and renewable energy investments required for 40% reduction by 2030 will be planned and implemented over the years.

5.4.1. Measures for Public Buses under İETT

İETT is public bus company affiliated to IMM and which has the bus fleet a total of 6,200 vehicles built by MAN, Ikarus, Mercedes-Benz, BMC, Phileas, Otokar, Temsa and Güleryüz and there are 783 bus lines excluding diversions.

İETT will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030. Main measure is electrification of buses, but also it is important to increase shift mode from cars to public buses by 10 % till 2030 (Table 40).

Table 40. GHG reduction mitigation measures of İETT

Action	Electrification of buses
Current Situation/Purpose	İETT is the bus company responsible for urban transportation. Which has the bus fleet a total of 6200 vehicles built by MAN, Ikarus, Mercedes-Benz, BMC, Phileas, Otokar, Temsa and Güleryüz
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053
Priority Level	High
Action Steps	By new electric buses an 100% conversion of Metrobus line and 30% of other buses
Action Type	Financial
Savings Amount	Till 2030, 814.100 MWh or 70 million liters of fuel will be saved.
Responsible	İETT, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and additional financing
Estimated Cost	600.000.000 EUR
Timing	2023-2030
Risks	Inability to allocate financing for purchase of new buses, insufficient charging infrastructure, higher cost of electric

Action	Increase the use of public buses
Current Situation/Purpose	İETT is the bus company responsible for urban transportation. which has the bus fleet a total of 6200 vehicles built by MAN, Ikarus, Mercedes-Benz, BMC, Phileas, Otokar, Temsa and Güleryüz
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053
Priority Level	High
Action Steps	Increase the use of public buses by 10% till 2030 Open new lines for public buses for better connection in the city by 10%
Action Type	Financial
Savings Amount	Till 2030, 29.050 MWh will be saved due to the shift mode.
Responsible	İETT, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and additional financing
Estimated Cost	20.000.000 EUR
Timing	2023-2030
Risks	Inability to allocate financing for purchase of new buses, insufficient charging infrastructure, higher cost of electric

5.4.2. Measures for Rapid Transit Railways Under METRO İstanbul

METRO İSTANBUL will reduce energy consumption by 40% in 2019 with its existing and additional energy reduction and renewable energy action plans and investments until 2030 (Table 41).

The İstanbul Metro is a rapid transit railway network that serves the city of İstanbul, Türkiye. It is operated by Metro İstanbul, a public enterprise controlled by the İstanbul Metropolitan Municipality. The oldest section of the metro is the M1 line, which opened in 1989; the system now includes 189 stations in service with 929 number of wagons in operation.

The system consists of ten lines: the lines designated M1A, M1B, M2, M3, M6, M7 and M9 are on the European side of the Bosphorus, while Lines M4, M5 and M8 are on the Asian side. The European and Asian networks do not connect directly but have been linked to each other through the Marmaray system since 2013. İstanbul Metro is connected with the underground systems of the Marmaray tunnel (which connects the lines on the city's European and Asian sides) and the F1 funicular, and with the surface network of the T1 and T4 tram systems as well as the T5 tram.



Table 41. GHG reduction mitigation measures of Metro İstanbul

Action	Energy efficiency in rail ayatem
Current Situation/Purpose	The İstanbul Metro is a railway the system which includes 189 stations in service with 929 number of wagons in operation.
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053
Priority Level	High
Action Steps	Optimizing train speeds and modeling expedition planning according to maximum recovery of train braking energy. In cases where the expedition planning cannot be modeled, the energy obtained by recycling is pumped back into the grid, converted into a form that can be used in different auxiliary units or used over storage systems. The above 2 actions should be applied together in energy saving practices aimed at reducing the use of train energy. It is aimed to improve energy consumption by 40% and 60 million kWh annually on lines where the two actions can be applied together. At electric vehicle charging stations, in order to reduce AC to DC power losses, an annual improvement of 5 million kWh is aimed by using the DC power supply used by the trains and supporting it with train recovery.
Action Type	Financial
Savings Amount	Till 2030, 65.000 MWh will be saved.
Responsible	Metro İstanbul, IMM
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and additional financing
Estimated Cost	88.000.000 EUR
Timing	2023-2030
Risks	Inability to allocate financing for purchasing braking systems, insufficient charging infrastructure, higher cost of electricity. Vehicle charging stations are not close to Metro lines and infrastructure support cannot be provided. Impacts that can be experienced in the travel planning according to the passenger density.

Action	Increase the use of Metro system
Current Situation/Purpose	The İstanbul Metro is a railway the system which includes 189 stations in service with 929 number of wagons in operation.
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053
Priority Level	High
Action Steps	Increase the use of Metro system by 5%.
Action Type	Financial
Savings Amount	Till 2030, 2.100 MWh will be saved.
Responsible	Metro İstanbul, İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and additional financing
Estimated Cost	To be determined
Timing	2023-2030
Risks	Insufficient financing and higher electricity prices

5.4.3. Additional Measures

The electrification of the transport sector will require significant investment in order to establish charging infrastructure and purchase electric vehicles. Additional GHG reduction mitigation measures for transportation are presented in Table 42.

Table 42. Additional GHG reduction mitigation measures for transportation

Action	Electrification of cars
Current Situation/Purpose	From all motorized trips about 19.5 percent of trips are made by private car, so it is very important to increase share of electric cars ins this sector
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053
Priority Level	High
Action Steps	To increase the number of electric cars by 124,000 vehicles, by making priority to electric cars in street driving, free parking, share of electric cars and additional measures which promote the use of electric cars
Action Type	Regulation
Savings Amount	Till 2030, 620.000 MWh of energy will be saved.
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and regulation
Estimated Cost	To be determined
Timing	2023-2030
Risks	No support for adaption of regulation or motivation system, insufficient charging infrastructure, higher cost of electricity

Micro-mobility options such as bicycles, electric bikes and electric scooters are becoming increasingly popular these days. Although they are not seen as active mobility, micro-mobility options are technologies that cannot be ignored. It is very important to implement electric sharing services as this service is getting more popular also in other big cities.

Action	Increase the use of micro-mobility options
Current Situation/Purpose	Cycling and use of electric bikes or scooters still not very popular in these days, so additional measures needed to make them more practical and popular
Relationship to Existing Plans	The Transportation and Logistics Master Plan 2023-2053
Priority Level	High
Action Steps	To increase the share of daily trips by bicycles, electric bikes and scooters by 5%.
Action Type	Regulation
Savings Amount	Till 2030, 200.000 MWh of energy will be saved.
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and regulation
Estimated Cost	To be determined
Timing	2023-2030
Risks	No support for adaption of regulation or motivation system, insufficient charging infrastructure, higher cost of electricity

Action	Positive energy places
Current Situation/Purpose	Not many places in the city are without crossing of motorized vehicles
Relationship to Existing Plans	SUMP
Priority Level	Medium
Action Steps	To increase the area of places without motorized vehicles by 5 %.
Action Type	Regulation
Savings Amount	To be determined
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Supervision and regulation
Estimated Cost	To be determined
Timing	2023-2030
Risks	No support for adaption of regulation

Action	Increase awareness of people for transport mode shift to public transport or micro-mobility
Current Situation/Purpose	As there many measures related to the transport mode shift it is necessary to start awareness campaign for citizens which should motivate and educate them to transport mode shift
Relationship to Existing Plans	SUMP
Priority Level	Medium
Action Steps	To start information and education campaign for citizens.
Action Type	Regulation
Savings Amount	To be determined
Responsible	İstanbul Metropolitan Municipality
Stakeholders	Ministry of Transport
Contribution of the Municipality	Organization of awareness campaign
Estimated Cost	1.000.000 EUR
Timing	2023-2030
Risks	No financing for awareness campaign

5.5. MONITORING OF TRANSPORTATION SECTOR MITIGATION ACTIONS

Establishing a monitoring process is an important part of part of implementation of the SECAP, which allows to measure progress toward the targets set in SECAP.

For each measure, it is very important to determine a measurable and observable indicator that would allow monitoring the progress of the measure and allow timely decisions to be made to ensure the implementation of the measure and the achievement of results. Indicators must be measurable, easily understood and accounted for. It is also necessary to identify responsible persons or institutions for the purposes of monitoring, which will be responsible for the collection and presentation of data. The suggested KPIs for monitoring the mitigation of transportation related measures are given in Table 43.

Table 43. Suggested KPIs for Transportation Related Mitigation Measures

Measure	KPI	Indicator	Timeline	Responsible
Electrification of buses	Number of new electric buses bought	Units	Units/year	İETT
Increase the use of public buses	Number of new bus lines opened	Units	Units/year	İETT
Energy efficiency in rail system	Number of trains modernized	Units	Units/year	Metro İstanbul
Increase the use of Metro system	Trip number	Number	Trips/year	Metro İstanbul
Electrification of cars	Number of charging places installed	Units	Units/year	IMM
Electrification of cars	Number of free parking places approved for electric cars	Units	Units/year	IMM
Increase the use of micro-mobility options	The number of bicycles, electric scooters and electric bikes provided for citizen	Number	Number/year	IMM, service providers
Positive energy places	Area of positive energy places	m^2	m^2/year	IMM
Increase awareness of people for transport mode shift to public transport or micro-mobility	Number of people reached	Number	Number/year	IMM, campaign providers

5.6. SUMMARY

The main results of the energy efficiency studies in the transportation sector presented above for İstanbul are as follows:

1. **Reduced energy consumption and carbon emissions:**
Improving energy efficiency in transportation would lead to lower energy consumption and carbon emissions, helping to mitigate climate change and improve air quality in İstanbul.

