Karachi Climate Action Plan

The Urban Unit
Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

The Urban Unit

Urban Sector Planning & Management Services Unit (Pvt.) Ltd.

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Acknowledgements

The preparation of Karachi Climate Action Plan (K-CAP) would not have been possible without the support and guidance of Mayor Karachi Mr. Murtaza Wahab Siddiqui, Ms. Sumera Senior Director KMC, Mr. Omar Masood CEO Urban Unit, Mr. Aman Kidwai COO Urban Unit and Mr. Zaidi Municipal Commissioner. We cannot thank them enough for their visionary leadership and unwavering support. The C40 team deserves recognition for their global expertise and significant contributions.

This report would not have been possible without insightful input and dedication of Environment and Climate Change teams. We extend special appreciation to the communication team for their extraordinary hard work in improving the quality of this report. We look forward to this journey ahead with successful implementation of the Karachi Climate Action Plan as one of the most crucial steps towards a sustainable and resilient future for Karachi City.

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Murtaza Wahab Siddiqui

Mayor of Karachi

Dear Karachiites,

Karachi, our dynamic megacity, faces critical climate challenges, including worsening urban flooding, rising temperatures, air pollution, water scarcity, and inefficient waste management systems. These issues not only threaten our city's sustainability but disproportionately impact marginalized communities, emphasizing the need for equity and inclusiveness in all our solutions. With a vision to transform Karachi into a sustainable yet competitive city, we are committed to reducing greenhouse gas emissions well below the levels of the base year 2022. This ambitious plan aligns with the Paris Agreement's goal to limit global warming to 1.5°C, paving the way for a healthier and safer future for all.

Our Karachi Climate Action Plan is a strategic and inclusive roadmap addressing key priorities: transitioning to cleaner modes of transportation, greening industries, expanding renewable energy use, enhancing waste management systems, managing urban flooding, and revitalizing critical areas such as Liyari and Malir. This document reflects the collaborative efforts of citizens, public and private sectors, civil society, and non-profit organizations.

We extend our heartfelt gratitude to C40 Cities, UNDP Pakistan, and The Urban Unit, Planning and Development Board, The Government of the Punjab for their invaluable support in developing this plan. Their partnership reflects a shared commitment to addressing the unique challenges of megacities like Karachi while aligning with global climate goals.

As your mayor, I am proud of this milestone achievement and pledge to ensure the plan's effective implementation. By engaging stakeholders, including the private sector, media, provincial and federal governments, and, most importantly, the citizens of Karachi, we can build a resilient, equitable, and sustainable future. Together, we can make Karachi a global model for climate action.

Syed Muhammad Afzal Zaidi

Municipal Commissioner
Karachi Metropolitan Corporation

Karachi is a city of resilience and opportunity, but the challenges we face today intensified urban flooding, growing pollution, waste mismanagement, and climate-induced vulnerabilities require decisive action. As the administrative head of the Karachi Metropolitan Corporation (KMC), I am proud to announce the Karachi Climate Action Plan as a crucial roadmap to address these issues and guide the city toward sustainability and resilience. This plan is not just a document; it is a collective commitment to transform Karachi into a greener, safer, and more equitable city for all its residents.

At KMC, we recognize our responsibility to turn this vision into tangible results by improving governance, ensuring interdepartmental coordination, and mobilizing resources efficiently. While the plan provides a framework, its success depends on the active collaboration of all stakeholders citizens, private businesses, NGOs, and government bodies. Together, we can ensure that Karachi remains not only a global economic hub but also a beacon of climate resilience and sustainability.

Let us act now for a better tomorrow

Sumera Hussain

Sr. Director Estate KMC
Focal Person of K-CAP
Karachi Metropolitan Corporation

I am honored to play a key role in driving Karachi city's transition toward a more sustainable and climate-resilient future. K-CAP is a landmark initiative in which we placed a strong emphasis on equity and community engagement to ensure that all voices, particularly those from marginalized and vulnerable groups, are heard and prioritized in our efforts.

I want to acknowledge the invaluable leadership and vision of our Mayor, whose unwavering commitment has been essential in moving this initiative forward. I would also like to express my sincere gratitude to esteemed partners, including C40 Cities, UNDP Pakistan, and the Urban Unit for their exceptional technical assistance and support.

Together, we can create a cleaner, greener and more sustainable Karachi for all.

M. Omar Masud

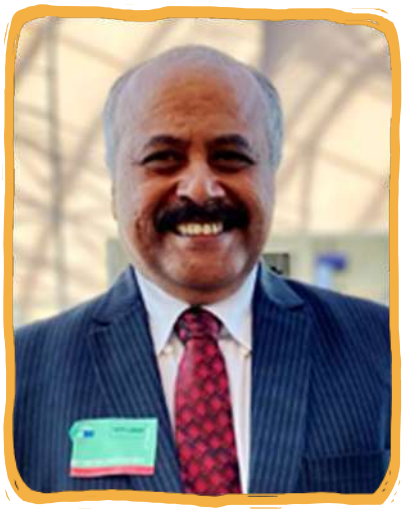
Chief Executive Officer
The Urban Unit
Planning & Development Board
Government of the Punjab

I am thrilled to see the Karachi Climate Action Plan (K-CAP) come to fruition. As the CEO of Urban Unit, I am immensely proud of our team's efforts in supporting the development of this landmark plan.

The K-CAP stands as a testament to Karachi's commitment in tackling the urgent issue of climate change. It outlines a comprehensive strategy for reducing greenhouse gas emissions and enhancing the city's resilience to climate-related challenges.

I would like to extend my heartfelt gratitude to Mayor Murtaza Wahab Siddiqui and the Karachi Metropolitan Corporation for their leadership and unwavering collaboration throughout this process. I also deeply appreciate the support and expertise provided by C40 Cities and all other stakeholders involved.

I am confident that the K-CAP will set an example for other cities, both in Pakistan and internationally. I look forward to witnessing the positive impact this plan will have on Karachi and its residents.
Congratulations to everyone who played a part in making this ambitious effort a reality!



Abid Hussainy

KCAP Project Team Lead
The Urban Unit
Planning & Development Board
Government of the Punjab

I am deeply honored to have led the development of the Karachi Climate Action Plan (K-CAP), Pakistan's first-ever climate action plan. This landmark achievement would not have been possible without the dedication and support of numerous individuals and organizations. I extend my heartfelt gratitude to:

Barrister Murtaza Wahab Siddiqui, Mayor of Karachi, for his visionary leadership and unwavering commitment to this initiative

Syed Muhammad Afzal Zaidi, Municipal Commissioner, for his invaluable insights and contributions

Ms. Sumera Hussain, Senior Director KMC, for her steadfast guidance and support throughout the project

Mr. Omar Masood (CEO, Urban Unit) and Mr. Aman Kidwai (COO, Urban Unit) for their technical expertise and consistent support

The C40 team for their global expertise and collaboration in shaping the K-CAP

Special gratitude to Ms. Shruti Narayan, Managing Director of Regions and Mayoral Engagement, Ms. Sanjana Acharya, Manager of Engagement and Climate Implementation, and the technical experts from C40 cities for their invaluable input

Ms. Van Nguyen, Deputy Resident Representative, Mr. Usman Manzoor, Program Manager, and their team—Ms. Arish Naseem and Ms. Sara Khalid—from UNDP Pakistan, for their critical support and partnership throughout this journey

Our Team of Experts: Dr. Noman Ahmed, Dr. Saeed-ud-din, Mr. Ali Habib, and Ms. Amna Shahab, for their technical contributions and insights

I would also like to acknowledge incredible efforts of our teams at the Urban Unit: Environment and Climate Change, GIS & RS, Communication, and Accounts & Finance and K-CAP Karachi Team.

I am truly proud to have been part of this transformative journey and am excited about the successful implementation of K-CAP for a sustainable future.

Ms. Shruti Narayan,
Managing Director of Regions and
Mayoral Engagement, C 40 Cities

Karachi, a C40 city since 2006, has developed its first-ever Paris-aligned Climate Action Plan (CAP) which lays out an ambitious roadmap towards becoming carbon neutral by 2050. The Karachi Climate Action Plan is a reflection of the city's climate commitment and a historic step in its ongoing journey of becoming a sustainable and resilient city.

The transformative and innovative CAP rightly places Karachi on the path of driven climate action showcasing an ambitious and achievable plan along with the vision of the political leadership - for a carbon-neutral and climate-resilient Karachi. The CAP aims to reduce Karachi's greenhouse gas emissions reduction of 3.7% by 2030, 34.8% by 2040 and 62.2% by 2050, in line with the Paris Agreement's goal to limit global warming to 1.5°C and C40's focus on ambitious climate actions in key sectors like manufacturing, energy, transport, and residential buildings. Karachi has also committed to C40's Urban Nature Accelerator and Sustainable Waste Systems Network.

The need for a Climate Action Plan (CAP) in Karachi is critical, driven by the city's significant economic role, rapid urbanisation, and escalating environmental challenges. The findings underline the urgency of addressing Karachi's vulnerability to extreme weather events, rising temperatures, and urban flooding, which are exacerbated by inadequate infrastructure.

I commend Karachi on its effort in achieving this significant milestone. C40 also acknowledges the efforts of UNDP and Urban Unit in developing this plan.

C40 looks forward to working with Karachi to implement and mainstream the CAP by developing solutions and implementing actions towards transformational, city-wide resilience to the impacts of climate change and build healthy, equitable and resilient communities to remain within a 1.5°C rise.

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AEDB	Alternative Energy Development Board
AD	Anaerobic Digestion
ARE	Alternative & Renewable Energy Policy
BaU	Business-as-Usual
BOD	Biological Oxygen Demand
BRT	Bus Rapid Transit
CAP	Climate Action Plan
CBOs	Community Based Organizations
CCAP	Karachi Climate Action Plan
CCRA	Climate Change Risk Assessment
CIRIS	City Inventory Reporting and Information System
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
COD	Chemical Oxygen Demand
DBCA	Delta Blue Carbon Project
DC	Direct Current
DIF	Diffuse Horizontal Irradiation
DoCC	Directorate of Climate Change
DoECC	Directorate of Environment and Climate Change
E&P	Existing and Planned
ECC&CD	Environment, Climate Change, and Coastal Development Department
EFBD	Emission Factors Database
EIA	Environmental Impact Assessment

ERP	Extended Producer Responsibility
EVs	Electric Vehicles
GHG	Greenhouse Gas
GH	Global Horizontal Irradiation
GPC	Global Protocol for Community-Scale
GTI	Global Tilted Irradiation
HOBC	High-Octane Blending Component
HSE	Health, Safety, and Environment
IPCC	Intergovernmental Panel on Climate Change
KDA	Karachi Development Authority
KCAP	Karachi Climate Action Plan
KHWP	Karachi Heatwave Management Plan
KPIs	Key Performance Indicators
KWSB	Karachi Water and Sewerage Board
KWSC	Karachi Water and Sewerage Corporation
KMC	Karachi Metropolitan Corporation
LDA	Lyari Development Authority
LPG	Liquefied Petroleum Gas
LED	Light Emitting Diode
MER	Monitoring, Evaluation, and Reporting
MDA	Malir Development Authority
MGD	Million Gallons per Day
MoCC	Ministry of Climate Change
MOU	Memorandum of Understanding
MW	Megawatt
MWh	Megawatt-hour
NCAP	National Clean Air Policy
NCCP	National Climate Change Policy

NDC	Nationally Determined Contribution
NEECA	National Energy Efficiency and Conservation Authority
PEC	Pakistan Engineering Council
PCATP	Pakistan Council of Architects and Town Planners
PDMA	Provincial Disaster Management Authority
PKR	Pakistani Rupee
PPIB	Private Power and Infrastructure Board
PV	Photovoltaic
R&D	Research and Development
RFO	Residual Fuel Oil
SBCA	Sindh Building Control Authority
SEECA	Sindh Energy Efficiency and Conservation Agency
SEPA	Sindh Environmental Protection Agency
SEPT	Sindh Environment Protection Tribunal
SHDDB	Sindh High-Density Development Board
SIDCL	Sindh Infrastructure Development Company Limited
SLGA	Sindh Local Government Act
SSWMB	Sindh Solid Waste Management Board
SMTA	Sindh Mass Transit Authority
SRM	Sustainable Resource Management
TDS	Total Dissolved Solids
TMCs	Town Municipal Corporations
UHI	Urban Heat Island
UNDP	United Nations Development Programme
WB	World Bank
WTP	Water Treatment Plant
ZLD	Zero Liquid Discharge

Executive Summary

The Karachi Climate Action Plan (K-CAP) is a transformative initiative aimed at addressing the multifaceted environmental challenges facing Karachi, a city with a population exceeding 20.38 million. This comprehensive document outlines the urgent need for immediate climate action, highlighting Karachi's vulnerability to climate change and the necessity for both adaptive and mitigative measures. The plan details the formal launch of K-CAP, emphasizing key stakeholder engagements and strategic reforms that set a solid foundation for sustainable urban development and climate resilience, all supported by a robust political framework.

The planning process is structured into different stages, ensuring a methodical approach to implementation. A thorough analysis of Karachi's current greenhouse gas emissions is included, projecting future trends and establishing specific reduction targets in line with global climate goals. The document assesses various climate risks faced by the city, such as urban flooding, coastal threats, drought, urban heat, and air pollution, while laying out adaptation strategies to enhance resilience. A governance framework is proposed to ensure effective oversight, alongside a dedicated monitoring, evaluation, and reporting (MER) framework to track progress and ensure accountability.

The need for a Climate Action Plan (CAP) in Karachi is critical, driven by the city's significant economic role, rapid urbanization, and escalating environmental challenges. The findings underline the urgency of addressing Karachi's vulnerability to extreme weather events, rising temperatures, and urban flooding, which are exacerbated by inadequate infrastructure. The current emissions baseline, highlighting air quality concerns, sets the stage for targeted strategies to mitigate risks and enhance resilience. This foundational analysis is pivotal, guiding the development of actionable strategies tailored to Karachi's unique challenges.

The launch of K-CAP showcased a commitment to climate resilience, led by the Mayor of Karachi and engaging a diverse array of stakeholders. Key reforms included the establishment of essential departments to integrate climate governance within the Karachi Metropolitan Corporation (KMC). Proposed amendments to the Sindh Local Government Act aimed to empower local authorities, ensuring climate-related mandates are effectively reinstated. Continuous stakeholder engagement is emphasized, supported by biannual meetings and targeted outreach activities to keep the public informed.

K-CAP builds on a robust foundation of ongoing and planned climate actions at national, provincial, and city levels. Pakistan's existing policies, such as the National Environmental Policy and the National Adaptation Plan, provide a strong framework that aligns with K-CAP's goals. Sindh's climate strategies further reinforce these efforts, while significant projects like the Bus Rapid Transit (BRT) Red Line and urban reforestation illustrate Karachi's proactive stance on both mitigation and adaptation.

The vision for K-CAP, approved in October 2023, aims for Karachi to evolve into a sustainable, competitive city that meets both local and global climate goals by reducing carbon emissions by 2050. The vision statement is as follows;

> **To be a sustainable yet competitive city contributing positively towards the local and the global climate by diminishing carbon emissions by 2050, through a knowledge-based governance system transforming into a green technology-based economy, leading to a sustainable, healthy and safe city as per principles of the Paris Agreement.**

Despite challenges like disjointed governance and limited resources, Karachi's leadership is committed to transformative climate action. The ongoing Greater Karachi Region Plan seeks to address long-term governance issues while enhancing livelihoods and habitats, particularly for vulnerable communities.

The Mayor of Karachi has officially endorsed the Climate Action Plan, reaffirming a strong commitment to addressing the pressing climate challenges the city faces. With a focus on proactive solutions, the Mayor is dedicated to ensuring that citizens are well-informed and actively involved in these efforts. This endorsement marks a pivotal step towards a more sustainable, resilient future for Karachi.

The multi-stage planning process commenced with extensive stakeholder engagement, including a pivotal workshop where the Mayor reaffirmed the commitment to K-CAP. The stages covered essential actions, from strategic climate assessments to the development of a detailed greenhouse gas emissions inventory, which identifies the primary sources of emissions and informs future mitigation strategies.

The Climate Change Risk Assessment reveals alarming trends regarding Karachi's vulnerability to climate hazards. Rising temperatures and increased flooding are highlighted, with specific adaptation goals set to address urban flooding, coastal risks, urban heat, and drought. The plan outlines actionable steps, such as enhancing drainage infrastructure and expanding green spaces, to bolster the city's resilience against climate impacts.

Our ambitious plan aims to reduce Karachi's greenhouse gas emissions reduction of 3.7% by 2030, 34.8% by 2040 and 62.2% by 2050, which is well below the emission levels of base year 2022. This plan is in line with the Paris Agreement's goal to limit global warming to 1.5°C and C40's focus on ambitious climate actions in key sectors like manufacturing, energy, transport, and residential buildings.

Robust governance structures, including the proposed Directorate of Environment and Climate Change, will facilitate effective climate action management.

Finally, the Monitoring, Evaluation, and Reporting (MER) framework ensures continuous assessment of progress, fostering a culture of transparency and stakeholder engagement throughout the implementation of K-CAP. This holistic approach underscores Karachi's commitment to a sustainable future, positioning the city to effectively navigate the challenges of climate change. The journey outlined in the K-CAP serves as a roadmap, guiding Karachi toward becoming a resilient and sustainable urban environment.

The Karachi Climate Action Plan represents a pivotal step toward ensuring the city's sustainability and resilience in the face of climate change. By integrating comprehensive strategies that address both mitigation and adaptation, K-CAP not only outlines a clear vision for reducing greenhouse gas emissions but also emphasizes the importance of stakeholder engagement and governance in achieving these goals. The commitment from Karachi's leadership and the establishment of robust frameworks signal a strong determination to transform the city into a competitive and sustainable urban center. As Karachi embarks on this ambitious journey, the collaborative efforts of government, civil society, and the private sector will be essential in overcoming challenges and seizing opportunities, ultimately fostering a healthier, more resilient city for current and future generations. The successful implementation of K-CAP will serve as a model for other cities in Pakistan and beyond, showcasing the power of collective action in addressing the global climate crisis.

How to Read a K-CAP document?

Karachi at a Glance

This section provides details on Karachi's demographic profile, highlighting its diverse population and economic significance. It further explores the rapidly changing urban landscape, shaped by swift urbanization and industrial expansion, which has led to mounting pressures on infrastructure and resources. Additionally, the climate context is addressed, underscoring the city's vulnerability to climate change due to rising temperatures, frequent flooding, and shifting weather patterns, all of which emphasize the need for comprehensive climate resilience strategies.

The K-CAP Journey

This section provides details on the journey of the Karachi Climate Action Plan (K-CAP), outlining the foundational principles that guide its framework, the methodology adopted for its development, and the long-term vision and political commitment driving its implementation. It also highlights that the plan builds on existing efforts, ensuring that Karachi's climate resilience journey benefits from prior initiatives and experiences.

Karachi Baseline Assessment

This section provides details on Karachi's baseline assessment, covering the Greenhouse Gas (GHG) emission inventory, the pathways to transition towards a Net Zero Karachi City in alignment with limiting global warming to 1.5°C, and a comprehensive Climate Change Risk Assessment (CCRA) to identify the city's vulnerabilities and risks posed by climate change.

Adaptation and Mitigation Goals & Actions

This section provides details on the adaptation and mitigation actions for Karachi, outlining the goals and targets for both adaptation and mitigation. It covers key sectors such as manufacturing industries, energy industries, transport, residential and commercial buildings, and solid and effluent waste. Additionally, the section explores the co-benefits that can be achieved from mitigation efforts.

Implementing Climate Actions

This section provides details on the implementation of climate actions, examining the current institutional framework, challenges, barriers, and opportunities in executing the Karachi Climate Action Plan (K-CAP). It outlines key measures for effective implementation and includes a proposal for climate budgeting within K-CAP to ensure financial sustainability and resource allocation.

Monitoring, Evaluation, and Reporting (MER) System

This section outlines the mechanisms for monitoring progress, evaluating the effectiveness of actions, and reporting results to stakeholders and the public.

Conclusion

It emphasizes the critical need for immediate and sustained climate action in Karachi and reflects on the progress made so far, reinforcing the city's commitment to a climate-resilient future. Through a blend of adaptation and mitigation strategies, coupled with strong institutional support and stakeholder engagement, K-CAP outlines a clear path toward achieving its ambitious goals. The conclusion reiterates the importance of collaboration between government, private sector, and civil society, ensuring that the journey towards a sustainable, net-zero Karachi continues beyond the plan's initial stages.

Annexure

The annexure section includes essential details regarding the activity data sources utilized for the greenhouse gas (GHG) emissions inventory of Karachi City. Additionally, it lists various projects identified under the K-CAP, outlining key initiatives aimed at addressing climate challenges and promoting sustainable development within the city.

Chapter 01

Karachi at a Glance

Karachi at a Glance

Karachi, a sprawling metropolis of Pakistan on the Arabian Sea, boasts a distinctive administrative and physical geography that significantly shapes its urban dynamics. It is one of the megacities of the world and the provincial capital of Sindh. The topography of the city comprises both flat and undulating plains with urban extent towards the North and mountains to the West. Two rivers, Malir and Lyari pass through the city flowing towards the south, and fall into the Arabian Sea.

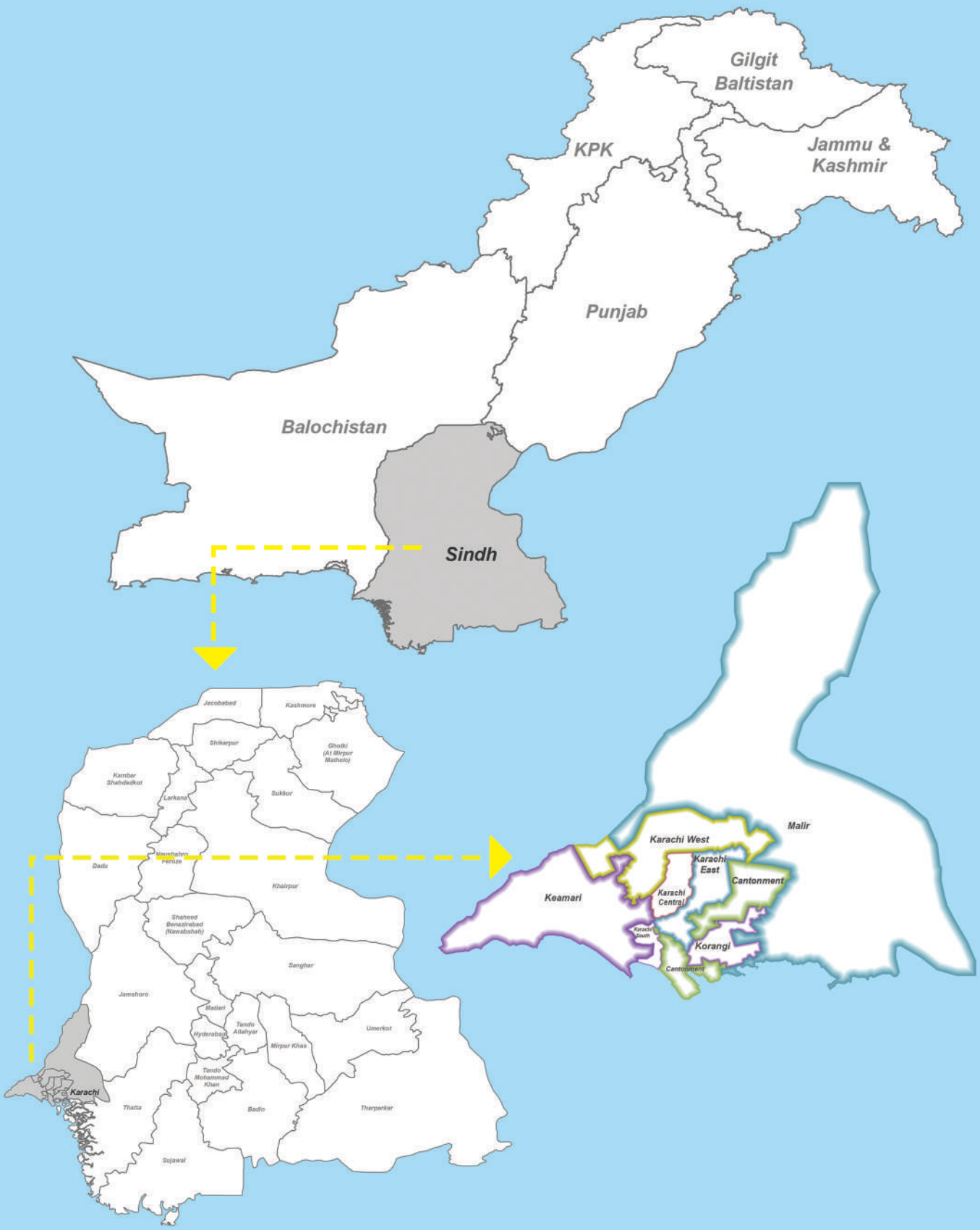


Figure 1. Location of Karachi City

1.1. Demographic Profile

With a total population of 20.3 million (4.10% growth rate) Karachi city comprises 07 urban districts; each characterized by varying population distributions. As the city evolves, so does its population density, currently standing at 4,115 people per sq. km., reflecting a significant increase from 2,794 persons per sq. km. This dynamic density mirrors Karachi's status as a thriving urban center, bustling with life, commerce, and cultural interactions.

Seven Districts
Karachi West, Karachi South, Karachi Central, Malir, Keamari, Korangi and Karachi East

24.8607° N
and 67.0011° E

20.38
Million People

25 Towns and 246
Union Councils

4,115
people per sq. km

Table 1: Demographic Profile of the City

Administrative Units/ Key Characteristics	Karachi Division	Central District	South District	South District	West District	Keamari District	Korangi District	Malir District
Population*	20.38 M	3.82 M	2.33 M	2.68 M	2.68 M	2.07 M	3.13 M	2.40 M
Pop. Growth*	4.1	4.3	4.71	4.35	4.35	2.07	3.29	3.79
Households HH*	3.43 M	0.65 M	0.42 M	0.46 M	0.46 M	0.32 M	0.49 M	0.41 M
Avg. HH Size*	5.93	5.86	5.47	5.76	5.76	6.47	6.34	5.77
Area (km2)**	3,640	64	81	88	88	761	95	2,487
Climate Conditions**	**Warm & Semi-Arid – Mild Climatic Conditions**							
Average Rainfall (mm/year)**		**194.77**	**159.55**	**173.75**	**166.84**	**165.23**	**173.75**	**173.75**

Sources:
Population Census 2023, Pakistan Bureau of Statistics, Government of Pakistan
Sindh Hazard and Risk Atlas 2022 and Disaster Management Plan of Karachi Districts 2022, PDMA, SUPARCO, World Bank and GoSindh

Sources:
https://www.pbs.gov.pk/sites/default/files/population/2023/Sindh.pdf
Pakistan Population Census 2017 https://urckarachi.org/2022/08/17/what-the-census-tells-us-about-karachi/)

1.2. Changing Urban Lanscape:

Karachi's dynamic urban landscape has witnessed significant transformations in land use patterns over the past three decades, reflecting the city's evolving socio-economic and environmental dynamics.

In 1990, bare land covered an extensive 2663 km^2, and while it increased to 2811 km^2 in 2000, a noticeable decline ensued, reaching 2156 km^2 in 2020. This represents a change rate of -13.44% between 2010 and 2020, indicating a shift towards more developed and built-up areas.

A fast-paced development is observed in the north and northeast of the city. Multiple land-owning agencies are carrying out development works in the city, for instance, the city core is comprised of Clifton/Defence Housing Authority and is under federal-military control. Similarly, the northeast of the city i.e. Malir is under provincial control, whereas the city government regulated cooperative housing societies.

It is observed that the Karachi city's population centers are seen expanding continuously from Karachi Port to the north, with notably dense populations in eastern districts such as Shah Faisal Town, Malir Town, Korangi Town, and Landhi Town due to favorable factors. The key factors include a flat terrain, strategic access via the National Highway (N-5) and Superhighway (M-9), as well as proximity to industrial hubs like Korangi, Landhi, and Port Qasim.

1.3. Climate Context:

Karachi has a subtropical hot desert climate according to Koppen's classification i.e. climate of lower middle latitudes, beneath the subtropical ridge, with descending air, high pressure, and dispersed clouds, resulting the hot, dry weather with bright sunny days in that area . A slight seasonal transition brings moderate winters from mid-December to mid-February due to northeasterly currents, influenced by local instability conditions. This is followed by a long, hot, and humid summer lasting from April to September, trailed by monsoon rains occurring from July to September.

The onset of the Asian monsoon over Karachi develops under low atmospheric pressure conditions with a high humidity profile which results in increased precipitation. The humidity levels usually remain high from March to November due to westerly winds, while very low in winter as northeasterly winds are dominant. During the monsoon season (mainly in June), tropical cyclones are usually formed.

Annual Air Temperature Anomalies show a noticeable increase in the frequency of warmer years, with the most recent eight years demonstrating an average departure of 0.5°C from the baseline average air temperature (1980-2023). Over the period from 1980 to 2023, 27 years experienced temperatures surpassing the baseline average air temperature of 32.2°C. Notably, 2015, 2016, 2018, and 2021 stand out as the warmest on record, with a departure of over 0.7°C, as depicted below.

The wind speed had average monthly velocities ranging from 10-22 km per hour during the years (2001-2022).

Baqa, M. F. C. (2021). Monitoring and Modeling the Patterns and Trends of Urban Growth Using Urban Sprawl Matrix and CA-Markov Model: A Case Study of Karachi, Pakistan. MDPI, Land, 10(7), 700; https://doi.org/10.3390/land10070700.
Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. Scientific data, 5, 180214. https://doi.org/10.1038/sdata.2018.214.

Annual air temperature anomalies show a rising trend, with the past eight years averaging 0.5°C above the 1980-2022 baseline. Twenty-seven years exceeded the baseline of 32.2°C, with 2015, 2016, 2018, and 2021 being the hottest, surpassing 0.7°C above average.

Figure 2. Temperature Anomalies (1980-2022)

1.4. Governance Struture in Karachi

Karachi operates within a complex three-tiered governance system comprising federal, provincial, and local bodies. This structure, defined by the Sindh Local Government Act (SLGA) of 2013 and subsequent amendments, outlines the distribution of responsibilities and authorities across various administrative levels. Although the governance structure for the KCAP is discussed in Chapter 5: Implementing Climate Action.

Metropolitan Governance

At the apex of Karachi's governance hierarchy is the Karachi Metropolitan Corporation (KMC), led by an elected mayor. The KMC oversees city-wide infrastructure development, urban planning initiatives, and strategic policy formulation. Below the KMC are Town Municipal Corporations (TMCs) and Union Committees (UCs), which manage local services such as solid waste management and community development within their respective jurisdictions.

Provincial Government Influence

The provincial government of Sindh holds substantial authority over urban planning and service delivery in Karachi. Key entities under provincial control include the Sindh Building Control Authority (SBCA), responsible for regulating building standards and urban development projects. The Karachi Development Authority (KDA), although historically influential, now focuses primarily on managing built areas within the city limits.

Hussain, M. A., Iqbal, M. J., & Soomro, S. (2012). Urban wind speed analysis in global climate change perspective: Karachi as a case study. International Journal of Geosciences, 3(05), 1000.

Sectoral Responsibilities of Key Provincial Government

Urban Transit and Infrastructure

The Sindh Mass Transit Authority (SMTA) oversees public transportation initiatives, while the Sindh Infrastructural Development Company Limited (SIDCL) manages major infrastructure projects, including the Bus Rapid Transit system.

Housing and Development

The Sindh Building Control Authority (SBCA) plays a pivotal role in issuing building permits, ensuring compliance with construction standards, and regulating high-density developments through the Sindh High Density Development Board (SHDDB).

Environmental Management

The Environment, Climate Change and Coastal Development Department (ECC&CD) and the Sindh Environmental Protection Agency (SEPA) enforce environmental laws, monitor pollution levels, and promote sustainable development practices across Karachi. The Directorate of Climate Change (DoCC) in Sindh is also established under ECC&CD that aims to work on climate related issues of the province.

Law & Order

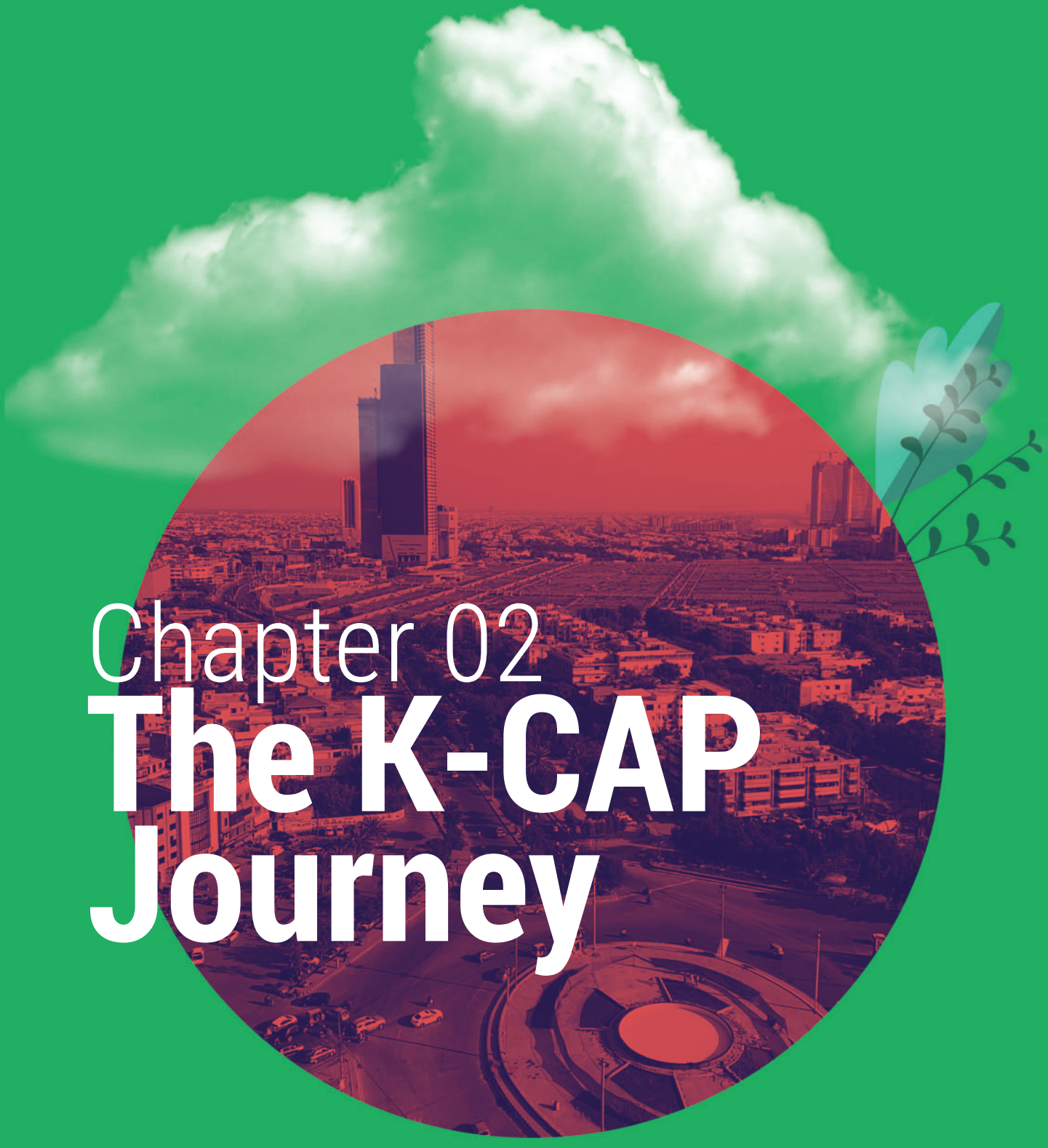
The Home Department, in coordination with the Karachi Police, ensures public safety and maintains law and order throughout the city.

Utility Services

Essential services such as water supply and sewage management are overseen by entities like the Karachi Water and Sewerage Board (KWSB), now known as the Karachi Water and Sewerage Corporation (KWSC), and the Sindh Solid Waste Management Board (SSWMB) for municipal waste disposal.

Education and Healthcare

The Sindh Education Department and Health Department manage public schools, hospitals, and healthcare facilities across Karachi, collaborating with federal authorities and private stakeholders to improve service delivery.



Chapter 02

The K-CAP Journey

The K-CAP Journey

Under the leadership of Mayor Karachi and in response to the C40 CAP Framework, a Karachi Climate Action Plan exercise began in October 2023. The overall project encompasses a series of steps that led to the foundation of Climate Action Plan of Karachi City.

Strategic Appraisal & Needs Assessment

Developing GHG Inventory

Emissions modeling, strategy identification, and target setting

Climate Change Risk Assessment (CCRA)

Adaptation goals, targets, and milestones

Action identification, prioritization, and definition

Monitoring plan

Climate action governance

Drafting of the climate action plan (CAP) document

More than 200 consultation meetings were held as part of the process, engaging diverse stakeholders. These included government departments, academic institutions, non-profit organizations, and local community members in Karachi. This inclusive outreach ensured a comprehensive gathering of perspectives and insights, contributing to a well-rounded and inclusive document for Karachi Climate Action Plan.

The K-CAP project ensured that aspirations and dreams of all the relevant stakeholders. The team conducted a series of one-on-one conversations, meetings, rapid strategic appraisal and visioning workshops. Extensive outreach was carried out with concerned stakeholders to apprise them about the urgency and importance of this planning exercise and connected tasks.

Figure 3. Key Stakeholders

Vision for Karachi – C4D

To Create and develop a Beautiful, Safe, Eco-friendly, Conducive, and Healthy Sustainable City.

میں ایک ایسا خوبصورت کراچی چاہتا ہوں جہاں
محفوظ اور صحت بخش ماحول کے ساتھ تمام بنیادی
سہولیات ہر خاص و عام کی دسترس میں ہوں۔

2.1. K-CAP Principles:

Before setting up key adaptation and mitigation measures and designing the future state of climate governance in Karachi, we adhered to certain design principles. These design principles were carefully agreed upon for an attainable and effective action plan for Karachi City.

Ambitious	Inclusive	Fair	Comprehensive & Integrated
Setting goals and implementing actions that evolve iteratively towards an ambitious vision	Involving multiple city government departments, stakeholders and communities (with particular attention to marginalized groups), in all phases of planning and implementation	Seeking solutions that equitably address the risks of climate change and share the costs and benefits of action across the city	Coherently undertaking adaptation and mitigation actions across a range of sectors within the city, as well as supporting broader regional initiatives and the realization of priorities of higher levels of government when possible and appropriate
Relevant	**Actionable**	**Evidence-based**	**Transparent and verifiable**
Delivering local benefits and supporting local development priorities	Proposing cost-effective actions that can realistically be implemented by the actors involved, given local mandates, finances, and capacities	Reflecting scientific knowledge and local understanding, and using assessments of vulnerability and emissions and other empirical inputs to inform decision-making	Following an open decision-making process, and setting goals that can be measured, reported, independently verified, and evaluated

Table 2: KCAP Methodology

2.2 K-CAP Methodology

Stage 01
Inception Phase

Desk Research on the existing legal and policy frameworks, organization structure, and city dynamics

Inception meeting with the Mayor Karachi, KMC, and Environment Department

Stage 02
Consultations Phase 01

The process of development of long-term vision and political commitment to implementing ambitious, transformational climate actions

Vision Development and Mayoral Commitment

Stage 03
Strategic Appraisal and Need Assessment

A check on the alignment of the city climate goals/targets with the CAP Framework requirements, the Paris Agreement, and national/ provincial/local climate goals/targets

A high-level review of internal and external policies, emissions baselines, hazards, and risks of the city

A statement on available baseline city climate, environmental, social, and economic indicator data

The Climate Change Risks and Vulnerability Assessment assesses climate risks, now and in the future, and ensures that the most vulnerable groups, sectors, and assets are protected.

A statement on the status of the city's GHG emissions inventory, emissions trajectories under the 'business as usual' scenario, and target trajectories under existing climate policies/plans.

Pathways Projecting Future Emissions – insights into the significant gap in the current carbon emissions and the desired goal of carbon neutrality.

Baseline Assessment
Stage 04

Consultations Phase 02
Stage 05
Actions Identification and Prioritization

Adaptation goals, targets, and milestones based on the assessments mentioned above and pathways (stage 4)

City climate actions that support emissions reductions or climate adaptation pathways in the short-medium-long term

A comprehensive climate governance system for effectively implementing a city's Climate Action Plan

Governance Framework
Stage 06

Stage 07
Monitoring & Evaluation

A Monitoring, Evaluation, and Reporting (MER) system enables cities to track and review the intended results and real progress against the city Climate Action Plan targets and actions

To determine the most appropriate structure for the city's climate action plan document aligned with the vision and priorities

CAP Development
Stage 08
Consultations Phase 03

Consultations Phase 04 Consultations Phase 05
Stage 09
Final CAP Development

Compilation of work across all eight stages and development of a comprehensive, evidence-based Climate Action Plan for Karachi City

2.3 Long-Term City Vision & Political Commitment

As C40 is a global network of mayors that are united in action to confront the climate crisis, Mayor Karachi is committed to using an inclusive, science-based, and collaborative approach to contribute its share in Pakistan's ambitious cumulative target of reducing its projected emissions by 50% by 2030. This target includes a 15% reduction funded through the country's own resources and a 35% reduction dependent on securing international grant finance. Setting evidence-based targets for emissions reduction in line with the 1.5°C fair share scenario and the NDC's targets for Karachi's waste, transportation, energy, and other sectors is the goal of the 1.5°C scenario development, which aims to enhance the economic, social, and health benefits for the city's communities.

To develop a long-term vision and attain political commitment, a workshop was convened on 23rd November 2023 led by Mayor Karachi and his team from Karachi Metropolitan Corporation in collaboration with UNDP, C40 Cities, and the Urban Unit. In the Workshop, the Mayor of Karachi recognized the role of the Mayor and KMC as custodians and proponents of implementing the K-CAP and assured fullest cooperation/commitment through the signing of a mayoral commitment, that states;

> “On behalf of the citizens of Karachi, I, the Mayor of Karachi, would like to express my full commitment to prioritize and accelerate climate actions for a low-carbon and climate-resilient urban development in Karachi City through the Karachi Climate Action Plan (K-CAP). With this project, evidence-based action planning is expected to manage all facets of sustainable development, and provide climate actions that are fair, equitable, and beneficial for all, as well as meet the commitments made under the Paris Agreement and NDCs.
>
> **(Barrister Murtaza Wahab, Mayor Karachi, 2023)**

The workshop participants enthusiastically contributed to this exercise and gave their input. The local community was also taken on board to carve out their vision for a resilient city. The K-CAP team diligently worked on the inputs and articulated options for further deliberations with the Mayor of Karachi.