2. **Lower costs**
Energy efficiency measures could also lead to lower fuel and maintenance costs for transport operators and individuals, helping to reduce the overall financial burden of transportation in İstanbul.

3. **Improved traffic flow**
By reducing congestion and travel times, energy-efficient transportation could improve traffic flow and reduce the overall stress and frustration associated with transportation in İstanbul.

4. **Enhanced quality of life**
With less congestion, better air quality, and more efficient transportation options, the quality of life for İstanbul residents could be significantly improved.

5. **Increased competitiveness**
Energy-efficient transportation could also help İstanbul become more competitive, by reducing the overall costs of transportation and making it a more attractive destination for businesses and visitors.

Overall, increasing energy efficiency in the transport sector in İstanbul would have significant economic, social, and environmental benefits, making it a worthwhile investment for the city and its residents.





















6. IMM WASTE, WATER AND WASTE WATER ACTION AND MITIGATION PLANS

6.1. BACKGROUND

6.1.1. İstanbul City-Wide Waste Profile

The city-wide waste sector is controlled and managed by IMM through its affiliated company İSTAÇ and district municipalities. Mixed domestic wastes collected from households and workplaces by 39 district municipalities are brought to solid waste transfer stations of İstanbul Metropolitan Municipality. The processes of transportation, recovery, energy generation and final disposal of domestic wastes from solid waste transfer stations to recycling and disposal facilities are managed by İstanbul Metropolitan Municipality. An average of 18.000 tons of household waste is generated daily in İstanbul. As of 2022, 1.162 tons of the waste generated is recycled by the district municipalities, and the remaining 16.838 tons/day of domestic waste is processed by IMM by sending 19% to the Waste Incineration and Energy Production Facility, 10% to the recycling facilities and 71% directly to the landfills. 12.015 tons of domestic waste per day is transported by IMM to the recycling and disposal facilities from the IMM Solid Waste Transfer Stations on the Anatolian and European Sides with waste transport trucks. Domestic waste production per capita in İstanbul is in the range of 1,1 – 1,2 kg/day.

In accordance with the Zero Waste Regulation and the Metropolitan Municipality Law, the separate collection and recycling of waste at the source is the responsibility of the district municipalities. By the District Municipalities, packaging wastes and household wastes from households and workplaces are collected separately and the packaging wastes are sent to licensed collection, sorting, and recycling facilities.

Biodegradable waste, such as park and garden waste and marketplace waste are collected separately at the source by the district municipalities and are sent to fermentation in Kemerburgaz Compost Facility. Biodegradable waste is composted and used as a soil conditioner for landscaping purposes in İstanbul's parks and gardens. As of 2021, food and food waste from institutions and organizations such as hotels and restaurants are collected separately by IMM and sent to Biomethanization Facilities, where they are recycled to produce energy and fertilizer.

Industrial quality non-recyclable textiles, paper, bags, nylon, fiber, etc. are collected separately by the district municipalities and are processed in Kemerburgaz Waste-Derived Fuel Facility to produce solid fuel and are given to cement factories as additional fuel.

An average of 86 tons of medical waste is collected and disposed daily from 9.651

health institutions, of which 12% is incinerated in a medical waste incineration facility and remaining 88% is sterilized in the sterilization facility and disposed of in the sanitary landfill.

Landfill gas (methane) generated in landfills is collected by gas collection pipes and burned in gas engines to produce electrical energy. In 2022, IMM produced 1.306.115,5 MWh of electricity from waste with its recycling and disposal facilities.

6.1.2. Waste Water

In İstanbul, İSKİ (İstanbul Water and Sewerage Administration, affiliated company of IMM) is responsible for water supply and treatment, sewarage system and waste water treatment. Waste water is collected by collectors and directed through tunnels to waste water treatment plants (WWTPs). The total length of the waste water channel network in İstanbul in 2019 was 16.461 km and in 2021 it is 18.304 km.

According to İSKİ 2019 Activity Report, there are 87 WWTPs in İstanbul with different capacities according to the needs of the areas it serves. In 2022, the number of WWTPs increased to 90. Waste water treatment plants are divided according to treatment process types as pre-treatment, biological waste water treatment based on carbon removal, and advanced biological waste water treatment based on nitrogen and phosphorus removal. According to İSKİ 2019 official data, the total capacity of the listed WWTPs in İstanbul is 5.812.000 m3/day. In 2022, the amount is 6.230.010 m3/day. According to the İSKİ 2019 Annual Report, the daily average amount of waste water treated at WWTPs in 2019 is 3.784.358 m3/day. In 2022, the daily average amount of waste water treated at WWTPs was 4.074.336 m3/day. Many advanced waste water treatment plants have been built taking the sub-basin characteristics into account. Given the two-layer flow structure of the Bosphorus watercourse, the plants were planned as preliminary treatment along the Bosphorus and other plants on the Marmara coastal areas have been built with advanced biological treatment specifications. Part of the biologically treated effluent is used for the irrigation of recreational areas (parks) as well as for industrial purposes. Significant energy is generated from the treatment plants as well.

6.1.3. Potable Water Supply

98% of the water resources of İstanbul are surface water resources. 75% of the water resources are in the Asian part of İstanbul while 25% is within the European part. In contrast, 60% of the population reside in the European section of the city whereas the rest live in the Asian part necessitating transmitting water from Asia to Europe. Water from rainfall times is impounded in dams and regulators, and then supplied to

the city following necessary treatment processes. To meet the growing water demand in İstanbul due to population increase and geographical expansion of service areas, potable water is provided from a long range of sub-basins extending from Kırklareli province in Europe to Düzce province in Anatolia. In 2019, İstanbul consumed 1,06 billion m³ water per year and 2,9 million m3 per day. In 2022, the average water consumption was 3,02 million m3/day. In the summer season, the city water demand peaks and exceeds 3,5 million m³ per day. The rough terrain of the city and conveying water from far distances lead to high energy consumption for pumping.

Water is collected in dams and natural lakes, then transferred to treatment plants via transmission lines. There are 18 surface water resources in İstanbul, including 2 natural lakes, 7 dams and 9 regulators. İstanbul has 14 surface water resources with storage, namely Pabuçdere, Kazandere, Sultanbahçe, Elmalıdere, Büyükdere, Kuzuludere, Düzdere, Terkos, Büyükçekmece, Sazlıdere, Alibeyköy, Elmalı-2, Ömerli, and Darlık. However, although the facilities in Sultanbahçedere, Elmalıdere, Büyükdere, Kuzuludere and Düzdere have storage, these 5 facilities operate like regulators because their active volumes are very limited. In addition, there are 4 facilities, namely Melen, Isaköy, Sungurlu and Yesilvadi, where water is taken with a regulator structure that does not have a storage volume. Accordingly, drinking water is provided to İstanbul with 18 facilities, 9 of which are with storage and 9 with regulators. Furthermore, there are 145 potable water wells feeding the regions of Silivri and Çatalca. The annual yield of potable water resources equals 1,6 billion m3. The total amount of raw water taken from water resources in 2019 was 1.087.970.256 m3 and 1.075.977,041 m3 of this amount was supplied from surface water resources[61].

Water collected in the resources is delivered to drinking water treatment plants and the network via transmission lines reaching a total length of 3.130 km in 2021. The rough geography and distance of water resources to the city brings about a large energy requirement. In every stage between the water resource and house taps, pumping systems are installed to enable pressure supply. In 2021, pumps of various capacities in 119 pumping stations all around İstanbul provide water to all corners of the city. In 2021, pumps of various capacities in 119 pumping stations located all over İstanbul provide water to all parts of the city. The electrical energy consumption of 117 pumping stations is presented in the İSKİ 2019 Annual Report. The electrical energy consumption of raw water pumping centers is 690.352.859 kWh/year, the electrical energy consumption of clean water pumping centers is 230.343.454 kWh/year

61 https://www.iski.gov.tr/web/assets/SayfalarDocs/faaliyetraporlari/faaliyetraporu/pdf/2019-FAAL%C4%B0YET-RAPORU.pdf

and the electrical energy consumption of waste water pumping centers is 18.678.350 kWh/year. Energy supply and efficiency in water sector is analyzed in the Energy Efficiency Chapter of IMM SECAP report.

Raw water in the drinking water resources reaches the water treatment plants via transmission lines for the required treatment processes. There are 21 water treatment plants in İstanbul. Ozonation technology is adopted in these facilities with a total capacity of over 4,4 million m3/day in 2019 to enable provision of drinking water complying with national and international standards. The total capacity in 2021 was about 4,9 million m3/day. There are 154 water storage tanks of various sizes in different parts of İstanbul in 2021. Constructed to provide water consumption balance, save energy, and minimize water cuts that may occur due to breakdowns and energy cuts, the total capacity of these tanks amounts to 1.792.080 m3 in 2021. Upon treatment, the water is supplied to the city via transmission lines and eventually through the drinking water distribution system. The drinking water network was 19.518 km in 2019 and 19.891 km in 2021.

6.1.4. Targets and Actions in Waste Management

The "İstanbul Waste Management Plan" has been prepared in line with the "Deadline 2020" Commitment, which aims to make İstanbul a Carbon Neutral and Resistant City by 2050 and will be published after its approval. In the waste management plan, prepared in accordance with the C40 targets and national targets, the goal is to stop dumping the waste directly to the landfills by 2050 and to produce energy from nearly 29% of waste and to recover nearly 71% of the generated waste.

The goal is to build an additional facility with a total capacity of 10.950 tons by the end of 2050, primarily by increasing the investments in the Mechanical Biological Treatment Facility. It is also aimed to make an additional investment for waste-to-energy plant, with additional 6.000 tons of waste capacity by the end of 2050.

IMM has already acted in the waste management sector since C40 report was published and while SECAP report is prepared.