Vision Statement

"To be a sustainable yet competitive city contributing positively towards the local and the global climate by diminishing carbon emissions by 2050, through a knowledge-based governance system transforming into a green technology-based economy, leading to a sustainable, healthy and safe city as per principles of the Paris Agreement."

2.4. Mayoral Endorsement

The Mayor of Karachi officially endorsed Karachi Climate Action Plan, demonstrating a commitment to addressing climate challenges proactively.
This endorsement highlights the importance of keeping our citizens informed and actively involved in our climate action initiatives.
Together, we aim to create a sustainable future for Karachi through collective efforts and informed participation.

بسم اللہ الرحمن الرحیم

C40 CITIES

UNDP

Mayoral Endorsement of Karachi Climate Action Plan

Climate change is becoming increasingly visible, undeniable, and unavoidable, both globally and here in Karachi. On November 23, 2023, I pledged as Mayor of Karachi to develop a comprehensive Karachi Climate Action Plan (KCAP) that aligns with both the Paris Agreement and the C40 Cities Climate Leadership Group framework, ensuring a sustainable and resilient future for our city.

I am pleased to endorse the Karachi Climate Action Plan, on behalf of citizens of Karachi, including its targets, governance structure, monitoring and evaluation framework, and projects developed by the Urban Unit Team with the support of UNDP and C40 Technical Assistance and Advice. We aim to adopt the KCAP in 2024-25 and implement it with the engagement of our citizens, stakeholders, civil society, and local council leadership, in line with C40's objectives to drive urban climate action and achieve the Paris Agreement's goals.

A key initiative within our plan is the "Mangroves & Lyari River Restoration" project, which aims to protect and restore critical segments of the Lyari River, wetlands, and mangrove forests. These vital "carbon sinks" are crucial for carbon sequestration and play a significant role in reducing our greenhouse gas emissions. In alignment with C40's emphasis on nature-based solutions and adaptation, we are also enhancing our parks and green spaces to better absorb heat and manage water, thereby mitigating the risks of heatwaves and flooding.

I am committed to addressing these challenges proactively and ensuring that our citizens are well-informed and actively involved in our climate action efforts. I urge all Karachi Metropolitan Corporation (KMC) and affiliated entities to implement the recommendations of the Karachi Climate Action Plan with urgency. This plan outlines our strategy to reduce Karachi's greenhouse gas emissions by emissions reduction of 3.7% by 2030, 34.8% by 2040 and 62.2% by 2050, aligning with the Paris Agreement's long-term goal to limit global warming to well below 2°C and to pursue efforts to limit the temperature increase to 1.5°C, as well as C40's focus on ambitious climate actions and innovative urban solutions.

KARACHI CLIMATE ACTION PLAN

Barrister Murtaza Wahab
Mayor of Karachi

20/9/2024
Date

Signature

Fig 4: Mayoral Endorsement

Climate Change is unfair!

It impacts some communities disproportionately.

2.5. Stakeholder Engagement

An inclusive and participatory approach was adopted for the development of the K-CAP, to ensure fairness and inclusiveness in climate action planning. Each stage in the preparation of the K-CAP was concluded with consultations with relevant stakeholders.

Stakeholder Meetings

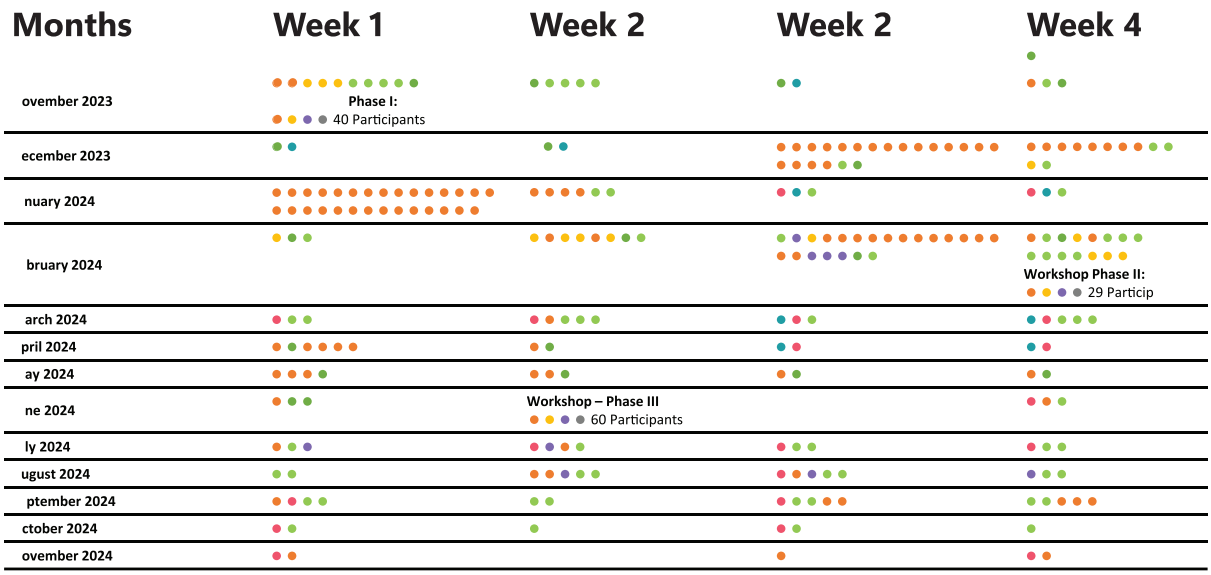


Table 3: Consultation Map

Key

- Government Departments /Autonomous Bodies / Attached Departments / Councils
- NGOs/CSOs
- C40 Team
- Local Community / Community Representatives
- Academia / Youth Groups
- Private Sector

Typically engaged groups

Sub-national and local government
Civil Society Organizations and NGOs
Donor agencies
Community-based organization
Research and academia

Typically, hard-to-reach groups

Climate migrants
Temporary residents
Older migrants
Private sectors
Children

These are the individuals who are displaced by the effects of extreme weather events such as floods, droughts, and heatwaves. Many of these migrants come from rural areas and coastal regions where agricultural livelihoods are threatened, or from areas affected by sea-level rise and coastal erosion. They often settle in informal urban settlements, facing challenges such as inadequate housing, limited access to healthcare, and poor living conditions.

The stakeholder consultation process for Karachi Climate Action Plan began with a kick-off session on October 24, 2023, marking the start of a highly organized engagement effort. The meetings, structured into weekly categories and marked by distinct color codes for each month, allowed for clear organization and tracking.

Phase 0I:

November 2023

Phase 02:

February and March 2024

Phase 03:

April through June 2024

Phase 04:

September 2024

Phase 05:

September 2024

Phase I:

The first phase of stakeholder consultations for the Karachi Climate Action Plan began in

November 2023.

The main focus of these consultations was to introduce K-CAP project, build awareness among stakeholders, and gather essential data for emission inventories, strategic appraisals, and comprehensive risk assessments.

This phase engaged a diverse range of environment and climate-related entities, including the Sindh Coastal Development Authority, Directorate of Climate Change, Environment, Climate Change and Coastal Development Department, Karachi Metropolitan Corporation, Forest and Wildlife Department, Sindh Energy Department, Transport and Mass Transit Department, Industries and Commerce Department, Agriculture, Livestock, and Fisheries Department; Mines and Mineral Department; and Local Government, Housing, and Town Planning Department; Irrigation Department.

Other notable stakeholders included the Oil and Gas Regulatory Authority; Karachi Water & Sewerage Board; Karachi Development Authority, Lyari Development Authority; Energy and Utilities Department K-Electric; City Railway Station Karachi; Sindh Solid Waste Management Board; Oil Companies Advisory Council; Bureau of Statistics, and the Provincial Disaster Management Authority, were consulted. Civil society and non-governmental organizations, including the WWF Regional Office, Urban Resource Center, Darya Lab Green Coalition Pakistan, Climate Action Center, and Civic Center, were actively involved.

Additionally, a stakeholder workshop was held in November 2023, with 40 participants from government and non-government sectors, who played a crucial role in setting the foundation for the climate action plan by identifying key challenges and brainstorming initial strategies. This momentum was carried forward till January 2024, where continuous stakeholder meetings facilitated ongoing feedback and refinement of strategies.

As a result of these engagements, a foundational understanding was established among stakeholders about K-CAP's goals, leading to improved data sharing and collaboration across departments. This initial phase also laid the groundwork for comprehensive data collection, fostering inter-departmental cooperation necessary for achieving K-CAP's climate action objectives, and strategic appraisal & rapid assessment.

Phase II:

In February and March 2024, the second phase of consultations for the K-CAP was conducted, engaging approximately 60 participants from diverse sectors, including government departments, non-profit organizations, academia, community representatives, and donor agencies. This phase aimed to validate data, gather critical input, and prioritize strategies for the effective implementation of K-CAP.

During the workshops, stakeholders reviewed progress and deliberated on the initial drafts of the plan, including Strategic Appraisal & Needs Assessment, GHG Inventory Development, Emissions Modeling and Target Setting, and Climate Change Risk Assessment (CCRA). Discussions centered on evaluating the findings of these reports to ensure alignment with departmental data and insights from prior visioning workshops. The sessions yielded valuable, actionable feedback on refining these reports, achieved consensus on strategic priorities, and identified critical gaps requiring further attention. Additionally, participants shared updates on their recent initiatives, highlighted success stories, and explored potential roles to enhance the inclusivity, collaboration, and overall effectiveness of K-CAP. This inclusive approach aimed to create a robust framework for addressing Karachi's climate challenges.

In order to gather diverse perspectives on climate challenges and ensure an inclusive approach to climate action planning, we conducted consultations with communities, local councils, children, elderly individuals, local council members, and climate migrants in Karachi.

Issues related to industrial waste disposal and its impact on mangroves and fishing, as well as climate migration, were highlighted. During a visit to Hassan Aulia Village in the Kemari District, the local council and elderly people participated in the climate action planning discussions. They raised concerns about flooding, heatwaves, and inadequate facilities in the area.

During the consultations at Rerhi Goath, the community and Masjid Imam highlighted severe climate risks such as coastal erosion, sea-level rise, tidal flooding, and saltwater intrusion, compounded by poverty, inadequate amenities, and limited access to clean water. Health issues like infections and diseases were linked to unclean water, pollution from small-scale factories, and poor waste management. The discussions underscored the need for urgent action to improve clean water access, regulate industrial pollution, and enhance waste management to build resilience in this vulnerable community.

During the consultation in Hasan Auliya Town, we engaged with residents, primarily from the Baloch community, who have lived in the area for generations (mainly, women, elderly people, and children). The discussions highlighted their vulnerability due to poor socio-economic conditions, exacerbated by extreme climate events like heatwaves, flooding, and water stress. Issues raised included inadequate housing, lack of access to basic services, and the environmental health risks posed by the Lyari River's surrounding settlements, particularly after the construction of the Lyari Expressway in 2018, which led to increased pollution and waste accumulation. The consultation emphasized the need for targeted climate adaptation strategies and improved waste management to address the community's pressing health and environmental concerns.

During the consultations with children (aged 3–11) in low-income areas, key concerns included the lack of open and green spaces for play and rest during hot summers and the need for clean drinking water. These discussions highlighted the suppressing demand for green cover in the city.
In addition to this, a consultation was held with climate migrants from Mal Island, now living in Mal Mahala, a low-lying, low-income area. The participants, primarily women and elders, shared their experiences of displacement caused by rising sea levels and seawater intrusion, which disrupted traditional livelihoods such as fishing, grazing, and cultivation.

The migrants highlighted how adaptive measures like clay boundaries (Gaar) and moving to higher ground became inadequate over time. The collapse of the barter economy and declining freshwater availability forced their migration. They now face poor living conditions, lack of basic services, and limited economic opportunities in Mal Mahala.

This consultation emphasizes the need to address the socio-economic vulnerabilities of displaced communities in climate action plans, focusing on targeted adaptation measures and improved resource access.
These community consultations were complemented by visits to heatwave hotspots, and emergency service centers. Site visits to the WWF Wetland Center, mangrove areas, Kidney Park, and afforestation zones also helped gather data and develop strategies for addressing the region's climate challenges.

All this information was added in the relevant sections of the report to strengthen the local context and input of all stakeholders in identifying the issues and challenges and suggestions to improve through sound actions and interventions.

Phase III

From April through June 2024, regular meetings were conducted to monitor progress and address any emerging challenges. These monthly sessions ensured that the action plan remained on track, fostering momentum throughout the engagement process.

During Phase III of consultations, a workshop was conducted with active participation from government departments, city administration, donor agencies, NGOs, civil society, and community representatives. The agenda included presentations on the GHG Inventory, pathway scenarios, climate change risk assessment, adaptation and mitigation pathways, and governance and monitoring frameworks. Discussions centered on refining these deliverables, addressing key climate challenges, and aligning targets with the evidence-based findings. A group activity was conducted to prioritize adaptation and mitigation actions. The key outcome was a consensus on the progress achieved and a commitment to prioritizing climate actions through an inclusive and participatory approach. The data-driven approach and comprehensive planning efforts received widespread appreciation.

Phase IV

In the fourth phase of stakeholder consultations for K-CAP, the focus was given to field-based evaluations and project design for initiatives proposed by the Honorable Mayor of Karachi. These initiatives aimed to design localized, practical solutions for climate resilience and sustainable urban development. Field visits were conducted to the identified project sites, allowing the K-CAP team (Annex-E) to assess ground realities, gather critical data, and engage with local communities.

Key locations included Nusrat Bhutto Colony, Gutter Baghicha, Lyari River, and Imtiyaz-Qayyumabad, where proposed projects encompassed diverse climate solutions. The pilot initiative for the upgradation of katchi abadis with vertical housing structures in Nusrat Bhutto Colony was evaluated to address informal housing challenges. In Gutter Baghicha, the team surveyed the site for developing a green space integrated with a solar park for local grid support, emphasizing renewable energy generation. Imtiyaz-Qayyumabad was examined for waste-to-energy and Lyari River was visited for the possible wastewater recycling projects, focusing on improving environmental conditions while creating socio-economic opportunities.

The field visits culminated in comprehensive project designs and feasibility proposals for each initiative. These proposals incorporated technical assessments, and environmental impact evaluations, to ensure the projects' viability and alignment with K-CAP's

objectives (Annex-B). For solid waste management, strategies emphasized decentralized recycling and energy recovery, while the sewage treatment proposal prioritized modular systems adaptable to Karachi's urban context.

This phase was instrumental in translating strategic priorities into actionable projects, marking a pivotal step in K-CAP's implementation journey. By grounding the proposed initiatives in field data and detailed analyses, Phase Four established a strong foundation for piloting transformative solutions to Karachi's pressing climate and urban challenges.

Phase V

In September 2024, during Phase V of K-CAP, a comprehensive presentation was delivered at the KMC Office, chaired by the Municipal Commissioner. The presentation covered all key components of the plan, including proposed governance structures, required legal amendments, and the monitoring, reporting, and evaluation framework essential for effective implementation. The session concluded with a significant milestone: the Mayor of Karachi formally endorsed all aspects of the plan, marking its finalization and readiness for action.

In total, over 200 meetings, 03 phases of workshops, and a number of sessions were conducted during the consultation period, bringing together representatives from government departments, autonomous bodies, city administration, Karachi Metropolitan Corporation, NGOs, CSOs, academia, youth groups, and the private sector, through workshops only. Community Consultations and meetings with representatives from Union Councils were also an integral part of the plan. This diverse range of participants ensured that the K-CAP was both comprehensive and inclusive, integrating perspectives from various sectors.

By actively involving these stakeholders, the Karachi Climate Action Plan has established a solid framework for addressing urban climate challenges and driving impactful climate action for the city.

2.6.We have not started from scratch

Karachi's journey towards climate resilience and sustainability is not beginning in a vacuum. Rather, it is built upon a solid foundation of ongoing and planned climate actions at the national, provincial, and city levels. This chapter delves into these established initiatives, examining the legislation, policies, and strategies that provide the groundwork for K-CAP. By understanding this interconnected web of commitments, Karachi can propel itself forward with confidence, leveraging existing strengths to craft a resilient and sustainable urban future.

National Commitments & Policy Frameworks

At the national level, Pakistan has made significant strides in setting the stage for comprehensive climate action, and these efforts naturally extend to Karachi, the country's largest city. The National Environmental Policy of 2005 provides a critical framework, guiding the development of policies that emphasize the adoption of renewable energy and cleaner technologies. This policy is complemented by the National Transport Policy of 2018, which focuses on building resilience within transport infrastructure while reducing greenhouse gas (GHG) emissions a priority mirrored in Karachi's objectives for creating a climate-neutral urban environment.

In pursuit of reducing emissions specifically within the transport sector, the National Electric Vehicle (EV) Policy of 2019 lays out ambitious goals to transform transportation across the country, including Karachi. This policy aligns seamlessly with K-CAP's vision of a sustainable transport system that moves towards net-zero emissions.
Another key element is the Alternative & Renewable Energy Policy (ARE) of 2019, which aims to increase the share of green energy in Pakistan's energy mix. Karachi, as the economic hub, stands to benefit significantly from this policy by integrating renewable energy solutions into its power infrastructure, thereby advancing K-CAP's decarbonization goals.

Pakistan's Updated Nationally Determined Contributions (NDCs) of 2021, presented under the Paris Agreement, set the country on a path to ambitious emission reduction targets. These commitments are pivotal for Karachi, providing the necessary impetus to design and implement mitigation measures that contribute to the global fight against climate change. Moreover, the National Climate Change Policy (NCCP) of 2021 further bolsters this effort by emphasizing the importance of GHG inventories and climate projections, which inform the evidence-based planning integral to K-CAP.

The National Adaptation Plan of 2023 further underscores the nation's climate resilience efforts by outlining six adaptation priorities: the agriculture-water nexus, natural capital, urban resilience, human capital, disaster risk management, and social inclusion focusing on gender and youth. These priorities resonate strongly with the adaptation strategies being developed for Karachi, ensuring that the city's efforts are in harmony with national objectives.

Managing waste in an environmentally sound manner is another national priority, as reflected in the National Hazardous Waste Management Policy of 2022. This policy ensures that Karachi's waste management strategies align with national objectives, particularly in achieving K-CAP's goals for reducing waste-related emissions. Additionally, the National Clean Air Policy (NCAP) of 2023 focuses on improving air quality, a concern that resonates deeply within Karachi's urban fabric, guiding K-CAP's actions toward managing air pollution more effectively.

Provincial Strategies & Alignments

Moving from the national to the provincial level, Sindh has demonstrated a strong commitment to sustainable development and climate resilience, which directly influences Karachi's climate action strategies. The Sindh Climate Change Policy of 2022 sets out provincial measures for mitigation, adaptation, and capacity building, ensuring that Karachi's efforts are part of a broader provincial agenda aligned with international commitments.

The Sindh Strategy for Sustainable Development of 2007 emphasizes research into climate impacts, providing a critical evidence base for both provincial and city-level climate resilience initiatives. This focus on research and data-driven decision-making is a cornerstone of K-CAP's approach to addressing the challenges posed by climate change.

Further reinforcing these efforts, the Sindh Growth Strategy of 2017 focuses on energy efficiency and climate adaptation, guiding Karachi's responses to climate projections and reinforcing the objectives outlined in KCAP. The Sindh Sanitation Policy of 2016 targets integrated solid waste management, an area where Karachi is making significant progress through projects like the Solid Waste Emergency and Efficiency Project. This alignment ensures that Karachi's waste management strategies contribute effectively to the province's broader sustainability goals.

Agriculture, a critical sector for the province, is addressed in the Sindh Agriculture Policy of 2018-2030, which aims for a resilient agricultural system. Karachi's climate action plan recognizes the importance of enhancing resilience among vulnerable farmers in the city's periphery, aligning with this provincial policy. Similarly, the Sindh Water Policy of 2023 addresses the province's water supply challenges, directly informing K-CAP's strategies concerning water governance and adaptation to future climate scenarios.

Disaster management is another key area where provincial and city-level efforts converge. The Sindh Disaster Management Policy (Draft) provides strategic insight for advancing disaster risk management from a reactive to a proactive approach, which is critical for Karachi's disaster risk reduction strategies. This proactive stance is crucial for building resilience in a city that is increasingly vulnerable to climate-related disasters.

City-Level Initiatives and Climate Actions

At city level, Karachi has already embarked on various climate initiatives that reflect its proactive stance on both mitigation and adaptation. These initiatives are part of a broader, more integrated strategy that K-CAP seeks to enhance. The Bus Rapid Transit (BRT) Red Line Project represents a significant transformation of Karachi's transportation system, focusing on public transport efficiency and reducing emissions. This project aligns with K-CAP's sustainable mobility objectives, demonstrating Karachi's commitment to creating a low-carbon urban environment.

Urban modernization efforts are further supported by the Competitive and Liveable City of Karachi Project and the Karachi Mobility Project, both funded by the World Bank. These projects focus on enhancing urban infrastructure, including the property tax system, private sector participation, solid waste management, and safe, accessible transport along key corridors. These initiatives are directly aligned with K-CAP's goals of improving urban resilience and sustainability.

Waste management, a critical component of Karachi's climate strategy, is being addressed through the Solid Waste Emergency and Efficiency Project, which enhances waste management practices by constructing sanitary disposal cells, upgrading transfer stations, and developing a comprehensive waste solution plan. These efforts are crucial for reducing waste-related emissions and contributing to the city's adaptation strategies.

Karachi's energy sector is also undergoing significant changes through the Power Acquisition Programme, which outlines a long-term strategy for power supply that emphasizes indigenous fuel resources and renewable energy. This program is closely aligned with KCAP's decarbonization efforts, aiming to reduce the city's carbon footprint through sustainable energy solutions.

Water and sanitation are other key areas of focus, with the Karachi Water and Sewerage Services Improvement Project addressing waste management and sewage. This project includes methane capture from sewage and solid waste, significantly contributing to GHG emissions reduction. Additionally, the Delta Blue Carbon Project (Sindh), while primarily outside Karachi, offers valuable lessons and potential synergies for similar projects within Karachi's coastal areas, supporting carbon sequestration efforts.

Karachi's transport system is also seeing innovation through the Karachi Metro Bus (Methane-Powered) project, which utilizes methane from the cattle colony, aligning with K-CAP's innovative approaches to sustainable transport. Heat management is another area where Karachi has made significant progress, with the Karachi Heatwave Management Plan outlining strategies to prevent heat-related illnesses and deaths, particularly among vulnerable populations.

Urban reforestation efforts, such as the Clifton Urban Forest using the Miyawaki Method, contribute to cooling, biodiversity, and urban resilience, aligning with KCAP's broader environmental goals. Finally, the Transforming the Indus Basin Project enhances resilience among vulnerable farmers, supporting KCAP's objectives of integrating climate-resilient agricultural practices within Karachi's periphery.

This indicates that the city is building on a solid foundation of ongoing and planned climate actions that span national, provincial, and city levels. These efforts reflect Karachi's commitment to both mitigation and adaptation, ensuring a comprehensive and holistic response to the challenges posed by climate change. Through careful coordination with related initiatives and institutions, Karachi is well-positioned to leverage existing strengths and address gaps, ultimately creating a resilient and sustainable urban environment. This approach ensures that Karachi's climate action plan is both ambitious and achievable, leveraging existing strengths and addressing gaps to create a resilient and sustainable urban environment. Moreover, the city's increasing vulnerability to climate change impacts, such as extreme weather events, rising temperatures, and urban flooding, underscores the need for a comprehensive Climate Action Plan.

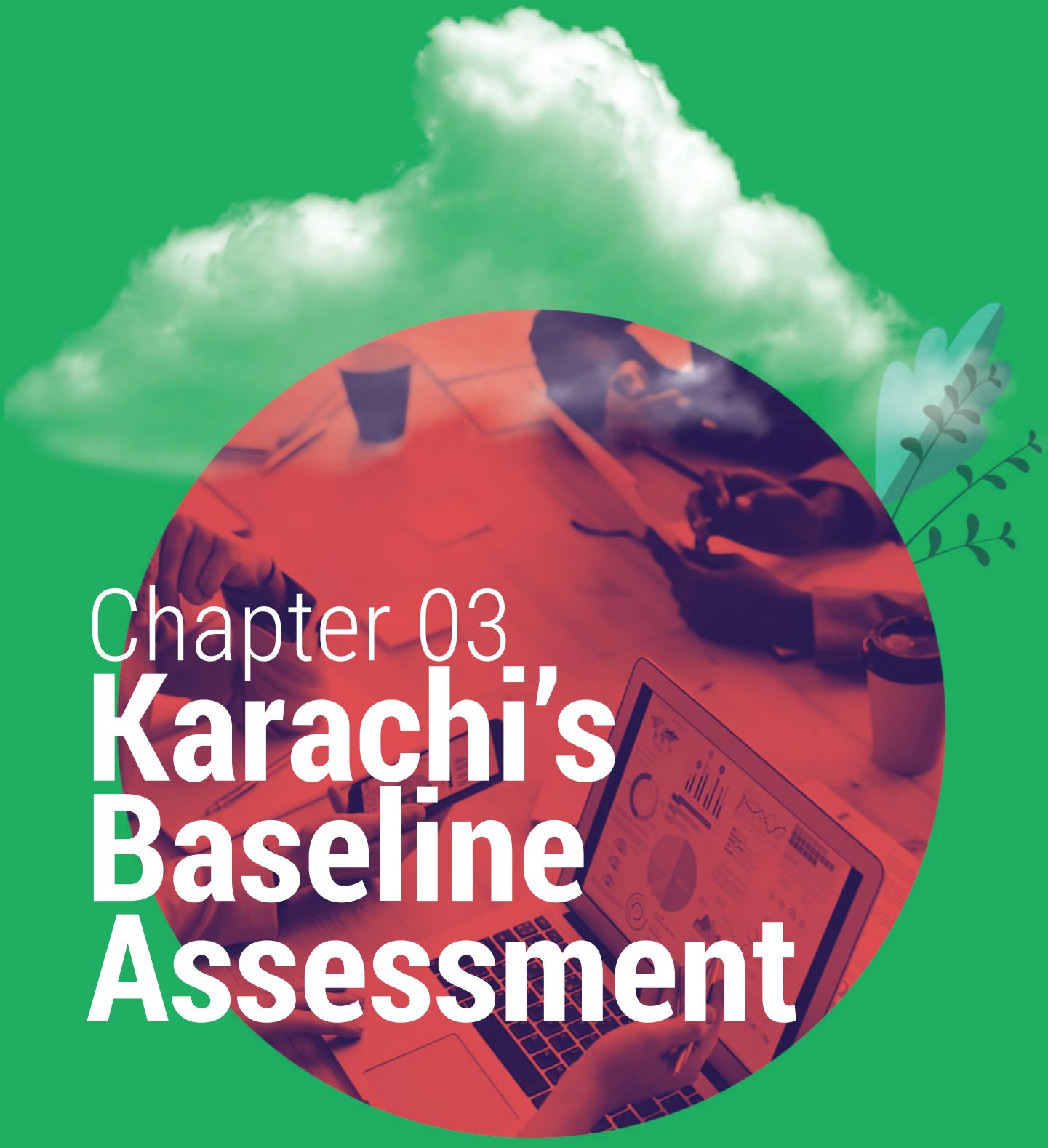
The K-CAP reflects the city's commitment to addressing the escalating risks of climate change. Developed in alignment with global climate goals under the Paris Agreement and supported by expertise from partners like the C40 Cities Climate Leadership Group, the plan marks a significant step towards sustainable urban development.
K-CAP emerged in response to Karachi's heightened vulnerability to climate impacts such as sea-level rise and extreme weather

events, which pose serious threats to lives, infrastructure, and economic stability. In addressing these challenges, K-CAP presents a comprehensive strategy focused on enhancing climate resilience and reducing greenhouse gas (GHG) emissions. The plan aligns with the broader Karachi Master Plan 2047, as well as other sector-specific frameworks, to ensure integrated and effective implementation.

The primary objective of K-CAP is to create a resilient urban framework that mitigates climate risks while promoting sustainable development. Key mitigation strategies target emissions-intensive sectors, incorporating innovative technologies and sustainable urban planning. In parallel, adaptation strategies strengthen Karachi's ability to manage climate impacts, protect natural ecosystems, and enhance community resilience.

Key components of K-CAP include a detailed Greenhouse Gas Emissions Baseline Inventory and Climate Change Risk Assessment (CCRA) which serves as the foundation for setting ambitious reduction targets and aids in prioritizing adaptation and mitigation actions for the city. The plan also outlines governance and institutional structures to oversee policy implementation and ensure accountability. Financial sustainability is addressed through innovative revenue-generation strategies aimed at funding climate initiatives and infrastructure improvements.

Furthermore, K-CAP emphasizes inclusivity and equity, prioritizing vulnerable communities through targeted adaptation measures and equitable distribution of climate benefits. A robust Monitoring, Evaluation, and Reporting (MER) framework ensures transparency and accountability, tracking progress towards goals and enabling adaptive management strategies.
The subsequent sections will provide more details on these aspects of K-CAP.



Chapter 03

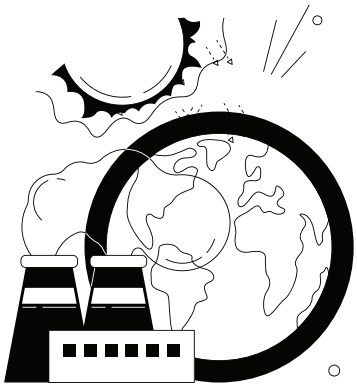
Karachi's Baseline Assessment

Karachi's Baseline Assessment

Karachi's Baseline Assessments include three integral elements;

A GHG Emission Inventory

Summarizes the key sectoral contribution of the GHG emissions in the City to form an evidence base that supports decisions in setting formal mitigation reduction targets and identifying key emissions reduction strategies



Pathways

Projecting Future Emissions 'Existing and Planned' policies, 'Ambitious', and Extended' scenarios for 2030 and 2050 using Pathways tools

Climate Change Risk Assessment (CCRA)

Provides the likelihood and potential impact of a range of climate hazards and the risks that are faced by different groups, systems, and areas of the city

3.1. GHG Emission Inventory

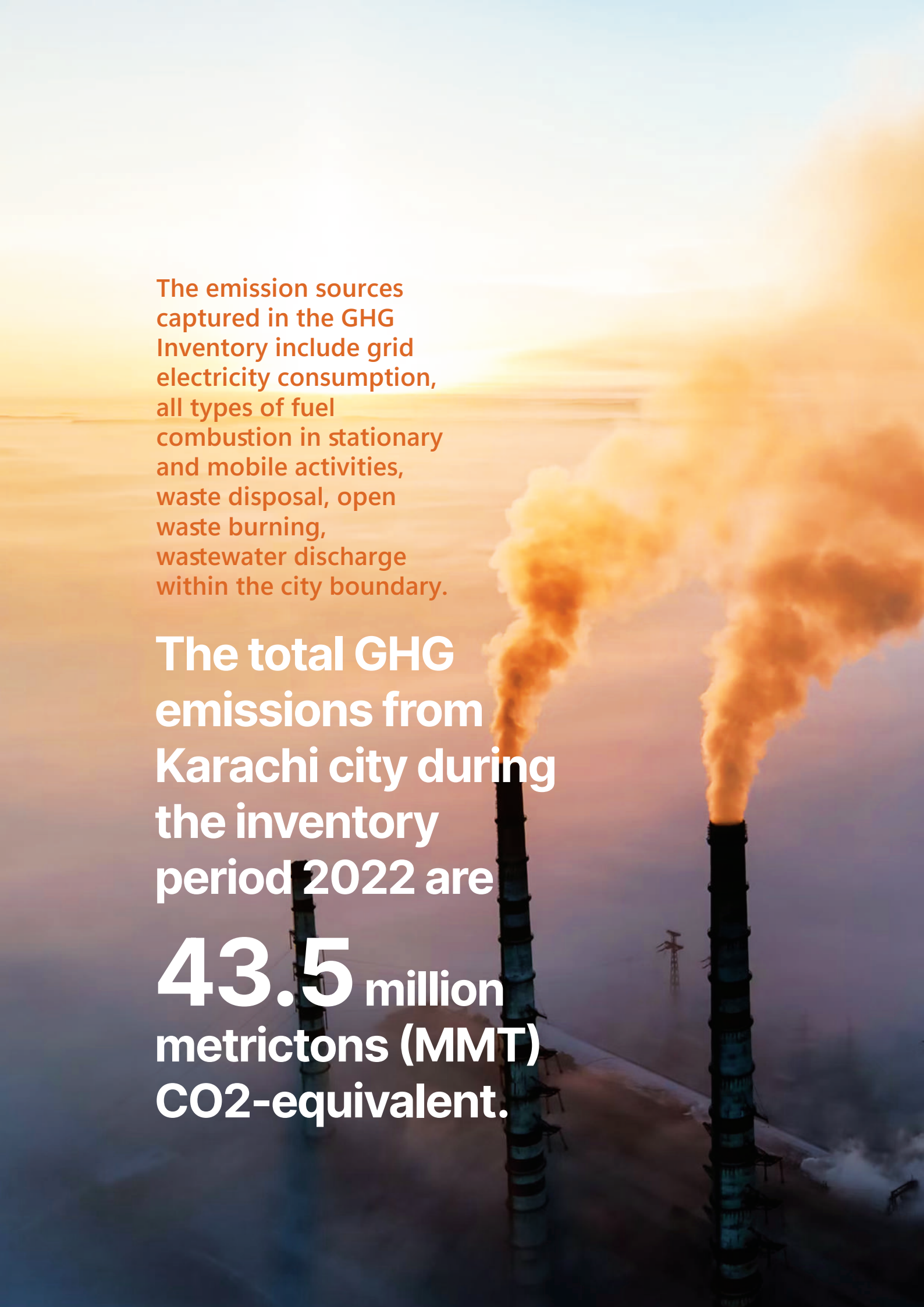
Developing a GHG emissions inventory is the first step in achieving the targets of an ambitious climate action plan as it determines the sources of emissions and quantifies the city's anthropogenic carbon footprint on the local environment. While the current report focuses on the results of emissions inventory which will form the basis for setting emission reduction targets and identification of action plans to achieve those targets, a study on the city's climate vulnerability assessment will also be carried out to address these vulnerabilities and prepare proactive sectoral plans.

This inventory is developed using the Global Protocol for Community-Scale (GPC) GHG Emissions Inventories. This protocol establishes accounting and reporting requirements for the estimation of GHGs (CO2, CH4, N2O, fluorinated carbons) from five sectors at BASIC/BASIC+ Levels and various scoping frameworks, i.e., city-induced, territorial. GHG emissions are quantified in terms of CO2e using the AR5 global warming potentials to compare and consolidate cumulative emissions from different sources.

The process of estimation of emissions was completed using the City Inventory Reporting and Information System (CIRIS) tool. This tool is developed by the C40 Cities and is compliant with the Global Protocol for Community-Scale GHG Emissions Inventories. It includes built-in formulas for units' conversion, emissions quantification, and calculation of CO2 equivalency based on the IPCC AR5 Report for all sectors and sub-sectors included in BASIC and BASIC+ Reporting Levels. The tool also provides results summaries in the form of graphs and tables for further analyses and managing city-scale GHG inventories. The boundary of the Karachi district was defined as the inventory boundary for the GHG Emissions Inventory. Considering the sectors included in the GPC Framework, data availability, and city characteristics, the BASIC-level reporting framework and the year 2022 are selected for this inventory. This level requires an estimation of CO2, N2O, and CH4 emissions from the Stationary Energy, Transport, and Waste Sectors. Activity data for emissions quantification was collected through both primary and secondary methods (Annex – A).

Karachi has not developed a GHG emissions inventory previously, therefore, the first step was to identify the sources of data and relevant stakeholders to collect activity statistics for stationary energy, transport, and waste sectors, followed by secondary data collection. The emission factors to quantify per unit GHG emissions from each sector and sub-sector, and consequently account for total GHG emissions from the entire activity of each sector were obtained from the Intergovernmental Panel on Climate Change (IPCC) Emission Factors Database (EFDB) dashboard. EFDB is an online documentary of reliable emission factors collated from the results of various global and peer-reviewed journal activity data.

The latest applicable inventory year is 2022 for the current emissions inventory for Karachi city, as the most recent published data was available for the year 2022.



The emission sources captured in the GHG Inventory include grid electricity consumption, all types of fuel combustion in stationary and mobile activities, waste disposal, open waste burning, wastewater discharge within the city boundary.

The total GHG emissions from Karachi city during the inventory period 2022 are

43.5 million metrictons (MMT) CO2-equivalent.

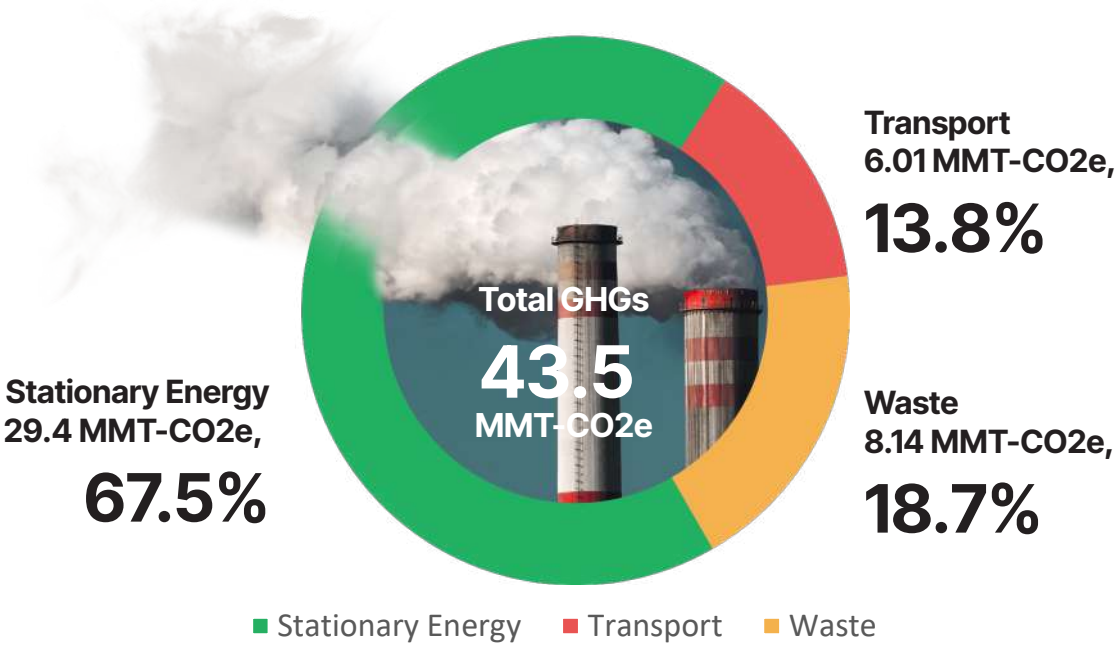


Figure 5: Total GHG Emissions Share

Emissions from stationary energy sources including grid electricity consumption and fuel combustion in residential, commercial, institutional, and industrial buildings for heat and energy generation dominate the emissions pool of Karachi City, by adding 29.4 MMt-CO2eq emissions in the troposphere.

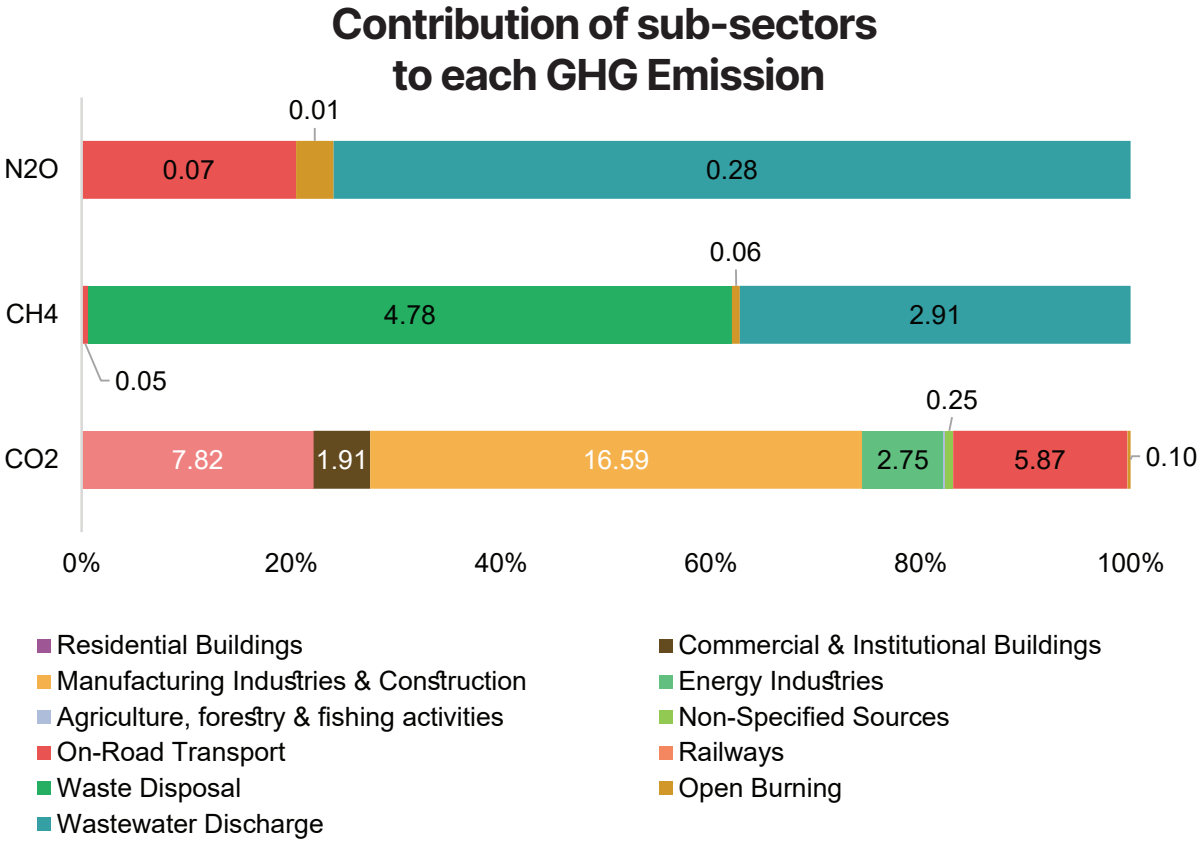


Figure 6: Sub-Sector Wise Share to CO2, CH4, and N2O Emissions

The contribution of each sub-sector to emissions of CO2, CH4, and N2O indicates Manufacturing Industries & Construction followed by residential buildings and on-road transportation are the major sources of CO2 emissions. Methane (CH4) emissions are mainly contributed by waste disposal and wastewater discharge activities. Wastewater discharge is also responsible for a major share of N2O emissions followed by the transport sector.