At the Kemerburgaz Waste Incineration and Energy Generation Facility, which was put into operation in 2021, an average of 3.000 tons of domestic waste is processed per day, and approximately 15-16% of the waste generated in İstanbul is incinerated.

As 45% of the domestic waste generated is biodegradable (organic) waste, one of the important topics in reducing and recycling waste is the management of biodegradable wastes. In this context, in line with the Provincial Environment Board Decision taken in 2021, biodegradable wastes from places with high biodegradable waste generation throughout İstanbul, such as hotels, restaurants, public institutions and organizations, hospitals, educational institutions, have been started to be collected by IMM. In Kemerburgaz Biomethanization Facility, which was put into operation in 2021, electrical energy is produced from biogas formed by anaerobic digestion process. In the Kömürcüoda Biomethanization Facility on the Asian side also electrical energy is produced from mixed domestic wastes by anaerobic digestion. Biodegradable Waste Management will be disseminated throughout İstanbul and a large part of the waste will be recovered. In addition, awareness of citizens will be increased by continuing information sharing, trainings and activities within the scope of cooperation with experts on waste management, non-governmental organizations and other civil initiatives.

In the Circular Works Workshop, which was put into operation in 2021, upcycling activities and prototype product designs are carried out with the participation of citizens and producer groups from corporate waste generated from IMM units. The scope, number and effectiveness of Upcycling workshops will be increased. Zero waste certificate has been obtained for 7 main service buildings within the body of IMM, and efforts for obtaining zero waste certificates in other buildings and campuses are continuing. At the same time, periodic zero waste awareness training is given in the training module established for all municipal administration employees. The operation of the existing facilities, additional investments and other activities are covered by transferring them from the IMM general budget to the Waste Management Branch Directorate's budget annually.

6.1.5. Targets and Actions in Water and Waste Water Management

65% of İstanbul`s population live in the European part of the city while the rest reside in the Asian part. Yet, the case is the opposite when it comes to water resources. For this very reason, transferring water between the continents was inevitable. Considering the population expected to top 20 million in the future, the Greater İstanbul Water Supply project has been undertaken

by the State Hydraulic Works (DSİ) under the Ministry of Agriculture and Forestry to supply the city's ever-growing water needs. In an inter-basin and inter-continental manner, water is taken from the Melen Creek in another province, Düzce, from 170 km and Bosphorus Crossing Tunnel was established.

Besides the tunnel section, the Greater İstanbul Water Supply Melen System[62] project to secure the drinking water supply to İstanbul until the year 2071, includes the Cumhuriyet Water Treatment Plant (capacity of 720.000 m3/day), the Melen Transmission Line and pumping stations, the Melen Dam (total impoundment volume of 694 million m3) and Regulator and the Sungurlu Dam. The completed facilities (Cumhuriyet Water Treatment Plant, Melen Transmission Line and Bosphorus Tunnel) have been transferred to İSKİ for operation and maintenance.

İSKİ is actively executing different actions to improve waste water management capacity. Waste water construction activities carried out by İSKİ include all kinds of waste water networks, collectors, pumping stations and lines and tunnel constructions, creek rehabilitation and storm water canal constructions with its jurisdiction.



62 https://bolge14.dsi.gov.tr/Sayfa/Detay/1191

6.2. WASTE AND WASTE WATER MANAGEMENT ACTION-MITIGATION PLANS

All other EU and Türkiye SECAP Reports present general targets and action-mitigation plans for the city and the whole municipality in general and waste sector is included in SECAPs as non-energy related sector.

The waste sector accounts for 9% of the emissions in İstanbul (Table 44). The vast majority (89%) of these are due to solid waste disposal. It is seen that the remaining approximately 11% of waste sector emissions originate from waste water treatment (5%), industrial waste incineration (3%) and composting (2%).

Table 44. Waste Sector Data and Emissions in 2019

IMM corporate	Amount	tCO_2e
Waste management (solid waste disposal)	18.467 ton	11.252
Waste management (biological treatment)	645 ton	113
Waste incineration (medical and hazardous waste)	63.958 ton	29.110
Waste water treatment plant	18.136.209 m^3	1.984
Subtotal	**-**	**42.459**

İstanbul city wide		tCO_2e
Waste management (solid waste disposal)	6.291.673 t	4.007.800
Waste management (biological treatment)	258.736 t	113.590
Waste incineration (medical and hazardous waste)	134.317 t	119.861
Waste water treatment plant	1.381.290.767 m^3	241.002
Subtotal	**-**	**4.482.252**

IMM provided the city wide targets for GHG mitigation in the waste, water and waste water sectors in İstanbul Climate Action Plan as presented in Table 45.

Table 45. İstanbul City Targets Set for Emission Mitigation[63]

Sector	Theme	Strategy	Target	2030	2040	2050
Waste	Landfill waste removal	Landfill removal	Removal of waste from landfill	-	50%	100%
	Recycling	Paper waste recycling	100% paper recycling by 2030	100%	-	-
	Recycling	Plastic waste recycling	100% plastic recycling by 2030	100%	-	-
	Organic waste	Park and garden waste recycling	Anaerobic digestion	50%	-	-
	Incineration	Textile waste removal from landfill	Waste derived fuel production facility	5%	50%	-
	Incineration	Diversion/removal from incineration	Diversion/removal from incineration	-	50%	100%
	Landfill gas capture	Increase landfill gas capture	Landfill gas capture	75%	%85	-
Water	Waster loss	Water loss reduction	Waster loss reduction	18%	23%	32%
	Water use	Water use reduction	Water use reduction	8%	11%	-
Waste-water	Wastewater treatment	Waste water reuse	Activated treatment with nitrogen removal and anaerobic digesters	72%	-	-

63 İstanbul Climate Change Action Plan https://cevre.ibb.istanbul/wp-content/uploads/2022/01/ist_iklim_degisikligi_eylem_plani.pdf

6.3. WASTE, WATER AND WASTE WATER SECTOR MITIGATION ACTIONS OF IMM AND ITS SUBSIDIARIES/AFFILIATE COMPANIES

The waste and waste water and GHG reduction mitigation measures of IMM are presented in the Table 46 - Table 50.

Table 46. Making Improvements in Solid Waste Management

Action	Removal of waste from landfills
Current Situation/Purpose	When IMM 2019 greenhouse gas inventory is analyzed, the share of emissions from solid waste disposal corresponds to 9% in the total city inventory. With this action, it is aimed to make improvements in solid waste management.
Relationship to Existing Plans	İstanbul Provincial Zero Waste Management Plan, İstanbul Climate Change Action Plan, İstanbul Waste Management Plan
Priority Level	High
Action Steps	Carrying out studies to reduce the amount of waste in İstanbul district Removal of discarded materials from solid waste landfills by recycling and reducing them into new products
Action Type	Plan/strategy, investment
Responsible	İSTAÇ, İstanbul Metropolitan Municipality
Stakeholders	İSTAÇ, District Municipalities, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Guide and implementer
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Inability to improve waste management by enterprises and industrial facilities, insufficient increase in recycling and recovery rates, difficulty in implementation and lack of cooperation due to high costs

Action	Using more efficient waste transport vehicles
Current Situation/Purpose	Currently waste collection operations (routes, pickup schedules) have more room to be optimized and thus there are unnecessary trips and detours performed by waste transport vehicles. Environmental impact and total GHG emissions could be decreased by optimizing trips and increasing efficient vehicles.
Relationship to Existing Plans	İstanbul Waste Management Plan, İstanbul Climate Change Action Plan
Priority Level	Medium
Action Steps	Optimization of waste collection operations (routes of waste vehicles, waste collection hours) to reduce environmental impacts and total GHG emissions Monitor fuel consumption of waste collection vehicles Monitor amount of emissions from waste collection vehicles Electrification of waste collection vehicles
Action Type	Plan/strategy
Responsible	İSTAÇ, İstanbul Metropolitan Municipality
Stakeholders	İSTAÇ, District Municipalities, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Guide and implementer
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	-

Action	Recycling of food and garden waste
Current Situation/Purpose	Currently the rate of recycling of food and garden waste is relatively low. Biodegradable (food and kitchen waste) wastes are processed by anaerobic digestion method in the biomethanization plant. Park and garden waste collected from markets and markets are also processed in the compost and recycling facility. With this action, it is aimed to make improvements in solid waste management.
Relationship to Existing Plans	İstanbul Climate Change Action Plan
Priority Level	Medium
Action Steps	Developing programs to reduce or completely prevent the disposal of any food waste during the processing, use, storage, sale, preparation, cooking and service of food Promote and increase separate collection of food waste Increase amount of compost waste
Action Type	Plan/strategy, investment
Responsible	İSTAÇ, İstanbul Metropolitan Municipality
Stakeholders	İSTAÇ, District Municipalities, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Guide and implementer
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Practical and technological; legal and corporate

Action	Increasing landfill gas capture rate
Current Situation/Purpose	As a result of the decomposition processes of the organic matter of the waste, landfill gas is produced. The main components of which are carbon dioxide and methane, while the methane content is in the order of 50-55%. Currently, methane released from landfill to ambient air is increasing GHG emissions and not all the methane is collected and used. It is planned to increase the landfill gas capture rate.
Relationship to Existing Plans	İstanbul Climate Change Action Plan
Priority Level	High
Action Steps	Preventing direct methane release to the atmosphere by capturing landfill gas from solid waste landfill and using it as electricity, heating or transportation fuel.
Action Type	Plan/strategy, investment
Responsible	İSTAÇ, İstanbul Metropolitan Municipality
Stakeholders	İSTAÇ, District Municipalities, Ministry of Environment, Urbanization and Climate Change
Contribution of the Municipality	Guide and implementer
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Practical and technological; financial and economic

Table 47. Reducing Emissions from Waste Water Treatment Processes

Action	Reuse of waste water
Current Situation/Purpose	In IMM 2019 greenhouse gas inventory, emissions from waste water treatment processes have a share of 0,45% in the total city inventory. With this action, it is aimed to reduce emissions from waste water treatment processes.
Relationship to Existing Plans	İstanbul Climate Change Action Plan
Priority Level	High
Action Steps	Supporting waste water recovery and reuse Preliminary studies are carried out to ensure the use of more sustainable and nature-friendly systems for the entire facility, which is managed within the metropolitan authority and where the waste water of the district is transmitted. The use of advanced environmental technologies to ensure process efficiency in the facility where the waste water of the district is transmitted. Carrying out R&D studies with universities in order to develop efficient and emission-preventing practices for the waste water treatment plant. Ensuring cooperation with relevant institutions and organizations to improve the process emissions for the facility where the wastes are transmitted.
Action Type	Investment project (public)
Responsible	İSKİ, and İstanbul Metropolitan Municipality
Stakeholders	İSKİ, Ministry of Environment, Urbanization and Climate Change, Ministry of Agriculture and Forestry, Ministry of Education, State Hydraulic Works; Professional Chambers, Organized Industrial Zones; District Municipalities; all Municipalities in the Marmara Region; Industrialists.
Contribution of the Municipality	Strategy/plan, investment
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Difficulty in implementation and lack of cooperation due to high costs

Table 48. Conducting Awareness Studies on Waste & Waste Water

Action	Conducting awareness studies on waste & waste water
Current Situation/Purpose	On the subject of waste and waste water, IMM organizes seminars for schools on zero waste, recycling and recovery. Greenhouse gas reduction can be achieved by ensuring the continuity of the work done and increasing the area of influence. With this action, it is aimed to carry out awareness studies to reduce emissions from waste and waste water.
Relationship to Existing Plans	İstanbul Climate Change Action Plan
Priority Level	High
Action Steps	Organizing incentive campaigns and competitions for waste reduction Increasing awareness to reduce the use of single-use plastics Ensuring increasing interest in the subject in competitions related to recycling to be organized in schools Online public release of annual/monthly environmental bulletin Establishing an incentive mechanism for the implementation of zero waste policy and recycling measures in commercial and public institutions
Action Type	Behavioral
Savings Amount	No reduction amount is foreseen for this activity, which will affect the reduction indirectly
Responsible	IMM
Stakeholders	Ministry of Environment, Urbanization and Climate Change, Ministry of National Education, İstanbul Metropolitan Municipality and schools
Contribution of the Municipality	Practitioner and mentor
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Inability to allocate time for trainings, inability to change citizen behavior patterns

Table 49. Reducing Water Use

Action	Water use reduction
Current Situation/Purpose	Conserving water saves energy. Energy is needed to treat, heat and pump water for domestic utilization, so reducing your water use also reduces GHG emissions.
Relationship to Existing Plans	İstanbul Climate Change Action Plan
Priority Level	High
Action Steps	Revise building and municipal code to encourage water use reduction, on-site water reuse, and recycling; Awareness rising actions for citizens Change of pipelines in regions with high water loss (if any) Implementation of monitoring and reporting system of recycling and water footprint amount, grey water usage rate Application of sustainable rainwater solutions (rain gardens, use of permeable materials, storage, etc.) Continuous monitoring of groundwater levels Installation of stormwater collection tanks Establishing roof gardens
Action Type	Investment project (public)
Responsible	İSKİ, and İstanbul Metropolitan Municipality
Stakeholders	İSKİ, Ministry of Environment, Urbanization and Climate Change, Ministry of Agriculture and Forestry, Energy and Natural Resources Ministry; State Hydraulic Works; District Municipalities; Forest management, TOKI
Contribution of the Municipality	Strategy/plan, investment
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Difficulty in implementation and lack of cooperation due to high costs

Table 50. Reducing Water Loss

Action	Water loss reduction
Current Situation/Purpose	The water loss/ leakage reduction may lead to the achievement of the significant savings in power consumption, reducing the need for new water resources, and water treatment facilities.
Relationship to Existing Plans	İstanbul Climate Change Action Plan
Priority Level	High
Action Steps	Management of supply lines and drinking water network with smart systems Establish new intelligent systems devices and digital tracking system
Action Type	Investment project (public)
Responsible	İSKİ, and İstanbul Metropolitan Municipality
Stakeholders	İSKİ, Ministry of Environment, Urbanization and Climate Change, Ministry of Agriculture and Forestry, Energy and Natural Resources Ministry, State Hydraulic Work, District Municipalities, Forest management, TOKI
Contribution of the Municipality	Strategy/plan, investment
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Difficulty in implementation and lack of cooperation due to high costs

6.4. SUMMARY

İstanbul Metropolitan Municipality through its affiliated company İSTAÇ and district municipalities are responsible of waste management sector in İstanbul city. Approximately 18.000 tons of municipal waste is collected each day in İstanbul and domestic waste production per capita is in range of 1,1-1,2 kg/day. According to Zero Waste Regulation and the Metropolitan Municipality Law, the waste is collected separately by type at the source and recycling is responsibility of the district municipalities. Today biodegradable waste is collected and composted in Kemerburgaz Compost Facility and used as a soil conditioner for green areas in Instanbul. Also, from 2021 food waste from different institutions are collected and treated in biomethanization facilites and energy and fertilizers are produced. Industrial quality non-recyvlable materials are collected and processed in Kemerburgaz Waste-Derived Fuel Facility and RDF (refuse-derivied fuel) is produced. Medical waste is either incinerated in special incineration facility or sterilized and disposed to landfill. Landfill gas is collected from landfilles to produce electricity.

The "İstanbul Waste Management Plan" has been prepared in line with the "Deadline 2020" Commitment, which aims to make İstanbul a Carbon Neutral and Resistant City by 2050 and will be published after its approval. In the waste management plan, prepared in accordance with the C40 targets and national targets, the goal is to stop disposing the waste directly to the landfills by 2050 and to produce energy from ca 29% of waste and to recover ca 71% of the generated waste. IMM has made strategic plans and already taken actions to improve collection process of different waste type and increase the capacity to recycle, reuse and energy production from waste and also to rise awareness among citizens and instititions to avoid of producing of waste.

İSKİ is responsible for water supply and treatment, sewarage system and waste water treatment in İstanbul. According to İSKİ 2019 Activity Report, there were 87 WWTPs in İstanbul with different capacities according to the needs of the areas it serves (in 2022 are 90 WWTPs) and the daily average amount of waste water treated at WWTPs in 2019 was 3.784.358 m^3/day (in 2022, 4.074.336 m^3/day). İSKİ is actively executing different actions to improve waste water management capacity and find possibilities for waste water recovery and reuse.

98% of the water resources of İstanbul are surface water resources. To meet the growing water demand in İstanbul due to population increase and geographical expansion of service areas, potable water is provided from a long range of sub-basins extending from Kırklareli province in Europe to Düzce province in Anatolia. In 2019, İstanbul consumed 1,06 billion m^3 water per year and 2,9 million m^3 per day (in 2022, 3,02 million m^3/day). The rough terrain of the city and conveying water from far distances lead to high energy consumption for pumping. Thus, it is essential to find different solutions (technical and awareness rising) to reduce water consumption and water losses.

The waste and waste water treatment capacity for baseline year 2019 was mapped to calculate GHG emissions. Baseline inventory shows that IMM corporate waste and waste water treatment emissions (42.459 $MtCO_2e$) comprise about 3% of total municipal corporate emissions. Main source of corporate emissions is solid waste disposal and incineration. The majority of emissions from the waste sector, detailed in this report, originate from the solid waste disposal and incineration sub-sectors.

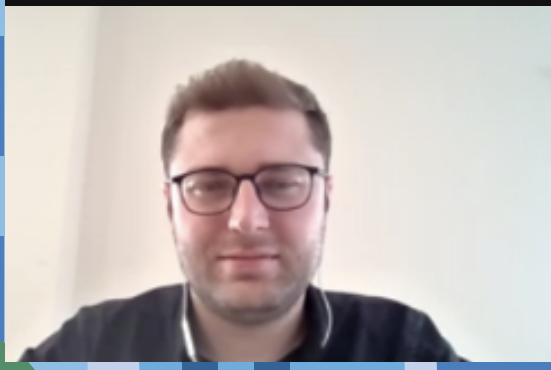
İstanbul is committed to reducing its GHG emissions in the future and the goal is to achieve net-zero emissions by 2050. Thus IMM has set effective targets for emission reduction in waste, water and waste water sector. IMM target in waste sector is to improve waste management practices and increase waste recovery rates by 2050. It is essential to decrease the rate of water losses and water usage in water sector and to improve waste water recovery and reuse in waste water sector.