Based on the results of the emissions inventory, it has been estimated that 2.1 tons of CO2eq emissions are released by each resident of Karachi city. Moreover, for every unit of GDP generated in terms of millions of US Dollars from stationary energy, transport, and waste sectors in the city, 247 tons of CO2 equivalent emissions are added into the air. The emissions can also be translated in terms of land area, where per km2 of land area in Karachi city emits 12,342 tons of CO2 equivalent emissions into the air.

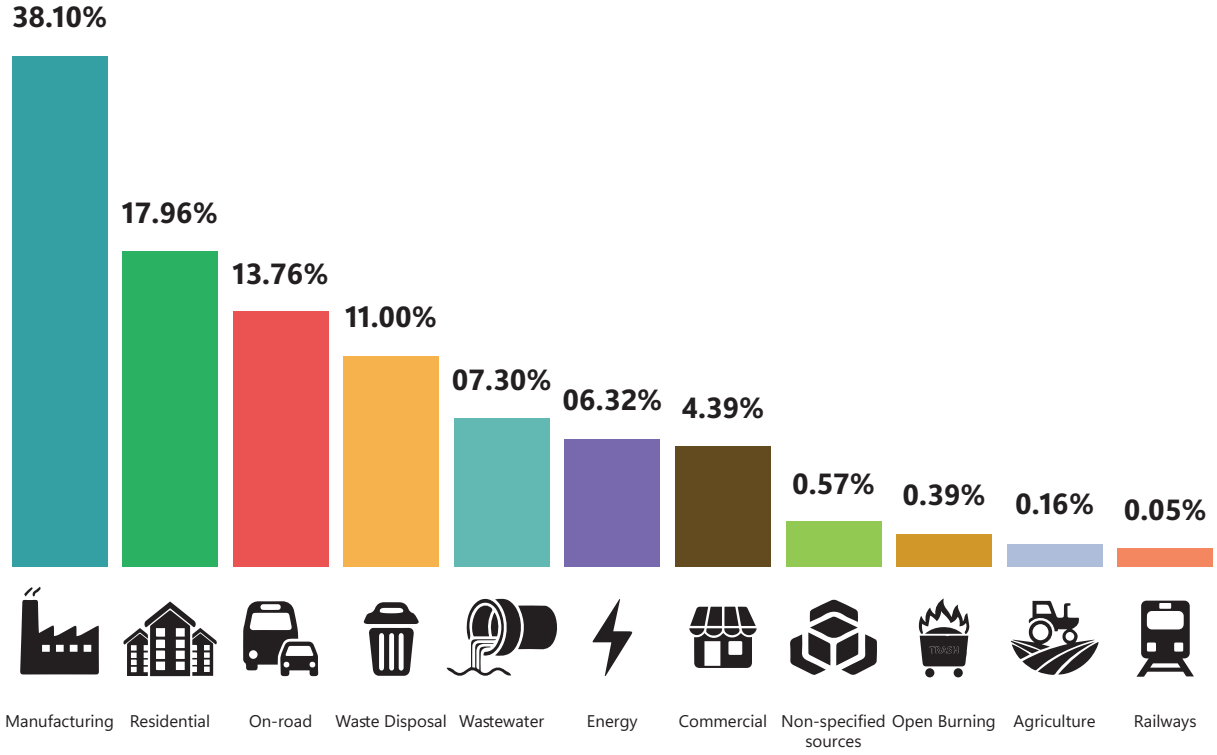


Figure 7: Sectoral Share of each sub-sector to total GHG Emissions in 2022

Stationary Energy Sector Emissions:

The Stationary Energy Sector includes emissions from fuel combustion and grid-supplied electricity consumption for energy and heat generation purposes in different buildings and industrial units within the Karachi City boundary. Emissions associated with electricity are associated with electricity generation and not from its consumption.

Results indicate that GHG emissions from manufacturing industries are highest in the stationary energy sector (56.5%). This is followed by the emissions from energy and heat generation activities in residential buildings (27%). Grid-supplied electricity contributes to 34% of the total emissions, whereas, natural gas contributes to 58% of total emissions. The rest of the emissions are contributed by LPG, RFO, crude oil, and diesel oil. The stationary energy sector emits 28 million metric tons of CO2 emissions, followed by 1,430 metric tons, and 36 metric tons of CH4 and N2O, respectively.

Scope 1 emissions included all emissions from fuel combustion and were estimated to be 19.47 MMt-CO2eq. Comparatively, scope 2 emissions included all emissions from grid-electricity consumption in different buildings and were estimated at 9.91 MMt-CO2eq.

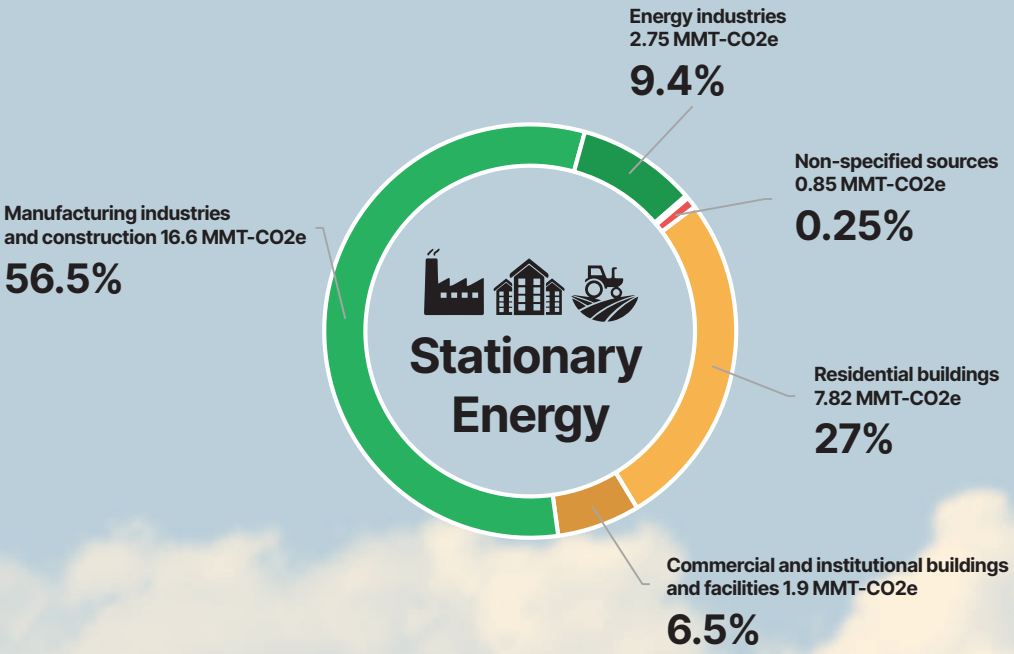


Figure 8: GHG Emissions from the Stationary Energy

Waste Sector:

Waste Sector is the second major contributor to GHG Emissions in Karachi City. The emissions of CH4 are highest (7.75 MMt-CO2eq) from the waste sector mainly caused by unmanaged solid waste disposal activities (59%). Open Burning of solid waste emits 0.1 MMt-CO2eq emissions (2%). Domestic wastewater discharge is responsible for 29% of emissions from waste sector. This sector is the major contributor of methane (CH4) emissions in Karachi city.

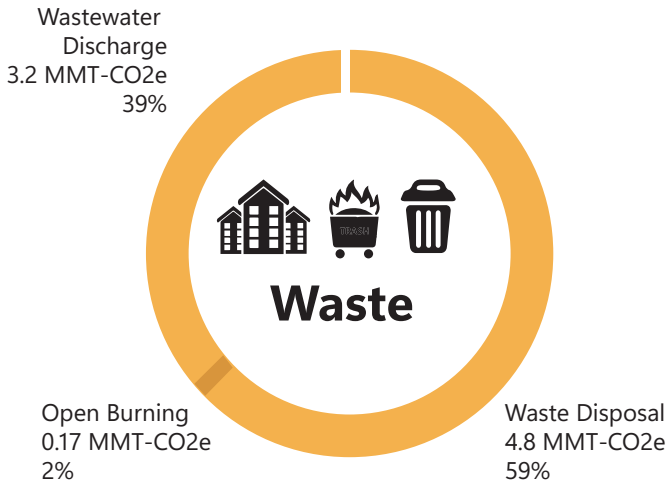


Figure 9: GHG Emissions from the Waste Sectors

Transport Sector:

Transportation sector includes emissions from the on-road transport and railway transit occurring within the Karachi city boundary. It is the third major contributor of GHG emissions. The on-road transportation includes emissions from the combustion of Motor gasoline (Petrol) and High-Octane Blending Component (HOBC) in on-road transport and Diesel Oil in both on-road transport and railways. Petrol accounts for 62% of emissions from the transport sector, followed by 36% of emissions from diesel oil, and 02% emissions from HOBC.

The gas-wise emissions contribution of transport sub-sectors revealed that the on-road transportation sub-sector is mainly responsible for emissions of all GHGs in Karachi City.

This emissions inventory forms the basis of emissions modeling, identification of key polluting sectors and key pollutants, action identification, planning emission reduction targets, and finally consolidation of an action plan. The results of this inventory were used to track future progress of emissions reduction through implementation of the Karachi Climate Action Plan.

Figure 10: GHG Emissions from the Transport Sectors

3.2. Transition towards a Net Zero Karachi City – Pathways to 1.5°C Warming

After completion of the current GHG inventory, the city's future GHG emissions were estimated based on a number of future emissions scenarios developed using the C40 Pathways Model and consultations with relevant stakeholders.

The objective of this scenario's development was to develop a robust evidence base, from which to derive ambitious citywide emissions mitigation targets and strategic objectives that guide the development of actions.

The C40 Deadline 2020 commitment categorizes member cities based on their economic development stage. Cities at various development stages are anticipated to decarbonize at different paces. Pakistan aims to set an ambitious cumulative target of reducing its projected emissions by 50% by 2030. This target includes a 15% reduction funded through the country's own resources and a 35% reduction dependent on securing international grant finance. Setting evidence-based targets for emissions reduction in line with the 1.5°C fair share scenario and the NDC's targets for Karachi's waste, transportation, energy, and other sectors is the goal of the 1.5°C scenario development, which aims to enhance the economic, social, and health benefits for the city's communities.

Karachi Emission Reduction Scenario

Karachi has embarked on its journey to develop a climate action plan aimed at mitigating greenhouse gas (GHG) emissions, aligning with the pertinent policies and obligations of the Government of Pakistan. The scenario formulation process involved rigorous consultations with key stakeholders, officials, and departments that have a direct contribution to Karachi's emissions. This data-driven scenario planning is designed to aid Karachi in advancing its climate action goals across a range of sectors, such as energy, buildings, transportation, waste, and water systems.

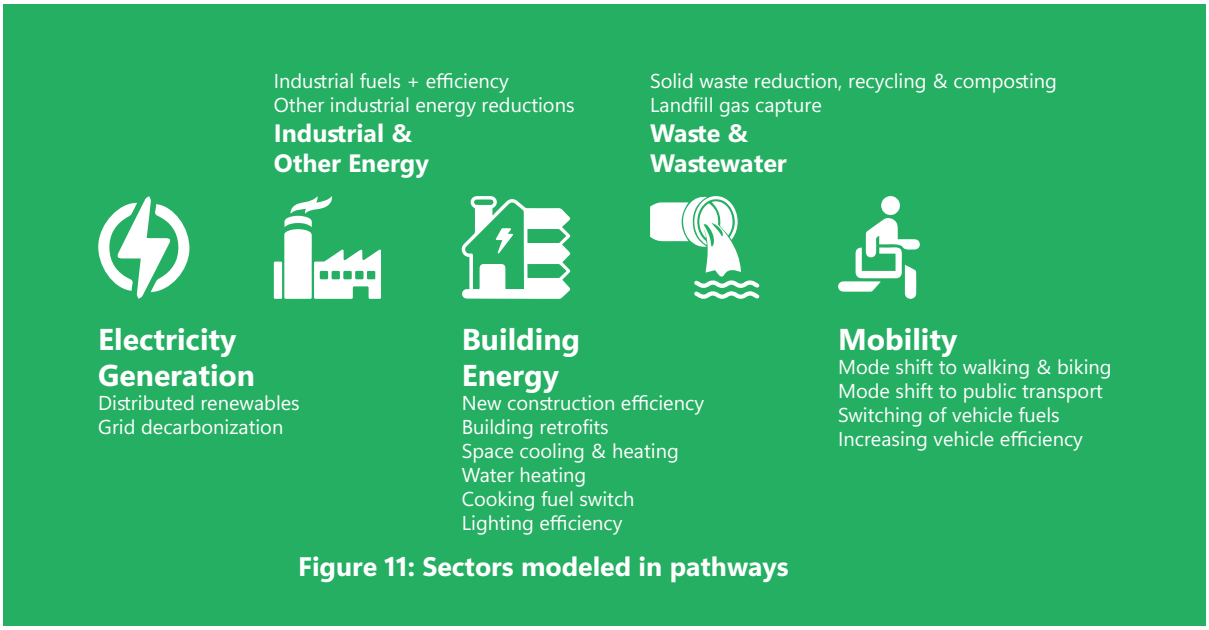


Figure 11: Sectors modeled in pathways

Source: Pakistan Updated Nationally Determined Contributions 2021.

The scenario planning phase provides a framework for Karachi City to identify key methods for reducing emissions in line with the objectives of the Paris Agreement. This stage entails tracing emission reduction trajectories and developing a business-as-usual emissions forecast that extends up to 2050. Taken as a whole, the Karachi Climate Action Plan components provide the analytical framework that identifies and develops actions for implementation.

Pathways is a future projection simulation tool used to develop projection scenarios based on GHG emission inventory which focuses on potential interventions and growth assumptions tailored to each sector responsible for emissions within the Karachi city boundary. This tool provides strategic-level analysis to assist KMC in identifying and ranking greenhouse gas (GHG) reduction strategies and how they would impact Karachi city's emissions by 2050. This model also enables swift visualization of GHG emission impacts resulting from different proposed policies, projects, and implementation assumptions.

To establish a credible pathway towards acquiring goals and target setting, three (03) emission reduction scenarios are developed.

The first scenario is a **business-as-usual scenario** which is forecasted based on economic and population growth rates for Karachi compared to the base year 2022.

The second scenario is an **existing & planned scenario** that highlights government commitments (i.e. policies, strategies, and regulations, etc.) and is expected to reduce GHG emissions in the future as compared to the Business as Usual (BAU) scenario.

Third is an **ambitious scenario** that comprises ambitious yet achievable strategies and actions to reach net zero emissions by 2050. These scenarios encompass various strategies outlined in the C40s pathways model. Stakeholder engagement is considered important and primarily aimed at identifying and validating the strategic assumptions within the Ambitious scenario.

These consultations focus on grasping the existing and planned strategies of each department and engage in iterative discussions on how these strategies could be scaled up to align with the targets of the Paris Agreement. The ambitious scenario is considered the most critical because it drives the actions detailed in the Karachi Climate Action Plan.

Business-as-usual (BAU)

No action scenario excluding the effects of ongoing or planned policies

Existing and planned (E&P)

Considers effects of existing or planned city actions along with regional and national policies

Ambitious

Includes the most ambitious yet achievable strategies for the city

Figure 12: Three Net Zero Scenarios Modeled in Pathways

Business-as-Usual Scenario

Business-as-Usual (BAU) Scenario for Karachi city represents the baseline forecast, reflecting a scenario of 'zero action scenario' or 'scenario of no additional action'. In this scenario, current actions and initiatives persist without further ambitious mitigation by the city or other entities against which further scenarios can be computed.

This baseline forecast acts as a benchmark against which the influence of emissions reduction scenarios can be assessed. Karachi city's GHG inventory is used to consider the effects of GDP and population growth rates using data sets such as geography, demographics, sectoral information, economic data, and Oxford Economics Global Cities Dataset. For each projection period and subsector, weightages of the GDP growth rate and population growth rate are assigned separately based on the activities derived from different sectors. For residential energy, transportation, and waste, weightage of composite growth factors is inclined toward population growth, whereas for other sectors weightage of composite growth factors is inclined towards GDP growth rate.

Growth Rate	2022 - 2030	2030 - 2040	2040 - 2050
Population Growth Rate	2.67%	2.83%	2.26%
GDP Growth Rate	6.96%	5.49%	4.93%

Fundamental emission values computed in the Business-as-Usual Scenario along with their sectors (stationary energy, transport, waste, industrial processes & product use, and agriculture, forestry & land use) are presented in the following figure.

Karachi City's annual emissions are projected to increase to **131.6 million tons CO2e**/year by 2050 as per BAU Scenario. Without urgent mitigation actions, Karachi City's annual emissions are forecasted to double **(118%)** by 2040 and triple **(213%)** by 2050, compared to the base year, 2022.

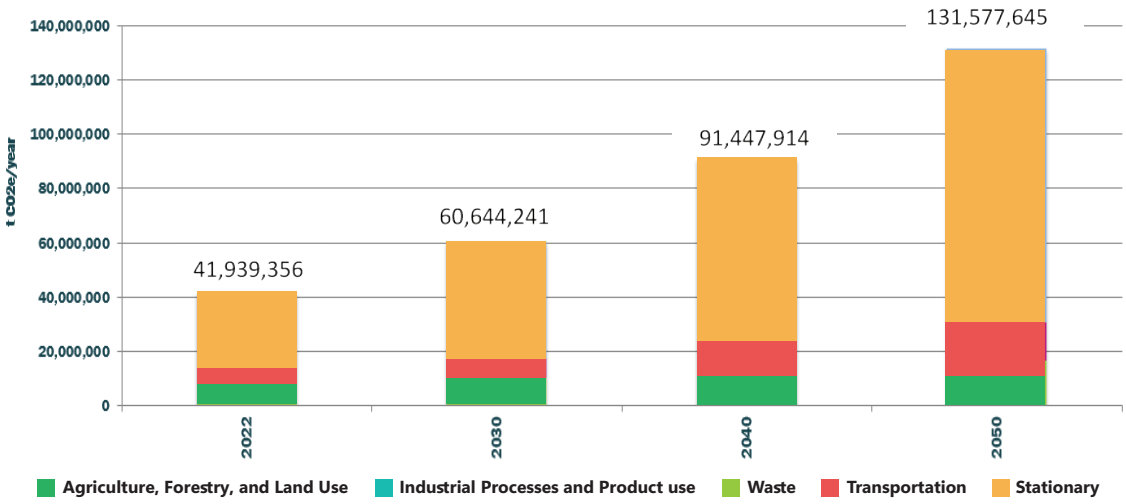


Figure 13: Business as Usual Scenario Key Emission Forecast 2022 to 2050

This increase in emissions is attributed to the high GDP and rapid population growth rates. In Karachi, emissions forecasts according to BAU, are susceptible to a wide array of economic, technical, and policy uncertainties. The variation in Karachi's base year emissions of GHG inventory (43.5 million tons CO2 e/ year) as compared to the Pathway model emissions (41.9 million tons CO2 e/ year) is due to calibration and model adjustment to improve the accuracy.

Emissions Trajectories from 2022 to 2050

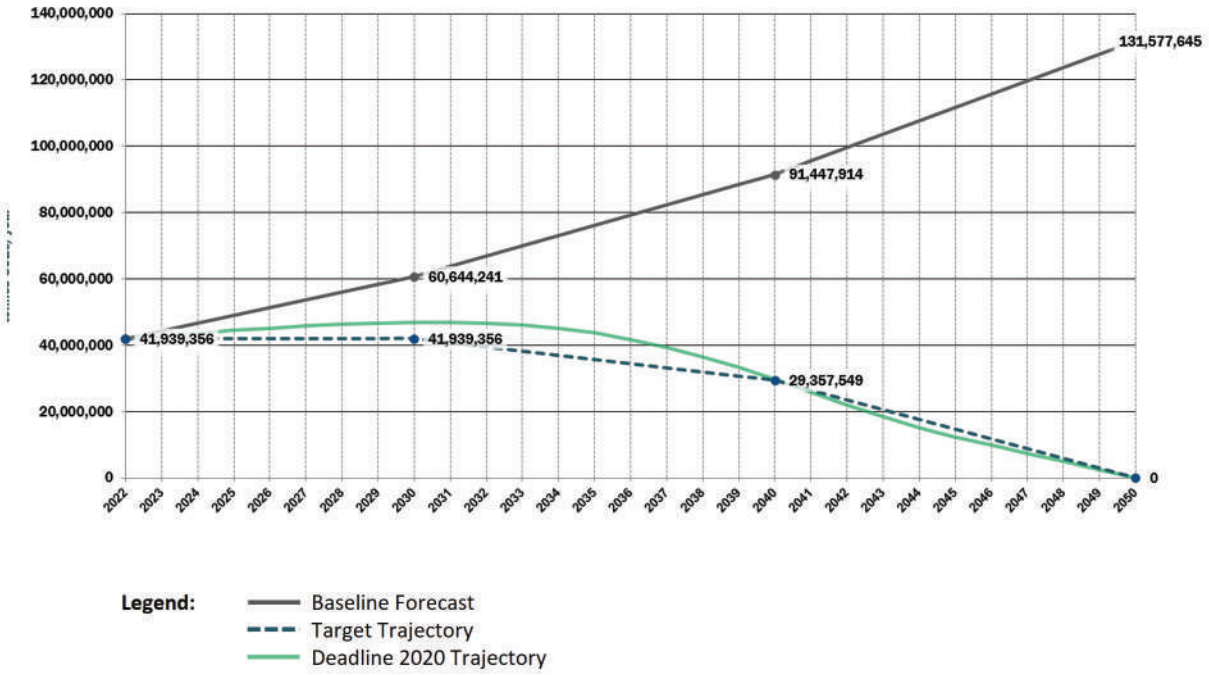


Figure 14: Karachi baseline and target trajectory forecast

The Deadline 2020 trajectory (represented by the green line in Figure 14) developed by C40 serves as a guide for key stakeholders and decision-makers of Karachi City. It helps assess how closely a city's ambitious scenario aligns with the principles of Deadline 2020 and their assigned trajectory.

C40 Knowledge Hub. https://www.c40knowledgehub.org/s/guidenavigation?language=en_US&guideArticleRecordId=a3s1Q000001iaiGQAQ&guideRecordId=a3t1Q0000007lEWQAY.
https://www.c40.org/cities/karachi/

Existing and Planned Scenario

The Existing and Planned (E&P) Scenario takes into account the projected decrease in emissions from existing plans and policies, which are being implemented in the city. This allows government departments to assess the gaps between what can be achieved through the existing regulatory framework and the remaining emissions that need to be addressed. This is necessary to meet city's existing targets under an ambitious scenario .

The E&P scenario uses the existing situation to demonstrate the emission reduction trajectory of Karachi City before execution of the K-CAP. The information acquired to develop this scenario was extracted from the existing commitments, plans, and policies i.e. NDCs (Nationally Determined Contributions), National Climate Change Policy, Karachi's Master Plan, K-Electric Limited Integrated Investment Plan FY 24- FY 30, National Electric Vehicle Policy, Sindh Solid Waste Management Act 2021. Environmental Protection Act 2014, Sindh Climate Change Policy 2022, and Sindh Sanitation Policies 2017.

This scenario marks the first phase in identifying areas that require additional mandatory mitigation actions, followed by the exploration of additional scenarios.
According to the E&P Scenario:

Emissions are expected to achieve **95.7** million tons CO2e/year by 2050, an increase of **128.4%** in comparison to the base year 2022. By 2050, Karachi can achieve a **44.6%** share of renewables initiative by K-electric and a **15%** improvement in process efficiencies of industries by NEECA and the industries department.

C40 Knowledge Hub (https://www.c40knowledgehub.org/s/guidenavigation?language=en_US&guideArticleRecordId=a3s1Q000001iaiGQAQ&guideRecordId=a3t1Q0000007lEWQAY)

Emissions Reduction Potential of Selected Actions

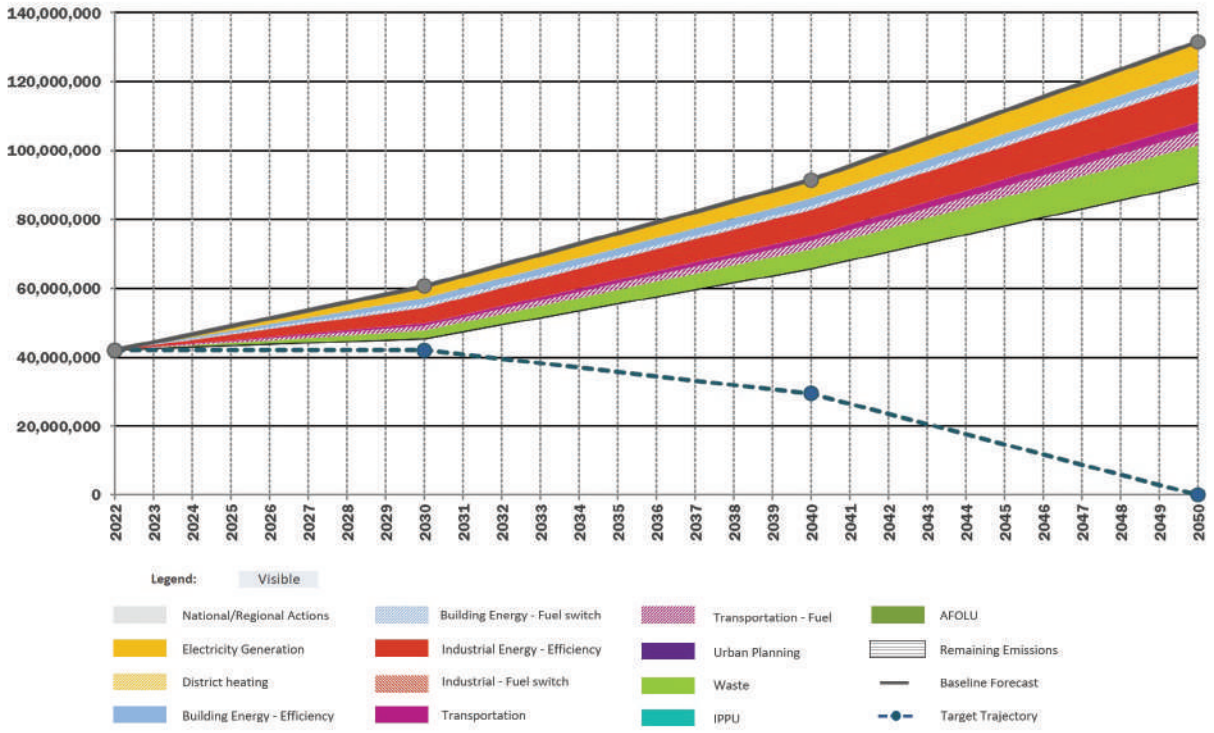


Figure 15: Pathways for Existing and Planned Scenario

The situation indicates that, in response to the rapidly growing demand, it is imperative to accelerate the transition towards renewable energy sources. The annual emission reduction in each sector under the E&P scenario is provided in Figure 6. The projection results of the E&P Scenario show that despite implementing all existing plans and policies, significant emissions remain. By 2050, industrial and other combined sectors will still emit 61.5 million tons CO2e/year, compared to 76.9 million tons CO2e/year in the base year 2022.

The E&P scenario has the GHG emission reduction potential of **35.9** million tons CO2e/year by 2050 compared to a BAU scenario of **131** million tons CO2e/year. By 2050, **95.7** million tons of CO2e/year of emissions still need to be addressed to reach the 2020 deadline trajectory and 1.5°C Paris Agreement.

This highlights the urgent need for more ambitious actions to fulfill Karachi City's commitments to climate change.

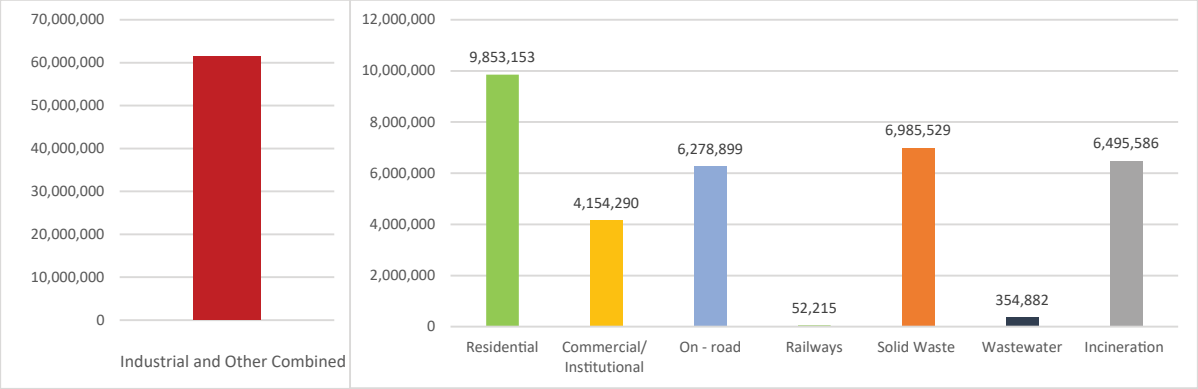


Figure 16: Remaining Emissions after Action in Existing and Planned Scenario

"Karachi's major emissions stem predominantly from the industrial sector, followed by **residential areas, municipal services** (including solid waste and wastewater), on-road transport, and commercial/institutional sources.

A closer analysis reveals that industrial emissions should be addressed as a top priority, though other sectors also demand focused attention. A **holistic approach** to emissions reduction is crucial, ensuring that efforts across all sectors are integrated and coordinated to drive **Net Zero** and create a **sustainable future".**

Ambitious Scenario

The GHG emissions reduction in the E&P scenario is not adequate to achieve the city's long-term targets of net zero emissions by 2050 and therefore requires additional strategies to align with the Paris Agreement. The strategies and actions in the ambitious scenario are defined as ambitious yet achievable. This scenario will provide the reference point for the development of credible net zero strategies and actions. The opportunities that will be explored in this scenario are:

- Scaling up of existing Provincial and National Programs
- High Emission reduction towards achieving the targets of a green economy and net zero

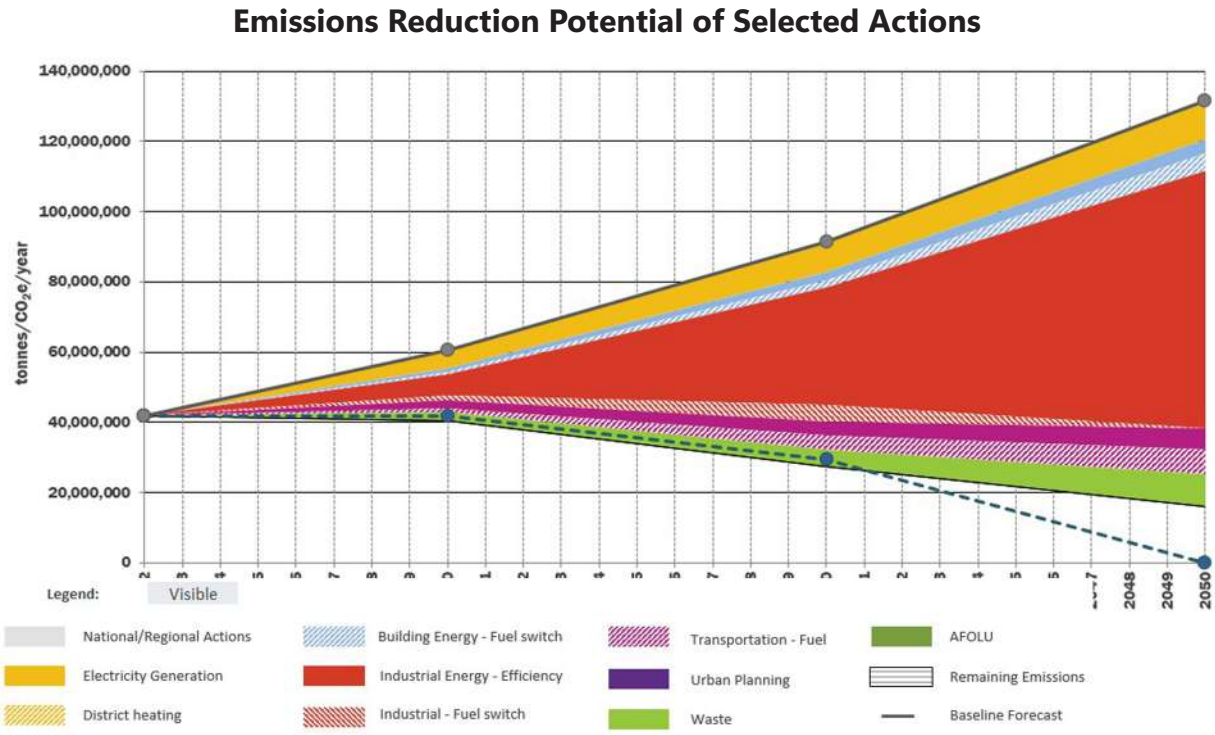


Figure 17: Pathways – Ambitious Scenario

This ambitious scenario is tailored to embrace cutting-edge technologies that will boost economic growth, generate new employment opportunities, and address energy poverty and instability. This forward-thinking vision aims to position Karachi city as a leader in the transition towards a green economy. The ambitious scenario encompasses a range of policy support measures, robust capacity-building initiatives, and rigorous enforcement of regulatory frameworks and monitoring mechanisms.

Overall emission reduction pathways with sectoral breakdown", are highlighted below, emphasizing the significance of enhancing industrial energy efficiency and electricity generation. This ambitious scenario can achieve an emission reduction of 3.7% by 2030, 34.8% by 2040 and 62.2% by 2050.

The sector-wise breakdown of annual emission reductions in each target year as well as the associated percentage share of total reductions to achieve the targets of mitigation and adaptation goals of an ambitious scenario is tabulated below.

Table 4: Summary of Sector-wise emissions percentage of reduction as per Ambitious Scenario

Sectors	2030	2040	2050
Industrial and other Stationary Energy	36.7%	59.4%	63.4%
Electricity Generation	25.9%	13.4%	9.4%
Building Energy	7.8%	6.9%	7.8%
Transport	16.8%	12.9%	11.4%
Waste	12.7%	7.5%	8.0%

The remaining emission reduction in each sector under the ambitious scenario is provided in Figure 16. After implementation of all the strategies proposed under the ambitious scenario, some of the emissions are still left under different sectors which is projected to be 12.1% (15.9 million tons CO2e/year) by 2050 as compared to total BAU emissions. Most of the residual emissions come from wastewater (4.9 million tons CO2e/year) due to the limited capacity of wastewater treatment and without any biogas capture systems; residential sector (3.5 million tons CO2e/year) due to inefficient appliances and limited retrofit actions; industrial and other combined sector (3.3 million tons CO2e/year) due to energy-efficient equipment, processes and limited implementation of energy performance and environmental quality standards; solid waste (2 million tons CO2e/year) due to limited capacity of methane capturing facilities at landfill sites.

Since remaining emissions of Karachi City are below the assigned Deadline 2020 trajectory, the city will monitor these residual emissions when updating the plan every four years.

For each sector and related themes, new strategies have been carefully identified and developed through a series of consultative sessions with government departments, private sectors, and local communities, ensuring that the plans are not only ambitious but also feasible within Karachi's unique context and the associated time frames. These strategies have been tailored to balance ambition with practicality, facilitating effective implementation.

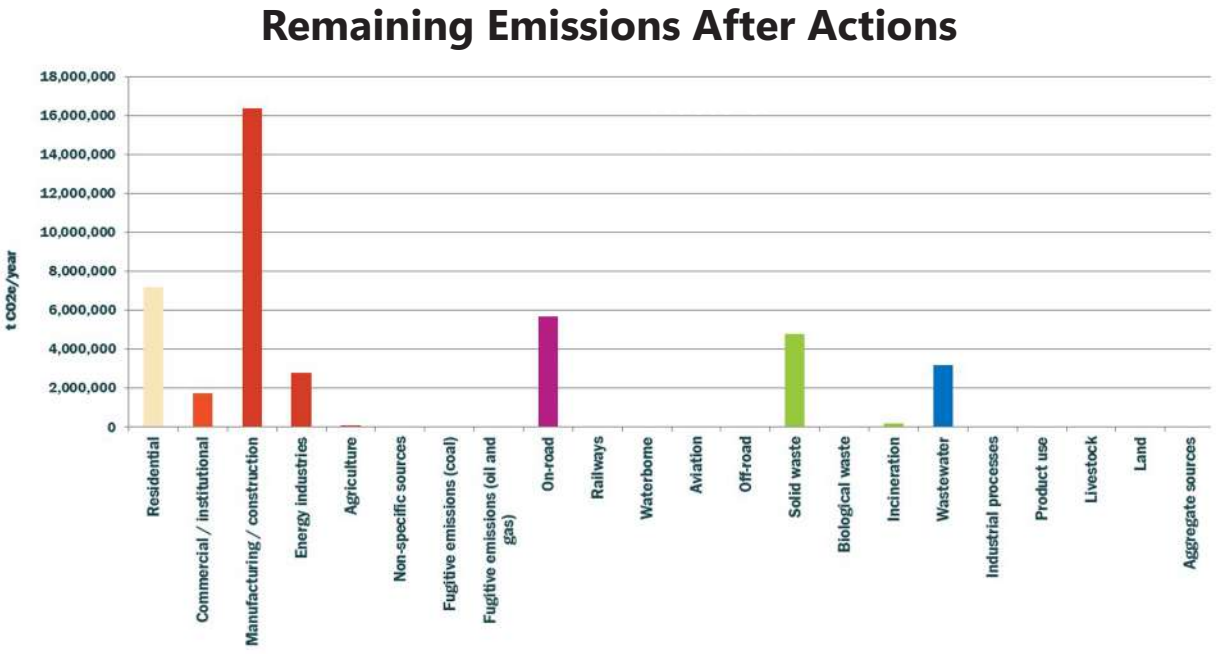


Figure 18: Pathways – Remaining Emissions after Action in Ambitious Scenario

3.3. Climate Change Risk Assessment (CCRA)

To assess the existing climatic risks, and their impacts and to understand the likelihood of future climate hazards and the potential impacts of these hazards, a thorough climate risk assessment was conducted for Karachi city in line with the UNDP strategic plan , C40´s CAP Framework and Cities Climate Transition Framework requirements, and CCRA guidelines .

Sindh, particularly, Karachi City, is facing multiple climatic challenges such as more frequent heatwaves in the urban centers; a decrease in mean rainfall, particularly along the coastal belt (10%–15% decrease in precipitation since 1960 - leading to drought conditions) affecting wetlands and mangrove ecosystems; more frequent storms; and increase intense daily rainfalls leading to urban flooding.

A total of five indicators are evaluated to assess its climate risk context. These are;

Urban Heat Risk | **Urban Flooding Risk** | **Drought Risk** | **Storm/ Coastal Risk** | **Air Pollution Risk**

https://www.undp.org/publications/undp-strategic-plan-2022-2025
https://www.c40knowledgehub.org/s/article/Cities-Climate-Transition-Framework?language=en_US

https://www.c40knowledgehub.org/s/guide-navigation?language=en_US&guideRecordId=a3t1Q0000007lEWQAY&guideArticleRecordId=a3s1Q000001iahxQAA

Urban Heat Risk

The Berkeley Earth Data estimates warming between 1900–1917 and 2000–2017, showing 0.9°C of warming in the vicinity of Karachi City, increasing advents of heatwaves.

Karachi frequently experiences extreme heat waves, with temperatures often surpassing 40°C. Heatwave days are defined as periods where the maximum daily temperature (Tmax) equals or exceeds the 90th percentile of recorded temperatures for at least six consecutive days in a year. Between 1980 and 2023, 28 heatwave events were recorded. These occurred in 1980, 1981, 1985, 1986, 1995, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012, 2015, 2022, and 2023. Notably, over half of these events (17 out of 28) took place in the last 16 years, underscoring an alarming trend. Heat stress has become a recurring challenge for Karachi. In 2022, the city experienced unprecedented heatwaves in March, marking the hottest temperatures recorded since 1901. These extreme heat events have also triggered secondary impacts, including outbreaks of diseases like malaria, dengue, and gastrointestinal infections, highlighting the indirect long-term health hazards associated with heat waves.

Historical data reveals a clear increase in both the frequency and intensity of heatwaves, driven by climate change. This trend has led to numerous adverse consequences, such as heightened water consumption and increased demand for water supply services, rising energy needs for cooling appliances like air conditioners, heat-related illnesses, and fatalities, exacerbated load shedding, and mounting pressure on healthcare and emergency response systems.

1875: 0.21 ± 0.43 °C **2020: 0.91 ± 0.31 °C**

Figure 19. Warming Stripes of Karachi City

The future scenario indicates that the number of hot days (with temperatures exceeding **35°C**) is projected to increase by 17-19 days annually under **SSP1-2.6** and by over **40** days under **SSP5-8.5** by **2080-2099,** increasing the vulnerabilities of densely populated urban areas with inadequate green spaces and poor ventilation, such as Korangi, Landhi, & Orangi Town.

https://data.berkeleyearth.org/locations/24.92N-67.39E#
Ibid

Heat Vulnerability in Karachi

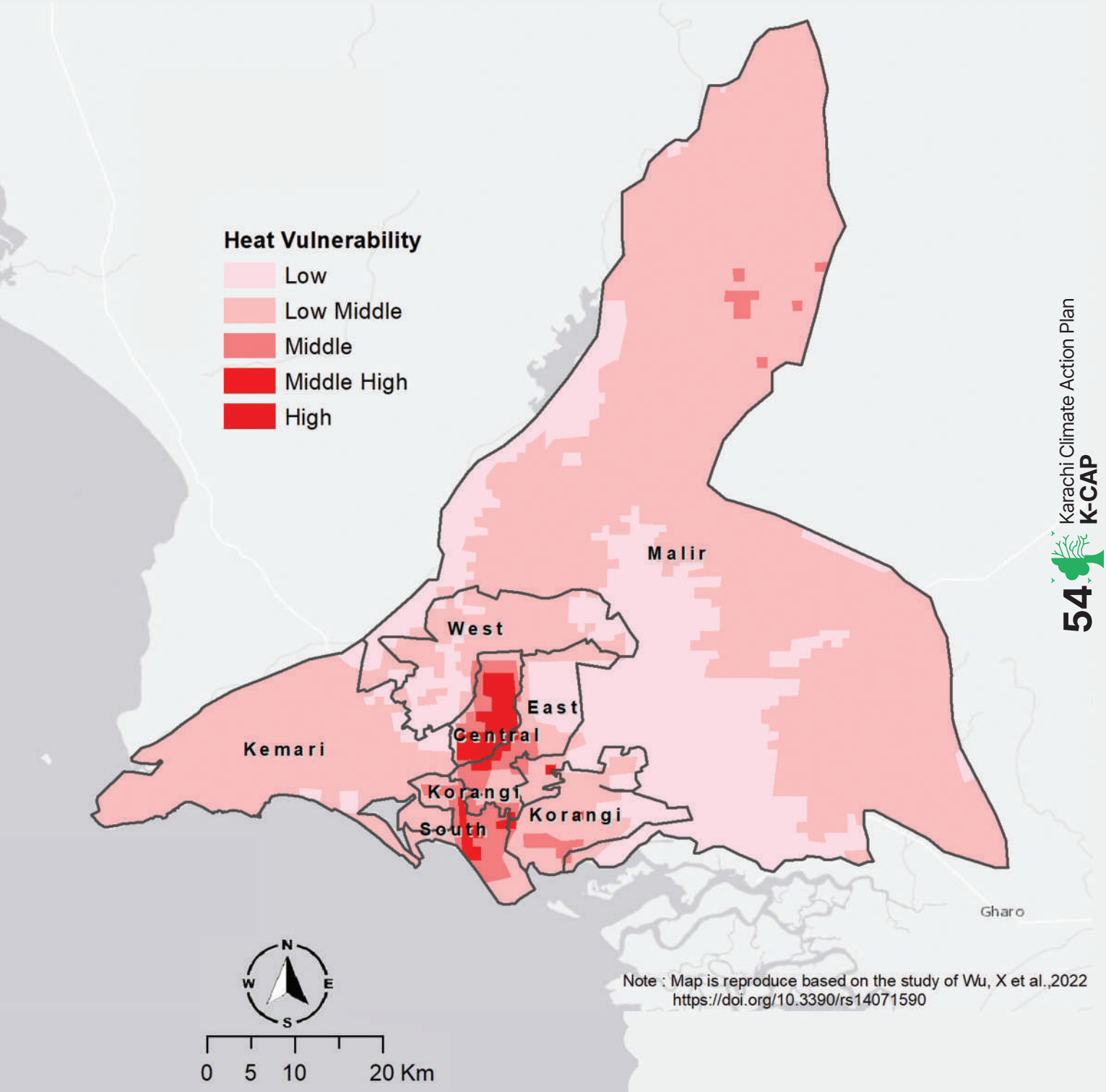


Figure 20: Heat Vulnerability in Karachi

Urban Flooding Risk

Karachi City's rapid urbanization and population increase are making it more susceptible to the effects of flash floods. During the Monsoon season (July to September), the risk of urban flooding is usually higher in the city which causes extreme disruption in routine activities and damage of infrastructure.

The city has 58 storm water drains (nullahs) which are connected with two non-perennial rivers i.e. Malir River and Liari River, that cross the densely populated areas in Karachi before falling out into the Arabian Sea. Malir River basin has a large network of streams but rapid urban sprawl and encroachment, resulted in the stream abatements.

Unfortunately, there is widespread encroachment on practically all natural drains and nullahs and they are filled with plastics and other waste items. More frequent and intense downpour events have caused colossal damage to lives and halted transportation and communication for several hours.

By overlaying almost **105 hotspots** across the city based on the historic flood locations hotspot, approximately **6.85%** population of Karachi is susceptible to flooding, situated within a **250**-meter buffer zone surrounding the flooding hotspots. Low-lying areas and informal settlements with poor drainage systems, such as Lyari, Saddar, and Gulshan-e-Iqbal are more vulnerable to flooding. It is predicted that the average largest one-day precipitation anomaly and five-day precipitation anomaly for **2020-2039** could be 15mm, with an overall precipitation change of **15%** in both **SSP1-2.6** and **SSP5-8.5** scenarios .

Flood Vulnerability in Karachi

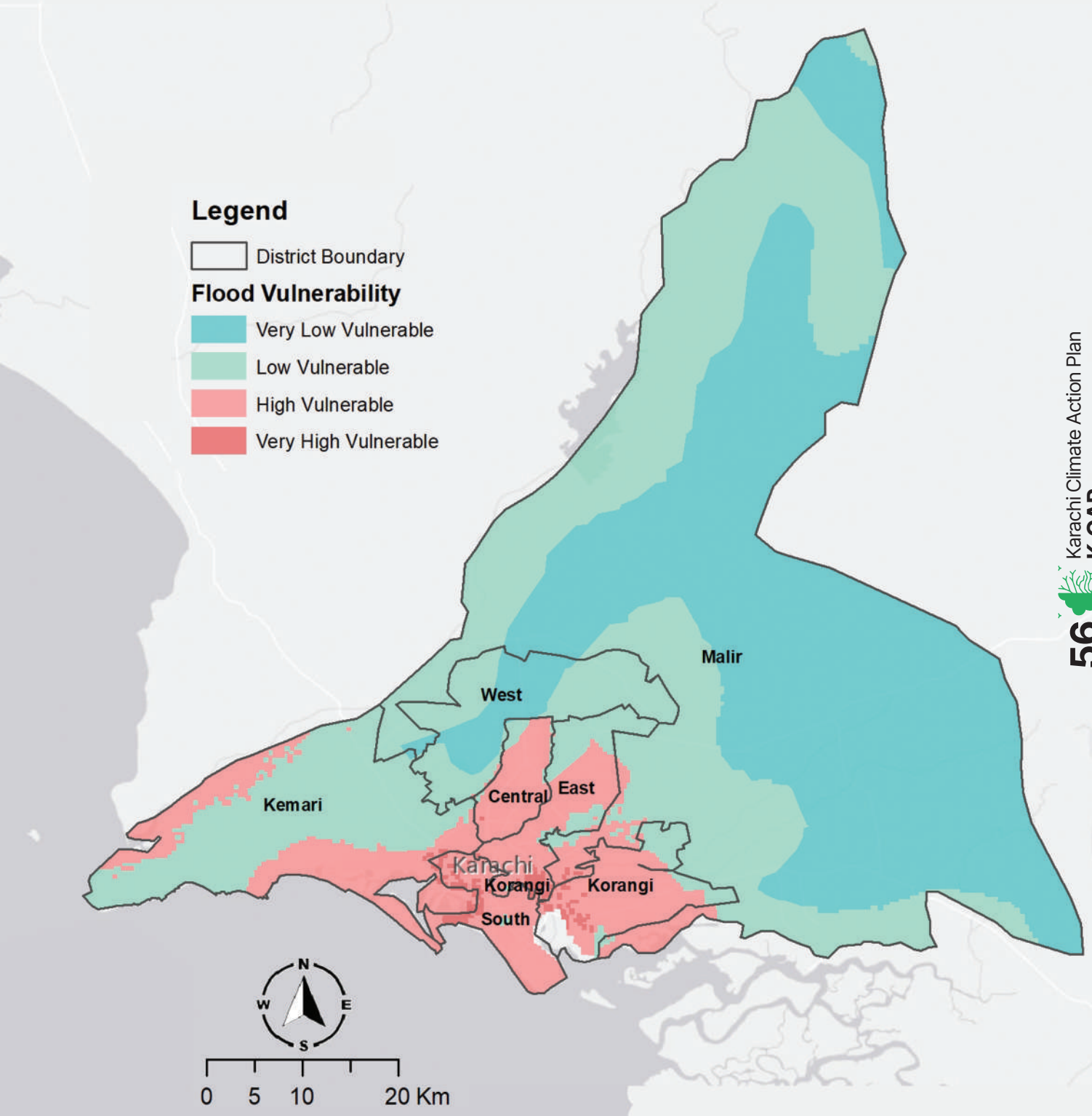


Figure 21: Flood Vulnerability in Karachi

Droughts Risk

Droughts in Karachi are characterized by prolonged periods of low rainfall, leading to water scarcity. The central eastern and southern areas are particularly susceptible due to high urban land coverage and limited adaptive capacity.

Moreover, livelihoods of Goths/villages that are highly dependent on groundwater for farming and daily uses, facing lower water demand due to drought conditions are causing more stress on water utilities. The drought conditions coupled with the stress on water utilities and the hub river/dam service area are expected to become more severe, stressing water resources further and potentially leading to subsidence & destabilization of infrastructure.

In future, the risk for the return period is medium, except for Karachi West & Malir where the risk is higher.

The future risk of metrological droughts in Karachi (South, West, Central) based on **5-10** years return periods is low, whereas the risk in Karachi West, Malir, and is medium to high. The metrological risk for the return period is medium, except for Karachi West and Malir where the risk is high.

Drought Vulnerability in Karachi

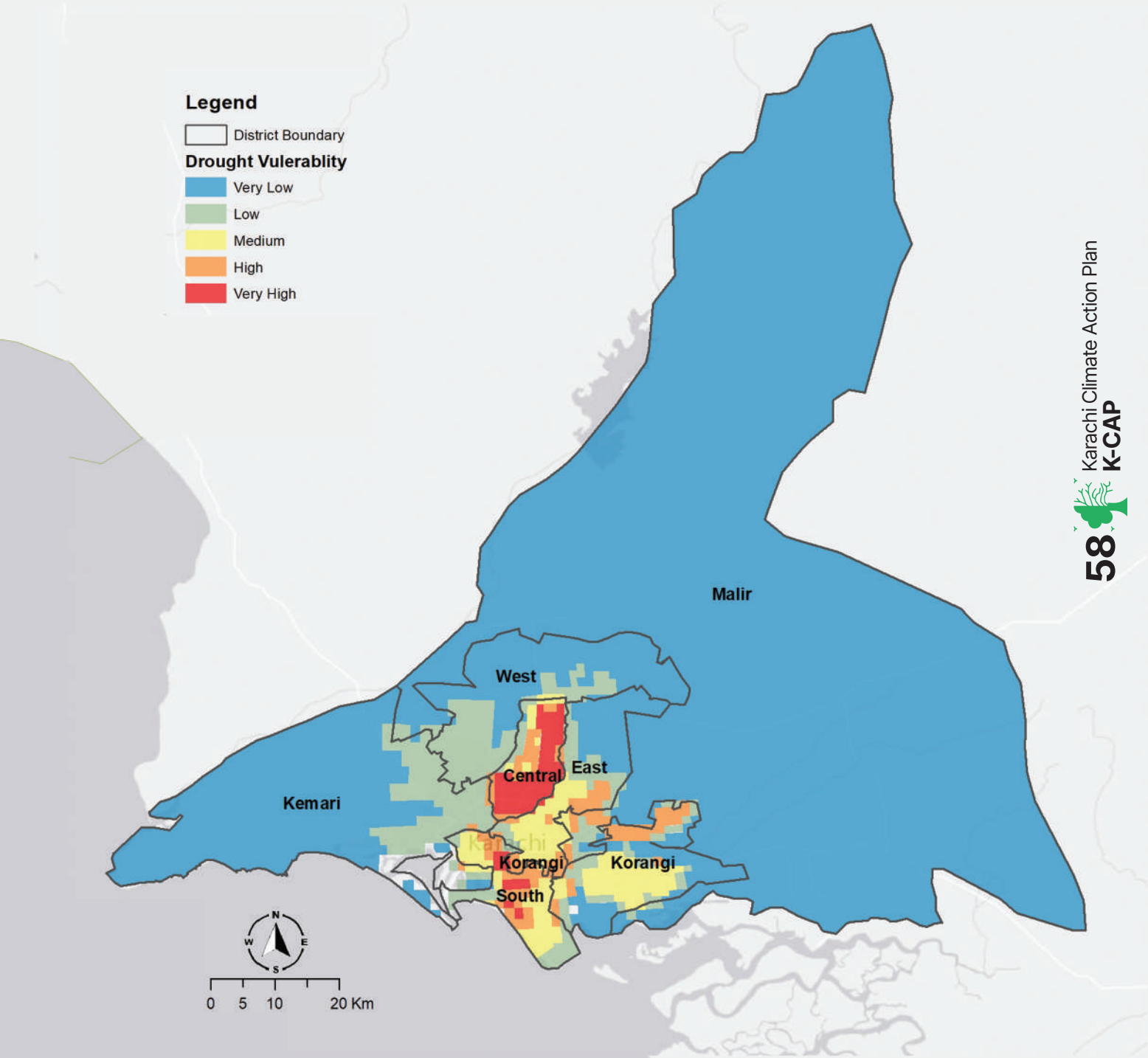


Figure 22: Drought Vulnerability in Karachi

Coastal Risk

Sea levels along Karachi coast have risen about 10 cm over the past century, with an annual increase of approximately **1.1 mm.** This rise has contributed to coastal erosion, tidal flooding, and saltwater intrusion. **The projected SST indicates a higher value of 0.35°C by the year 2045. Sea levels are projected to rise by up to 60 cm** by the end of the century if effective mitigation measures are not implemented.

Coastal regions and low-lying areas near the sea, such as **Clifton, DHA, and Ibrahim Hyderi** are some of the most vulnerable areas in the city. The future coastline risk analysis reveals that a significant portion of Karachi's coastal areas, including **Hawks Bay**, **Manora Island**, **DHA, Korangi Industrial Area, Ibrahim Hyderi, and Korangi Fish Harbor** Authority, will be submerged.

Multi-Hazard Vulnerability and Risk Assessment: Informed Disaster Management Plan of Sindh. 2023-2032. PDMA. SUPARCO, World Bank, and Government of Sindh

Mangroves Assessment

The coastline of Sindh is approximately 350 km long, further divided into two geographical pockets: the Indus Delta and the Sandspit. Using Landsat 5, 7, and 8, mangrove cover assessment was done based on Landsat 30m spatial resolution at five different intervals (2010-2023), revealing that the area under mangroves in 2023 decreased to 11.74 km2 in 2023 from 12.1 km2 in 2010. In 2013, 2015, and 2020, the areas covered with mangroves were 12.65, 13.27, and 13.16 km2 respectively. Unplanned and unregulated urban development is found to be a major cause of a decrease in mangrove cover.

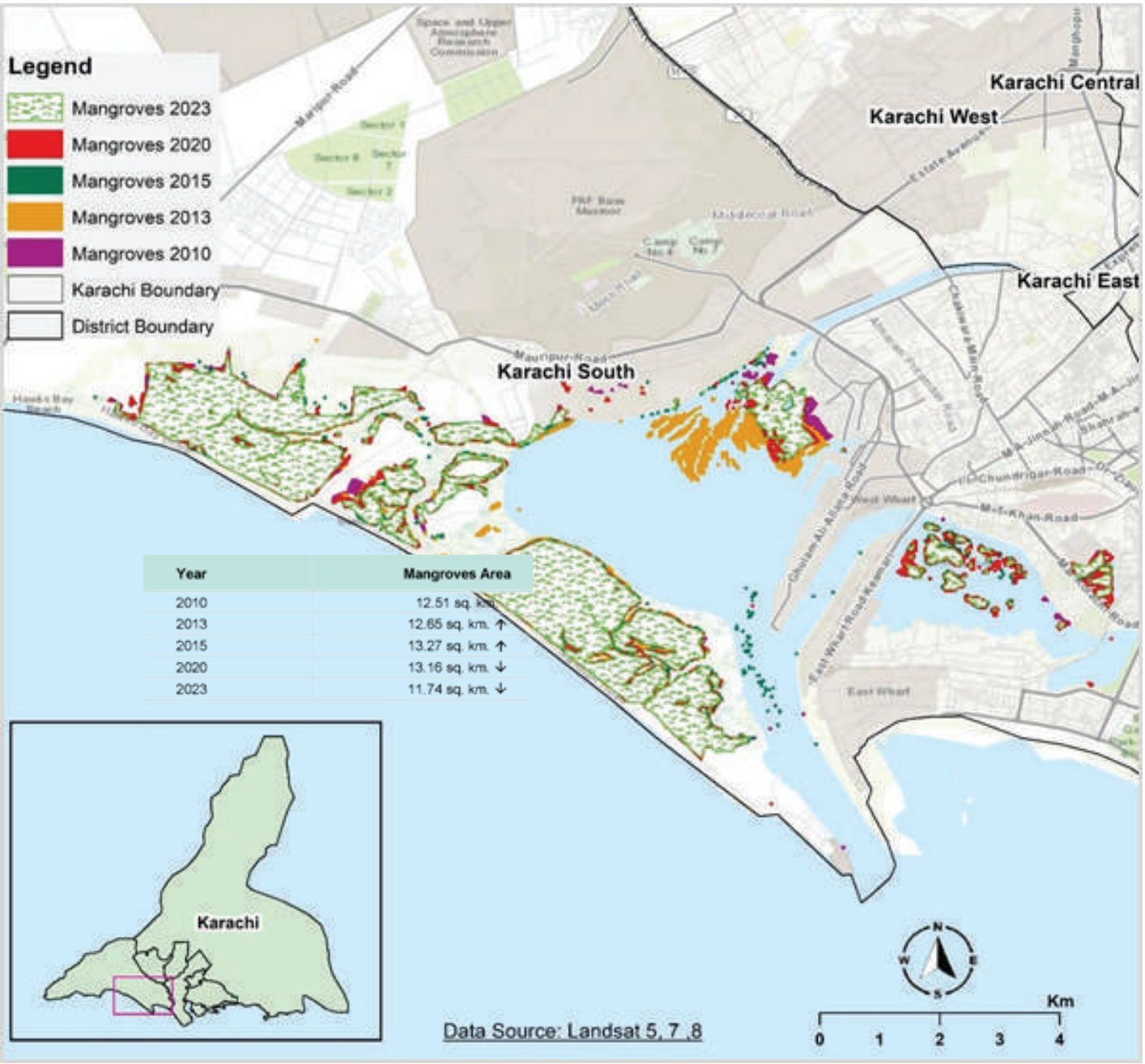


Figure 23. Mangrove Change Detection Map (2010 – 2023)

Air quality

The World Air Quality Report concludes that residents in Karachi city have lost 2.7 years from their average life expectancy because of high exposure to poor air quality. Karachi does not have an adequate number of equipment for air quality profiling and source-based apportionment. There are 03 air quality monitoring sensors installed in Karachi, the details of which are as follows;

Table 5: Air Quality Monitors in Karachi

Monitors	Location	Parameters	Time Period
Continuous AQMS	US Consulate Karachi	PM2.5	May 2019-Present
Beta-Attenuation Monitor (BAM)	Magnificence Center	PM2.5, PM10	March 2022-Present
	Railway Road Karachi	PM2.5, PM10	May 2023- Present
Purple Air Low-Cost Sensor			
Gaia Air Quality Monitor	University of Karachi		

The daily average PM2.5 variations from June 2019 to October 2023 show peak concentrations of 221.5 µg/m3, 191.08 µg/m3, and 233 µg/m3 on January 13, 2021, January 22, 2022, and January 12, 2023, respectively. The maximum recorded summer season concentration is 87 µg/m3 on June 22, 2022.

Carbon Monoxide concentration shows that Karachi East and Karachi Central are the most polluted areas, followed by Karachi South, Cantonment, and Korangi Districts. **Nitrogen Dioxide** concentration is higher in the most populated areas with high commercial, industrial, and residential activity, most confined in Karachi Central, East, and Korangi districts. **Sulfur Dioxide** is recorded as the highest among all other pollutants in Karachi city, making it the key pollutant. **Ozone** is high in the western and southwestern parts of Karachi city.

Reducing particulate pollution to WHO guidelines could add 2.6 years to the life expectancy of Karachi's residents.

Data Source: Landsat 5, 7, 8, prepared by the Urban Unit, 2024
University of Chicago. (2023). Pakistan Fact Sheet. Air Quality Life Index.

Annual Average Sulphur Dioxide (Nov 2022-Oct 2023)

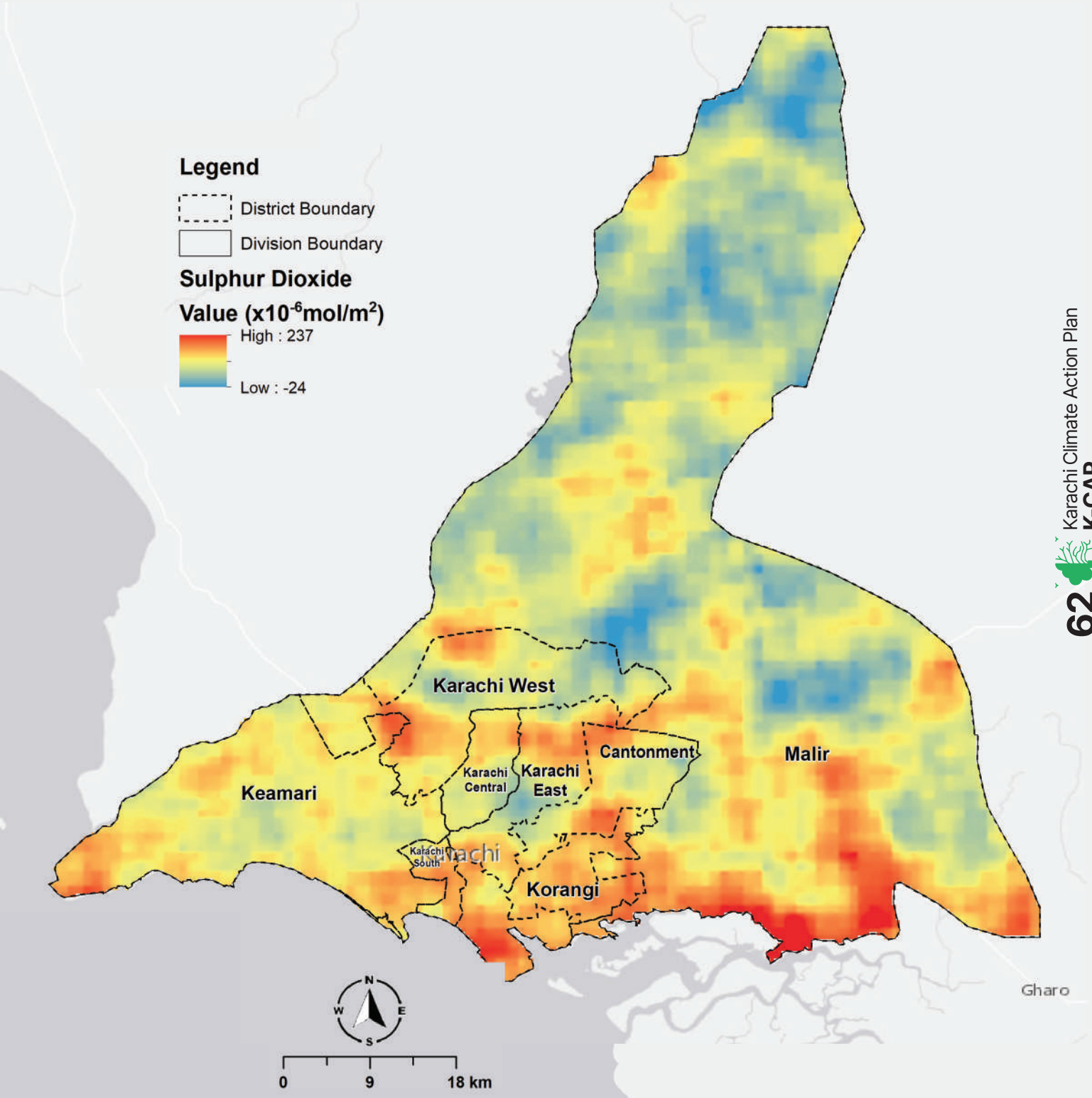


Figure 24. Annual Average Concentration of Sulfur Dioxide (Nov 2022 – Oct 2023)

Annual Average Carbon Monoxide (Nov 2022-Oct 2023)

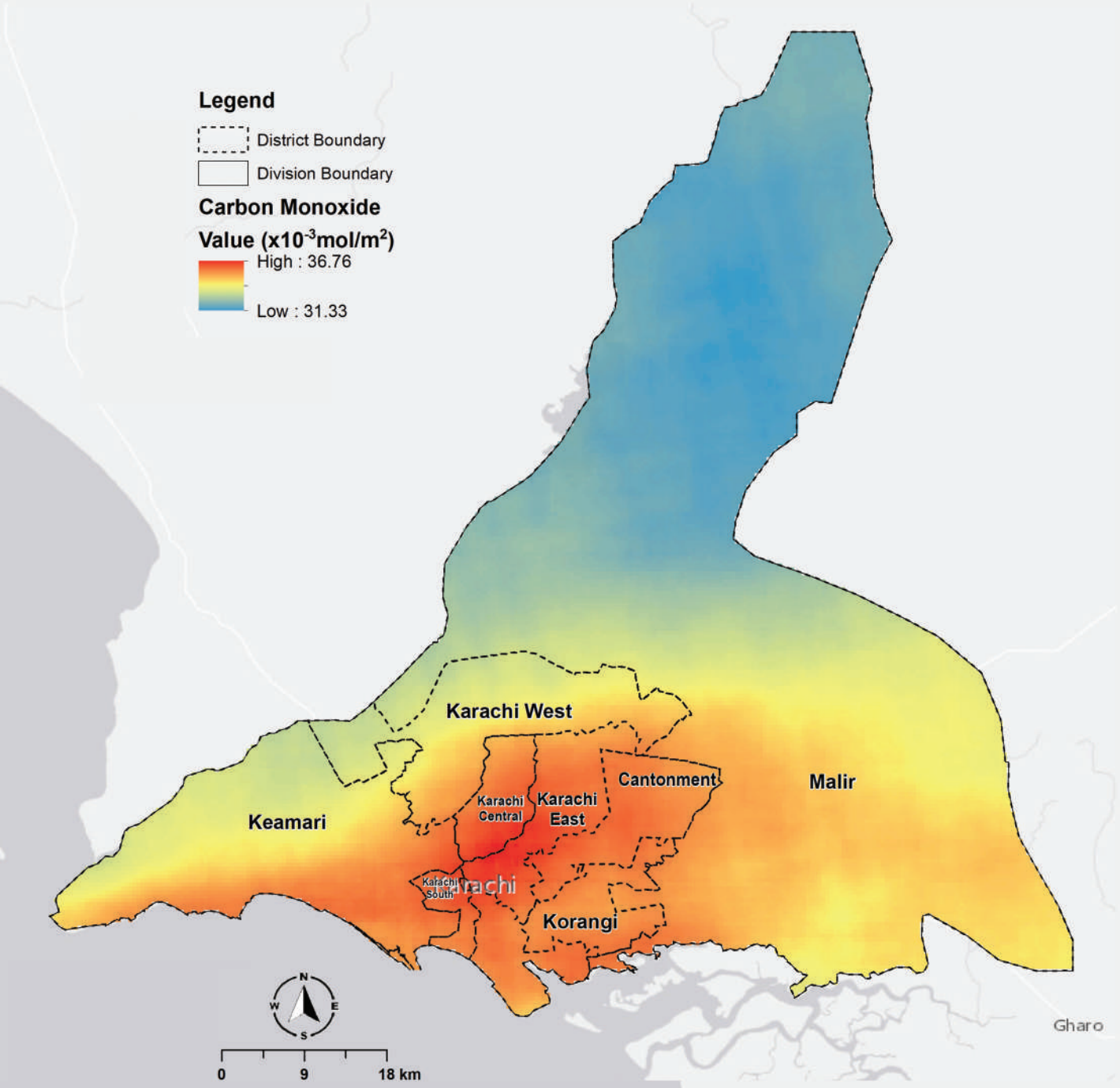


Figure 25. Annual Average Concentration of Carbon Monoxide (Nov 2022 – Oct 2023)

Annual Average Nitrogen Dioxide (Nov 2022-Oct 2023)

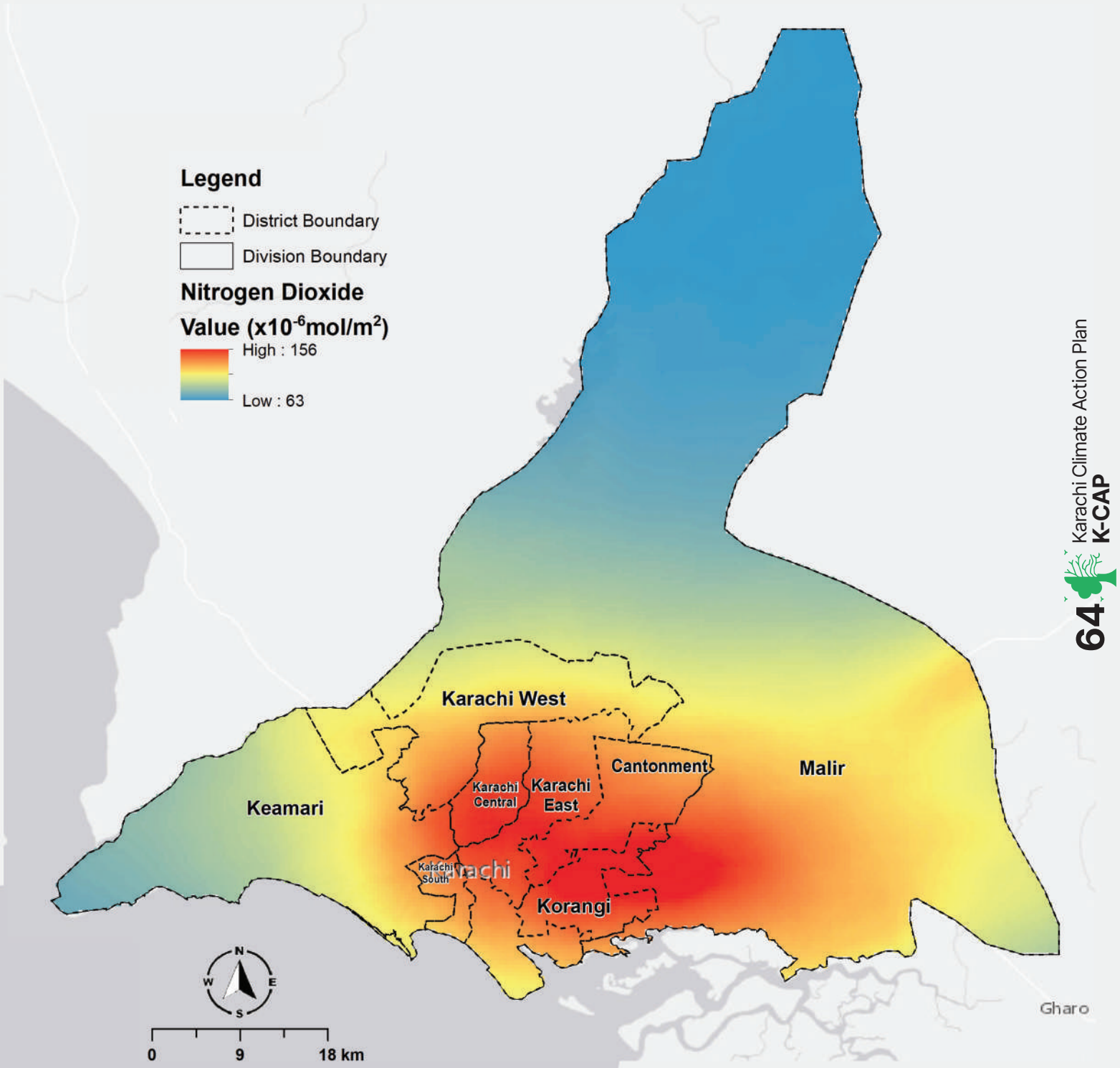


Figure 26. Annual Average Concentration of Nitrogen Dioxide (Nov 2022 – Oct 2023)

Annual Average Ozone Concentration (Nov 2022-Oct 2023)

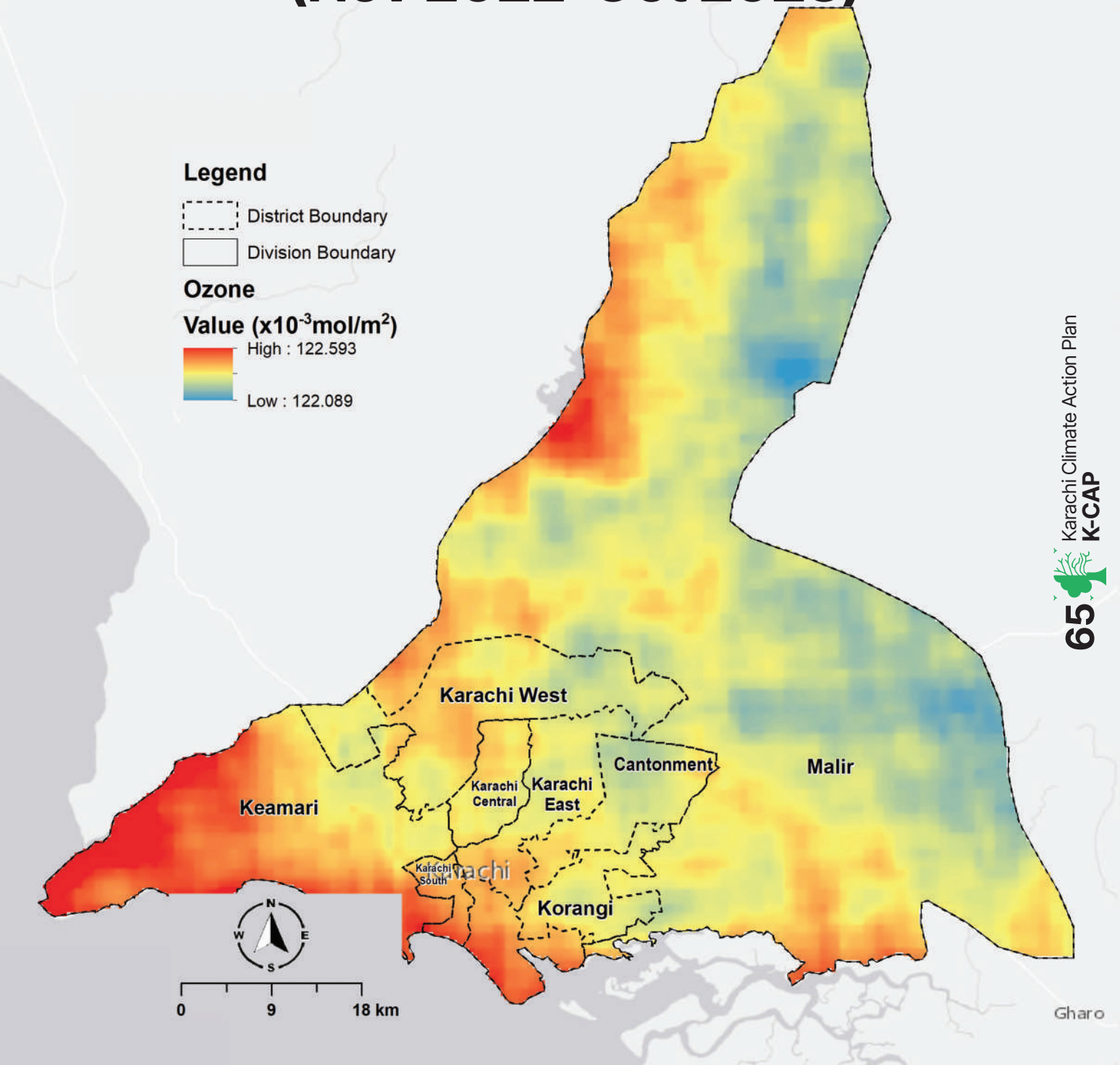


Figure 27. Annual Average Concentration of Ozone (Nov 2022 – Oct 2023)

Annual Average Aerosol Index (Nov 2022-Oct 2023)

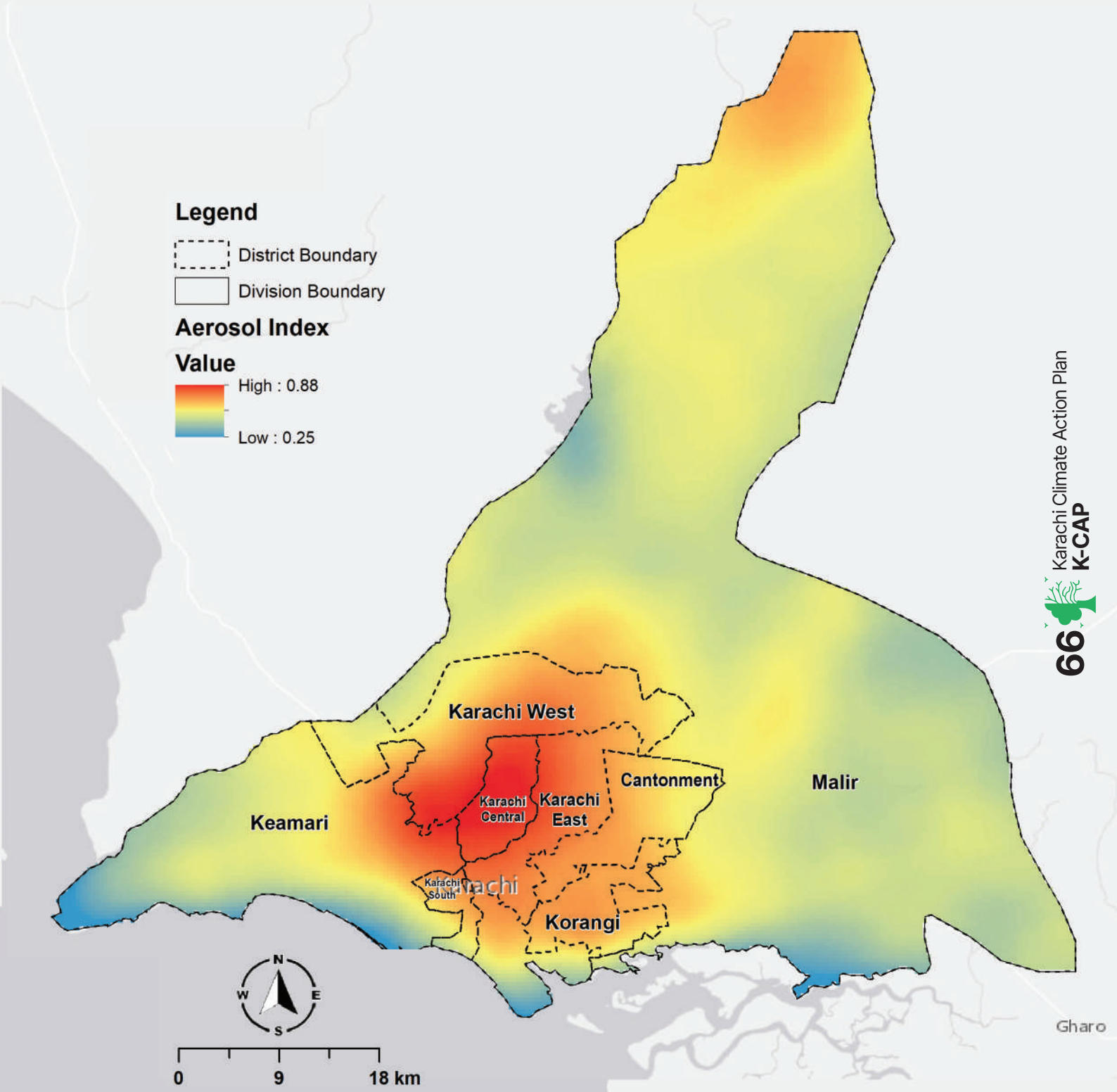


Figure 28. Annual Average Aerosol Index (Nov 2022 – Oct 2023)

Table 6: Life Expectancy Gains from reducing PM2.5

Region	Life Expectancy Gains from reducing PM2.5 to WHO guideline of 5 µg/m³ (Years)	Life Expectancy Gains from reducing PM2.5 to National guideline of 15 µg/m³ (Years)	Life Expectancy Gains from reducing PM2.5 by 30% (Years)
East Karachi	2.7	1.8	1.1
West Karachi	2.6	1.5	0.9
South Karachi	2.6	1.5	0.9
Malir Karachi	2.6	1.7	0.9
Central Karachi	2.6	1.6	0.9

Socio-economic Vulnerabilities

To assess demographic and socio-economic contexts and to capture the multidimensional characteristics of socioeconomic vulnerability, a district-wise assessment, is conducted to analyze the literacy rate and gender distribution within the city. In terms of vulnerabilities, the findings are summarized below;

The access to information indicators revealed that Karachi West District has the lowest percentage of households owning Internet facilities (37.28%) while Karachi East District has the highest percentage (67.61%).

The Population Census 2023 indicates serious gaps in housing structures. There are 3.44 million households for a population of 20.383 million with an average household size of 5.93. The district-wise assessment shows that the Karachi South District has the lowest percentage at 10.92%, and Karachi West District has the highest percentage of households, at 23.65%, living in 'own' houses.

Similarly, access to the urban recreation spaces, 19.24% have access to daily urban recreation space within 1km whereas 80.76 % do not have access to any daily urban recreation space within a 1-kilometer radius. However, in the event of a flood, the portion of Karachi's population with access to a daily urban recreation space may potentially decrease from 19.24 % to 18.35%. District South (Gulberg Town, Civil Lines Karachi) has the highest accessibility to parks and grounds. But it may reduce during flood events.

In terms of access to health services, 82.06 % of Karachi's population has access to health facilities within a 5-kilometer radius. However, during a flood event, the proportion of Karachi's population with access to a healthcare facility within a 5-kilometer radius potentially decreases from 82.06% to 75.8%.

In the event of a flood, the percentage of Karachi's population able to access a mass transit station within 1 kilometer potentially decreases from 22.75 % to 19.42 %.