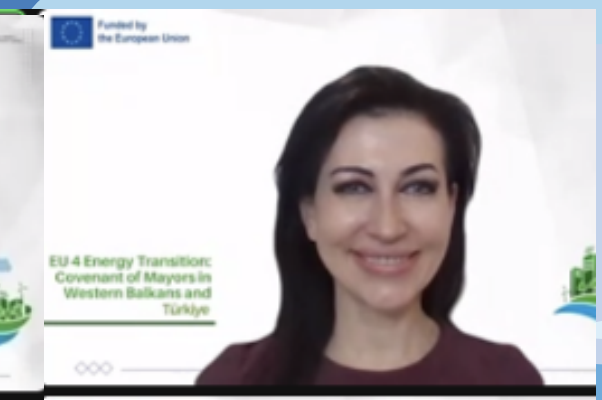




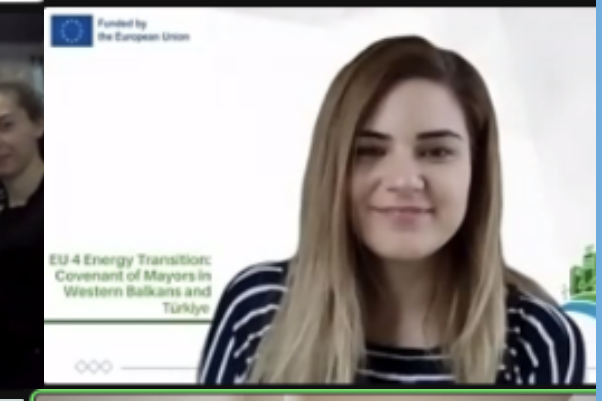






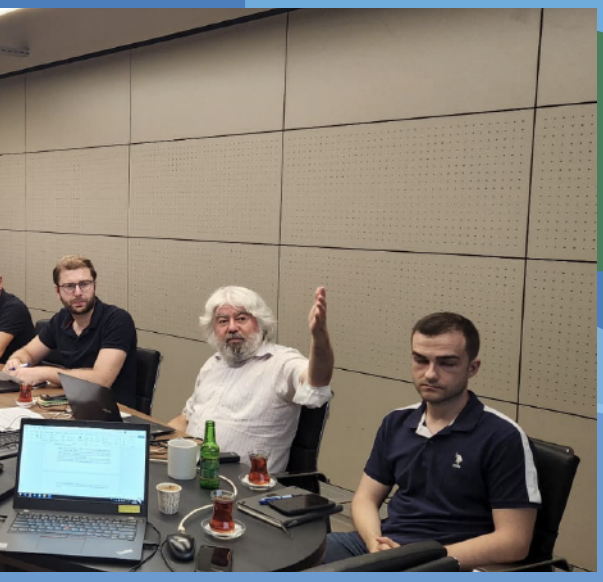

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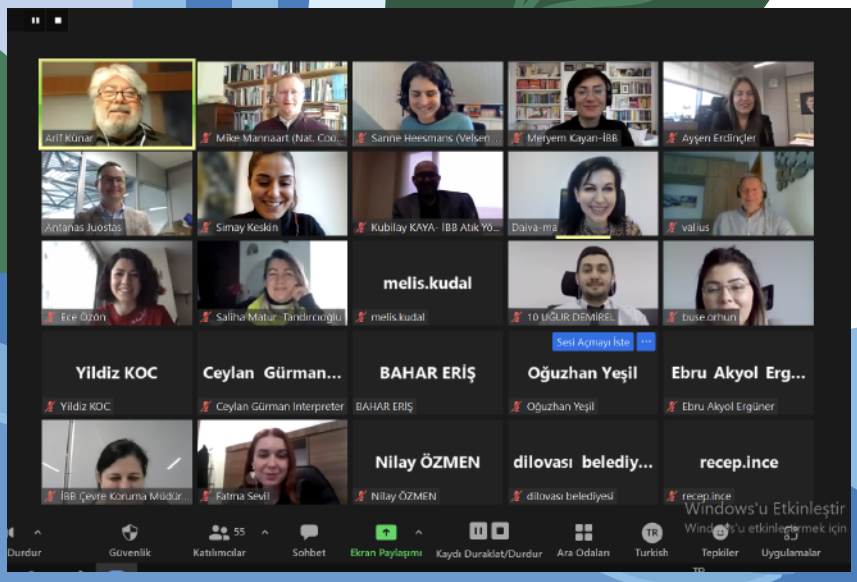



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İBB Çevre Koruma Müdür...
Fatma Sevil
Nilay ÖZMEN
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dilovası belediyesi
recep.ince
recep.ince
Durdur
Güvenlik
Katılımcılar
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Sohbet
Ekran Paylaşımı
Kaydı Duraklat/Durdur
Ara Odaları
Turkish
Tepkiler
Uygulamalar
Windows'u Etkinleştir



7. GHG EMISSION PROJECTIONS

7.1. BUSINESS AS USUAL (BAU) SCENARIO (IMM)

According to strategic documents IMM's goal is to achieve net-zero emissions by 2050. BEI has shown that total IMM emissions in 2019 were 1.544.908 $ktCO_2e$, and if anything less would be done, this would only increase.

The business as usual (BAU) scenario assumes the changes to the GHG emissions in the BEI sectors over the period 2019-2030 without climate change mitigation actions within IMM which have been considered in this document but including national-level measures. The changes are driven by the changes in socio-economic parameters (such as population and GDP) and the introduction of nationwide measures that are outside of the municipality's influence.

Energy consumption and GHG emissions in IMM's stationary energy sector are projected to decrease gradually due to national energy efficiency legal measures in public and commercial buildings, municipal public street lighting, application of more efficient space heating solutions. IMM transport sector is planned to grow due to national strategic goals to increase the share of railroads and urban public transport. Therefore, an annual increase in final fuel and electricity consumption in the transport sector is foreseen. GHG emissions from the waste sector in the municipality are predicted to increase.

According to the BAU scenario, with the continued growth of the city's population and economy, the emissions at IMM level in 2030 are expected to grow by 5,0% compared to 2019 with emissions in transport sector growing by 24,3%, energy use and subsequent GHG emissions in the stationary energy sector decreasing by 10,5% and emissions in waste sector rising by 11%. Total reported GHG emissions of IMM would be over **1.620.560 tCO_2e** per year in 2030 (Figure 24).

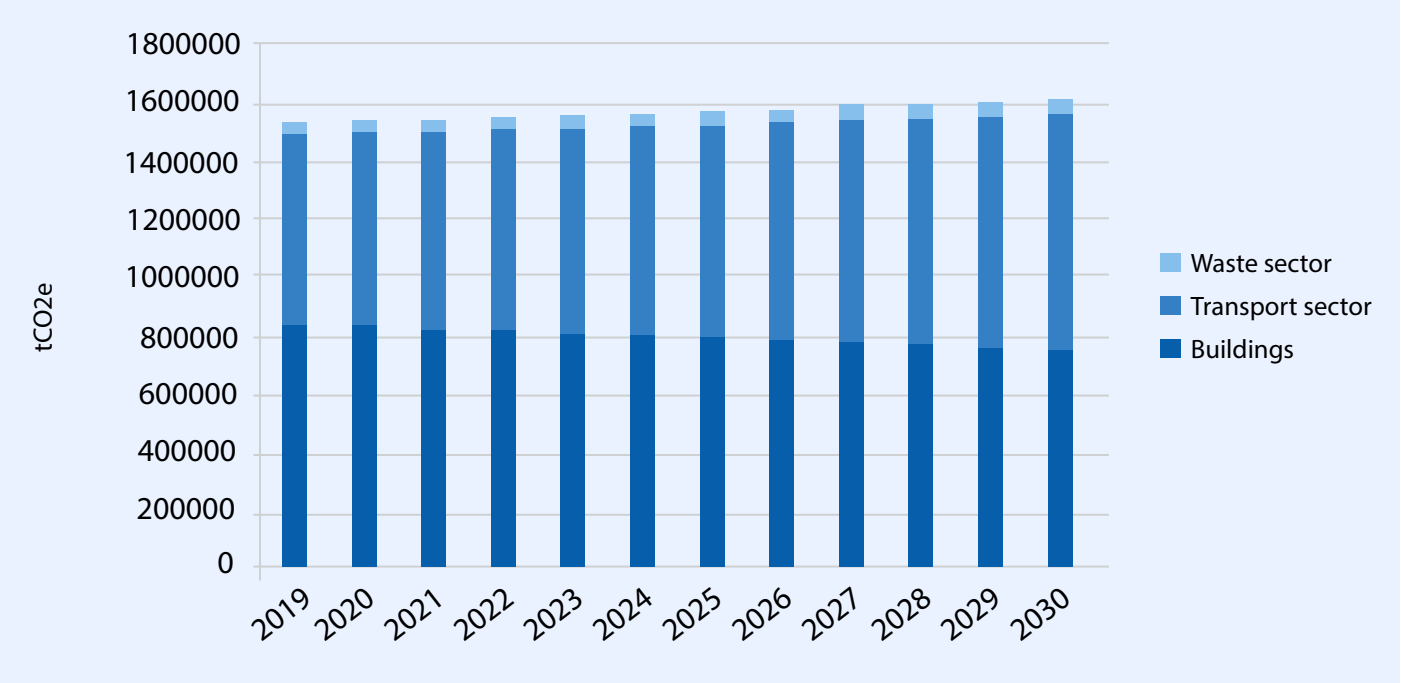


Figure 24. BAU projections of GHG emissions of IMM BEI sectors

7.2. MITIGATION SCENARIO

The climate change mitigation scenario assumes the implementation of mitigation actions described in this document (see Buildings and Transport Chapters). The total sum of predicted GHG reductions in Stationary energy (Buildings) and Transport sectors was calculated encompassing measures of IMM affiliates and subsidiary companies aimed at reducing energy and fuel consumption till 2030 by 40%.

GHG emission reduction targets of the measures described in previous chapters are expressed in anticipated energy and fuel savings converted to energy savings per year (MWh/yr) in Stationary energy and Transport sectors. These energy savings were converted to GHG emission savings assuming that proportions of fuel and energy use in final energy consumption will remain the same as in 2019 and multiplying the shares by respective emission factors.

The implementation of these actions results in a projected total emission reduction of **40% compared to the BEI and 42,8% compared to BAU scenario** (Table 51). Reduction of CO_2e emissions in 2030 will mostly be the result of improvements in energy efficiency in municipal and commercial buildings, urban planning and the positive changes in public transport sector (increase of railroad share thus reducing the number of diesel-driven buses, implementing sustainable mobility actions, etc.).