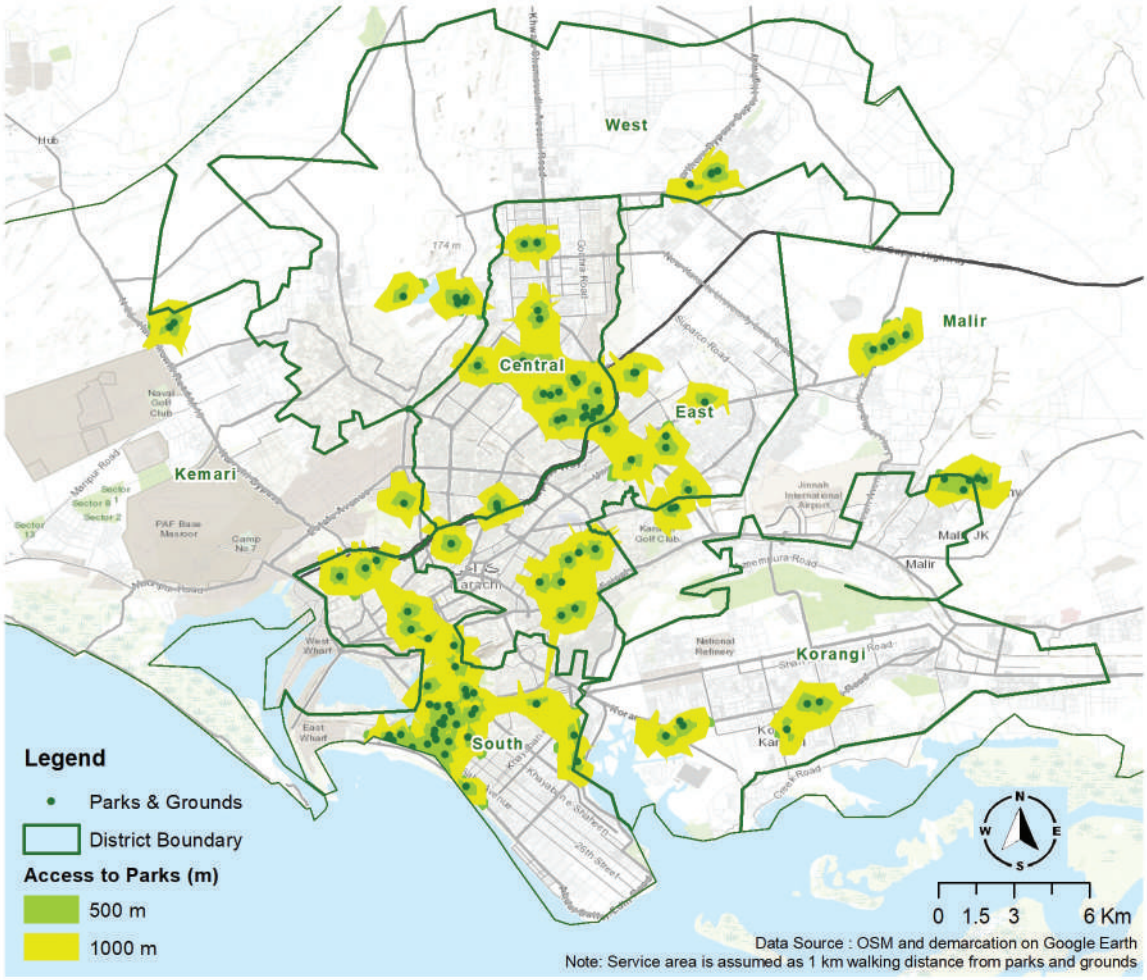
Approximately 70 % of Karachi's population, has access to fire stations within a five-minute response time. Karachi has 21 fire stations, including mini stations. However, areas such as Gulshan Hadeed, Khaiabad, Gulshan e Bahar, and Surjani Town Sectors 1, 2, and 4, which are densely populated, fall beyond the five-minute response time. Further, 30% of Karachi's population, categorized as the un-serviced population due to the lack of fire service coverage within the standard five-minute response time, are also exposed to heat stress (<30°C). This compound risk worsens their vulnerability. District Korangi (Jaffae-e-Tayayar Society, Malir town, Bhatia Colony), District East (Sachal Goth), and District West (Surjani Town sector 1) are exposed to these overlapping risks.

The qualitative assessments of the impact of climate hazards on key city sectors in Karachi City including water and sanitation, transport, health, energy, and biodiversity are given in table 7.

University of Chicago. (2024). Pakistan Fact Sheet. Air Quality Life Index. https://aqli.epic.uchicago.edu/wp-content/uploads/2024/08/Pakistan-FactSheet_2024.pdf?mc_cid=4761943032&mc_eid=b40c57d0c1

Pakistan Social and Living Standards Measurement (PSLM), 2019-20 https://www.pbs.gov.pk/sites/default/files//pslm/publications/pslm_district_2019-20/PSLM_2019_20_District_Level.pdf

Pakistan Bureau of Statistics, Population Census, Table 1: Households, population, household size, and annual growth rate.; Pakistan Bureau of Statistics, Table 7.4: Percent distribution of households by housing tenure.



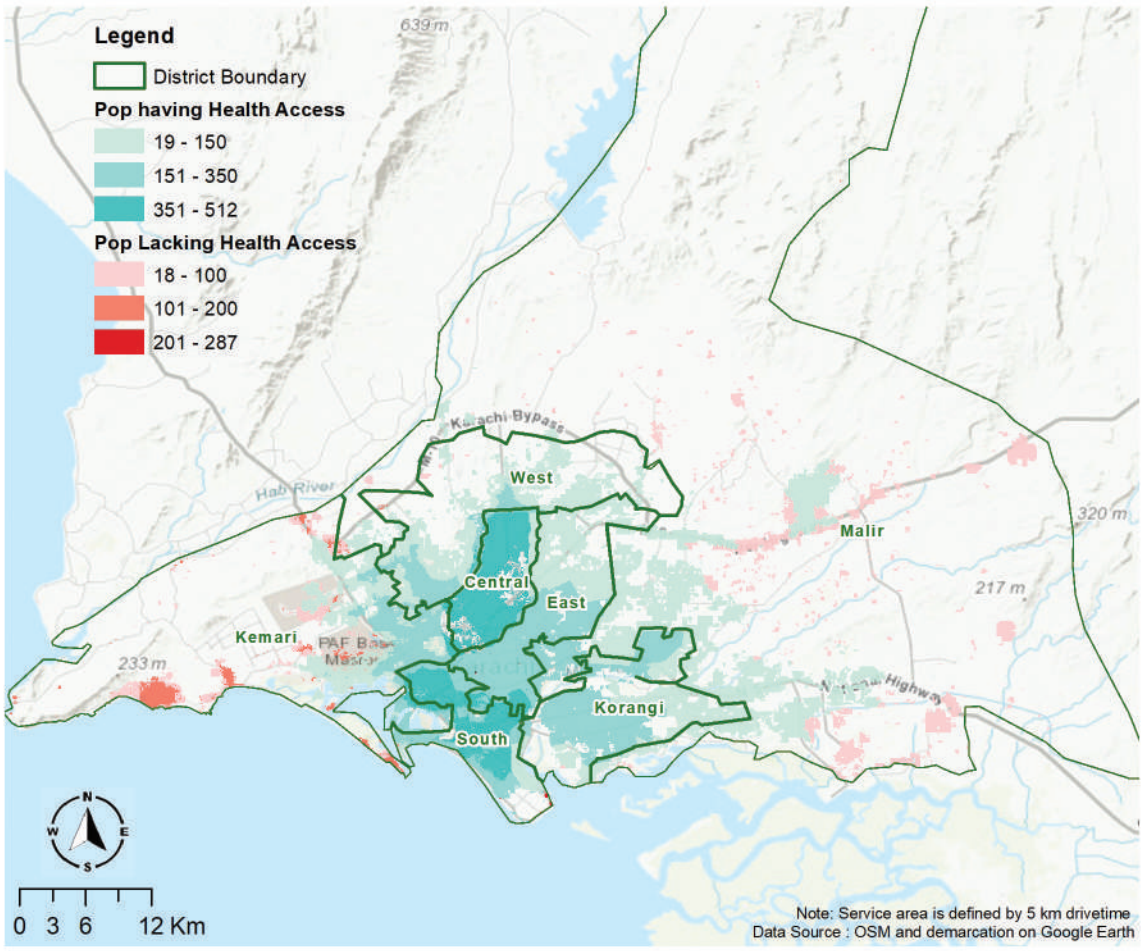
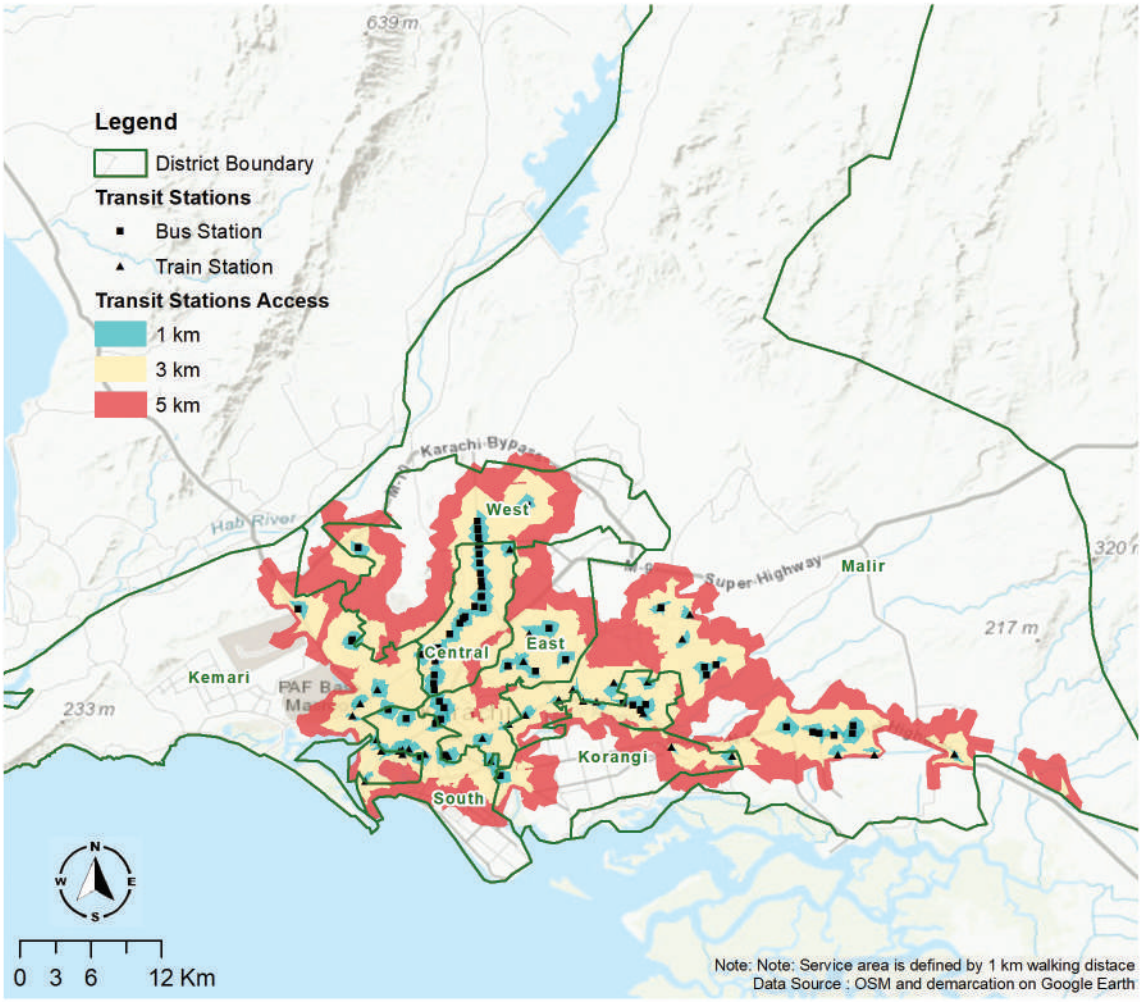


Figure 29. Access to Parks & Grounds and Health Services in Karachi



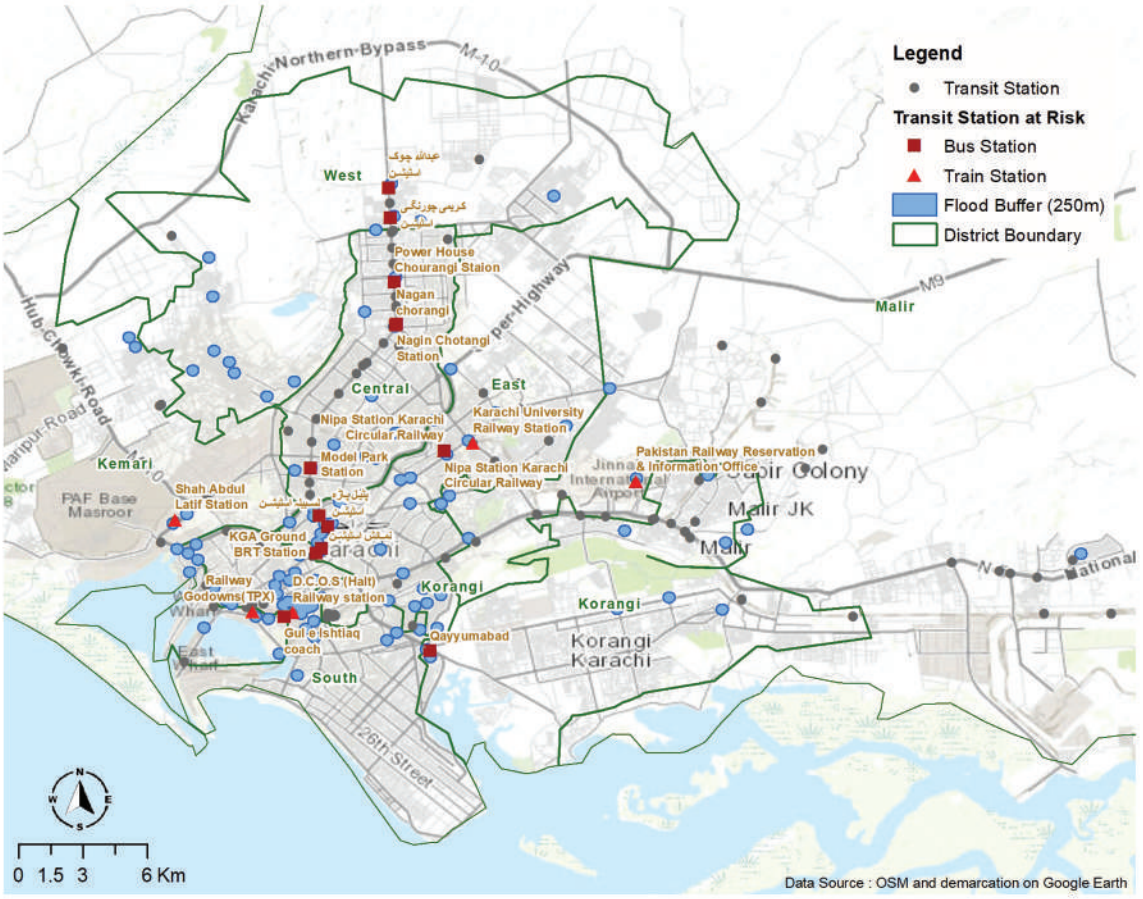


Figure 30. Access to Transit Stations with Limited Access during Flooding in Karachi

Table 7: Sectoral Impacts

Climate Hazards	Water & Sanitation	Transport	Health	Energy	Biodiversity
Heat Waves	Greater demand for water during extreme heat episodes from already stressed water utilities of Karachi Consumers transition towards more costly service options for water supply High price of non-formal water supply through vendors	Extreme heat episodes coupled with the blooming population density in the inner city, rising traffic congestion, and the non-resistant fabric of roads (and buildings) lead to a more pronounced heat island effect. Thermal expansion and deformation of road infrastructure due to extreme heat episodes Bukled road infrastructure due to heat Heat waves can damage transportation infrastructure and pose challenges for maintenance and construction. Higher temperatures can put stress on bridge infrastructure through thermal expansion of bridge joints and paved surfaces, and deterioration of steel, asphalt, protective cladding, coats, and sealants.	Increased pressure on health and emergency response infrastructure Psychological and social stresses Outbreaks of malaria, dengue fever, and multiple gastroenteritis diseases Citizens' risk of stroke, heart disease, and asthma Excessive heat stress on labor productivity	Increased energy consumption for cooling leading to extreme energy shortages/load sheddings Substantial energy loss due to limited efforts to promote energy conservation Consumers transition towards more costly service options for energy supply	Shrinking green cover of Karachi City and extreme heat events are badly affecting local biodiversity. Rise in the air and water temperatures affecting marine life Fatal impacts on the city's biodiversity (including Zoos and Safaris) during heatwaves
Flooding	Water supply services disturbed due to infrastructure damage infrastructure damage Sewerage and drainage infrastructure damage	Connectivity disturbed due to infrastructure damage Movement of goods and services impacts	Health services impacted due to infrastructure damage Contamination and Sprout of diseases like typhoid, cholera, and hepatitis from flood and sewer water Contamination of water supply lines with sewerage and impacting the health of the community	Power supply affected due to infrastructure damage Electric shocks to the community due to the breakdown of the system and open wires	Species migration pattern disturbs • Depending upon flood duration, the severity of impacts on insects and local flora and fauna varies Reduce species' ability to find food, shelter and reproduce

The International Labor Organization (ILO) underscores the detrimental impact of excessive heat stress on labor productivity, with significant losses occurring at temperatures above 24–26°C, reaching up to 50% at 33–34°C. By 2030, Pakistan may lose 5.5% of working hours due to heat stress, particularly in construction, where losses could rise to 8.83% (Source: Working on a warmer planet: The impact of heat stress on labor productivity and decent work. International Labour Office – Geneva, ILO, 2019. ISBN 978-92-2-132968-8. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_711919.pdf)

Climate Hazards	Water & Sanitation	Transport	Health	Energy	Biodiversity
Droughts	The livelihoods of Goths/ villages are highly dependent on groundwater for farming and daily uses. Drought conditions result in lowering the water table and decreasing aquifers yield to very low levels. Greater water demand due to drought conditions, leading to more stress on water utilities Awareness, education, and initiatives in water conservation Water harvesting, and wastewater recycling are non-significant leading to severe water-stressed conditions	High water demand and lower or decline may cause subsidence (the sinking of the ground) and destabilize the ground or ground-based infrastructures. However, this sector is not impacted by this hazard recently.	Health and nutrition issues in most vulnerable groups leading to increased burden on health sector Migration and low quality of health and hygiene	Drought conditions reduce electricity production from plants that require cooling water for operation, however, no significant impact is reported on this sector.	Loss in plant growth and reduced vegetation in Karachi city which is already facing loss in green cover Threat to local biodiversity of the city Loss of green spaces and cover
Sea-Level Rise and Tidal Coastal Flooding	Water supply services disturbed due to infrastructure damage and inundation of structure Wastewater treatment plants in the coastal zone of Karachi are impacted due to coastal flooding. Saltwater infiltration and the corrosion is impacting WWTPs. The material or substrate for sewer pipes are damaged by water table rise in the coastal areas and erosion.	Changes in harbor facilities to manage storm surges and high tides Increased erosion of infrastructure Flooding of terminal areas of ports and infrastructure damage	Increased health issues, specifically due to contamination and outbreaks of infectious diseases due to coastal flooding in low-lying areas of Karachi, leading to increased vulnerabilities	Power supply affected due to infrastructure damage	Saltwater intrusion and tidal flooding impact local biodiversity thus directly affecting fishing communities' livelihood and ecosystem deterioration Increased flooding in coastal areas and estuaries, is negatively impacting wetlands and local biodiversity, mainly turtles and fishes

The socio-economic impacts of climate change disproportionately burden women in Karachi, particularly those in homeless communities. They face increased exposure to waterborne illnesses and respiratory infections due to extreme heat and relentless rains, compounded by inadequate shelter and sanitation. Limited access to healthcare intensifies these health risks, while caregiving responsibilities further exacerbate their vulnerabilities.

Climate Migration

The 2021 report on climate-induced migration underlined the fact that the massive shrinkage of the Indus Delta in the past two decades has led more than 1.2 million people to migrate towards Karachi City. The trend towards permanent migrations has increased in recent years due to frequent and extreme climatic events. Residents of coastal regions like Keti Bander and Kharo Chan are moving towards larger cities like Karachi. Those with limited resources often settle in the urban slums of intermediate cities, while those with more resources migrate to Karachi and other neighboring urban centers.

Multiple other factors are substantially increasing climate risks and vulnerabilities in the city. Inadequate affordable housing and poor urban planning have led to settlements around nullahs and drains, with encroachments around Gujjar Nullah and Lyari River serving as prime examples. Additionally, improper solid waste management clogs the drains – the city's natural response system – thereby heightening flood risks.

The city has already witnessed an influx of over 50,000 climate migrants in recent years, primarily displaced by extreme weather events and environmental degradation. This growing population intensifies the strain on Karachi's existing infrastructure, exacerbating challenges such as housing shortages, water stress, and inadequate healthcare services.

Without robust climate adaptation measures, improved urban planning, and effective waste management, the influx of climate migrants will significantly amplify socio-economic and environmental pressures, underscoring the urgent need for proactive local action.

Karachi, Pakistan's largest metropolis, is projected to receive **2.4 million** internal climate migrants by 2050 if the Paris Agreement's 1.5°C benchmark is surpassed. This migration is driven by climate-induced vulnerabilities such as rising sea levels, water scarcity, and agricultural disruptions in surrounding regions.

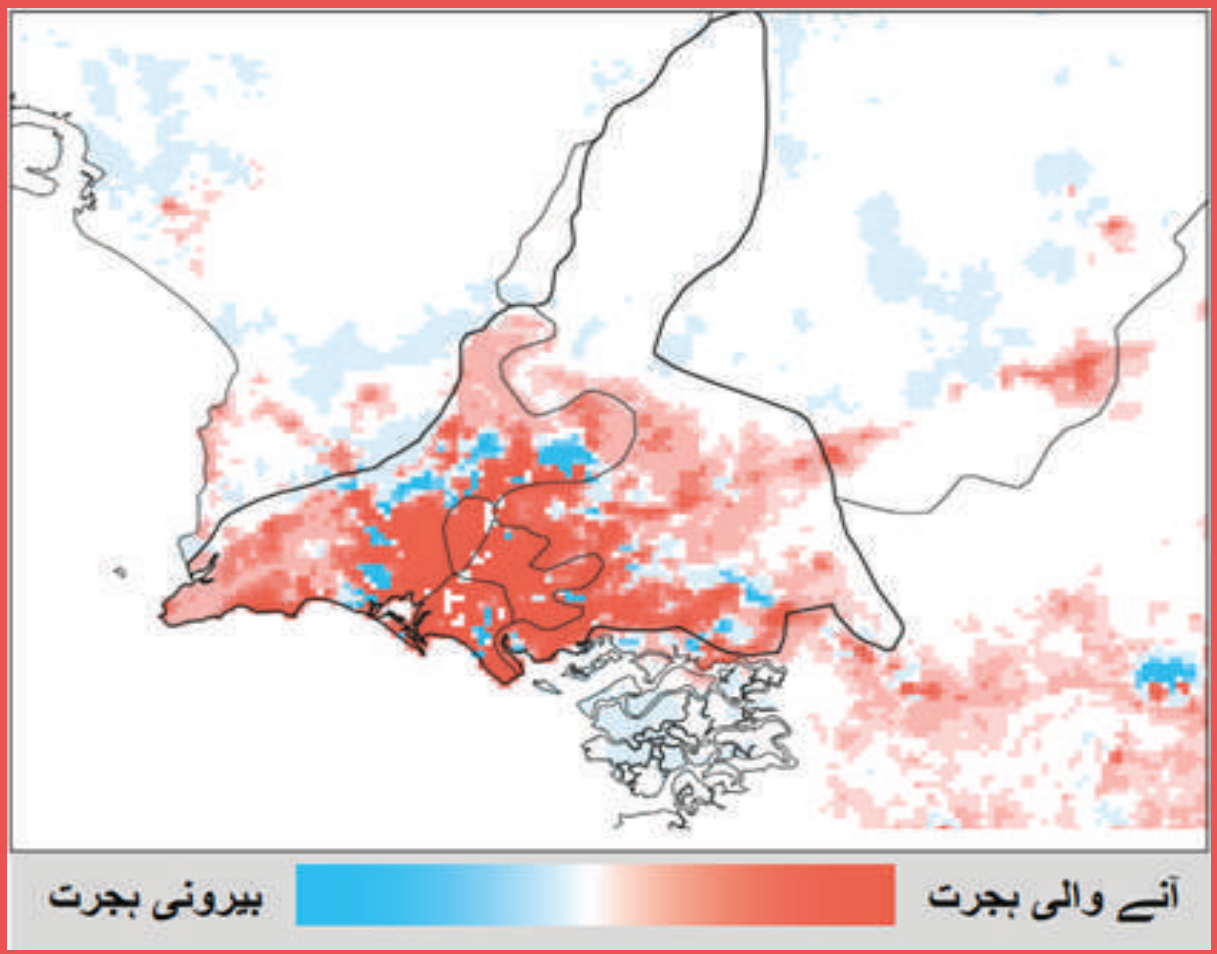
Research report on Climate Induced Migration: Global discourse, local realities and governance
https://islamic-relief.org/wp-content/uploads/2022/05/IRWClimateInducedMigration_Digital-V2.pdf
Research report on Climate-Induced Migration: Global discourse, local realities, and governance
https://islamic-relief.org/wp-content/uploads/2022/05/IRWClimateInducedMigration_Digital-V2.pdf
https://www.c40.org/wp-content/uploads/2024/09/Climate-migration-release-Sept-2024.pdf

C40 Cities

کی حالیہ اشاعت میں شہروں میں موسمیاتی نقل مکانی کے تخمینے فراہم کیے گئے ہیں۔

اس رپورٹ میں کراچی کی
جانب موسمیاتی نقل مکانی کے رجحانات کا تفصیلی تجزیہ پیش کیا گیا ہے۔
پیشگوئی کے مطابق، 2050 تک کراچی میں موسمیاتی تبدیلی کے باعث آنے والے مہاجرین کی تعداد 2.3 ملین تک پہنچ سکتی ہے، خاص طور پر مایوس کن منظرناموں میں۔ زیادہ تر مہاجرین خشک سالی، پانی کی کمی، اور فصلوں کی پیداوار میں کمی جیسے مسائل کا سامنا کرنے والے علاقوں سے آئیں گے۔

تحقیق کے مطابق، کراچی آنے والے موسمیاتی مہاجرین کی اکثریت نوجوان کام کرنے والے افراد پر مشتمل ہوگی، اور خواتین کی تعداد مردوں کے مقابلے میں زیادہ ہو سکتی ہے۔ نقل مکانی سے نمٹنے کے لیے جامع شہری منصوبہ بندی اور موسمیاتی تخفیف کی پالیسیوں کو نافذ کرنا ضروری ہے۔ کراچی کے وسطی علاقوں میں زیادہ مہاجرین کی توقع کی جا رہی ہے، جس سے شہری گنجانیت اور سہولیات پر دباؤ بڑھے گا۔ یہ تحقیق موسمیاتی تبدیلی کے اثرات کو کم کرنے اور پائیدار شہری ترقی کے لیے فوری مقامی اور قومی اقدامات کی ضرورت پر زور دیتی ہے۔



Residents carry belongings as they wade through a flooded area during a heavy monsoon rains in Karachi in August 2020

Image: picture-alliance/AP Photo/F. Khan

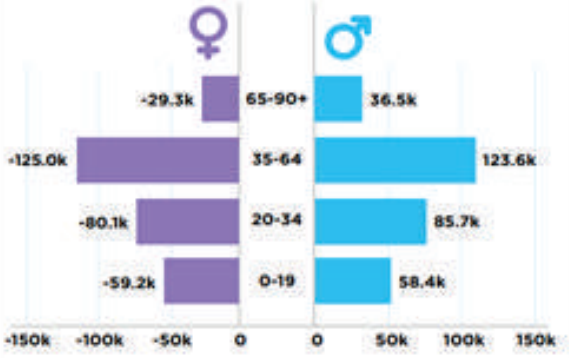
موسمیاتی اثرات کا سامنا

کراچی کی طرف منتقل ہونے والے موسمیاتی مہاجرین کے حوالے سے توقع ہے کہ وہ اپنے اپنے آبائی علاقوں میں ہر سال مختلف، بایں منسلک موسمیاتی دباؤ کے عوامل کا سامنا کرتے رہے ہیں۔ اکثریت (60 فیصد سے زائد) کے حوالے سے امکان ہے کہ انہیں شدید خشک سالی اور پانی کی کمی کا سامنا ہوگا، جو کہ نصف سے زیادہ متوقع موسمیاتی مہاجرین کو یا تو پینے کے پانی کی کمی یا فصلوں کی پیداوار میں کمی کے ذریعے متاثر کرے گی۔

کراچی میں موسمیاتی مہاجرین کی وہ فیصد تعداد جسے اپنے آبائی علاقوں میں موسمی اثرات کا سامنا ہے۔

موسمیاتی مہاجرین کی آبادیاتی خصوصیات

2050 تک کراچی میں منتقل ہونے والے موسمیاتی مہاجرین کی اکثریت (دو تہائی تعداد) نوجوان، کام کرنے والی عمر کے افراد (20 سے 24 سال) کی ہوگی۔ تحقیق میں شامل کردہ کسی بھی دوسرے شہر کے برعکس، کراچی میں مرد مہاجرین کی تعداد کے مقابلے میں خواتین مہاجرین کی تعداد ممکنہ طور پر ایک وسیع فرق سے زیادہ ہوگی (52 فیصد - 48 فیصد)۔

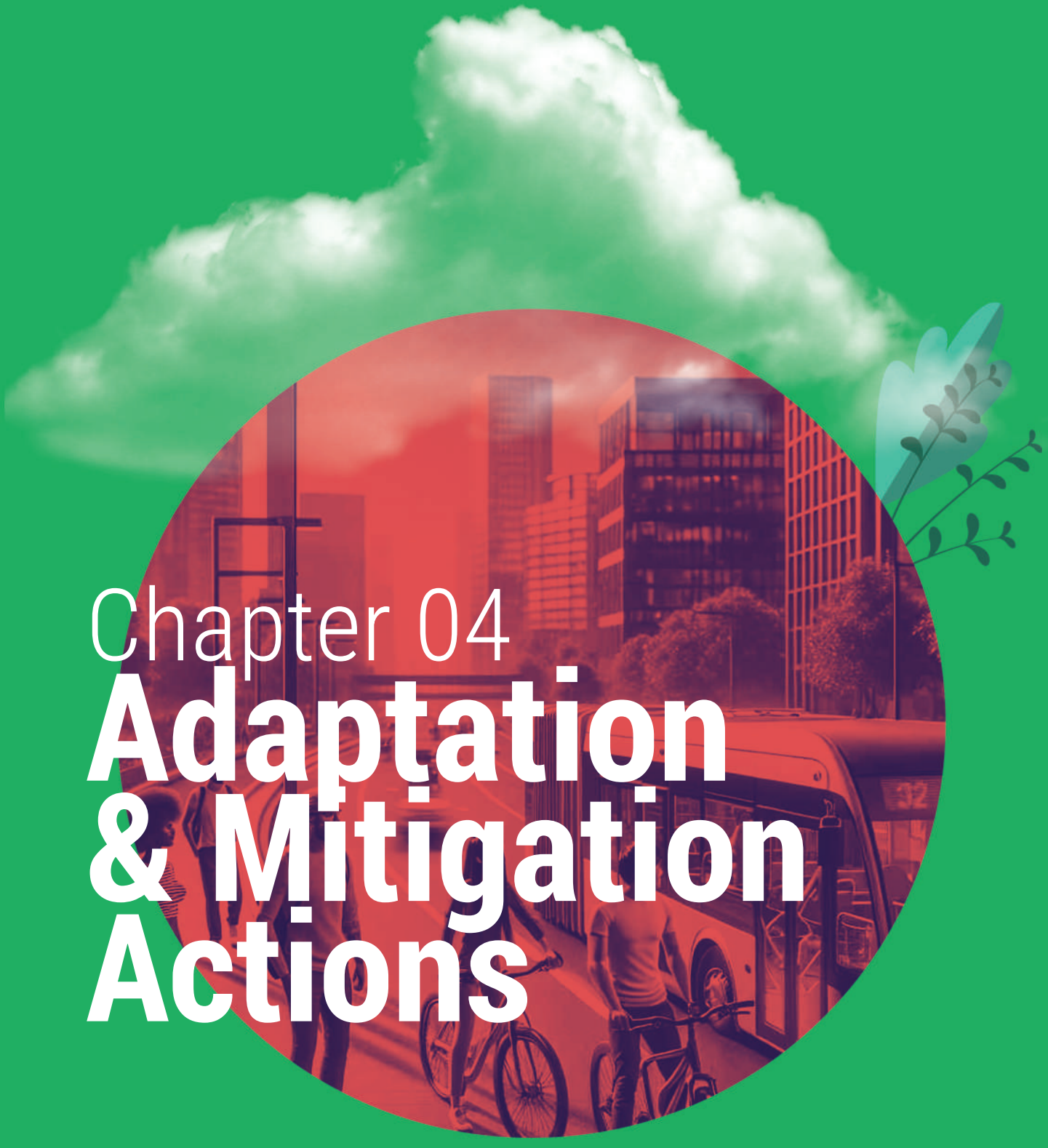


کراچی میں موسمیاتی مہاجرین کی عمر اور جنس۔

Associated Issues

A hydraulic modeling exercise conducted by the World Bank using HEC-RAS evaluated two scenarios, a baseline scenario reflecting the current state of channel blockages and indentations caused by solid waste. The improved scenario assumed that drains were clear of solid waste and functioning smoothly as a natural response system. The results revealed a 30% reduction in flood risk through proper waste management (blockage-free drains) in Karachi City. Hence, the management of solid waste will not only mitigate the effects of GHG reductions but also predominantly increase the adaptive capacity of the city to manage intense rainfalls. Similarly, proper urban planning and enforcement as well as provision of affordable housing could reduce the risk and vulnerability of the population situated in the high-risk areas. Lack of green cover and ill urban planning are leading to heat stress in the city and urging for concrete actions at local level.

The CCRA indicates a number of challenges that Karachi City is presently facing concerning climate change, but along with this it brings an opportunity for evidence-based climate action planning; setting up goals/targets/milestones; identification and prioritization of actions for adaptive and mitigative measures, and an updated governance & execution framework to implement a sound action plan to minimize the devastating impacts of climate change on the infrastructure, human health and biodiversity of Karachi City.



Chapter 04

Adaptation & Mitigation Actions

Adaptation & Mitigation Actions

Key Projects are provided at Annex - B.

Building on the City's Vision and a comprehensive evidence-based assessment of climatic risks, hazards & vulnerabilities; inventorying the city's emissions; and based on ambitious scenarios adaptation and mitigation actions are identified for Karachi City.

Each section begins by providing a detailed overview of the specific challenges Karachi faces, informed by empirical data and climate projections. This is followed by an analysis of key issues, which highlights the underlying factors exacerbating these vulnerabilities, such as inadequate infrastructure, rapid urbanization, and socio-economic disparities. The chapter then transitions into presenting targeted adaptation strategies, which are developed in alignment with international best practices and localized knowledge. These strategies are not only designed to mitigate the immediate impacts of climate change but also to build long-term resilience across the city's diverse communities.

The adaptation goals and actions outlined in this chapter are crafted to be both ambitious and achievable, recognizing the urgent need for action while acknowledging the constraints faced by the city's governance and resources. These actions span a wide range of sectors, including water management, urban planning, health services, and environmental conservation.

On the whole, the chapter identifies **11 key adaptation goals** for each key climate risk, ensuring targeted and effective responses. These sub-strategies and goals are detailed in the subsequent sections, providing a clear roadmap for enhancing Karachi's resilience to climate impacts.

Adaptation Goals & Targets

Goal 01
Enhance Flood Resilience in High-Risk Districts

Target 1.1: By 2027, implement nature-based flood mitigation features in 100 parks located in high flood-prone districts, including the creation of lakes, depressions, recharge wells, and raised grounds for emergency assembly.

Target 1.2: By 2030, improve vegetation cover and permeable surfaces in 100 public parks within flood-prone areas to enhance their ability to drain excess flood and rainwater.

Goal 02
Improve Stormwater Drainage Infrastructure

Target 2.1: By 2030, ensure that the three high flood-risk districts of South, Central, and Korangi have separate, appropriately sized, and fully functional drainage infrastructure for sewage and stormwater. The upgraded drainage systems will be designed to manage both current and anticipated future volumes of water, free from blockages.

Goal 03
Restore Natural Riverbeds to Enhance Ecosystem Capacity

Target 3.1: By 2035, restore the riverbeds of the Malir and Lyari rivers by:

Constructing two new small dams for temporary water storage to mitigate flood impacts.

Removing encroachments from at least 5% of the Malir riverbed area.

Planting vegetation along 30 km of riverbeds to enhance flood resilience and ecosystem health.

Removing solid waste from the Malir and Lyari rivers to reduce pollution, enhance water quality, and restore ecosystem functions, contributing to improved flood resilience and the overall health of the riverbeds.

Goal 04
Improve Mangrove Forest Cover to Provide Protection Against Tidal Erosion and Flooding Risks

Target 4.1: By 2030, increase the mangrove forest cover within the Karachi municipal area by at least 500 hectares. This expansion will enhance the natural coastal defenses, reducing the city's vulnerability to tidal erosion and flooding.

Goal 05
Enhance Coastal Infrastructure to Reduce the Impact of Flooding and Inundation

Target 5.1: By 2027, develop and implement land use planning, zoning, and building codes that account for sea level rise and coastal flooding. These regulations should prohibit new buildings in at-risk areas and mandate that existing structures be retrofitted to withstand future coastal risks.

Goal 06
Build resilience against heat stress by increasing urban green space in heat-risk areas

Target 6.1: By 2026, additional shade, preferably from native trees, will be provided in all public parks in the five towns with the highest heat risk: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and North Nazimabad.

Target 6.2: By 2030, the following measures will be implemented:

Planting of at least 10,000 native trees in public parks and along roadsides, coupled with monitoring and evaluation systems, and tagging of trees for tracking growth and survival to maximize their long-term survival and effectiveness.
Provision of eco-friendly shade at over 100 key bus stops across the city, prioritizing heat-stressed areas.
Development of urban roof gardens in all existing public buildings and new commercial constructions.
Use of light or cool grey color for all new ground-level construction (roads, pavements, etc.) to reduce surface temperature.
Establish Urban Forests focusing on the rehabilitation of open areas and designated forest lands through afforestation and reforestation, contributing to carbon sequestration and improving the city's resilience to extreme heat and other climate hazards.

Goal 07
Provide additional drinking water facilities for the vulnerable population in public parks and primary government schools in high-heat-risk areas.

Target 7.1: By 2027, clean drinking water facilities will be available in all public parks and schools in the five towns with the highest heat risk: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and Ibrahim Hyderi.

Goal 08
Increase access to cooling for the population through the adoption of energy-efficient fans

Target 8.1: By 2026, all government procurement of electric fans will be limited to the most efficient NEECA 5-Star models.

Target 8.2: By 2027, 50,000 DC (direct current) fans will be distributed to vulnerable populations in off-grid and poor-grid areas to increase their access to sustainable cooling.

Goal 09
Reduce heat stress for the population of Karachi through improved building design

Target 9.1: By 2030, all government educational and health facilities in Karachi will be retrofitted to reduce heat stress on children and patients.

Goal 10
Build resilience of the vulnerable population by increasing their access to water

Target 10.1: By 2026, rainwater harvesting storage will be built on the rooftops of all public buildings. This measure aims to capture rainwater during the monsoon season and store it for use during dry periods, thus reducing the city's dependence on external water sources.

Target 10.2: By 2027, storage facilities for stormwater runoff will be constructed, with the capability to treat and reuse the collected water. These storage facilities will help manage stormwater, reduce the risk of flooding, and provide an additional water source during droughts.

Target 10.3: By 2030, at least two constructed wetlands will be established for the treatment of wastewater. The treated water will be reused for irrigation and watering public parks, contributing to water conservation and reducing the pressure on Karachi's limited water resources.

Goal 11
Minimize the health impacts of air pollution on vulnerable populations by advanced monitoring, targeted awareness campaigns, and timely health advisories.

Target 11.1. By 2026, a comprehensive air quality monitoring network will be established in all hotspot areas of Karachi to provide real-time data on pollution levels for the citizens.

Target 11.2. By 2026, localized health advisories based on real-time air quality data will be developed and disseminated to inform and protect vulnerable populations.

Target 11.5. By 2030, health systems and urban planning will be fully adapted to address air quality challenges, ensuring long-term resilience and reduced health impacts for vulnerable communities.

Urban Floods

Karachi has long grappled with severe monsoon-related challenges, particularly over the last four decades, due to a compromised drainage system. This has resulted in frequent urban flooding whenever there is sustained rainfall. The city, home to 58 stormwater drains (locally known as nullahs), relies on these drains, which are connected to two non-perennial rivers—the Malir River and the Lyari River. These rivers traverse densely populated areas of Karachi before emptying into the Arabian Sea. However, widespread encroachment on nearly all natural drains and nullahs, combined with the dual use of storm drains as sewers, has led to severe blockages, exacerbating the city's vulnerability to flooding during heavy downpours.

The 1977 floods, with 267 deaths and extensive displacement, highlighted the impact of encroachments along the Malir River. Old city areas, commercial hubs, and low-lying regions face recurrent flooding. Inadequate stormwater drainage in inner-city localities like Gulshan-e-Iqbal, particularly along University Road, the Societies Union area on Shahrahe-Faisal, and Tipu Sultan Road, experiences severe flooding. Similarly, Katachi Abadis in Mehmoodabad and Manzoor Colony, situated along the Malir River, are significantly impacted by excessive flooding and stagnant water.

Based on the assessment done in 2020 , the flood vulnerability map indicates that a significant portion of District South, along with sections of District West, Korangi, and East, exhibits a very high vulnerability. These areas characterized by very high vulnerability typically experience dense population, low elevation, and frequent flooding.