Table 51. Summary of IMM BEI, 2030 emission trajectory in the BAU scenario and emissions totals with measures in 2030

BEI sectors	IMM BEI (2019) tCO_2	IMM BAU emissions in 2030 (tCO_2e)	IMM emissions in 2030 with measures (tCO_2e)	Reduction against 2019
Stationary Energy	845.152	756.411	507.091	%40
Transport	657.297	817.020	394.378	%40
Waste	42.459	47.129	25.475	%40
TOTAL	**1.544.908**	**1.620.56**	**926.944**	**%40**

Figure 25 shows the projections of CO2e emissions of BEI sectors in mitigation scenario. As measures are planned to be applied starting from 2023, the period from 2019 to 2023 was considered as BAU scenario. The first impact on emission reduction will be observed in 2024 and emissions will continue decreasing gradually till 2030 when total annual reduction of 40% will be reached.

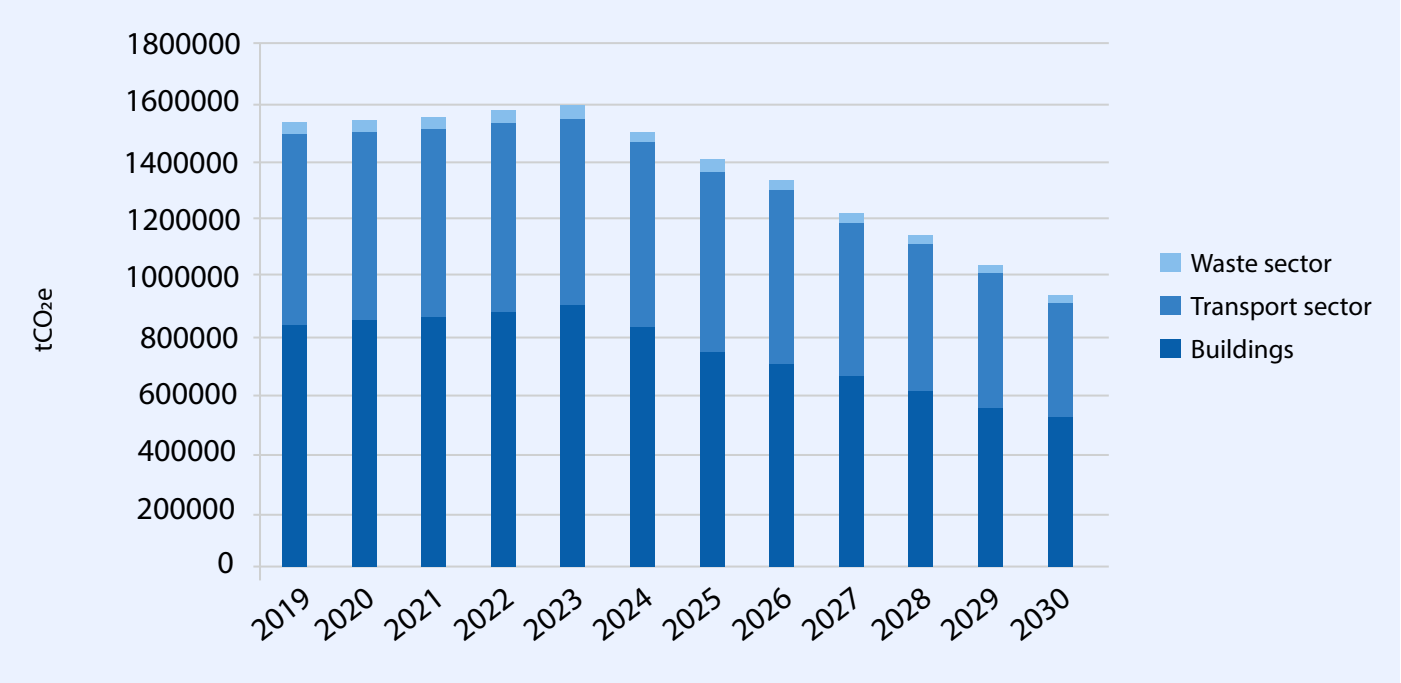


Figure 25. Mitigation action scenario projections of GHG emissions of IMM BEI sectors

It should be noted that Stationary energy and Transport sectors of IMM have potential to achieve even higher GHG emission reductions and have demonstrated ambition to reach the zero-emission state in 2050. For this reason, it is highly likely that IMM's corporate greenhouse gas emissions will have decreased by more than 40% by 2030. As IMM's areas of activity are closely related to the İstanbul city's main activity sectors, the achievement of the longer period targets will strongly depend on the collaboration between the municipality's institutions, industry, commercial and other sectors.



8. SECAP MONITORING

According to GCoM requirements, the city should regularly monitor progress in implementing the action plan and toward achieving the targets and goals set. Monitoring of SECAP implementation is conducted by each individual city and local government in accordance with locally applicable rules and provisions as identified in the plan. The monitoring information can be reported through the recognized online reporting platforms:

CDP-ICLEI unified reporting system

https://www.cdp.net/en/cities

the SECAP reporting platform, available in "MyCovenant" (the European Covenant Extranet

https://mycovenant.eumayors.eu/signatory-registration

Table 52 provides an overview of the most important elements a city-level monitoring framework related to the climate action plan(s) put in place under the GCoM should contain and explains the frequency and elements of reporting to the GCoM.

Table 52. Overview on city-level monitoring and reporting to GCoM [64]

Monitoring Element	Reporting to GCoM
GHG Emissions Inventory	
Regular update of the GHG emissions inventory. The city is required to keep track of the city-wide emissions. When updating inventories, cities must take into consideration all possible changes outlined in Table 6 in chapter 3, even if those changes are not significant.	Every two years A more recent inventory must be reported to GCoM.

64 https://www.globalcovenantofmayors.org/wp-content/uploads/2019/04/Data-TWG_Reporting-Framework_GUIDANCE-NOTE.pdf

Monitoring Element	Reporting to GCoM
GHG Emissions Inventory	
Inventory update due to significant changes Signatories are required to update their inventories in case significant changes take place that trigger a recalculation of the inventory (incl. changes in inventory boundary, calculation methodology, improvements in data accuracy, discovery of errors, etc.). This may also trigger the need for a recalculation of historic inventories (see chapter 3 for further details).	As soon as possible, at the latest when the next inventory update is due
Climate Risk and Vulnerability Assessment	
Regular update of the Climate Risk and Vulnerability Assessment The city should monitor the climate hazards it is exposed to, vulnerable population groups, as well as its adaptive capacity.	Every two years The assessment results and information reported previously must be confirmed or updated according to more recent assessments performed.
Climate Action Plan	
Progress toward commitments in the climate action plan(s) Each signatory has to keep track on the progress toward achieving the mitigation target(s) and adaptation goal(s) set within the plans. This is performed by the city and must be publicly disclosed.	Every two years After the formal adoption of the climate action plan(s), ***a progress toward target/goal*** achievement must be reported every two years

Monitoring Element	Reporting to GCoM
Climate Action Plan	
Status of the implementation of each action/action area/sector in the climateaction plan(s) Each signatory should keep track of the implementation progress of all mitigation and adaptation measures using the key performance indicators set in the adopted plan(s)	Every two years ***The status of implementation of each action/action area/sector*** contained in the plan(s) has to be reported every second year after submission of the action plan(s) (with the possibility to update or add actions).
Cost of each action/action area/sector It is recommended to also keep track of the implementation cost related to individual actions	Every two years ***The implementation costs of actions/action areas/sectors*** contained in the action plan(s) should be reported every second year after submission of the action plan(s)
Required revisions of the climate action plan(s) Cities are required to make provisions for regularly updating their action plan(s) when needed	At the next reporting cycle It is mandatory to resubmit the climate action plan(s) to GCoM when there are significant changes



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10. ANNEXES

ANNEXES

ANNEX 1. Energy Reduction Targets for IMM Buildings and Facilities

İSTAÇ 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Recovery and Compost Plant Fermentation area automatic temperature measurement	With a revision to be made on the SCADA, to automatically and more realistically read the temperature of the air to be sucked through the product by running at least one of the blower motors to the suction. Thus, providing energy efficiency in blower motors.-Thus, it is aimed to achieve at least 10% energy efficiency over these motors.	Short term, until the end of 2023	İSTAÇ	9.000 EUR	63 MWh/year
2	Recycling and Compost Plant Biofilter fan motors efficiency	Driving variable speed flow rate by measuring biofilter fan motors with air quality analyzers	Short term, until the end of 2023	İSTAÇ	7.000 EUR	70 MWh/year
3	Installation of SPP on the roof of the administrative building	Establishing a solar power plant on the roof of the building and reaching a structure that produces its own energy to a significant extent.	Short term, until the end of 2023	İSTAÇ	450.000 EUR	90 MWh/year

İSTAÇ 2030 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Zero Emission Building Application	With the implementation of insulation, LED conversion, boiler replacement, automation and energy monitoring system in İSTAÇ buildings/facilities, 40% reduction will be achieved compared to 2019 energy consumption until the end of 2030.	Medium term, until the end of 2030	İSTAÇ	3.000.000 EUR	5.000 MWh/year
2	Establishment of GES Power Plant by strengthening the roof of the Compost Facility	It will be tried to ensure that the building has a structure that produces the majority of the energy it consumes.	Medium term, until the end of 2030	İSTAÇ	1.200.000 EUR	12.500 MWh/year
3	Inclusion of the facilities under construction within İSTAÇ within the scope of ISO 50001	Seymen Waste Water Treatment Plant, which is under construction within İSTAÇ, Kömürcü room New underground treatment plants are included in the scope of ISO 50001 and Energy Studies are carried out.	Medium term, until the end of 2030	İSTAÇ	-	
4	Heating and cooling systems revision	Renewing the Heating Cooling Ventilation systems of all facilities within ISTAÇ and replacing them with high efficiency systems	Medium term, until the end of 2030	İSTAÇ	1.000.000 EUR	2.000 MWh/year
					TOTAL	19.723 MWh/year