Conversely, most parts of District West and Malir display low or very low vulnerability, attributed to factors such as low population density, infrequent flooding, and higher elevation. According to recent assessments, approximately 6.85% of Karachi's population is susceptible to flooding, especially within a 250-meter buffer zone surrounding identified flooding hotspots. The Climate Change Risk Assessment (CCRA) identifies the South and East districts as the most vulnerable, with 28 and 23 hotspots, respectively. These districts alone account for nearly 50% of Karachi's 105 identified flooding hotspots. The increasing frequency and intensity of extreme rainfall events in recent years indicate that urban flooding risks will likely multiply in the future, necessitating significant improvements in drainage infrastructure and adaptation measures.

Key Issues

Encroachment and Infrastructure Misuse:

The encroachment on natural watercourses and nullahs, coupled with the misuse of storm drains for sewage, has severely compromised Karachi's drainage capacity. Solid waste is another area of concern that clogged drains and increased flood risks. This has led to frequent blockages and subsequent flooding during heavy rains. These issues disproportionately affect vulnerable communities, particularly those in low-lying and informal settlements (especially women, children, and older age people). These areas often lack proper infrastructure, leaving them more susceptible to waterlogging, sanitation issues, and health risks from contamination. Prioritizing these communities for improved drainage systems and solid waste management is critical to reduce their exposure to flood-related disasters.

Flood-Prone Areas:

Flooding hotspots are concentrated in the South, East, and Korangi districts, with a significant portion of the population living within high-risk zones. These areas are particularly vulnerable due to their proximity to blocked drainage systems and compromised riverbeds. Most informal housing communities lack the resources to protect their homes and suffer greatly during flooding events. They face not only property damage but also health risks, including the spread of waterborne diseases and respiratory issues.

Ecosystem Degradation:

Urban development has encroached upon riverbeds and nullahs, obstructing natural water flows and exacerbating the risk of urban flooding. The degradation of these natural flood management systems has made Karachi more susceptible to flooding during monsoon seasons. Vulnerable communities of Karachi living near these degraded areas face increased risks of property damage and displacement during heavy rains. These communities often lack access to resources for flood preparedness or recovery, further compounding their vulnerability.

Nizamani, J. A. (2020). Assessment of different hazards and vulnerabilities with sparse data in coastal city of Karachi, Pakistan (Master's thesis, Middle East Technical University).

Main Adaptation Strategies

Floodwater Storage and Drainage in Flood-Prone Hotspots

To address the challenges posed by impermeable urban surfaces such as concrete and paving, which prevent water from naturally draining public parks and open spaces can be utilized as floodwater storage areas. By improving the permeability and storage capacity of these spaces, excess water can be effectively drained and stored, reducing the risk of flooding in surrounding areas. Nature-based solutions, such as creating natural lakes, depressions in parks, and installing rainwater recharge wells, can play a crucial role in mitigating urban flooding. These measures help store excess water and recharge groundwater, contributing to long-term water security. Additionally, incorporating lower elevation grounds in public parks can serve as emergency assembly points during floods. By prioritizing the enhancement of open spaces in these neighborhoods, flood risks can be reduced, providing a safer environment for at-risk populations, including low-income families, elderly residents, and children, who are often the hardest hit during extreme weather events.

Sewerage and Stormwater Infrastructure Improvements

Karachi's stormwater drains are currently used as sewers, leading to blockages and overflow during heavy rains. To mitigate this, it is essential to improve and separate the sewage and rainwater drainage systems, particularly in high flood-risk districts like South, Central, and Korangi. Enhancing the solid waste management infrastructure, as supported by projects like the World Bank's SWEEP (Karachi Water and Sewerage Services Improvement Project), will further reduce blockages in drainage systems and contribute to better flood management (Annex-D).

Decentralized waste management infrastructure should also be developed to improve the efficiency of waste disposal and reduce the risk of drainage blockages. Strengthening the capacity of the Sindh Solid Waste Management Board and Karachi Metropolitan Corporation is crucial to ensuring effective service delivery in solid waste management, sewerage, and drainage services. This adaptation strategy would reduce the risks of waterborne diseases, property damage, and displacement, providing a safer and healthier environment for at-risk populations. Prioritizing these communities ensures that they are better protected during heavy rainfall events, improving their resilience to flooding and associated health hazards.

Ecosystem-Based River Catchment Management:

Restoring the natural riverbeds of the Malir and Lyari rivers is critical for reducing the risk of flash floods and improving flood management in Karachi. Encroachment on riverbeds has significantly compromised the city's natural drainage capacity, leading to frequent urban flooding. Studies have shown that approximately 21% of the Malir River's stream bed has been encroached upon, disrupting water flow and contributing to flooding.

The ongoing World Bank-funded Sindh Resilience Project aims to mitigate flood risks by developing small dams for water recharge, enhancing emergency response capabilities, and constructing protective embankments.

As part of the adaptation strategy, removing encroachments from riverbeds, planting vegetation along riverbanks, and enhancing water storage capacity will be prioritized. Rehabilitating these ecosystems and enhancing natural flood management can help protect these communities by reducing the frequency and severity of flooding and safeguarding the community health.

Goals & Targets

Adaptation Goal 1: Enhance Flood Resilience in High-Risk Districts

Target 1.1:

By 2027, implement nature-based flood mitigation features in 100 parks located in high flood-prone districts, including the creation of lakes, depressions, recharge wells, and raised grounds for emergency assembly

Target 1.2:

By 2030, improve vegetation cover and permeable surfaces in 100 public parks within flood-prone areas to enhance their ability to drain excess flood and rainwater

Adaptation Goal 2: Improve Stormwater Drainage Infrastructure

Target 2.1:

By 2030, ensure that the three high flood-risk districts of South, Central, and Korangi have separate, appropriately sized, and fully functional drainage infrastructure for sewage and stormwater. The upgraded drainage systems will be designed to manage both current and anticipated future volumes of water, free from blockages.

Adaptation Goal 3: Restore Natural Riverbeds to Enhance Ecosystem Capacity

Target 3.1: By 2035, restore the riverbeds of the Malir and Lyari rivers by:

Constructing two new small dams for temporary water storage to mitigate flood impacts

Removing encroachments from at least 05% of the Malir riverbed area

Planting vegetation along 30 km of riverbeds to enhance flood resilience and ecosystem health

Removing solid waste from the Malir and Lyari rivers to reduce pollution, enhance water quality, and restore ecosystem functions, contributing to improved flood resilience and the overall health of the riverbeds

These goals and targets outline a comprehensive approach to reducing urban flood risk in Karachi through infrastructure improvements, ecosystem restoration, and the strategic use of public spaces, in the vulnerable areas of the city

By implementing these measures, Karachi can build greater resilience against the increasing threat of urban flooding in the face of climate change and reduce the burden on public health.

The Cry of Lyari People

A Case of Hasan Auliya Town

Lyari River is one the longest river in Karachi city which passes through four out of six districts and four main industrial estates of Karachi. A sizeable population of low-income groups in Karachi city is living on the riverbank of the Lyari River. Some of these settlements are very old (before the partition) and some were settled due to the consequences of historic migrations of Karachi.

Hasan Auliya Town is known to be one of the oldest settlements in Karachi (more than 125 years). Most of the people residing there belong to the Baloch Community and many of them lived there for generations.

They are low-income groups, living in congested un-plastered RCC houses with multiple stories. From 1970 onwards, a large number of male populations worked in the Middle East as laborers and workers; whereas in Karachi the male population was involved in labor work (construction sector, workshops, and factories) as drivers; and females as sweepers and maids. The prevailing socio-economic conditions have already made them a vulnerable population, and this vulnerability has been further exacerbated due to extreme climatic events, like heatwaves, flooding, and drought/water stress.

In 2018, the new Lyari Expressway (16km highway) on both sides of the Lyari River relocated some of the settlements and left the areas as open space which took no time to become a huge dumpsite, leading to another health issue and nuisance and a source of methane production!

Source: Tariq, M., Faisal, F., Arif, M., Naz, R., & Amanat, M. (2019b). Exploring sustainable solution for wastewater treatment; a case study of Lyari river (BS Thesis, NED University Karachi);
https://newslinemagazine.com/magazine/highway-to-hell/

Frequency of flooding has been increased since the last decade, although we have increased the heights of our rooms but still unable to escape from the deadly floods. We need help!", said Um-e-Maria (a 40 Years old female resident of Auliya Town) while indicating the flood level on the wall of her one-bed room

Najma Bibi (70-year-old female) outlined the continuous health-related issues of her grandchildren.

"Diarrhea, skin infections, and flu become a constant part of our children's lives, and we have no money for healthcare"

"During hot summers, we spend our noon sitting under the Layari Express Overhead Bridge. This is our tree, our room, and playground of our kids!"

"We need a space to play - a playground and clean drinking water"

"Can we get rid of mosquitoes? We can't sleep at night."

Children (Age 3 - 11) of Hassan Auliya Town

Coastal Risks

Karachi, as a coastal megacity, faces significant challenges from climate change-related coastal risks. The city's low-lying plains are particularly vulnerable to the impacts of cyclones, storm surges, sea level rise, and coastal erosion. These risks are projected to intensify over the coming decades, posing a severe threat to the city's infrastructure, economy, and the well-being of its residents. The situation is compounded by the degradation of natural coastal defenses, such as mangrove forests, which historically provided a buffer against such threats.

Using the Coastal Risk Screening Tool, forecasts for 2050 reveal that substantial portions of Karachi's coastal areas including Hawks Bay, Manora Island, DHA, Korangi Industrial Area, Ibrahim Hyderi, and Korangi Fish Harbor Authority are at high risk of submersion due to annual flooding. This makes it imperative for the city to adopt and implement robust adaptation strategies aimed at mitigating these risks.

Low-income households, particularly in Karachi's coastal areas, often live in inadequate housing, such as single-room homes constructed from bamboo or wood. This makes them highly vulnerable to health risks during extreme weather events like cyclones and storm surges, as they lack the infrastructure and resources to cope with such disasters. These communities not only struggle with economic hardships but also face frequent natural disasters, including cyclones, floods, and sea-level rise, which exacerbate their poverty and increase displacement risks. The socio-economic vulnerabilities of these coastal populations highlight the urgent need to prioritize adaptive actions in these areas, ensuring that the most vulnerable are equipped with resources and resilient infrastructure to mitigate the impacts of climate change and natural disasters. Prioritizing low-income coastal communities for climate adaptation will be critical in reducing their exposure to these escalating risks, improving their resilience, and addressing their socio-economic challenges.

Key Issues

Vulnerability to Cyclones & Storm Surges:

Karachi's coastal geography makes it highly susceptible to cyclones and associated storm surges, which can cause widespread flooding and infrastructural damage. These extreme weather events disproportionately affect low-income coastal populations.

Sea Level Rise & Coastal Erosion:

The rising sea levels pose a long-term threat to Karachi's coastline, exacerbating the risk of coastal erosion and leading to the permanent submergence of low-lying areas. Communities living in low-lying coastal areas face the threat of displacement and loss of livelihoods, particularly fishing communities who rely on access to coastal resources for their survival.

Degradation of Natural Coastal Defenses:

The reduction of mangrove forest cover, which acts as a natural barrier against tidal surges and coastal erosion, has weakened the city's resilience to coastal risks. The loss of mangroves leaves coastal communities more exposed to storm surges and erosion, increasing the risk of damage to their homes and livelihoods and increase migration, leading to another burden on urban infrastructure and increase the vulnerabilities and the gap to have affordable housing.

Inadequate Coastal Infrastructure:

Much of the existing infrastructure along Karachi's coast is not designed to withstand the projected increase in sea levels and the intensity of coastal flooding events, leaving buildings and other structures highly vulnerable. Hence, poorly built coastal infrastructure puts marginalized communities at even greater risk, as they often reside in informal settlements with inadequate protection against rising sea levels and flooding.

Main Adaptation Strategies

Coastal Ecosystem Restoration:

Mangrove Forest Restoration:

One of the most effective nature-based solutions for enhancing coastal resilience is the protection and restoration of mangrove ecosystems. Karachi, being located within a mangrove ecological zone, has the potential to significantly improve its coastal defenses through mangrove restoration and expansion. Restoring mangroves will provide coastal communities and fishermen with increased protection from storm surges and flooding, securing their livelihoods and properties.

Expansion of Mangrove Cover:

The Karachi 2020 Plan already prioritizes the conservation and expansion of mangrove forests. The existing mangrove cover, estimated at 1,000 hectares, can be increased by rehabilitating degraded areas and planting new mangroves. Restoration efforts have identified an additional 778 hectares of potential mangrove habitat, which could be converted back to forests, offering both protective and carbon sequestration benefits. Expanding mangrove cover will improve fish stocks, providing a sustainable resource for local fishermen while safeguarding their boats and settlements from coastal erosion.

Climate Finance Opportunities:

By increasing mangrove cover, Karachi can also access international climate finance. For example, the Delta Blue Carbon project for Sindh's mangroves raised significant revenue through carbon credits, providing a financial incentive for further mangrove restoration. These financial gains can also support coastal community development projects, improving infrastructure and providing resources for fishermen to adapt to climate change.

Enhancing Coastal Infrastructure:

Resilient Building Design:

Adapting the built environment to withstand the impacts of coastal flooding is crucial. This includes retrofitting existing buildings with measures like elevation and moisture-resistant foundations and enforcing stringent building codes for new constructions in vulnerable areas. Resilient building design will reduce the risk of structural damage to homes and businesses, especially for coastal communities and fishermen, ensuring that their homes and infrastructure remain intact during extreme climate events.

Zoning & Land Use Planning:

To reduce future risks, it is essential to integrate sea level rise projections and coastal flooding risks into land use planning and zoning regulations. This could include banning new construction in high-risk coastal areas and ensuring that new buildings are set back from the shoreline. Implementing these measures will help protect coastal communities, particularly fishermen, by limiting the encroachment of haphazard developments and ensuring that they are not displaced by the increasing frequency of coastal floods.

Goals & Targets

Adaptation Goal 4: Improve Mangrove Forest Cover to Provide Protection Against Tidal Erosion and Flooding Risks

Target 4.1:

By 2030, increase the mangrove forest cover within the Karachi municipal area by at least 500 hectares.

This expansion will enhance the natural coastal defenses, reducing the city's vulnerability to tidal erosion and flooding.

Adaptation Goal 5: Enhance Coastal Infrastructure to Reduce the Impact of Flooding and Inundation

Target 5.1:

By 2027, develop and implement land use planning, zoning, and building codes that account for sea level rise and coastal flooding.

These regulations should prohibit new buildings in at-risk areas and mandate that existing structures be retrofitted to withstand future coastal risks.

Climate Sensitivities of Rerhi Goth and Hundreds of other villages of Eastern Coast of Karachi

Karachi's population along the coastal belt is bloomed significantly over the last few decades.

The coastline along Rerhi Goath **(~1050km)** is severely exposed to climate change risks, such as coastal erosion, sea-level rise, tidal flooding, and saltwater intrusion. The villagers fall in low-income quantile, thus the poverty level, inadequate amenities, limited access to basic services are some of the key factors that has increased their vulnerabilities to climate change. Access to safe drinking water is a continuous struggle for the resident of Rerhi Goth. The water tankers bring water for the local people to meet their need from a nearby dam which costs these poor people at **Rs. 3,200 - 3500 ($ 9 – 13 @278.12/$) per 5000 gallons.** Unfortunately, this water is also not clean, leading to multiple infection diseases. News reported higher level of skin infections, gastrointestinal and kidney diseases.

Improper solid waste management and presence of a number of small-scale factories (mainly textile and chemical ones) has further deteriorated ecological conditions in the area, and badly affecting the environmental and human health of the Rerhi Goth villagers.

Source: The Urban Unit KCAP Team Field Visit 2024 and Arab News. August 2, 2019. https://www.arabnews.com/node/1537811/%7B%7B

Urban Heat Risks

Karachi, Pakistan's largest city, has experienced significant warming over the past century. The Berkeley Earth Data estimates that between 1900-1917 and 2000-2017, the vicinity of Karachi City has seen a temperature increase of approximately 0.9°C. This trend has intensified over the last decade, with rising temperatures leading to frequent and severe heatwaves. The drivers of this increase include inadequate urban planning, vehicular and industrial emissions, changes in coastal sea breezes, and the changing day arcs of the sun. These factors have exacerbated the urban heat island effect, making Karachi one of the most heat-vulnerable cities in the world.

According to projections by the World Bank Climate Change Knowledge Portal, Karachi falls under the extreme heat and extreme population class for the period between 2080-2099.

The IPCC A6 Atlas also forecasts that mean temperatures in Karachi could rise by 1.1-1.2°C under SSP1-2.6 and by 4.1-4.6°C under SSP5-8.5 by the end of the century. The city's central districts, particularly Karachi Central, are more sensitive to heatwaves and are projected to be the worst-hit areas.

Key Issues

The Climate Change Risks Assessment highlights that Karachi Central and South have high sensitivity to heat exposure, while West, East, and Malir North show medium-high sensitivity. Other areas rank medium-low or lower. Karachi Central stands out as the most vulnerable district and requires targeted interventions to mitigate heatwave impacts.

The increasing frequency and intensity of heatwaves pose severe risks to Karachi's population, particularly the 62% of residents living in informal settlements with limited access to clean water and uninterrupted electricity. These areas are highly vulnerable due to poor housing conditions, inadequate ventilation, and a lack of access to cooling technologies. The high population density, combined with the lack of green spaces and shade, exacerbates the urban heat island effect, leading to elevated temperatures and increased health risks.

Access to cooling remains a significant challenge, with Pakistan ranking among the top five countries globally in terms of cooling demand. However, the penetration of cooling appliances is low, particularly among the most vulnerable populations. The reliance on fans, which are often inefficient and energy-consuming, further strains the city's electricity infrastructure, leading to frequent power outages during peak heat periods.

Main Adaptation Strategies

To address the urban heat risks in Karachi, a multi-faceted approach focusing on increasing urban green spaces, enhancing access to cooling, providing public drinking water facilities, and improving building design is proposed. These strategies aim to build resilience against heat stress, particularly in high-risk areas, and provide co-benefits such as enhanced biodiversity, GHG mitigation, and improved public health.

Increasing Urban Green Spaces

Expanding urban green spaces is a key adaptation strategy for building resilience against heat stress. This includes increasing public park areas and providing shade from native tree species. The co-benefits of this approach include enhanced biodiversity and reduced greenhouse gas emissions. Additionally, other public spaces, such as bus stops, can be equipped with shade, and rooftop gardens can be promoted in public sector buildings and large corporations. To further reduce land surface temperatures, all asphalt and concrete surfaces should be standardized to light or cool grey colors.

To ensure urban greening projects in Karachi contribute to meaningful ecological impact rather than mere beautification, efforts must be taken to emphasize planting native, drought-resistant species to enhance biodiversity and climate resilience. Greening initiatives must be integrated with strategies for urban heat mitigation, air quality improvement, and flood management to maximize their impact. Community engagement in planning and maintaining green spaces will be prioritized, alongside measurable goals such as increasing canopy cover and reducing urban heat islands.
Karachi will prioritize urban afforestation to combat the urban heat island (UHI) effect and enhance climate resilience. Mapping open areas for targeted afforestation and reforestation, with a focus on ecosystem-based adaptation and carbon sink preservation could support the purpose. Community-based afforestation, agroforestry, and corporate forest initiatives will be central to this effort.

The greening of the city strategy will significantly improve air quality by acting as a natural air filter. Trees and vegetation trap dust, particulate matter, and harmful gases, while cooler temperatures reduce ground-level ozone formation. By mitigating the urban heat island effect, greenery lowers energy consumption and emissions from cooling systems. Shaded streets and parks promote walking and cycling, cutting vehicular pollution, and trees act as windbreakers, minimizing dust resuspension. Urban greening thus provides a multifold advantage, addressing both heat stress and air pollution effectively.

To ensure the effective implementation of this adaptive strategy on urban green spaces, encroachment of existing public parks, and the sustainability of plantation activities will be critical. To effectively address the challenges of encroachment and urban greening, the Karachi Metropolitan Corporation (KMC) must reclaim encroached land, involve private organizations and NGOs for sustainable restoration, engage communities for park stewardship, and allocate adequate resources for maintenance. For displaced individuals, alternative low-cost housing, livelihood support, and gradual relocation should be prioritized. Phased relocation plans, inclusive stakeholder engagement, and affordable housing integration within urban policy will help mitigate climate-related impacts while fostering equitable resilience for vulnerable populations.

Air Quality is discussed in detail in mitigation section.

Enhancing Access to Cooling

Given Pakistan's high cooling demand and low penetration of cooling appliances, enhancing access to energy-efficient cooling is critical. This includes promoting the use of energy-efficient ceiling and pedestal fans that meet the 5-Star NEECA Minimum Energy Performance Standards (MEPS). These fans offer dual benefits of reducing electricity consumption and lowering greenhouse gas emissions.

This adaptation strategy will prioritize providing cooling solutions to Karachi's most vulnerable populations, particularly in heat-stressed areas, as a first step. For informal settlements with limited access to electricity, Direct Current (DC) fans can provide a sustainable cooling solution for the most at-risk groups, including the elderly, children, and low-income communities, who have access to relief during extreme heat events. By promoting 5-star rated ceiling and pedestal fans, these communities can reduce electricity use while mitigating heat-related health risks like heatstroke and dehydration. The strategy could include incentives such as subsidies or financial support for households in vulnerable communities to purchase energy-efficient fans or install solar-powered systems. Additionally, local government partnerships with community organizations could help with the distribution and installation of cooling devices. This focused approach improves health outcomes and enhances resilience by providing affordable, sustainable cooling solutions in vulnerable areas.

Public Drinking Water Facilities

Access to clean drinking water is essential for reducing heat stress, particularly in high-heat-risk areas where vulnerable communities face increased exposure to extreme temperatures. Additional drinking water facilities can be installed in public parks, particularly in the five towns most at risk: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and North Nazimabad. These facilities should also be provided in public and private primary and secondary schools to ensure that vulnerable children have access to clean drinking water during heatwaves.

Expanding hydration facilities to community centers, markets, and bus stops in high-density areas ensures residents, especially children, the elderly, outdoor workers, and low-income families, have access to water and can avoid heat-related illnesses. At construction sites, prioritizing flexible work hours, hydration, and heat stress awareness is essential to protect workers from extreme heat and ensure their safety and productivity. These measures can significantly reduce the risk of health complications due to heat stress and support overall community well-being.

By improving water access, the strategy promotes health and well-being, enhances community resilience, and helps reduce the burden on healthcare systems during extreme heat events.

Improving Building Design

Improving building design to reduce heat absorption is another critical adaptation strategy. Simple measures such as painting roofs white to reflect heat, adding shade over windows, and installing wall insulation and double-glazed glass can significantly reduce indoor temperatures. As a priority, all government educational and health institutions in Karachi should be retrofitted with these features to reduce heat stress for patients and children.

For children in schools and healthcare settings, improving building design will be an effective strategy to significantly reduce the risk of heat-related illnesses, improve concentration, and enhance overall comfort. In classrooms, lower temperatures help children focus better, while in healthcare institutions, it ensures that young patients are less susceptible to heat stress, which can complicate recovery or exacerbate existing conditions. Retrofitting all government educational and health institutions in Karachi with these features can provide a much-needed shield from the intense heat and support children's physical and cognitive development.

Goals & Targets

The following adaptation goals and targets have been set to address urban heat risks in Karachi:

Adaptation Goal 6:

Build resilience against heat stress by increasing urban green space in heat-risk areas of Karach

Target 6.1:

By 2026, additional shade, preferably from native trees, will be provided in all public parks in the five towns with the highest heat risk: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and North Nazimabad.

Target 6.2:

By 2030, the following measures will be implemented;

Planting of at least 10,000 native trees in public parks and along roadsides, coupled with monitoring and evaluation systems, and tagging of trees for tracking growth and survival to maximize their long-term survival and effectiveness

Provision of eco-friendly shade at over 100 key bus stops across the city, prioritizing heat-stressed areas

Development of urban roof gardens in all existing public buildings and new commercial constructions

Use of light or cool grey color for all new ground-level construction (roads, pavements, etc.) to reduce surface temperature

Establish Urban Forests focusing on the rehabilitation of open areas and designated forest lands through afforestation and reforestation, contributing to carbon sequestration and improving the city's resilience to extreme heat and other climate hazards

Adaptation Goal 7:

Provide additional drinking water facilities for the vulnerable population in public parks and primary government schools in high-heat-risk areas

Target 7.1:

By 2027, clean drinking water facilities will be available in all public parks and schools in the five towns with the highest heat risk: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and Ibrahim Hyderi.

Adaptation Goal 8:

Increase access to cooling for the population through the adoption of energy-efficient fans

Target 8.1:

By 2026, all government procurement of electric fans will be limited to the most efficient NEECA 5-Star models.

Target 8.2:

By 2027, 50,000 DC (direct current) fans will be distributed to vulnerable populations in off-grid and poor-grid areas to increase their access to sustainable cooling.

Adaptation Goal 9:

Reduce heat stress for the population of Karachi through improved building design

Target 9.1:

By 2030, all government educational and health facilities in Karachi will be retrofitted to reduce heat stress on children and patients.

Green Energy, Green Spaces

Kidney Hill Park Shines in Karachi

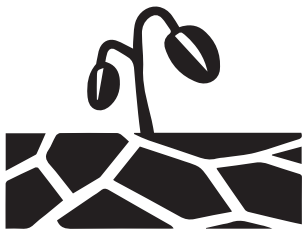
Kidney Hill Park, a once-neglected hillock in Karachi, has been transformed into a lush green oasis, offering residents a much-needed escape in the heart of the bustling metropolis. The park, which spans over 62 acres, serves as a "green lung" for the city, helping to combat urban pollution and heat stress while providing a recreational space for families and nature enthusiasts. The Karachi Metropolitan Corporation (KMC) spearheaded the development of Kidney Hill into a vibrant urban park, planting thousands of native plants and trees and creating walking tracks, making it a shining example of reclaiming and revitalizing green spaces in congested urban areas.

Photo/File

Kidney Hill has become the first-ever park in Karachi which will use solar panel-generated electricity.

Adding to its green credentials, Kidney Hill Park has now become Karachi's first-ever solar-powered park. This initiative is part of KMC's broader strategy to embrace renewable energy and reduce its electricity expenses. The solar energy system powering the park reflects KMC's commitment to sustainability and environmental conservation. The transition aligns with ongoing efforts to solarize KMC-managed hospitals, street lights, and other facilities, underscoring the corporation's leadership in promoting eco-friendly solutions across the city.

Source: https://tribune.com.pk/story/2327278/kidney-hill-park-termed-green-lung;
https://www.zameen.com/blog/kidney-hill-park-karachi.html;
https://www.nation.com.pk/28-Nov-2024/kmc-building-converted-on-solar-energy-mayor-hints-more-ae-projects:
https://english.aaj.tv/news/30346029/kidney-hill-becomes-first-solar-powered-park-in-karachi



Drought Risks

Karachi, a sprawling metropolis in an arid region of Pakistan, heavily relies on external water sources to meet its vast demand. The city requires an estimated 1,400 million gallons per day (MGD) of water, yet it only receives about 650 MGD from the Hub and Indus River catchments. This substantial shortfall of 45% is partially addressed through numerous pumping hydrants scattered across the city. However, this reliance on external sources and the existing supply deficit makes Karachi particularly vulnerable to drought conditions.

The Climate Change Risk Assessment (CCRA) for Karachi highlights that densely populated central, southern, and eastern sectors of the city are highly vulnerable to droughts. These regions, characterized by extensive urban land coverage and high poverty rates, have limited adaptive capacity due to their socio-economic vulnerabilities. In contrast, the northeast and northwest regions are less susceptible to drought, while the southwest and south coastal areas experience elevated drought risk due to factors such as high population density and low groundwater levels.

Key Issues

Karachi's vulnerability to drought is exacerbated by several key issues. The city's heavy reliance on external water sources, combined with a significant supply shortfall, places immense pressure on its water infrastructure. The densely populated and impoverished areas in the central, southern, and eastern sectors are particularly at risk due to their limited ability to adapt to drought conditions. The lack of groundwater reserves and poor water management practices further aggravate the situation, leaving large segments of the population exposed to severe water scarcity during periods of drought.

The socio-economic conditions in these vulnerable areas hinder the population's capacity to cope with drought. High poverty rates, inadequate access to clean water, and limited infrastructure for water storage and conservation contribute to the heightened risk. Furthermore, rapid urbanization of Karachi has led to the loss of natural landscapes that could otherwise support groundwater recharge and water conservation efforts. This has increased city's dependence on dwindling external water supplies, making it even more vulnerable to the impacts of climate change.

Main Adaptation Strategies

A comprehensive adaptation strategy focusing on nature-based solutions, water conservation, and reuse is essential to manage this issue. These strategies aim to build resilience among vulnerable populations by increasing their access to water through sustainable practices and infrastructure improvements.

Nature-Based Solutions for Groundwater Recharge

One of the most effective ways to combat drought is to enhance the recharge of groundwater, which can be achieved through nature-based solutions. Constructed wetlands, for instance, can be used to treat wastewater and facilitate its reuse for irrigation and watering in public parks. These wetlands not only provide a sustainable method of wastewater treatment but also help in groundwater recharge by allowing treated water to percolate into the ground.

Additionally, rainwater and stormwater harvesting can play a crucial role in increasing water availability during dry periods. Implementing structures such as gutters, tanks, and reservoirs to capture and store rainwater can provide a local source of water that can be used during droughts. These systems can be integrated with centralized infrastructure to enhance their effectiveness in groundwater recharge.
Overall, by enhancing groundwater recharge, nature-based solutions will reduce water scarcity risks, ensuring that vulnerable communities have reliable access to water even during droughts.

Water Conservation & Reuse

Reducing water demand through efficient use is a key strategy in managing drought risks. In Karachi, sewage water is already being used for irrigation, but this practice can be expanded by improving the treatment of sewage. By increasing the capacity of existing wastewater treatment plants and utilizing nature-based solutions, the city can further enhance its ability to reuse wastewater for non-potable purposes.

Furthermore, rooftop water harvesting should be promoted through building codes, master plans, and regulatory regimes. Making rooftop water harvesting mandatory for all public buildings will not only reduce the demand for external water sources but also increase local water availability. This strategy can be particularly effective in addressing the water needs of the most vulnerable populations during drought conditions.

These actions will significantly benefit the citizens of Karachi, especially those in informal settlements, who often face limited access to clean water. By promoting water conservation and increasing local water storage, these communities will have a more sustainable and reliable water supply during droughts, reducing their dependency on external and often expensive water sources, which are evident during field assessments. Furthermore, the reuse of treated wastewater can ensure that essential services, such as irrigation and sanitation, are maintained without depleting potable water resources.

Goals & Targets

The following adaptation goals and targets have been established to address the drought risks in Karachi:

Adaptation Goal 10:
Build resilience of vulnerable population through increasing their access to water

Target 10.1

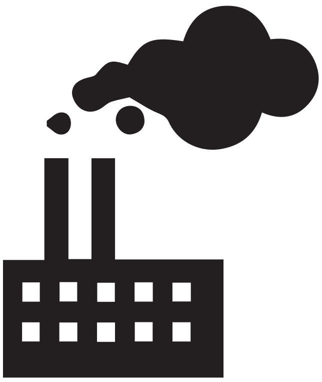
By 2026, rainwater harvesting storage will be built on the rooftops of all public buildings. This measure aims to capture rainwater during the monsoon season and store it for use during dry periods, thus reducing the city's dependence on external water sources, particularly for vulnerable populations during water shortages.

Target 10.2

By 2027, storage facilities for stormwater runoff will be constructed, with the capability to treat and reuse the collected water. These storage facilities will help manage stormwater, reduce the risk of flooding, and provide an additional water source during droughts.

Target 10.3:

By 2030, at least two constructed wetlands will be established for the treatment of wastewater. The treated water will be reused for irrigation and watering public parks, contributing to water conservation and reducing the pressure on Karachi's limited water resources. This will ultimately provide the targeted community with enhanced green spaces and contribute to sustainable water use, improving local environmental quality and well-being.



Air Pollution

The growing challenge of air pollution in Karachi poses significant health risks, particularly to vulnerable populations, and threatens the overall well-being of urban environments. To address these challenges, concrete actions are required to both reduce exposure and enhance resilience against the impacts of poor air quality.

Adaptation Goal 11: Minimize the health impacts of air pollution on vulnerable populations by advanced monitoring, targeted awareness campaigns, and timely health advisories

Target 11.1

By 2026, a comprehensive air quality monitoring network will be established in all hotspot areas of Karachi to provide real-time data on pollution levels for the citizens. This initiative will significantly benefit vulnerable populations, including children, the elderly, and individuals with respiratory conditions, by enabling them to take timely preventive measures during high pollution periods. Healthcare providers will also benefit, as the availability of real-time data will allow them to anticipate and manage air pollution-related health cases more effectively. Additionally, policymakers and urban planners will be empowered with precise data, helping them design targeted interventions and strategies to address air quality issues in the city's most affected areas/targeted actions.

Target 11.2

By 2026, localized health advisories based on real-time air quality data will be developed and disseminated to inform and protect vulnerable populations. These advisories will provide actionable guidance, such as staying indoors during pollution peaks or using protective masks, to
minimize exposure. Schools, workplaces, and community centers will also benefit from receiving tailored advice, ensuring informed decision-making to safeguard health. Furthermore, media outlets, civil societies, local councils, and NGOs can use these advisories to amplify awareness campaigns, ensuring that the entire community becomes more informed and proactive in addressing air pollution-related risks.

Target 11.3

By 2030, health systems and urban planning will be fully adapted to address air quality challenges, ensuring long-term resilience and reduced health impacts for vulnerable communities. This adaptation will improve access to healthcare services equipped to manage air pollution-related conditions, especially for populations most at risk. Urban planning measures, such as increasing green spaces and creating pollution buffer zones, will improve overall air quality while contributing to a healthier living environment for all residents. Stakeholders, including developers, environmental organizations, and public health authorities, will collaborate to establish sustainable urban ecosystems, making Karachi more resilient to air pollution challenges and enhancing the overall quality of life for its citizens.

A linked dashboard is recommended to be developed to provide real-time city AQ updates on key sectors like transport, waste, drainage, and public health, along with climate preparedness ratings for districts. Integrating air quality data with this system would support data-driven decisions, enhancing resilience and addressing both air pollution and climate risks.

4.2: Integration with Existing Policies and Plans

By aligning with existing federal and sub-national policies, strategies, and plans, such as the Nationally Determined Contributions (NDCs 2021), National Adaptation Plan (NAP 2023), Karachi 2020 Plan, Karachi Heatwave Management Plan (KHWP), and the plans of the Sindh Disaster Management Authority (SDMA), this strategy ensures a cohesive approach to enhancing the city's resilience. The adaptation goals and targets also leverage synergies with existing projects and plans to maximize effectiveness and efficiency. The alignment with ongoing projects, such as the USD 100 million World Bank SWEEP project, the USD 300 million Sindh Resilience Project, and the Delta Blue Carbon program, exemplifies the integration of adaptation priorities with funded initiatives. These projects not only address immediate climate risks but also contribute to long-term mitigation goals by reducing greenhouse gas emissions and enhancing sustainable practices.

Local residents, the municipal sector, local CBOs/NGOs/Civil Society, youth groups, and community leaders will be taken on board for implementation of adaptation and mitigation measures through a collaborative approach,

In conclusion, these adaptation goals and strategies not only lay out the path for immediate interventions but also envision a resilient Karachi that can withstand future climate impacts while continuing to thrive as a vibrant, inclusive metropolis.

4.3: Priority Adaptation Actions

This section outlines sector-specific adaptation strategies, goals, and targets across four critical areas: urban flood risk, coastal risks, urban heat risk, and drought risk.

It highlights targeted measures to enhance resilience within these sectors, ensuring sustainable and effective climate adaptation. Additionally, the section elaborates on priority actions for each sector, detailing implementing stakeholders, measurable indicators, implementation timelines, and indicative costs.

The indicative costs are categorized into three levels:

Low-Cost Actions (below PKR 10 million), Medium-Cost Actions (between PKR 10 million and 150 million), and High-Cost Actions (above PKR 150 million)

This structured approach provides a clear pathway for prioritizing and financing adaptation efforts for Karachi City.

Sectoral Adaptation Strategies

Table 8:

Sector	Sectoral Adaptation Strategies	Goals	Targets
Urban Flood Risk	a. Floodwater storage and drainage in flood-prone hotspots	South, East, and Korangi districts have increased resilience to floods	Implement nature-based flood mitigation features in 100 parks by 2027
			Improve vegetation cover and permeable surfaces in 100 public parks by 2030
	b. Sewerage and stormwater infrastructure	Improve stormwater drainage infrastructure to cope with urban flooding	Upgraded drainage systems in three high flood-risk districts of South, Central, and Korangi by 2030
	c. cosystem-based River catchment management	Improve ecosystem capacity against floods by restoring natural riverbeds	Restore the riverbeds of the Malir and Lyari rivers by 2035
Coastal Risks	a. Coastal ecosystem restoration	Improve the mangrove forest cover to protect against tidal erosion and flooding risk	By 2030, increase the mangrove forest cover within the Karachi municipal area by at least 500 hectares
	b. Enhance coastal infrastructure	Enhance coastal infrastructure to reduce the impact of flooding and inundation	By 2027, develop and implement land use planning, zoning, and building codes that account for sea level rise and coastal flooding
Urban Heat Risk	a. Increase urban green spaces to build resilience	Increasing urban green space in high heat risk areas of Karachi	By 2026, additional shade from native trees provided in the highest heat-risk areas: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and North Nazimabad
	b. Public drinking water facilities	Additional drinking water facilities for the vulnerable population in public parks, primary government schools in high heat risk areas	Clean drinking water facilities available in all public parks and schools in the highest heat risk areas by 2027: Malir, Gulberg, Gulshan-e-Iqbal, Lyari, and Ibrahim Hyderi
	c. Access to cooling	Increase access to cooling for population through the adoption of energy-efficient fans	All public procurement of electric fans will be limited to the most efficient NEECA 5-Star models by 2025
		Reduce heat stress for the population of Karachi through improved building design	50,000 DC fans distributed to vulnerable populations in off-grid and poor grid areas by 2027
	d. Improve building design		All government educational and health facilities retrofitted to reduce heat stress by 2030

Sector	Sectoral Adaptation Strategies	Goals	Targets
Drought Risk	a. Nature-based solutions for groundwater recharge, water conservation and use	Build resilience of the vulnerable population by increasing their access to water	Rainwater harvesting storage built on rooftops of all public buildings by 2025 Storage facilities for stormwater runoff constructed by 2027. At least two constructed wetlands established for the treatment of wastewater
Air Quality	a. Minimize the health impacts of air pollution on vulnerable populations by advanced monitoring, targeted awareness campaigns, and timely health advisories	Build resilience through information sharing, preparedness and targeted actions.	By 2026, a comprehensive air quality monitoring network established in all hotspot areas of Karachi By 2026, develop and disseminate localized health advisories based on real-time air quality data By 2030, fully adapt health systems and urban planning to address air quality challenges for long-term resilience

Sector-wise Adaptation Actions

Urban Flood Risk

Table 9:

Sectoral Strategy	Adaptation Action	Stakeholders	Indicators	Timeframe	Cost
a. Floodwater storage and drainage in flood-prone hotspots	Integrate nature-based flood mitigation features in the Strategic Development Plan for restoration and addition of public parks	Lead: Parks & Horticulture department	**Output:** Number of parks and public spaces restored or enhanced with developed with flood mitigation measures and stormwater drainage	2025 – 2026	Medium
	Integrate parks and open public spaces with stormwater drainage to create retention areas.	Supporting: KMC	**Outcome:** Reduction in flood peak levels in nearby urban areas during heavy rainfall events	2027 – 2030	Medium
b. Sewerage and stormwater infrastructure	Develop a plan to undertake the conversion of footpaths and suitable open spaces to permeable surface material in high-flood risk zones	Lead: Parks & Horticulture department Supporting: KMC	**Output:** Number of high-flood risk zones with implemented permeable surfaces, integrated landscape drainage, and enhanced stormwater infrastructure	2025 – 2027	High
	Identify feasible locations to integrate street-side landscape with storm drainage network	Lead: KMC	**Outcome:** Percentage reduction in surface water flooding incidents in targeted high-flood risk zones following infrastructure improvements	2025 – 2027	Medium

Sectoral Strategy	Adaptation Action	Stakeholders	Indicators	Timeframe	Cost
	Undertake infrastructure development for drainage of sewage and stormwater in high flood-risk zones	Lead: Karachi water and Sewage Corporation (KWSC)		2025 – 2030	High
c. Ecosystem-based River catchment management	Develop a plan to restore the natural riverbeds of the Malir and Lyari rivers by removing the encroachment in the catchment area and planting vegetation cover	Lead: Parks & Horticulture department Supporting: KMC, KWSC	**Output:** Area (in square meters) of riverbed and catchment area cleared of encroachments and restored with vegetation cover **Outcome:** Improvement in river flow and reduction in flood risk during peak rainfall periods, as measured by water flow rates and flood incident frequency	2025 - 2027	High
Coastal Risk					
a. Coastal ecosystem restoration	Undertake mapping exercise to identify land availability to expand mangrove forest cover	Lead: Karachi Port Trust (KPT)	**Output:** Area of land identified and allocated for mangrove forest expansion through the mapping exercise	2025 - 2027	Medium
	Allocate budget for mangrove ecosystem restoration and plantation		**Outcome:** Increase in coastal resilience as measured by reduced shoreline erosion rates and improved storm surge protection in areas with restored mangrove cover	2025 - 2027	Medium
b. Enhance coastal infrastructure	Develop land use planning, zoning, and building codes for coastal buildings and enforce regulations prohibiting new construction in high-risk areas	Lead: KPT Supporting: Pakistan Engineering Council (PEC)	**Output:** Number of zoning plans and building codes updated or newly developed to restrict construction in high-risk coastal areas **Outcome:** Reduction in new construction permits issued in designated high-risk coastal zones, indicating effective regulation and enforcement of building restrictions	2025 – 2027	Low

Sectoral Strategy	Adaptation Action	Stakeholders	Indicators	Timeframe	Cost
Urban Heat Risk					
a. Increase urban green spaces to build resilience	Allocate budget for urban green development	Lead: KMC	**Output:** Number of public buildings equipped with green roofs and green walls as part of pilot initiatives **Outcome:** Reduction in average surface temperature in areas surrounding pilot green infrastructure, contributing to urban heat resilience	2025	Medium
	Integrate green roofs and green walls as pilot initiatives in public buildings	Lead: KMC		2025 – 2027	Medium
	Prepare a heat response plan with a focus on precautionary measures, early warning systems, and emergency response protocols	Lead: KMC Supporting: Sindh Health Department		2026	Low
b. Public drinking water facilities	Install clean drinking water facilities in public parks, prioritizing high-heat risk zones	Lead: Parks & Horticulture department Supporting: KMC	**Output:** Number of public parks in high heat risk zones equipped with clean drinking water facilities **Outcome:** Increase in visitor satisfaction and park usage in high-heat risk zones, as measured through visitor feedback and foot traffic data	2025 – 2027	Medium
c. Access to cooling	Update public procurement guidelines to specify only 5-star energy-labeled fans	Lead: SEECA Supporting: NEECA, Sindh Public Procurement Regulatory Authority	**Output:** Number 5-star labeled fans procured **Outcome**: Reduction in electricity costs in public buildings A number of vulnerable households receiving DC fans, indicating improved energy efficiency and cooling access	2026	Low
	Implement program for the provision of energy-labeled DC fans to vulnerable populations	Lead: SEECA Supporting: NEECA, Sindh Energy Department		2025 – 2027	High

Sectoral Strategy	Adaptation Action	Stakeholders	Indicators	Timeframe	Cost
d. Improve building design	Develop action plan to retrofit all public education and health facilities in Karachi with improved heat insulation	Lead: SEECA, Supporting: Sindh Education Department, Sindh Health Department, Sindh Energy Department	**Output:** Approval of a comprehensive action plan outlining the heat insulation retrofit measures for public education and health facilities **Outcome**: Reduction in indoor temperatures in retrofitted education and health facilities, improving comfort levels and resilience to heat waves	2025 - 2030	Medium

Drought Risk

a. Nature-based solutions for groundwater recharge, water conservation and use	Identify opportunities for recycling and reuse of water utilizing both nature-based solutions (e.g. constructed wetlands) and infrastructure development (e.g. rainwater harvesting)	Lead: KWSC	**Output:** Number of public buildings identified and included in the rainwater harvesting and water recycling/reuse plan **Outcome:** volume of water recycled/reused through implemented systems in public buildings, reflecting enhanced water conservation	2025 - 2027	High
	Develop a plan to build rainwater harvesting capacity in public buildings	Lead: KMC		2025 – 2027	Medium






Sectoral Strategy | **Adaptation Action** | **Stakeholders** | **Indicators** | **Timeframe** | **Cost**

Air Quality

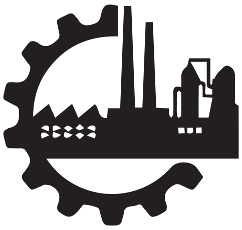
a. Minimize the health impacts of air pollution on vulnerable populations by advanced monitoring, targeted awareness campaigns, and timely health advisories	Establish a comprehensive air quality monitoring network in hotspot areas to provide real-time data	Lead: ECC&CDD and DoCC Supporting: KMC, Private Sector	**Output**: Number of monitoring stations installed and operational in hotspot areas **Outcome**: Improved access to real-time air quality data for citizens and stakeholders	2025 – 2026	Medium
	Develop and disseminate localized health advisories based on real-time air quality data	Lead: Health Department Lead: Health Department Supporting: Media, NGOs/Civil Societies	**Output:** Number of localized advisories disseminated **Outcome:** Reduced exposure and health impacts for vulnerable populations	2025 – 2026	Low
	Adapt health systems and urban planning to address air quality challenges for long-term resilience	Lead: Health and Urban Planning Departments, KDA, KMC	**Output:** Number of healthcare facilities equipped to manage air pollution-related cases; integration of air quality measures in the urban/master plan of Karachi and legal frameworks **Outcome:** Improved community resilience to air quality challenges and reduced health burdens	2025 - 2030	High

4.4: Mitigation goals & targets

The C40 Pathways Ambitious Scenario indicated a GHG emissions reduction potential of 114 million The GHG emissions reductions are set for each of the main categories, that are prioritized based on technical mitigation potential and validated from stakeholder feedback. The projection of expected GHG emissions reduction for the ambitious scenario from the C40 pathways tool results in an annual reduction of about **114.7 million tons of CO2e by the year 2050** as shown in the table below **(reduction of 87% from the projected BAU scenario and 82%** from base year).

In 2022, Karachi's total GHG emissions were **43.5 million tons of CO2e** annually. The manufacturing, residential, transport, and waste sectors contribute over 88% of these emissions, amounting to a combined total of 38.4 million tons of CO2e. Particulate pollution has also emerged as a growing concern for Karachi, with significant impacts on public health, the environment, and urban livability. This issue cuts across various sectors, including transport, agriculture, industries, and energy, necessitating coordinated mitigation efforts. These sectors are prioritized within the Karachi Climate Action Plan (KCAP) for targeted emission reduction strategies, which are outlined below.

	2022	2030	2040	2050
BAU emissions	41,939,356	60,644,241	91,447,914	131,577,914
Achieved with mitigation actions		40,484,009	27,493,440	16,868,587
Emissions reductions-Total:		20,160,232	63,954,474	114,709,327
Percentage reduction from Base year:		3%	55%	82%
Percentage reduction from BAU scenario:		33%	70%	87%



Manufacturing Industries

The manufacturing sector is critical to Karachi's economy but is also a significant contributor to the city's greenhouse gas (GHG) emissions. As of 2022, the sector was responsible for 38.1% of Karachi's total GHG emissions, making it the largest single contributor among all sectors. This high level of emissions is primarily due to the sector's reliance on fossil fuels for captive power generation, coupled with outdated machinery and inefficient resource management practices. Given its substantial share of emissions, the manufacturing sector is a top priority in Karachi's Climate Action Plan (KCAP) for targeted mitigation strategies. This section outlines the key issues, mitigation strategies, and goals for reducing emissions in the manufacturing sector, with a focus on the textile, pharmaceutical, food, and steel industries.

Key Issues

The high GHG emissions from Karachi's manufacturing sector stem from several critical issues:

Fossil Fuel Dependence:

The sector heavily relies on fossil fuels such as natural gas, diesel, furnace oil, and LPG for captive power generation, significantly contributing to emissions.

Inefficient Machinery:

A substantial portion of the sector continues to use outdated, inefficient machinery, leading to higher energy consumption and emissions.

Weak Resource Management:

There is a lack of effective resource efficiency management practices, further exacerbating emissions and operational inefficiencies.

Given the ambitious scenario for GHG emissions reduction by 2050, the manufacturing sector alone is expected to contribute 63% of the total reduction, amounting to 78 million tons of CO2e per year. A significant portion of this reduction 73 million tons of CO2e will come from energy efficiency gains, while the remaining 5 million tons of CO2e will be achieved through fuel switching, primarily by adopting solar power for captive generation.

Mitigation Strategies

The manufacturing sector offers the highest potential for GHG emissions reduction in Karachi. The following key mitigation strategies have been identified:

Energy Efficiency:

Promote technically and economically feasible technologies to enhance productivity and reduce inefficiencies in industrial processes.

This strategy includes optimizing energy use in machinery and operations, particularly in the most polluting sub-sectors.

Fuel Switching:

Transition from fossil fuels to clean and renewable energy sources, such as solar, wind, or biomass, for captive power generation.

This strategy is crucial for achieving significant emissions reductions.

Sector-Specific Interventions:

Form strategic partnerships to implement emission reduction measures across the dominant manufacturing sub-sectors in Karachi, including textiles, pharmaceuticals, food, and steel.

These interventions may involve sector-wide energy audits, technology upgrades, and regulatory reforms.

Textile Sector

The textile industry is the largest within the manufacturing sector, representing 78% of Pakistan's garment manufacturing and export activities. Ongoing initiatives such as the WWF-Pakistan project for decarbonizing the textile sector have identified priority actions, including economizer/air preheater installations for steam boilers, condensate and steam recovery, waste heat recovery, and heat exchanger installations for hot wastewater. A total of twenty-five textile companies in Pakistan signed the "Net-Zero" pledge to achieve zero net GHG emissions latest by 2050. Supporting these initiatives can accelerate the sector's transition to low-carbon operations.

Pharmaceutical, Food, and Steel Sectors

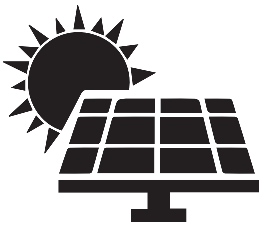
After textiles, these three sectors are crucial for realizing GHG emissions reductions. The pharmaceutical sector, with half of its national members based in Karachi, along with the food sector, housing 8 of the 10 largest companies in Karachi, presents significant opportunities for targeted interventions. In steel sector, studies have identified substantial opportunities for energy efficiency improvements, including waste heat recovery systems, energy-efficient motors, and technical training for employees.

Goals & Targets

The following mitigation goals and targets have been established to minimize GHG emissions in Karachi's manufacturing sector:

Goal#	Mitigation Goals	Short Term (2030)	Medium Term (2040)	Long Term (2050)
Goal 01	Enhance energy efficiency in the manufacturing sector	Focus on the textile sector, implementing energy efficiency measures and supporting ongoing initiatives At least 20% improvement in energy efficiency for large textile manufacturers	Expand efforts to include the pharmaceutical, food, and steel sectors, with a focus on sector-specific energy efficiency and emissions reduction measures. At least 50% improvement in energy efficiency across all priority industrial sectors in Karachi.	Achieve a net GHG emissions reduction of 78 million tons of CO2e per year, contributing to Karachi's overall emissions reduction targets

By implementing these strategies and achieving the outlined goals, the manufacturing sector will play a pivotal role in reducing Karachi's GHG emissions and transitioning the city towards a sustainable, low-carbon future



Energy Sector

The energy sector in Karachi is a pivotal area for climate action, as it underpins the city's overall GHG emissions profile. The sector's current heavy reliance on fossil fuels for electricity generation and industrial activities poses significant challenges in meeting the ambitious emission reduction targets set out in the K-CAP. However, the sector also holds substantial potential for decarbonization through adoption of renewable energy sources and grid improvements. By 2050, the implementation of distributed renewables and grid decarbonization could result in an annual reduction of approximately 18 million tons of CO_2e. This section details the key issues, mitigation strategies, and goals for transforming Karachi's energy sector.

Key Issues

The key issues facing Karachi's energy sector include:

High Fossil Fuel Dependence:

The city's energy generation is predominantly based on fossil fuels, contributing significantly to its GHG emissions. The transition to cleaner energy sources is crucial for reducing the carbon footprint of the energy sector.

Rooftop Solar Adoption Barriers:

Although the cost of solar photovoltaic (PV) systems has decreased by over 90% in the last decade , barriers such as lack of access to financing and technical expertise have hindered widespread adoption, particularly for residential and commercial consumers.

Low Penetration of Net-Metering:

Net-metering, which allows consumers to sell excess solar energy back to the grid, has not been widely adopted in Karachi. Currently, less than 1% of households in Pakistan have net-metering connections, indicating significant potential for growth. However, rising electricity prices have triggered an increase in net-metering applications with a 70% year-on-year growth reported in 2023.

Grid Decarbonization Challenges:

K-Electric, the sole grid utility in Karachi, faces the challenge of integrating renewable energy sources into the grid. While there are plans to add 1,282 megawatts of renewable energy by 2030, further investments and policy support are needed to fully decarbonize the grid.

World Data. https://ourworldindata.org/grapher/solar-pv-prices

Main Mitigation Strategies

To address these issues, K-CAP outlines several key mitigation strategies:

Grid Decarbonization

Increase Renewable Energy Share:

This strategy focuses on expanding the integration of solar, wind, hydro, and biomass energy generation into Karachi's grid. K-Electric's plan to add 1,282 megawatts of renewables by 2030 is a significant step in this direction.

Enhance Transmission Efficiency

Upgrading transmission and distribution systems to reduce energy losses is essential for maximizing the efficiency of renewable energy sources and minimizing the overall carbon footprint of the grid.

Distributed Renewables

Promote Rooftop Solar PV Systems:

Enhancing the adoption of rooftop solar across public, residential, commercial, and industrial sectors is a key strategy. This involves providing financial incentives, improving access to financing, and offering technical support to consumers.

Incentivizing Clean Energy:

Provide incentives and support for households and businesses to install solar panels and generate their own electricity.

Goals & Targets

Goal #	Mitigation Goals	Short Term (2030)	Medium Term (2040)	Long Term (2050)
Goal 02	De-carbonize the electricity grid of Karachi.	K-Electric adds 1,282 megawatts of renewables. 25% of all homes in Karachi have rooftop solar. 30% of commercial buildings in Karachi have rooftop solar. 100% Conversion to solar energy of KMC operated facilities including hospitals, street lights	40% conversion of Public Buildings to Solar or other renewable sources	40% of all homes in Karachi have rooftop solar. 60% of commercial buildings in Karachi have rooftop solar. 70% of K-Electric electricity generation is from renewables. 80% conversion of Public Buildings to Solar or other renewable sources

The following goals and targets are established to drive the decarbonization of Karachi's energy sector: By implementing these strategies and achieving the outlined goals, Karachi will significantly reduce its GHG emissions from the energy sector, contributing to the broader aim of transforming the city into a low-carbon, sustainable urban center by 2050.

DAWN, May 2024. https://www.dawn.com/news/1833228
NEPRA State of Industry Report 2023.

Transport

Transport sector in Karachi is one of the largest contributors to the city's greenhouse gas (GHG) emissions, accounting for almost 90% of the annual 51.4 million tons of CO_2e emissions from the city. This sector's emissions primarily stem from four key sources: trucks, cars, motorcycles, and buses. As the city continues to grow, so does the demand for transportation, making it imperative to transition towards more sustainable modes of transport. The Karachi Climate Action Plan (KCAP) aims to significantly reduce emissions from the transport sector through the adoption of electric mobility, expansion of public transport, and promotion of non-motorized transport options.

Key Issues

Heavy Reliance on Fossil Fuels:

A majority of the city's transport is powered by petrol, diesel, and natural gas, making it a major source of GHG emissions. This reliance on fossil fuels is unsustainable and poses a significant challenge to reducing emissions.

Dominance of Private Vehicles:

A large portion of the city's emissions comes from private vehicles, including cars and motorcycles. The growing number of private vehicles exacerbates traffic congestion and air pollution, further contributing to GHG emissions.

Underdeveloped Public Transport System:

Although efforts are underway to improve public transport, the existing system is still inadequate to meet the needs of the city's growing population. The limited availability and accessibility of public transport discourage its use, leading to increased reliance on private vehicles.

Limited Infrastructure for Non-Motorized Transport:

Infrastructure for walking and cycling is underdeveloped, making these modes of transport less attractive and less safe for residents. This limits the potential for a shift towards more sustainable, non-motorized transport options.

Slow Adoption of Electric Vehicles (EVs):

Despite huge target sets for transitioning to electric mobility provincially and nationally, the adoption of electric vehicles (EVs) in Karachi remains slow. Barriers such as the high cost of EVs, lack of charging infrastructure, and limited awareness hinder the transition.

Mitigation Strategies

To address these issues, the KCAP outlines several key strategies aimed at reducing GHG emissions from the transport sector:

E-Mobility Transition:

Scale up the deployment of electric buses, building on the initial steps already taken in Karachi.

Support infrastructure development, such as charging stations, to facilitate a broader transition to electric vehicles (EVs).

Pakistan's NDC 2021 and National Electric Policy 2021 have set ambitious targets for e-mobility: by 2030, more than 50% of new motorcycles and buses, and over 30% of new cars and trucks sold should be electric. These targets increase to over 90% by 2040, emphasizing the need for a comprehensive infrastructure to support this transition. Karachi has already made initial strides in deploying electric buses as part of a Green Climate Fund project, with additional financing from the Asian Development Bank.

Mode Shift to Public Transport:

Enhance inclusivity and access to sustainable public transport systems to encourage a shift away from private vehicle use.

This includes expanding bus rapid transit (BRT) networks and improving the overall quality of public transportation. The city has established a dedicated company, Trans Karachi, to operate the Bus Rapid Transport (BRT) system. Currently, the Green and Orange lines are operational, and the Red and Yellow lines are under construction. Future plans include the Blue and Brown lines, as well as 11 BRT lines, which will also feature three dedicated "pink bus" routes for women and families. The 43 km Karachi Circular Rail (KCR) revival project, categorized under the China-Pakistan Economic Corridor (CPEC) with a budget allocation of approximately 2 billion USD, will play a key role in this transition. The KCR stations will link with the BRT stations, ensuring a seamless and efficient public transport system that complements the shift towards electric mobility. The World Bank, Asian Infrastructure Development Bank, and other partners have collectively committed over 1 billion USD to support mass transport systems in Karachi, reinforcing the city's move towards sustainable transport solutions.

Mode Shift to Walking and Cycling:

Develop infrastructure to support non-motorized transport, such as pedestrian pathways and dedicated cycling lanes

Promote safe and accessible walking and cycling options across the city

Increase Vehicle Efficiency and switch to cleaner fuels:

Regulate and monitor vehicle emission limits and encourage the adoption of cleaner fuels

Implement stricter emissions standards and incentivize the use of hybrid and electric vehicles

Goals & Targets

The following goals and targets have been established to guide the transformation of Karachi's transport sector:

Goal #	Mitigation Goals	Short Term (2030)	Medium Term (2040)	Long Term (2050)
Goal 03	Reduce GHG emissions from the transport sector	6: BRT lines, including green and orange lines, are operational. Karachi Circular Railway (KCR) is revived and operational. Local electric vehicle manufacturing is initiated	90% of new motorcycles, cars, trucks, and buses sold are electric. 11 BRT lines are operational	100% of new motorcycles, cars, trucks, and buses sold are electric. Local electric vehicle manufacturing is established, with major players like BYD operating in Karachi

By implementing these strategies and achieving the outlined goals, Karachi will significantly reduce its GHG emissions from the transport sector, contributing to the broader aim of transforming the city into a low-carbon, sustainable urban center by 2050.

Buildings

The residential and commercial building sectors in Karachi present significant opportunities for reducing greenhouse gas (GHG) emissions. This potential lies not only in retrofitting existing structures to improve energy efficiency but also in ensuring that new buildings are designed and constructed with sustainability at the forefront. These sectors account for nearly 10 million tons of CO2e emissions annually, primarily due to the consumption of electricity and natural gas. Addressing energy use in these buildings is critical to meeting Karachi's climate goals.

Key Issues

The building sector's contribution to GHG emissions is substantial, with residential buildings emitting 7.8 million tons and commercial and institutional buildings contributing 1.9 million tons of CO2e in 2022. The reliance on electricity and natural gas for heating, cooling, cooking, and other energy needs is the primary source of these emissions. Specifically, 37% of these emissions fall under Scope 1 (direct emissions from sources owned or controlled by the entity), while the remaining 73% are Scope 2 (indirect emissions from the consumption of purchased electricity, steam, heating, and cooling).

The key challenges in reducing emissions from the building sector include:

Energy Inefficiency:

Many existing buildings are not equipped with energy-efficient appliances or insulation, leading to significant energy wastage.

Fossil Fuel Dependence:

A large proportion of energy use in buildings relies on fossil fuels, particularly natural gas, for space heating, water heating, and cooking.

High Energy Demand:

The growing population and urbanization in Karachi are increasing energy demand, particularly in the residential sector, further exacerbating emissions if not addressed through sustainable practices.

The main strategy for reducing emissions will be to substitute the use of fossil fuels for renewables such as solar, wind, and biomass.

Mitigation intervention	Residential		Commercial	
	Existing	**New**	**Existing**	**New**
Energy Efficient Cooling	Retrofit fans with 5-Star Energy Label	Install 5-Star Energy Label fans	Retrofit fans with 5-Star Energy Label	Install 5-Star Energy Label fans
		Install Energy Label air-conditioners	Retrofit with energy-efficient chillers	Install Energy Label air-conditioners
Energy Efficient Space Heating	Transition from gas to electric	Install Energy Label reversible air-conditioners	Retrofit with heat-pump	Install energy-efficient chillers Install heat-pump
Water Heating	Transition from gas to electric	Install electric water heaters	Transition from gas to electric	Install electric water heaters
Building envelope	Add wall, and roof insulation	Construct cavity insulation wall	Add wall insulation	Construct cavity insulation wall
		Roof insulation		Roof insulation
Cooking	Transition from gas to electric	Use electric cooking	Transition from gas to electric	Use electric cooking
				Use biomass pellet cooking to replace inefficient open biomass burning
Other	Retrofit with efficient refrigerators, lighting	Use the efficient refrigerator	Retrofit hotel laundry to energy and water-use-efficient	Install efficient and low-water-use laundry equipment
		Use efficient lighting		

Table 12: The proposed set of interventions

Mitigation Strategies

To address various challenges, several mitigation strategies have been identified for the residential and commercial building sectors:

Building Envelope Improvements:

Implement wall and ceiling insulation to minimize energy losses in both new construction designs and retrofitting of existing buildings

This includes the use of energy-efficient windows, doors, and roofing materials

Energy-Efficient Appliances:

Replace inefficient lighting, heating, and cooling appliances with 5-star energy-labeled products

Encourage the adoption of energy-efficient technologies, such as LED lighting and inverter-based air conditioners

Water Heating Transition:

Promote the switch from gas to electric water heaters in both residential and commercial buildings, focusing on energy-efficient models and possibly integrating solar water heating systems

Cooking Fuel Switch:

Transition from gas to electric cooking appliances in both residential and commercial sectors

Where feasible, adopt biomass pellet cooking in commercial activities to reduce reliance on fossil fuels, focusing on areas where firewood or charcoal is largely used

Goals & Targets

The following goals and targets have been established to guide the reduction of GHG emissions in the residential and commercial building sectors:

Goal #	Mitigation Goals	Short Term (2030)	Medium Term (2040)	Long Term (2050)
Goal 04	Reduce GHG emissions in residential and commercial building energy use	All electric fans in existing buildings replaced with 5-Star Energy Label Install energy-efficient fans and air conditioners in new buildings 15% of homes using electric cooking 30% of commercial enterprises using electric or biomass pellet cooking 50% water heating transition to electric All new buildings have wall and roof insulation	60% of homes using electric cooking 70% of commercial enterprises using electric or biomass pellet cooking 70% water heating transition to electric All hotels using energy and water-efficient laundry equipment	Achieve a 9-million-ton CO_2e per year reduction compared to Business as Usual (BaU) 70% of homes using electric cooking 80% of commercial enterprises using electric or biomass pellet cooking

These strategies and goals are designed to create a sustainable and energy-efficient future for Karachi's residential and commercial sectors, contributing significantly to the overall reduction in GHG emissions and helping the city meet its climate action targets.

Solid & Effluent Waste

Karachi, with its rapidly growing population and urban sprawl, faces significant challenges in managing its solid and effluent waste. The city generates approximately 16,500 tons of solid waste daily and discharges about 500 million gallons of sewage per day. This immense volume of waste, if not properly managed, not only poses health and environmental risks but also contributes significantly to greenhouse gas (GHG) emissions. Proper management of solid and effluent waste is crucial for reducing the city's carbon footprint and mitigating the impacts of climate change.

Key Issues

Management of solid and effluent waste in Karachi presents several critical issues:

High Waste Generation:

With 16,500 tons of solid waste generated daily, the city's waste management infrastructure is overwhelmed. A significant portion of this waste is organic, which, when left to decompose in landfills, releases methane a potent greenhouse gas.

Inadequate Sewage Treatment:

Karachi discharges around 500 million gallons of sewage daily, translating to about 70% of the total water supplied in the city. Most of this sewage is untreated and ends up in natural water bodies, causing environmental pollution and health hazards.

Limited Waste Processing:

The city lacks adequate facilities for composting, recycling, and landfill methane capture. This limitation hampers the city's ability to reduce GHG emissions from waste management effectively.

Impact on Flood Risk:

Poor solid waste and sewage management exacerbate flood risks in Karachi, as clogged drains and waterways impede the city's ability to handle heavy rainfall and stormwater.

Waste Mitigation Action	GHG Emissions Reduction per Year in Million Tons CO2e 2030
Composting	1.6
Landfill Methane Capture	0.9
Wastewater Treatment	0.001
Recycling	0.051
Total	2.6

Table 13: The potential GHG emissions reduction that can be achieved through various waste mitigation actions:

Mitigation Strategies

To address the issues related to solid and effluent waste management, Karachi's climate action plan outlines several key mitigation strategies:

Solid Waste Reduction:

Prioritize the reduction, reuse, and recycling of waste, particularly plastic waste

Implement policies and programs to encourage waste segregation at the source and promote the circular economy.

Innovative Waste Processing Solutions:

Implement landfill methane capture projects, composting programs, and wastewater treatment plants to reduce emissions from waste management. Explore the use of anaerobic digestion and other innovative technologies to process organic waste

Goals & Targets

The following table outlines main goals and targets for reducing GHG emissions from solid and sewage waste in Karachi:

Goal #	Mitigation Goals	Short Term (2030)	Medium Term (2040)	Long Term (2050)
Goal 05	Reduce GHG emissions from solid and sewage waste	GHG emissions reduced by 2.6 million tons CO2e per year	GHG emissions reduced by 4.8 million tons CO2e per year	Emissions reduced by 9.3 million tons CO2e per year

These goals align with Karachi's broader climate action plan, aiming to significantly reduce the city's carbon footprint while improving public health and environmental quality. By implementing these strategies, Karachi can make substantial progress towards becoming a more sustainable and resilient city.

4.5: Priority Mitigation Actions

This section outlines strategic priorities and goals for mitigating climate impacts in key sectors, including energy and buildings, transport, and waste management. It details sector-specific strategies and associated targets designed to reduce emissions and enhance sustainability. Furthermore, the section presents a comprehensive list of mitigation actions aligned with each strategy, accompanied by measurable indicators, implementation timelines, and estimated costs, providing a clear roadmap for achieving Karachi's climate mitigation objectives.

Sectoral Mitigation Strategies

Table 14: Sectoral Mitigation Strategy

Sector	Sectoral Adaptation Strategies	Goals \ Targets
Energy & Buildings	a. Increase the share of renewable energy in the energy mix	30% share of renewables by 2030, up to 90% by 2050
	b. Improve T&D infrastructure to achieve greater efficiency	Accelerate grid enhancement plans
	c. Improve resource efficiency and scale up industrial decarbonization to reduce emissions from the manufacturing sector	Reduce energy and water consumption in manufacturing industries, and promote circular economy approaches
	d. Improving efficiencies in the building sector by switching to energy-efficient appliances, increasing the share of rooftop Solar PV, and improving building designs	Promoting green buildings, upgrading existing infrastructure, and 100% adoption of energy-efficient technologies and solutions in new buildings
Transport	a. E-mobility transition	Electrification of all 2- and 3-wheelers by 2050 Electrification of all buses by 2050
	b. Mode shift to public transport	Increasing sustainable and inclusive public transport network coverage by 50% by 2050 to shift demand away from private vehicles
	c. Mode shift to walking and cycling	Develop infrastructure to increase safe and accessible walking and cycling options across the city
	d. Increase vehicle efficiency and switch to cleaner fuels	Phase out all high-emission public and private vehicles Phase out high-emitting fuels for vehicles
Waste Management	a. Minimize plastic consumption to lower emissions and plastic waste	Reduce plastic waste disposed to landfills by 30% by 2030
	b. Improve waste collection, processing, and recycling infrastructure	Decentralize waste management to improve recovery through segregation and recycling, up to 50% by 2030
	c. Improve efficiencies and bottlenecks in water supply and sanitation	Minimize losses and improve efficiencies in water/ sanitation infrastructure

Sector-wise Mitigation Actions

Section presents a comprehensive list of mitigation actions aligned with each strategy, detailing measurable indicators, implementation timelines, and estimated costs. The indicative costs are categorized into three levels for clarity: Low-Cost Actions (below PKR 10 million), Medium-Cost Actions (between PKR 10 million and 150 million), and High-Cost Actions (above PKR 150 million). This structured framework ensures a clear understanding of the financial requirements for each mitigation initiative.

Energy & Buildings

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
a. Increase the share of renewable energy in the energy mix	Develop a long-term generation capacity expansion plan for K-Electric to increase the share of renewable energy in the generation mix to at least 90% by 2050	Lead: K-Electric	**Output**: Completion and approval of a long-term generation capacity expansion plan targeting at least 90% renewable energy by 2050 Number of energy-efficient transformers installed **Outcome:** Percentage increase in renewable energy's share in K-Electric's energy generation mix each year, progressing toward the 90% target by 2050 Percentage reduction in energy losses across the electricity distribution network, demonstrating improved efficiency and lower operational costs	2025 - 2030	High
	Solarization of KMC-operated buildings and facilities, including hospitals, parks, streetlights, etc	Lead: KMC Supporting: K-Electric		2025 - 2030	Medium
	Solarization of all public buildings in Karachi city	Lead: K-Electric Support: P&D Department		2030 - 2050	High
b. Improve T&D infrastructure to achieve greater efficiency	Develop an accelerated grid enhancement and efficiency improvement plan	Lead: K-Electric		2025 - 2030	High
	Install energy-efficient transformers			2025 - 2030	High

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
c. Improve resource efficiency and scale up industrial decarbonization to reduce emissions from the manufacturing sector	Collaborate with textile industry associations to roll out awareness-raising and capacity-building campaigns for textile manufacturers, including, targeted advice, training, assistance, and pilot demonstrations	Lead: SEECA, Support: Textile associations (APTMA, PRGMEA, PHMA, APTPMA); manufacturers	**Output:** Number of textile manufacturers participating in awareness, capacity-building campaigns, and pilot demonstrations for resource efficiency and decarbonization	2025 – 2035	High
	Monitor the achievement of textile companies that have signed the Net-Zero pledge		Number of textile companies monitored for Net-Zero pledge achievements, with progress reports documented	2025 - 2030	Low
			Establishment of the Industrial Decarbonization Directorate/Cell		
	Set up an Industrial Decarbonization Directorate/ Cell in the Sindh Energy Department or SEECA to facilitate manufacturing companies in increasing uptake of RE and EE technologies and solutions, with dedicated support for SME's	Lead: Sindh Energy Department Support: SEECA, SMEDA	**Outcome:** Percentage reduction in GHG emissions reported by textile manufacturers that have engaged in capacity-building activities and implemented resource efficiency measures	2025 - 2030	Medium
			Increase in renewable energy and energy efficiency technology adoption rates among manufacturing companies facilitated by the Industrial Decarbonization Directorate/Cell		
			Percentage of textile companies achieving interim Net-Zero milestones as tracked through the monitoring program, indicating progress toward the Net-Zero pledge		

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
d. Improve resource efficiency and scale up industrial decarbonization to reduce emissions from the manufacturing sector	Mandatory energy audits of large energy-consuming industries and companies	Lead: SEECA, Support: NEECA	**Output:** Number of mandatory energy audits conducted in large energy-consuming industries and companies Development of regulations for cap-and-trade schemes and carbon levies for industrial emissions **Outcome:** Percentage reduction in energy consumption among industries that have undergone mandatory energy audits, indicating improved energy efficiency Decrease in total industrial emissions in sectors covered by cap-and-trade and carbon levy regulations, reflecting successful emission reductions from regulatory measures	2030 - 2050	Medium
	Develop regulations for cap-and-trade schemes and carbon levies for industrial emissions	Lead: Ministry of Industries and Production, MoCC &EC (Pak EPA), Support: Sindh DoCC & ECC&CDD		2035 - 2050	Low
e. Improving efficiencies in the building sector by switching to energy-efficient appliances, increasing the share of rooftop Solar PV, and improving building designs	On-bill financing for NEECA labeled Energy Efficient appliances to replace old/inefficient cooling appliances with energy-labeled products: 5 Star Energy labeled fans NEECA labeled energy-efficient refrigerators and air conditioners with low-GWP refrigerants	Lead: K-Electric Support: SEECA, Sindh Energy Department	**Output:** Number of energy-efficient appliances (NEECA-labeled) financed and installed Development and approval of roadmap for solar PV installations Number of residential building bylaws updated **Outcome:** Reduction in household energy consumption and associated emissions among participants in the on-bill financing program Increase in the percentage of low-income and informal housing units retrofitted with energy-efficient equipment and rooftop solar PV Improvement in energy efficiency of new residential buildings	2025 - 2030	Medium

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
	Develop a roadmap for installation of solar PV and retrofitting low-income and informal housing with energy-efficient equipment by 2035	Lead: Sindh Energy Department, Support: SEECA		2030 – 2050	High
	Introduce energy-efficient design considerations in residential building bylaws to improve new residential building designs: New house construction to follow energy-efficient building codes (wall insulation, roof insulation, etc.) Enhance roof insulation of existing houses Replace windows with double-glaze	Lead: KMC, Support: Karachi Development Authority, Karachi Cantonment Board, Pakistan Council of Architects and Town Planners (PCATP)		2025 – 2030	Low
	Specify the minimum standard of 5-star NEECA-labeled cooling appliances (Fans, Air conditioners, and Refrigerators) in Provincial Public Procurement Guidelines.	Lead: Sindh Public Procurement Regulatory Authority		2025 – 2027	Medium
	Bulk replacement of old/inefficient cooling appliances with 5-star labeled models in public buildings	Lead: SEECA, Support: KMC		2025 – 2030	High
	Develop an action plan for rooftop solar PV installation in municipal buildings.	Lead: KMC Support: Sindh Energy Department	**Output:** Completion and approval of an action plan detailing the timeline, budget, and targeted municipal buildings for rooftop solar PV installation. **Outcome:** Reduction in grid electricity consumption and generator fuel savings in municipal buildings	2025 – 2030	High

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
f. Improving efficiencies in the building sector by switching to energy-efficient appliances, increasing the share of rooftop Solar PV, and improving building designs	Amend building bylaws to mandate energy and water-efficient equipment, and energy-efficient insulation in new commercial building designs	Lead: Sindh Planning & Development Department, Support: Pakistan Green Building Council, PEC, PCATP, SEECA, KMC	**Output:** Number of building bylaws amended Number of existing commercial buildings retrofitted with improved envelope technology and state-of-the-art insulation solutions	2025 – 2030	Low
	Establish a mandate to improve the envelope technology of existing buildings, incorporating state-of-the-art insulation solutions to minimize cooling load		Number of mandatory energy audits conducted in public and private commercial buildings Number of buildings obtaining green certifications	2025 – 2030	Low
	Create a retrofit accelerator program for commercial buildings with energy-labeled efficient appliances along the lines of global best practices	Lead: Sindh Planning & Development Department Support: SEECA	**Outcome:** Reduction in average energy and water consumption per square meter in new commercial buildings	2025 – 2035	Low
	Mandatory energy audits for public and private commercial buildings	Lead: SEECA	Decrease in overall cooling load and energy consumption in retrofitted buildings	2030 – 2050	Medium
	Promote voluntary certifications such as EDGE Green buildings, BRI, and LEED	Lead: SEECA, Support: Pakistan Green Building Council, NEECA, PEC, PCATP	Percentage reduction in energy consumption across commercial buildings participating in the retrofit accelerator program Improvement in sustainability performance metrics (e.g., carbon footprint, energy intensity) in buildings with green certifications	2027 - 2050	Low

Transport

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
a. E-mobility transition	Introduce a financing scheme for 2-wheeler EVs	Lead: State Bank of Pakistan, Government of Sindh	**Output:** Number of 2-wheeler EVs financed	2025 - 2040	High
	Develop a plan to establish a network of charging stations	Support: KMC, transport & mass transit department	Number of EV charging stations developed Number of old 3-wheelers replaced	2027 - 2035	High
	Pilot EV chargers integrated with streetlighting infrastructure	Lead: KMC	**Outcome:** Increase in share of 2- and 3- wheeler EVs in the city	2027	Medium
	Conduct assessment of feasibility and market potential for battery swapping stations and charged battery rentals	Lead: Transport & mass transit department, Support: KMC	Percentage decrease in fuel consumption Improvement in air quality metrics	2025 - 2030	Low
	Develop a plan to replace all department owned 2-wheelers with EVs	Lead: KMC		2025 – 2030	Medium
	Introduce a program for the replacement of old 3-wheelers with EV models	Lead: Government of Sindh		2030 – 2040	Medium
	Offer incentives for 2-wheeler and 3-wheeler EVs such as reduced tolls and taxes	Lead: Government of Sindh, transport & mass transit department		2030 – 2040	Medium

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
b. Mode shift to Public Transport	Develop a plan to expand the fleet of E-buses and expand the network, targeting increased coverage by at least 50% by 2050	Lead: Transport & mass transit department	**Output:** Public transport E-buses expansion plan developed **Outcome:** Percentage increase in public transport coverage and accessibility by E-buses	2025 - 2030	High
c. Mode shift to walking and cycling	Map existing pedestrian infrastructure, including length of footpaths, connectivity of neighborhoods, lighting, etc.	Lead: KMC	**Output:** Number of pedestrianization projects initiated 2. Development and approval of a cycling track master plan **Outcome:** Increase in pedestrian and cyclist usage in areas with improved infrastructure, as measured by foot traffic counts and cycling track utilization Reduction in vehicular traffic congestion in areas where pedestrianization projects and cycling tracks are implemented	2025-2027	Low
	Develop a pedestrianization project in high foot-traffic areas incorporating considerations for infrastructure development, redesigning traffic signals, sign boards, and increased accessibility components such as ramps and curbs, benches, lighting and play areas	Lead: KMC		2027-2030	Medium
	Develop a cycling track master plan for main residential and commercial neighborhoods	Lead: KMC		2027-2030	Medium

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
d. Increase vehicle efficiency and switch to cleaner fuels	Build a network of vehicle monitoring inspection centres	Lead: NEECA, Support: Transport & mass transit department, SEECA	**Output:** Number of vehicles monitoring inspection centers established	2025 - 2035	Medium
	Develop regulations for annual inspection and certification of vehicles that are more than 5 years old, including penalties for vehicles that exceed emission limits		Development of regulations for vehicle inspection and certification **Outcome:** Percentage increase in compliance with vehicle emission standards Reduction in average emissions per vehicle among vehicles inspected	2025 - 2035	Medium
	Develop regulations to introduce cleaner fuels for vehicles	Lead: Government of Sindh, transport & mass transit department		2025 - 2035	Low
Waste Management					
a. Minimize plastic consumption to lower emissions and plastic waste	Enforce regulations to ban the use of single-use plastic bags in Karachi	Lead: KMC	**Output:** Number of awareness campaigns conducted Number of public areas designated and developed as waste-free and single-use plastic-free zones **Outcome:** Reduction in single-use plastic bag usage Decrease in littering and plastic waste	2025 - 2027	Low
	Campaign for awareness raising to reduce plastic consumption, and littering and improve hygiene	Lead: Sindh Solid Waste Management Board Support: KMC		2025 – 2035	Medium
	Develop waste-free and single-use plastic-free zones in public areas to demonstrate and increase awareness among citizens			2025 – 2030	Low

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
b. Improve waste collection, processing, and recycling infrastructure	Develop waste management guidelines for improved segregation of waste (with emphasis on monitoring and enforcement)	Lead: Sindh Solid Waste Management Board Support: KMC	**Output:** Completion and dissemination of waste management guidelines Number of awareness campaigns conducted Number of new landfill sites developed	2025 - 2030	Low
	Develop a framework and guidelines for waste segregation at the household level.		**Outcome:** Increase in the percentage of households practicing waste segregation Reduction in mixed waste collected	2025 - 2035	Low
	Awareness campaigns to educate citizens on the benefits of waste segregation and composting at the household level		Increase in compostable and recyclable waste recovery rates	2025 – 2035	Medium
	Develop new landfill sites to reduce load at Jam Chakro and Govind pass	Lead: Sindh Solid Waste Management Board		2030 - 2050	High
c. Improve waste collection, processing, and recycling infrastructure	Develop a framework for Extended Producer Responsibility (EPR)	Lead: MoCC&EC, Support: Sindh Solid Waste Management Board	**Output:** Development of methane capture project Development of an organic fertilizer production facility	2030 - 2035	Low
	Conduct techno-economic assessment for the adoption of methane capture technology at landfill sites (considering potential revenue from voluntary carbon markets)	Lead: Sindh Solid Waste Management Board	**Outcome:** Reduction in methane emissions from landfill sites Increase in the production and usage of organic fertilizer	2025 – 2030	Medium

Sectoral Strategy	Mitigation Action	Stakeholders	Indicators	Time frame	Cost
	Conduct feasibility assessment for Organic fertilizer production from sewage for domestic and farming use			2025 - 2030	Low
	Develop new landfill sites to reduce load at Jam Chakro and Govind pass	Lead: Sindh Solid Waste Management Board		2030 – 2050	High
d. Improve efficiencies and bottlenecks in water supply and sanitation	Replace large water pumps/ motors with IE3 / IE4 motors	Lead: Karachi Water & Sewerage Board (KWSB) Support: KMC	**Output:** Number of motors/pumps replaced Number of awareness sessions conducted **Outcome:** Reduction in energy consumption of pumps/motors Estimated methane emission reduction Improvement in sewage drainage system efficiency	2025 - 2030	Medium
	Conduct an assessment for the potential of Methane capture from improved sewage treatment	Lead: KWSB		2030 - 2035	High
	Develop and implement a plan to disaggregate sewerage and drainage system	Lead: KWSB, Support: KMC		2030 - 2050	High
	Launch a community health awareness program covering indoor air pollution, GHG emissions, SWM, recycling, etc. to engage the citizens, increase their awareness, and improve compliance	Lead: KMC		2024 - 2030	Medium

The climate change mitigation strategy, goals, and targets, covered in this chapter, lay a clear roadmap for achieving substantial reductions in greenhouse gas emissions, aligning with both national and international targets. By prioritizing key sectors such as manufacturing, energy, transport, and waste management, the city can address its most significant sources of emissions while also leveraging opportunities for economic growth and social development. The ambitious goals set for short, medium, and long term; that is 2030, 2040, and 2050, respectively, are grounded in actionable strategies that will help in reducing emissions, enhance energy efficiency, promote renewable energy, and foster sustainable urban development.