İSTON A.Ş. 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Increasing awareness about energy efficiency.	To ensure that all personnel within the scope receive ISO 50001:2018 awareness at least once a year by providing warning images, e-mail alerts and awareness training.	Short term, until the end of 2023	İSTON A.Ş.	-	
2	To increase energy efficiency without compromising comfort and production quality.	To save 3% of the general consumption by applying switches to the windows.	Short term, until the end of 2023	İSTON A.Ş.	5.000 EUR	
3	To increase energy efficiency without compromising comfort and production quality.	By placing an O_2 sensor in the boiler chimney, automatic burner adjustment automation is made to save 10% of the general consumption.	Short term, until the end of 2023	İSTON A.Ş.	25.000 EUR	
4	To increase energy efficiency without compromising comfort and production quality.	To save 10% of the general consumption by eliminating air leaks.	Short term, until the end of 2023	İSTON A.Ş.	5.000 EUR	
5	To increase energy efficiency without compromising comfort and production quality.	To save 10% of the overall consumption by converting non-led luminaires to LED.	Short term, until the end of 2023	İSTON A.Ş.	5.000 EUR	

İSTON A.Ş. 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
6	To increase energy efficiency without compromising comfort and production quality.	Automatic burner adjustment automation by placing an O_2 sensor in the boiler chimney, to save 10% of the overall consumption.	Short term, until the end of 2023	İSTON A.Ş.	25.000 EUR	
7	To increase energy efficiency without compromising comfort and production quality.	To save 10% of the general consumption by eliminating air leaks.	Short term, until the end of 2023	İSTON A.Ş.	5.000 EUR	
8	Regulation on Procedures and Principles for Increasing Energy Efficiency in Transportation	Ensuring energy efficiency by providing Economic Driving technique training	Short term, until the end of 2023	İSTON A.Ş.	5.000 EUR	

İSTON A.Ş. 2030 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	To increase energy efficiency without compromising comfort and production quality.	To save 10% of the overall consumption by using a steam generator.	Medium term, until the end of 2030	İSTAÇ	650.000 EUR	
2	To increase energy efficiency without compromising comfort and production quality.	Increasing the Engine Efficiency Class in Hadımköy Facilities to save 10% of the general consumption.	Medium term, until the end of 2030	İSTAÇ	285.000 EUR	
3	To increase energy efficiency without compromising comfort and production quality.	To save 10% of the overall consumption by using a steam generator.	Medium term, until the end of 2030	İSTAÇ	1.075.000 EUR	
4	To increase energy efficiency without compromising comfort and production quality.	Increasing the Engine Efficiency Class in Tuzla Facilities to save 10% of the general consumption.	Medium term, until the end of 2030	İSTAÇ	250.000 EUR	

İSKİ 2023 ENERGY ACTION TARGET TABLE

No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Change of Lighting Fixtures Project	By the end of 2023, it is aimed to save 15% energy compared to the energy consumption of 2019 by converting the lighting fixtures in B Block, one of the Headquarters campus buildings, to led fixtures.	Short term, until the end of 2023	İSKİ, Support Services Department, Electrical Machinery and Material Supply Department	200.000 EUR	
2	Replacement of VRF system outdoor units	By replacing the air conditioning system in Block B, one of the headquarters campus buildings, with an efficient system, it is aimed to save 15% energy compared to the energy consumption of 2019 until the end of 2023.	Short term, until the end of 2023	İSKİ, Support Services Department, Electrical Machinery and Material Supply Department	200.000 EUR	
3	Change of Lighting Fixtures Project	It is aimed to save 15% energy compared to the energy consumption of 2019 by the end of 2023, by converting the lighting fixtures in the Laboratory, one of the Headquarters campus buildings, to LED fixtures.	Short term, until the end of 2023	İSKİ, Support Services Department, Electrical Machinery and Material Supply Department	100.000 EUR	

İSFALT İSTANBUL ASFALT FABRİKALARI SAN. VE TİC. A.Ş. 2023 ENERGY ACTION TARGET TABLE

No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Change of Lighting Fixtures Project	By the end of 2023, it is aimed to save 15% energy compared to the energy consumption of 2019 by converting the lighting fixtures in B Block, one of the Headquarters campus buildings, to led fixtures.	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
2	Reducing the Energy Intensity Index for Natural Gas Energy	With the thermal insulation project, it is aimed to reduce the heat recovery in the furnaces in operation by 2% until the end of 2022 and by 2% until the end of 2023.	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
3	Increasing energy efficiency awareness of new hires from 2021 (%)	It is aimed to ensure participation in the Energy Management System by providing Energy Efficiency Awareness Training to all newly recruited employees as of 2021.	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		

İSFALT İSTANBUL ASFALT FABRİKALARI SAN. VE TİC. A.Ş. 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
4	Increasing the awareness of 5operators and maintenance department with training on energy efficient maintenance and machine use (person)	With the Energy Efficient Machine Use Training, it is aimed to raise awareness by training 25 people until the end of 2022 and 50 people until the end of 2023.	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
5	Providing Energy Management Awareness Training to Employees	It is aimed to provide Energy Management Awareness Training to 20% of all personnel until the end of 2022, and to 50% of all personnel until the end of 2023, and to evaluate the training effectiveness by conducting an awareness exam after the trainings.	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
6	Providing Energy Management Awareness Training to Employees	Following the Energy Management Awareness Trainings, an Energy Efficiency Suggestion Form is distributed to all employees, and it is aimed to receive 5 suggestions from each employee until the end of 2022, and 10 suggestions until the end of 2023.	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
7	Use of RES	Use of 1 MW renewable energy until the end of 2022 and 1,5 MW until the end of 2023	Short term, until the end of 2023	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		2,4 MWH RES

İSFALT İSTANBUL ASFALT FABRİKALARI SAN. VE TİC. A.Ş. 2030 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Reducing Electrical Energy Leakage Losses	It is aimed to determine the highest electrical energy consumption by separating the electrical panels and meters in the facilities and to prevent energy losses by 30% with the renovation to be made afterwards.	Medium term, until the end of 2030	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
2	Switching to Warm Asphalt Production	Production of asphalts produced at 150 degrees to ambient in the factory at 110 degrees in existing conventional asphalts. It is aimed to save 35% of the existing natural gas consumption from 10m³ / ton asphalt.	Medium term, until the end of 2030	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
3	Investment of New Plants	It is aimed to save energy by purchasing new facilities.	Medium term, until the end of 2030	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
4	Retirement of Hot Oil Boilers	It is aimed to install electrical heating systems to heat the bitumen and keep it warm.	Medium term, until the end of 2030	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
5	Starting Studies for Green Energy Certificate	By the end of 2030, it is aimed to complete 50% of the steps to obtain a Green Energy Certificate.	Medium term, until the end of 2030	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		
6	Education and Training Initiatives	It is aimed to put into practice specific programs to enable personnel to work with new energy technologies.	Medium term, until the end of 2030	İSFALT, IMM, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, NGOs		

İSTANBUL HALK EKMEK 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Edirnekapı Factory Lighting revision	Conversion of lighting used in production area and outdoor lighting to led lighting	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	44.000 EUR	28 MWh/year
2	Edirnekapı Factory valve jackets purchase	Boiler room valve jackets and leak valve replacements 120 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	125.000 EUR	120 MWh/year
3	Edirnekapi Factory trap maintenance	Maintenance of 30 traps, replacement of traps for leaks 831 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	70.000 EUR	831 MWh/year
4	Edirnekapı Factory Steam pipe insulation maintenance	Making deficiencies of production area and boiler room pipe insulation 1.500 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	125.000 EUR	1.500 MWh/year
5	Edirnekapı Factory tunnel oven heat insulation maintenance	Determination and insulation of areas with excessive heat leakage in tunnel oven 2.000 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	180.000 EUR	2000 MWh/year
6	Edirnekapı Factory Boiler Room Maintenance	Cleaning the pipe bundles of the operating steam boilers with a special solution, removing the slag layer, accelerating the heat exchange 100 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	12.000 EUR	100 MWh/year
7	Edirnekapı Factory Removal of air leaks	10% reduction in air consumption 65 MW/year by measuring and repairing a demo kit to prevent air consumption leaks in the enterprise	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	5.000 EUR	65 MWh/year
8	Edirnekapi Factory Compressor replacement	The current compressor will be 132 kW, the compressor to be purchased will be 75 kW and 17,1 KWH will be gained in idle operation. 49 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	90.000 EUR	49 MWh/year

İSTANBUL HALK EKMEK 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
9	Edirnekapı Factory Generator automation	Generator soft switch system was made (when the energy was restored, diesel use decreased 1,5 M3/year)	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	7.500 EUR	
10	Cevizli Factory Lighting revision	Conversion of lighting used in production area and outdoor lighting to led lighting 37 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	35.000 EUR	37 MWh/year
11	Cevizli Factory valve jackets purchase	Boiler room valve jackets and leak valve replacements 97 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	10.000 EUR	97 MWh/year
12	Cevizli Factory trap maintenance	Trap maintenance, trap replacement, 300 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	25.000 EUR	300 MWh/year
13	Cevizli Factory Steam pipe insulation maintenance	Making deficiencies of production area and boiler room pipe insulation 600 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	50.000 EUR	600 MWh/year
14	Cevizli Factory tunnel oven thermal insulation maintenance	Determination and insulation of areas with excessive heat leakage in tunnel oven 300 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	30.000 EUR	300 MWh/year
15	Cevizli Factory Boiler Room Maintenance	Cleaning the pipe bundles of the operating steam boilers with a special solution, removing the slag layer, accelerating the heat exchange 100.000 kW/year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	10.000 EUR	65 MWh/year
16	Cevizli Factory Generator automation	Generator soft switch system was made (when the energy was restored, diesel use decreased 1,5 M3/year)	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	10.000 EUR	27 MWh/year

İSTANBUL HALK EKMEK 2023 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
17	Cevizli Plant Elimination of air leaks	10% reduction in air consumption 27 MW/year by measuring and repairing a demo kit to prevent air consumption leaks in the business	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	5.000 EUR	27 MWh/year
18	Cebeci Factory tunnel oven thermal insulation maintenance	determination and insulation of areas with excessive heat leakage in tunnel kilns 750 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		750 MWh/year
19	Cebeci Factory Operation steam condensate lines renewal	Operation steam condensate lines were renewed. In this way, return condensate was fully ensured to reach the boiler condensate tank. Energy savings were achieved by using hotter water in preheating. 300 MW/Year gained	2021	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		300 MWh/year
20	Cebeci Factory Boiler room maintenance	Cleaning the pipe bundles of the operating steam boilers with a special solution, removing the slag layer, accelerating the heat exchange 100 MW/Year	2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		100 MWh/year
21	Cebeci Factory Interior Lighting	The lighting fixture, which was 265 w in production, was replaced with leds with a consumption value of 70 w. 70 luminaires were changed. 78 MW/Year	2020	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		78 MWh/year
22	Cebeci Factory Interior Lighting	The lighting fixture, which was 300 w in production, was replaced with a luminaire with a consumption value of 60 w. 60 luminaires were changed. 83 MW/Year	2020	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		83 MWh/year
23	Cebeci Factory Administrative Building and Other Lighting	The lighting fixtures were changed in the administrative building, flour pressing rooms, flour warehouse, cooling tower, final fermentation generator and booster rooms 65 MW/Year	2020	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		65 MWh/year
24	Cebeci Factory Outdoor Lighting		2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		

İSTANBUL HALK EKMEK 2023 ENERJİ EYLEM HEDEF TABLOSU						
No.	İşlem Başlığı	Eylem Tanımı ve Amaç	Eylem önceliği ve Süre	Sorumlular ve Paydaşlar	Tahmini Eylem Bütçesi	Tasarruf
25	Cebeci Factory Engine changes	ENERGY SAVING AT LINE REVISIONS - AT THE CHANGE OF DOUBLE STOP MOTORS WITH SERVO, 12KWH/DAY*2 LINE: 24 KWH/DAY ENERGY GAIN IS ACHIEVED. 7,2 MW/Year	2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		7,2 MWh/year
26	Cebeci Factory Generator automation	Generator soft switch system was made (when the energy was restored, diesel use decreased 1,5 M^3/year)	2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		
27	Cebeci Factory Elimination of air leaks	Demo set was prepared to prevent air consumption leaks in the enterprise, 13% air consumption gain was achieved with measurement and repair) 35 MW/year	2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		35 MWh/year
28	Cebeci Factory compressor replacement	The machine, which is idle in Edirnekapı Factory, is maintained and used in the period when production is low. 37 kW compressor is used instead of 55 kW. 26 MW/Year	2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		26 MWh/year
29	Cebeci Factory Organic bread production planning	By changing the organic bread production line, 1-hour oven preparation energy was saved. 9 MW/Year as Electricity, 191 MW/Year as Natural Gas	2022	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		200 MWh/year
30	Cebeci Factory Engine changes	The work of converting the last fermentation chambers from asynchronous motor to servo motor will be obtained 20 KW/Day per line. 18 MW/Year for 3 lines	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	7.500 EUR	18 MWh/year
31	Cebeci Factory Engine changes	ENERGY SAVE IN LINE REVISIONS - AT THE CHANGE OF DOUBLE STOP MOTORS WITH SERVO, 12KWH/DAY*1 LINE: 12 KWH/DAY ENERGY GAIN IS ACHIEVED. 3,6 MW/Year	Short term, until the end of 2023	İHE, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	7.500 EUR	3,6 MWh/year
					TOTAL	**7.819 MWh/year**

İETT 2023 ENERGY ACTION TARGET TABLE

No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	LED Conversion	Conversion of lighting systems in garages to LED	Short term, until the end of 2023	İETT, IMM	600.000 EUR	1.800 MW/year
2	Elimination of air leaks	Preventing losses by eliminating leaks in air-operated systems	Short term, until the end of 2023	İETT	10.000 EUR	150 MWh/year
3	Replacement of electric motors	Replacing low efficiency motors	Short term, until the end of 2023	İETT	50.000 EUR	25 MWh/year
4	Heating line insulation	Elimination of insulation deficiencies in heating lines	Short term, until the end of 2023	İETT	50.000 EUR	750 MWh/year
5	Solar power plant installation (1 MW)	Solar power plant installation in suitable areas on garage roofs through energy performance contract	Short term, until the end of 2023	İETT, IMM, Energy and Natural Resources Ministry	1.250.000 EUR	RES 1.500 MWh/year electricity production

İETT 2030 ENERGY ACTION TARGET TABLE

No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	New Efficient Boilers	Replacing natural gas boilers with cascade system	Medium term, until the end of 2030	İETT, İBB,	350.000 EUR	Annual fuel savings of 109 TOE
2	Solar power plant installation (5 MW)	Solar power plant installation in suitable areas on garage roofs through energy performance contract	Medium term, until the end of 2030	İETT, IMM, Energy and Natural Resources Ministry	6.250.000 EUR	7.500 MWh/year
3	Electric bus purchase	100% conversion on Metrobus line and 30% on other buses	Medium term, until the end of 2030	İETT, İBB	600.000.000 EUR	Annual fuel savings of 70 million liters
					TOTAL	**11,725 MWh/year**

METRO A.Ş. 2030 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
1	Energy efficiency at stations/premises	Dimming in lighting in locations with low density, use according to intensity (gradual dimming with the use of motion sensor, temperature sensor). An annual improvement of 2,6 million kWh is aimed at 15% in lighting consumption	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 2.600.000 EUR	2.600 MWh/yıl
2	Energy efficiency at stations/premises	Use of natural lighting. It is aimed to improve lighting consumption by 5% to 200 thousand kWh annually.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 4.000.000 EUR	200 MWh/yıl
3	Energy efficiency at stations/premises	Taking advantage of technology that accumulates kinetic energy based on passenger steps in high-density locations. It is aimed to make an annual improvement of 300 thousand kWh by reducing the consumption of the turnstile in the station and the equipment that provides	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 750.000 EUR	300 MW/yıl
4	Energy efficiency at stations/premises	Contributing to city heating needs with heat pump applications from tunnels	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		
5	Energy efficiency at stations/premises	Elimination of generator needs with cogeneration application in places where city heat need and Metro İstanbul electricity need are balanced	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.		
6	Energy efficiency at stations/premises	Use of permanent magnet synchronous motor	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 1.000.000 EUR	
7	Energy efficiency in rail system	Driverless train technologies	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 320.000.000 EUR	
8	Energy efficiency at stations/premises	EC fan applications	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 1.000.000 EUR	

METRO A.Ş. 2030 ENERGY ACTION TARGET TABLE						
No.	Action Title	Action Description and Objective	Action priority and Duration	Responsible and Stakeholders	Action Budget	Saving
9	Energy efficiency in rail system	Optimization of train speeds. It is aimed to improve train energy consumption by 30% and 50 million kWh annually.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 4.000.000 EUR	
10	Energy efficiency in rail system	Recovery with train braking energy, use with on-board storage systems. It is aimed to recover 30% from train energy consumption and improve 40 million kWh.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 80.000.000 EUR	40.000 MW/year
11	Energy efficiency in rail system	Recovering with train braking energy, pumping back into the grid, transfer to vehicle charging stations. 20% recovery from train energy consumption, 15 million kWh improvement is targeted.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 4.000.000 EUR	15.000 MWh/year
12	Overall energy efficiency	Near point feeding to avoid transmission and distribution losses. By reducing cable losses, 1,2% and annual 600 thousand kWh improvement is targeted.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 2.800.000 EUR	600 MWh/year
13	Overall energy efficiency	Reducing transformer losses by supplying energy from the High Voltage Transmission line. By reducing transformer conversion losses, it is aimed to improve 0,6%, 280 thousand kWh.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 4.200.000 EUR	280 MWh/year
14	Overall energy efficiency	Use of renewable energy sources. With the 8,6 MWp SPP installation, it is aimed to reduce the annual 6346,8 tons of CO_2e emissions.	Orta vadeli, 2030 sonuna kadar	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 6.300.000 EUR	12.900 MWh/year Production RES
15	Overall energy efficiency	Hybrid SPP, RES tree model design and renewable energy use in parking areas. With the installation of a 0,9 MWp hybrid power plant, it is aimed to reduce the annual CO_2e emissions of 531,3 tons.	Medium term, until the end of 2030	Metro İstanbul, IMM, Ministry of Transport, Ministry of Environment, Urbanization and Climate Change etc.	~ 400.000 EUR	1.350 MWh/year Production RES
					TOTAL	**73.230 MWh/year**



ISTANBUL METROPOLITAN MUNICIPALITY

DEPARTMENT OF ENVIRONMENTAL PROTECTION AND DEVELOPMENT