Successful implementation of these strategies, goals, and targets requires strong governance, effective partnerships, and sustained investment which will be covered in the following chapter. Moreover, the emphasis on co-benefits such as cost reductions, improved public health, and resilience to climate impacts highlights the broader advantages of this transition.

4.6: Mapping co-benefits from Mitigation

The measures identified in the K-CAP shall impact the hard-to-access target groups identified in this document. Climate migrants constitute an important and evolving category. Evidence during the K-CAP assignments has informed that climate migrants possess a very high grade of vulnerability after entering Karachi. With no access to appropriate housing, livelihoods, and services such as healthcare and welfare support, these people generally survive on social networks, clan connections, and help extended by some social welfare organizations. These people either reside in already overcrowded abodes of relations temporarily or struggle with partial shelterlessness. With enhanced impacts of interventions through K-CAP, these people shall benefit from reduced temperatures, better air quality, and hence a lesser burden on healthcare benefits.

The elderly and children are other common vulnerable groups. Past experiences from the June 2015 heatwave incident in Karachi informed that a sizable number of casualties were of the elderly and also children. They are typically constrained to live indoors in tough domestic environments, generally with limited ventilation and access to thermal relief through fans and other appliances. With the enhanced and improved status of public spaces, this category of people shall be the first beneficiaries of K-CAP. They may find it appropriate to frequent public spaces with better environmental and social conditions to escape episodes of harsh climate. Additionally, improved air quality through various interventions shall help reduce the common disease burden that typically affects the children and elderly.

Using the C40 guidelines for mapping of integration of adaptation and mitigation co-benefits (AMIA Tool), the synergy and trade-off potential, mal-investment risk, and piggybacking opportunities for each of the mitigation strategies identified. The following potential co-benefits are particularly analyzed for each of the key mitigation actions identified for K-CAP:

Health Benefits:

Mitigation efforts would reduce associated diseases such as respiratory and heat-related illnesses. Health improvements can also contribute to reduced healthcare costs and improved workforce productivity, creating additional social and economic benefits.

Air Quality Improvements:

Mitigation actions from substituting use of fossil fuels in particular, not only reduce GHG emissions but also lower pollutant gases and particulate matter which are responsible for poor air quality and health risks.

Social Benefits:

These can include improved public spaces, better quality of life for vulnerable communities (through energy-efficient appliances), and enhanced social cohesion in areas that adopt sustainable practices.

Nature-Based Solutions:

Improvement in biodiversity, provision of ecosystem services, and enhancing climate resilience.

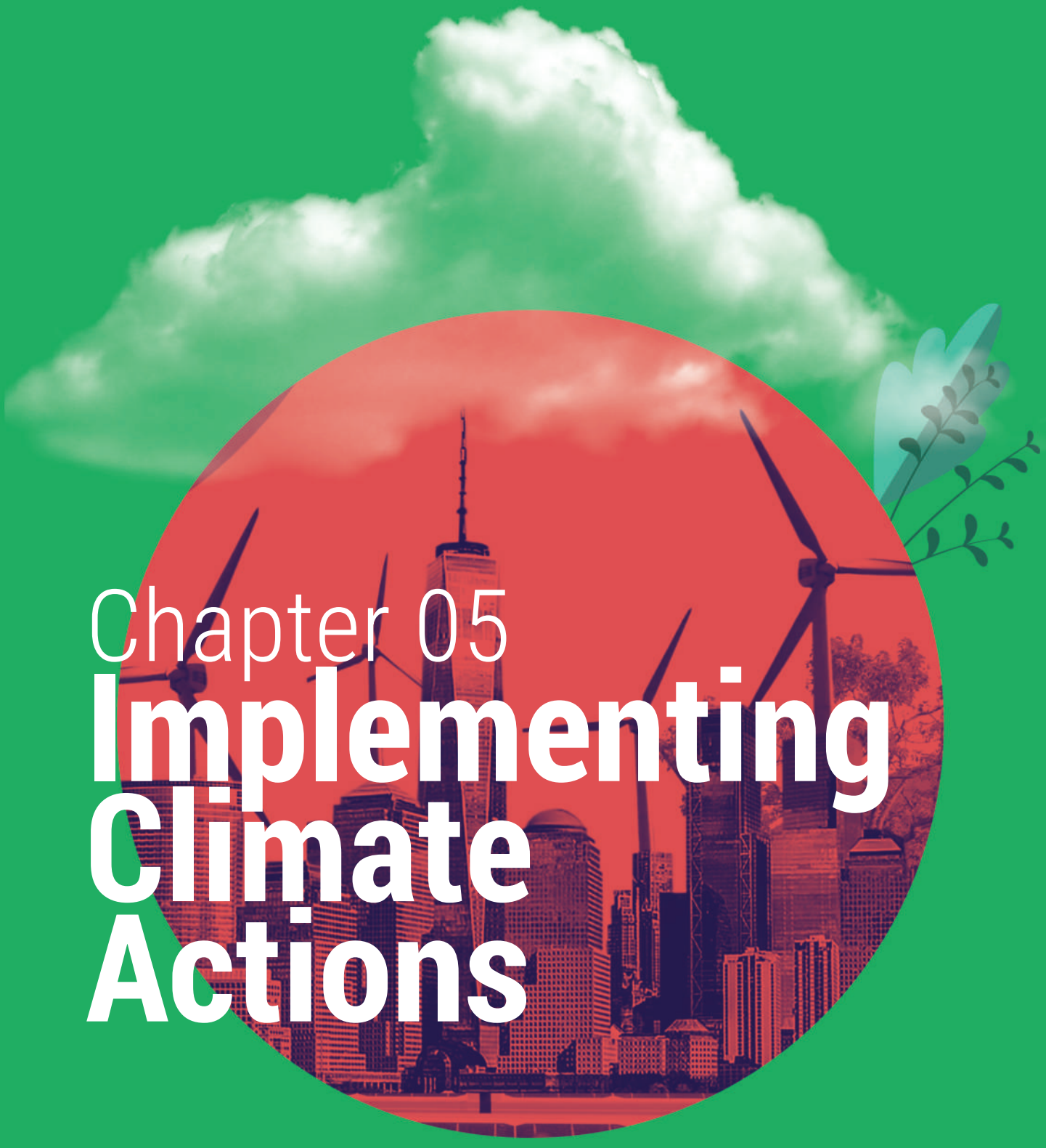
These solutions also offer co-benefits such as flood mitigation and community engagement through the creation of green spaces.

A summary table of co-benefits from the proposed adaptation strategies derived from this tool is summarized here.

Mapping mitigation actions Co-benefits and synergies

Mitigation Goal	Co-Benefits	Synergies
Energy Efficiency in the Industrial Sector and Renewables adoption	**Cost reduction:** The operating cost of the industry is reduced, leading to lower product and service costs for consumers **Air quality:** Reduced emissions from fossil fuel energy sources, and reduced exhaust of pollutant gases and particulate matter improve local air quality and decrease respiratory diseases **Health benefits:** Lower industrial pollution leads to a healthier workforce and community	WWF textiles efficiency World Bank – IFC industrial decarbonization Net-Zero Pakistan
Distributed Renewables, Grid De-Carbonization	**Cost reduction:** Residential and commercial consumers benefit from lower electricity costs **Air quality and health:** Reduced reliance on fossil fuels cuts emissions, improving air quality and lowering rates of asthma and other pollution-related diseases **Resilience**: Enhanced energy security through diversified, local, renewable energy sources, reducing vulnerability to energy supply disruptions	World Bank Sindh Solar Project K-Electric plans for renewables
Energy Efficient fans in Schools & vulnerable areas communities	**Reduced electricity use:** Lower energy demand contributes to mitigation efforts **Health benefits:** Improved indoor air quality and cooling reduce heat-related illnesses and improve learning environments for children. **Energy savings:** Reduced need for heating and cooling, lowering energy bills for schools and reducing emissions	Collaboration with education and health departments for implementation in heat-prone areas
Primary school insulation	**Health and comfort:** Insulation creates healthier and more comfortable indoor environments, which can improve student concentration and performance	Synergies with energy-saving retrofitting initiatives
Sewage treatment through constructed wetlands and operational of existing wastewater treatment plants	**Nature-based solution:** Enhances biodiversity by creating habitats for wildlife **Water quality:** Improves local water quality, reducing pollutants entering water systems, and benefiting both humans and ecosystems **Social benefits:** Creates green spaces and improves the aesthetic value of urban areas, enhancing community well-being **Health benefits:** Better water management reduces waterborne diseases	Alignment with city water management and biodiversity strategies Synergies with public health and urban greening programs

Table 15: Mapping mitigation actions co-benefits and synergies



Chapter 05

Implementing Climate Actions

Implementing Climate Actions

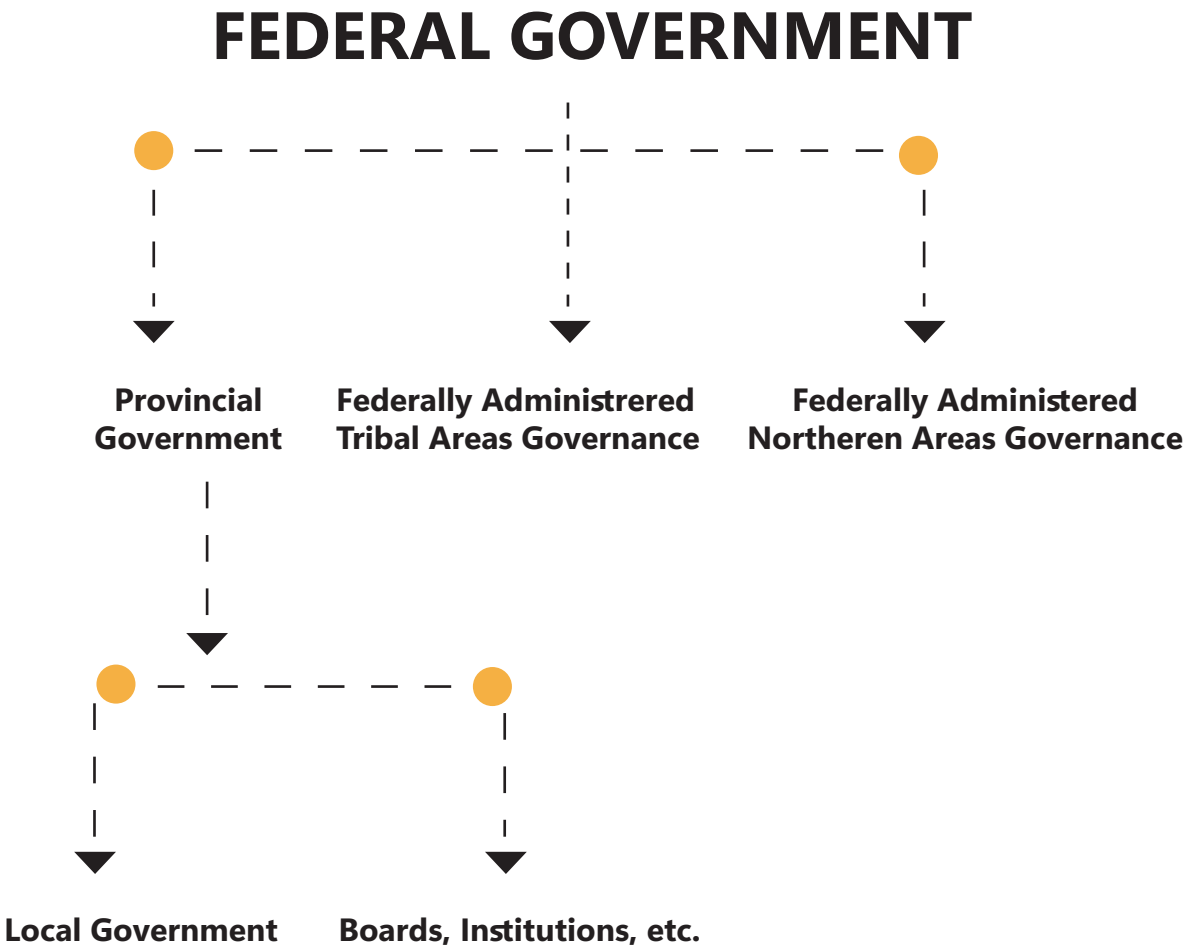
Climate governance is an integral component of climate action planning and plays a critical role in effectively implementing a city's Climate Action Plan. Due to nature of climate action cutting across the work of different departments and agencies in Karachi, in order to ensure good climate governance, there is a need for mainstreaming the climate action plan throughout city governance systems and structures, across the sectors and departments involved in delivering climate actions within the plan.

This chapter provides existing and proposed governance framework to achieve the goals, targets and actions of K-CAP effectively and efficiently.

5.1: Existing Institutional State

There is a three-tiered government system in Pakistan, i.e. federal, provincial, and local government. Karachi is the provincial capital of Sindh and, as per Sindh Local Government Act 2013, the local government body and department operate according to the Sindh Local Government Act 2013.

Figure 31: Three-tiered governance system



The government of Sindh is headed by the Chief Minister, while several departments look after the affairs of the province under the supervision of provincial ministers and appointed secretaries. The local Government Department is one of the major departments that look after the affairs of major institutions including local governments in Sindh.

In Karachi, climate functions are predominantly managed at the provincial level by the Environment, Climate Change, and Coastal Development Department (ECC&CDD). This department holds the mantle for implementing provincial climate change policy and action plan, engaging in legislative reviews, adapting national policies, and crafting sector-specific operating procedures and guidelines. The ECC&CDD oversees several attached departments including:

About- Organogram. (n.d.). Retrieved November 2021, 8, from Local Government Department : https://www.lgdsindh.gov.pk/

Sindh Environment Protection Agency (SEPA):

The regulatory and enforcement arm of the ECC&CDD, responsible for implementing Sindh Environmental Protection Act 2014

Sindh Coastal Development Authority (SCDA):

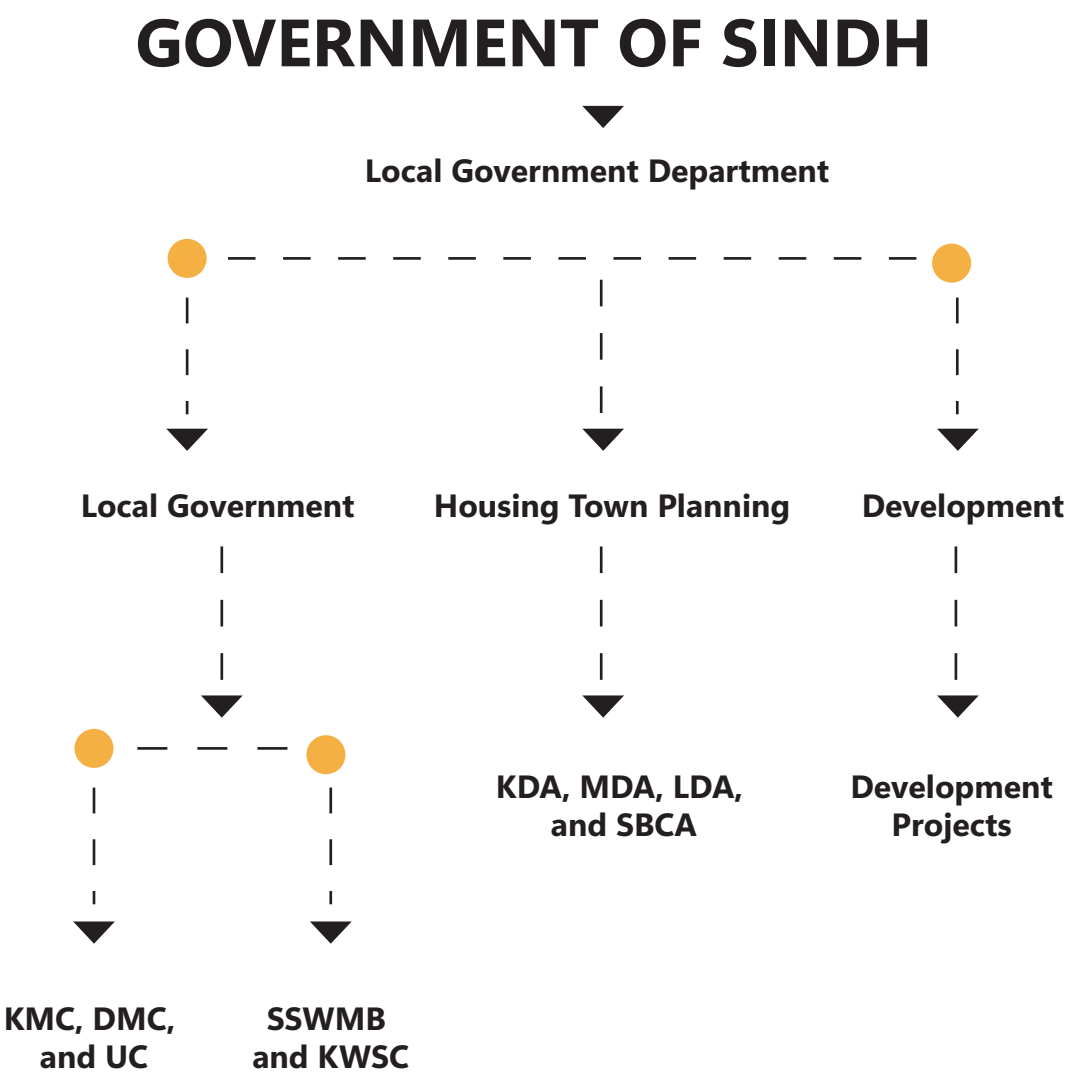
Focuses on development and socio-economic growth of Karachi's coastal areas, ensuring coastal resilience through conservation and development efforts

Directorate of Climate Change (DoCC):

Though responsible for climate functions, encompassing both mitigation and adaptation strategies, faces a significant challenge due to its predominantly administrative workforce lacking the necessary technical expertise

Sindh Environment Protection Tribunal (SEPT). Manages all contraventions under the Sindh Environmental Protection Act 2014

Figure 32. Provincial government hierarchies



The Local Government Department has three wings, i.e. a) Local Government, b) Housing, Town Planning, and c) Development. The local government wing of the department heads the Karachi Water and Sewerage Corporation (KWSC), Sindh Solid Waste Management Board (SSWMB), and other institutions. The second wing of the Local Government Department is the Housing and Town Planning wing which covers the public sector land management authorities e.g. KDA, LDA, MDA, etc. along with Sindh Building Control Authority (SBCA) and the Town Planning Directorate of the Government of Sindh. The third wing of the Local Government Department looks at various Development Projects through directorates.

Karachi relies predominantly on KMC as its local government body. However, this reliance becomes a vulnerability, as the KMC lacks representation and integration across multiple city departments, which mainly fall under the provincial government. This complexity necessitates a clear understanding of the city's powers and capacities to effectively implement climate action that varies across different sectors. By leveraging its unique position and the urgency of climate issues, KMC can advocate for the inclusion of climate mandates in the Sindh Local Government Act (SLGA- 2013) and other relevant legislations in later phases.

The delivery of major services in Karachi is undertaken by a complex web of multiple agencies with either singular or shared jurisdictions. These agencies come under the Sindh Local Government Department and are mainly part of the provincial government, rather than the local government. While the provincial government holds significant authority over key infrastructure and operational systems, effective climate action requires coordinated efforts across multiple levels of government and sectors. Understanding these powers and capacities is essential for devising and implementing effective climate action plans.

Existing Organizational Structure of Karachi Metropolitan Corporation

In Karachi, Karachi Metropolitan Corporation (KMC) plays a crucial role in municipal governance, although its involvement in climate action governance is currently limited. The KMC currently harbors only one designated position, Director (Environment), which remains vacant. The responsibilities tied to this role primarily revolve around environment and climate change, highlighting a limited scope for climate action within the administrative wing. To transform this position into a focal point for mainstreaming, implementing, and monitoring the progress of comprehensive climate action, substantial enhancements in terms of staff expertise, technological capabilities, a broader mandate, and required institutional arrangement under KMC have been developed in the form of DoECC and CCB, details of which are available in section 5.3.

Figure 33. Organogram of Karachi Metropolitan Corporation (KMC)

Karachi City Council:

The Executive set-up of the KMC i.e. City Council consists of 246 elected chairmen representing various constituencies within Karachi. This political platform holds significant potential for championing and coordinating climate action initiatives within the city. However, the council's focus has primarily been on approving budgets and plans, formulating municipal rules and bylaws, and overseeing the performance and accountability of KMC departments and officers. Despite its pivotal role, the council's mandate regarding climate change lacks clarity, resulting in a greater emphasis on cross-cutting themes such as municipal services. At the helm of the KMC is the Mayor of Karachi, an elected official, who serves as the head of the city's administration and holds significant decision-making authority.

5.2: Challenges, Barriers, & Opportunities to Implement KCAP

The barrier in the way of implementation efforts for Karachi's climate action efforts is governance fragmentation. Climate-related functions are predominantly managed at the provincial level by the ECC&CDD through the DoCC and SEPA, leaving the Karachi Metropolitan Corporation (KMC) with no clear mandate for climate action. This lack of a dedicated city-level body results in poor coordination, limited resources, and an inability to mainstream climate initiatives. Conflicting political interests and insufficient stakeholder engagement may further exacerbate the challenge, impeding cohesive and effective implementation of climate action plans. However, during the development of K-CAP, extensive consultation efforts and stakeholder engagements have led to the formulation of a climate governance framework, explained in the next section. This framework has been endorsed by the Mayor and is set for implementation alongside the launch of K-CAP.

Table 16:

Institutional challenges for climate action

Sectors	Key Infrastructure /Operational Systems	City's Authority/ Capacity	Jurisdiction	Challenges
Decarbonizing the Electricity Grid	Bulk power supply and generation (K-Electric, NTDC)	Limited authority; relies on entities like PPIB and AEDB for renewable projects	Federal Government, Private Sector	Lack of authority to enforce renewable energy initiatives at household/ business level, governance issues, need for capacity building, and strategic planning
Optimizing Energy Use in Buildings	Energy efficiency in buildings (SBCA, NEECA)	Lacks a viable programmatic framework and long-term strategy	Provincial Government	The absence of a comprehensive framework and long-term strategy limits the city's direct role in implementing renewable energy initiatives locally
Enabling Next Generation Mobility	Public transport (Department of Transport and Mass Transit, SMTA, SIDCL, TransKarachi)	Authority to implement low/zero-emission technologies; plans for zero-emission BRT network by 2030	Provincial Government	Challenges in funding, coordination, political will, overcrowding, route irregularities, inadequate infrastructure, and reliance on less efficient transportation modes
Improving Solid Waste Management	Solid waste management (SSWMB, KMC)	Jurisdiction over solid waste management infrastructure, responsibility for developing/managing sanitary landfill sites; provincial policies in place	Provincial Government, Local Government	Poorly managed dumping sites, issues in political will and governance, inadequate facilities, outdated vehicles, insufficient funds, and complex informal sector involvement

Sectors	Key Infrastructure /Operational Systems	City's Authority/ Capacity	Jurisdiction	Challenges
Enhancing Resilience of Drinking Water & Wastewater /Sanitation Systems	Water and sanitation infrastructure (KWSC)	Authority to influence water security policies/regulations, implementation of the KWSSIP for reforms and rehabilitation, and addressing climate risks	Provincial Government	Governance issues, funding constraints, outdated infrastructure, delayed critical projects, political will
Managing Disasters, Risks & Impacts of Extreme Weather Events & Sea Level Rise	Disaster management (PDMA, ECC&CD, SCDA, Sindh Irrigation Department)	Authority to influence and control disaster response, coastal infrastructure, stormwater, and river system management, aligned with Sindh Climate Policy	Provincial Government, Local Government	Coordination issues, resource constraints, political interference, bureaucratic inefficiency, financial support needs, technical skill gaps, and leadership challenges
Climate Education & Community Empowerment	Climate resilience education (MoCC, ECC&CD, PDMA, Sindh Education Department)	Some authority; shared responsibility among various entities	Federal Government, Provincial Government	Poor coordination, low awareness, and implementation challenges
Enhancing the Resilience of Natural Capital	Agricultural production (Sindh Agriculture and Irrigation Departments, Sindh Forest Department)	Influence over agricultural policies, commitment to addressing agricultural challenges, and management of natural ecosystems for climate adaptation	Provincial Government	Rapid urbanization, lack of data, poor coordination, low awareness, and need for effective ecosystem management

5.3: Key Measures for Effective Implementation of K-CAP:

The challenges identified in previous section are addressed through development, implementing and monitoring effective climate governance for the Karachi Climate Action Plan within the KMC. This necessitates strategic inputs and measures at multiple levels; the implementation of climate governance reforms in local governance is planned to be conducted in two phases, phase one is an immediate action to be taken alongside the launching of the K-CAP, while phase two focuses on legislative reforms that require provincial approval which is planned as a long-term measure (details of phase II are mentioned in Deliverable H as K-CAP Climate Governance).

Phase I

Establishing an institutional framework for implementation and oversight of K-CAP, based on the existing legal framework of the SLGA Act 2013 Manual Guide

Phase II

Legislative amendments to SLG Act 2013; aim to explicitly include climate change as a mandated responsibility of local government bodies like the KMC

Phase I:
Establishing Institutional Arrangement as per Existing SLGA Framework

Establishment of the Directorate of Environment and Climate Change and Climate Change Board

The Directorate of Environment and Climate Change (DoECC) is responsible at the bureaucratic level for the implementation, monitoring, and regulation of K-CAP. DoECC also addresses technical human resource constraints of the KMC. This directorate will be pivotal in executing climate action initiatives and overseeing their progress. Additionally, a Climate Change Board (CCB) will be created for the sake of a formal coordination mechanism is necessary to facilitate both horizontal and vertical integration with various sectors and departments; therefore, addressing the institutional and stakeholder challenges.

Both the DoECC and the CCB will be established based on the existing legal framework outlined in the Sindh Local Government Act (SLGA) 2013 Manual Guide. The following sections detail the legal basis for the establishment of the Board and the Directorate, outlining their objectives, functions, roles, and the human resources required for their effective operation. By setting up these institutional structures, challenges for a robust and coordinated approach to climate governance, and successful implementation and monitoring of K-CAP are addressed.

Figure 34.
Institutional structure for K-CAP climate governance

Existing Legal Framework for Establishing the DoECC and Supporting K-CAP Initiatives

To legally establish the Directorate of Environment and Climate Change (DoECC) within the Karachi Metropolitan Corporation (KMC), specific provisions of the Sindh Local Government Act (SLGA) 2013 will be leveraged. Key provisions include:

K-CAP as a Special Development Programme:

Categorizing K-CAP as a Special Development Programme under Schedule II, Part I, Section 2 provides a robust legal framework for its implementation.

Chapter VI - Section 76: Development Plans:

This section empowers the council to prepare and implement development plans, justifying establishment of the DoECC.

Chapter VI - Section 78: Works:

This section allows the council to lay down procedures for the preparation and approval of plans and estimates for works executed by the council.

DoECC: Custodian of K-CAP

The Directorate of Environment and Climate Change (DoECC) will serve as the custodian of K-CAP on behalf of the Mayor of Karachi. The Director of Environment will oversee K-CAP implementation, focusing on planning, implementation, GHG inventory updates, assessments, revisions, proposing new climate-related projects, and legislation and budget allocation.

Organizational Structure of the Directorate

The DoECC will have two specialized wings: the Urban Planning and Regulatory Wing, and the Environment and Climate Change Wing.

Organizational Structure of the Directorate

Urban Planning and Regulatory Wing:

This wing will oversee the implementation of the new Karachi Master Plan 2047, coordinate urban development projects, enforce building codes, and advise on regulatory amendments.

Environment and Climate Change Wing:

This wing will develop and implement strategies for climate mitigation and adaptation, manage GHG emissions, and oversee resource allocation and financial planning.

Mandate and Responsibilities

The Directorate of Environment and Climate Change (DoECC) within the KMC, will have the following mandate and responsibilities.

Mandate

Custodian of K-CAP:

The DoECC serves as the custodian of K-CAP on behalf of Mayor Karachi.

K-CAP Implementing Body:

The Director of Environment is positioned as the central figure, responsible for overseeing K-CAP implementation.

Responsibilities

Planning and Implementation:

The DoECC leads planning, implementation, and monitoring of K-CAP initiatives.

GHG Inventory Updates:

After every 02 years, the Greenhouse Gas (GHG) inventory will be updated.

Assessments: Regular, biannually, or every six months, assessment of K-CAP's KPIs will be conducted to ensure its effective implementation.

Climate Change Initiatives:

The DoECC will propose new climate-related projects.

Legislation and Budget Allocation: Proposing climate legislation, budget allocation, and amendments to byelaws will fall under its purview.

Establish A Localized MER Cell under DoECC

Monitoring, Evaluation, and Reporting (MER) Cell established under the Environment and Climate Change wing of DoECC to track K-CAP implementation, details and structure of the MER Cell are discussed in Chapter 6: Monitoring, Evaluation, and Reporting System, develop GHG inventories, and prepare climate risk assessments.

A centralized data platform will be created to ensure the reliability and timeliness of climate-related information. The functions and mandate of the MER cell are discussed in detail in Chapter 6 on MER.

Climate Change Board

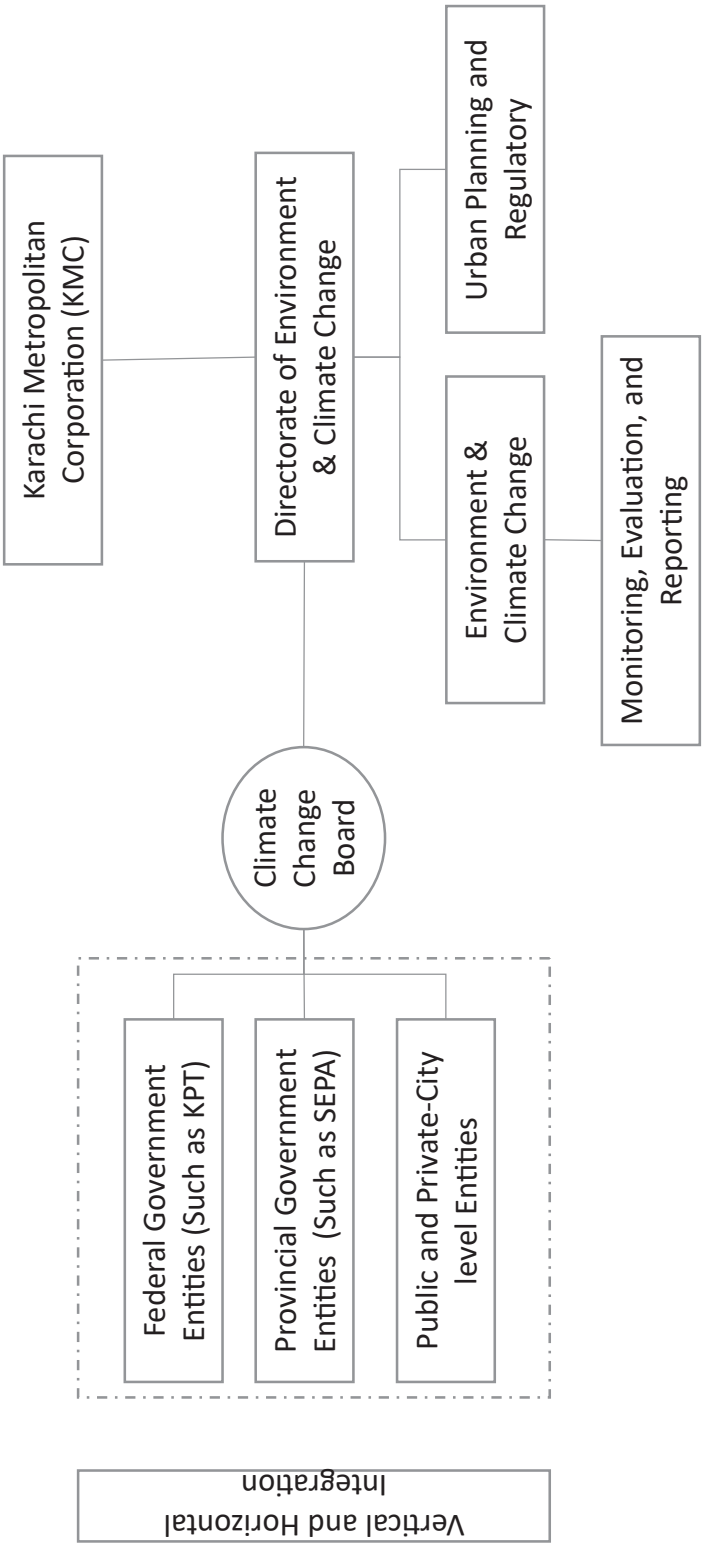
The Climate Change Board (CCB) under the Karachi Metropolitan Corporation (KMC), established within the framework of the Sindh Local Government Act (SLGA) 2013, represents a pivotal initiative for coordinating city-wide climate action. Chaired by the Mayor or Municipal Commissioner, the CCB will bring together a diverse array of stakeholders from municipal departments, provincial and federal bodies, academia, industry, and the private sector.

This collaborative structure aims to provide strategic direction, facilitate decision-making, and ensure cohesive implementation of the Karachi Climate Action Plan (K-CAP). With a mandate to foster both vertical and horizontal integration of climate initiatives, the CCB will oversee policy alignment, project evaluation, and resource allocation, fostering synergy among stakeholders for effective climate resilience and sustainable urban development.

Operating through structured decision-making processes and regular meetings, the CCB will serve as the central advisory body, guiding the city towards its climate goals. By integrating diverse perspectives and expertise, the board will ensure that K-CAP initiatives align with broader sustainability objectives while addressing local climate challenges comprehensively.

Figure 35

INSTITUTIONAL HIERARCHY FOR K-CAP IMPLEMENTATION



5.4: Proposal for Climate Budgeting within K-CAP

The budget framework outlined for the Directorate of Environment and Climate Change (DoECC) under the Karachi Metropolitan Corporation (KMC) presents a strategic approach to funding and sustaining the Karachi Climate Action Plan (KCAP). For its inaugural year, the budget includes initial setup costs, annual salaries, operational expenses, project implementations, research and development, and a dedicated Monitoring, Evaluation, and Reporting (MER) Cell to ensure that the DoECC is equipped to initiate and manage comprehensive climate action initiatives effectively. In subsequent years, the budget focuses on sustaining operational and project costs, leveraging ongoing projects' revenues and additional funding sources such as grants, public-private partnerships, and international climate funds.

Financial Framework

To secure these funds, a dedicated budget head for climate action within the KMC budget is proposed, mirroring successful models adopted by other government departments. This allocation, approximately 0.1% of the KMC budget, ensures transparency and accountability in climate-related expenditures.

Securing Additional Resources:

Beyond internal allocations, the strategy recommends leveraging grants from the Sindh government and federal sources dedicated to climate change. International climate funds offer avenues for additional support, while public-private partnerships can inject private investment into critical climate resilience projects.

Revenue Streams and Sustainability:

Utilizing revenue streams outlined in the Sindh Local Government Act 2013, including conservancy and drainage taxes, enhances financial sustainability for ongoing climate initiatives. Moreover, exploring opportunities in the global carbon market through carbon credit projects provides an innovative funding mechanism for sustainable urban development.

By integrating these strategies, Karachi is poised to strengthen its resilience against climate challenges while fostering a greener, more livable city for its residents.

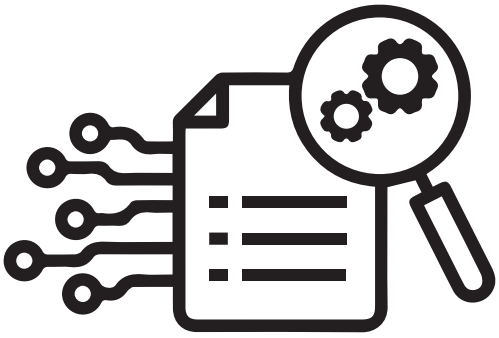
Chapter 06

Monitoring Evaluation and Reporting (MER) System

Monitoring Evaluation & Reporting (MER) System

The objective of the Karachi Climate Action Plan Monitoring Evaluation and Reporting (MER) system is to establish a transparent and adaptive framework to track and assess progress toward the ambitious goals set by the Paris Agreement. This system aims to enhance accountability, facilitate continuous improvement, and identify effective strategies or areas needing adjustments through stakeholder engagement. Additionally, the system aims to strengthen the city's eligibility for climate funding and support global best practices in climate action planning and monitoring.

The development of the MER system is influenced by the C40 City Climate Action Planning (CAP) Monitoring, Evaluation, and Reporting Guidance. This guidance provides frameworks and methodologies to design an effective MER system for Karachi's climate action plan. The approach ensures alignment with global best practices, promoting transparency, accountability, and continuous improvement.



MER Department atct as an integral part of DoECC within Karachi's Climate Governance framework. This department is responsible for developing baseline standards, coordinating data collection, and producing regular reports on climate action progress. It ensures effective coordination with relevant departments and fosters a culture of learning and adaptation by staying updated on best practices and feedback.

6.1: Monitoring

The MER department is responsible for gathering data from primary sources and stakeholders, both internal and external, analyzing and validating this data, and producing regular reports on K-CAP's progress. These reports will be crucial for making informed decisions and refining strategies within the Climate Governance framework, and these reports will also be made available to the public on the Karachi Metropolitan Corporation (KMC) website.

Additionally, the MER Department will evaluate these reports to measure the effectiveness of K-CAP and identify areas for improvement by discussing the results Climate Change Board (CCB) which will guide strategic decisions and necessary policy adjustments within the Directorate of Environment and Climate Change Board. The MER department's core mission is to continuously improve. It will promote a culture of learning and adaptation by staying updated on best practices, incorporating feedback, and applying lessons learned to strengthen the K-CAP.

Organizational Structure of MER Department

The MER Department plays a critical role within the city's climate governance framework, dedicated to overseeing and assessing climate action initiatives. Its organizational structure is designed to ensure effective leadership, expert analysis, and thorough coordination across the city's diverse areas.

Deputy Director MER

The Deputy Director MER Department provides overall leadership and strategic direction. This role ensures that the department's activities align with the city's climate goals and oversees the implementation of monitoring, evaluation, and reporting processes. The deputy director is crucial for maintaining focus on achieving climate-related targets and objectives.

Assistant Head

The Assistant Head assists the Deputy Director in managing day-to-day operations. This role ensures effective team collaboration and workflow, facilitating the department's ability to meet its goals and maintain operational efficiency.

Climate & Environmental Analyst

The Climate and Environmental Analyst focuses on assessing and evaluating climate-related data, ensuring its accuracy and reliability. This role provides scientific insights and recommendations that are essential for making informed decisions and refining strategies.

GIS Specialist

The GIS Specialist manages the Geographic Information Systems (GIS) within the department, facilitating spatial analysis and the visualization of climate data. This role supports detailed reporting and mapping efforts, helping to understand and manage the spatial aspects of climate actions.

Reporting and Communication Officers

The Reporting and Communication Officers will be responsible for compiling and disseminating progress reports on climate action initiatives. This role manages communication strategies to ensure transparency and public reporting, keeping stakeholders and the public informed about progress and outcomes.

Stakeholder Engagement Officer

The Stakeholder Engagement Officer focuses on fostering partnerships and community involvement. This role manages relationships with stakeholders, facilitates collaboration, and collects feedback, ensuring that climate initiatives are inclusive and effectively address community needs.

Senior MER Officer

Each Senior MER Officer will be responsible for overseeing climate monitoring and evaluation activities in each of Karachi's 25 towns. This role involves coordinating local efforts, ensuring that climate action initiatives are effectively implemented, and providing detailed reports on progress and
challenges specific to each town.

MER Officer

The MER Officers are assigned to oversee each of the 256 Union Councils (UCs) in Karachi. These officers conduct on-the-ground assessments of climate-related activities within their assigned UCs, collect data, and provide valuable insights for monitoring and evaluation processes.

Technical Advisors and Subject Matter Experts

Technical Advisors and Subject Matter Experts provide specialized expertise in areas such as renewable energy, waste management, water resources, and urban planning. They advise on best practices and innovative solutions for climate action and support the development and implementation of the technical aspects of the MER system.

Together, these roles form a comprehensive team dedicated to enhancing the effectiveness of climate action through rigorous monitoring, evaluation, and reporting. The structure ensures that the MER Department can efficiently track progress, improve strategies, and contribute to the city's climate goals across all levels.

Monitoring of KPIs for Sectoral Themes

The five sectoral themes identified in Climate Change Risk Assessment (CCRA) (discussed in Chapter 3) were translated into adaptation and mitigation actions, goals, and strategies (discussed in Chapter 04). These actions, goals, and strategies were aimed to address the specific risks and challenges associated with each sector, ensuring a comprehensive approach to climate resilience and sustainability. Detailed monitoring indicators are specified in the MER Indicator Matrix to track progress and measure the effectiveness of these goals against the identified goals and projects through Key Performance Indicators (KPIs) for the identified sectoral themes. (Annex -C)

Updating Monitoring KPIs

The Climate Change Board (CCB) will reassess and update the Climate Change Risk Assessment (CCRA) every two years based on the updated Greenhouse Gas (GHG) inventory. The MER Department, utilizing its maintained database, will present recommendations and proposed changes to the CCRA; stakeholder feedback will be collected and incorporated into these recommendations. Once approved by the CCB, the updated CCRA will be issued to the Directorate of Environment & Climate Change (DoECC) and the MER Department for updating of Adaptation and Mitigation goals and KPIs, accordingly, which will then be referred for monitoring for the next two years.

Data Management

During the development of the Karachi Climate Action Plan (KCAP), it was identified that while information across various sectors was available, a lack of coordination often led to outdated or missing data. To address this gap, a dedicated information platform will be established.

The primary goal of this information platform is to centralize and streamline data management, providing stakeholders with up-to-date information relevant to their needs. This platform will offer real-time updates on Key Performance Indicators (KPIs) and facilitate efficient data access and dissemination.
Key features of the platform will include:

Real-Time KPI Tracking:

Regularly updated progress on KPIs to ensure stakeholders have access to the most current data

Centralized Information Access:

A unified platform for all stakeholders to access relevant information, improving coordination and reducing data discrepancies

Public Access:

Integration with the Karachi Metropolitan Corporation website, allowing citizens to view progress dashboards and stay informed about climate action initiatives

By implementing this information platform, data dissemination will be significantly improved, making it easier for both stakeholders and the public to access and understand climate action progress

Initial Data Collection Strategy

Initially the MER department will gather information regarding progress and their impact on Karachi's climate for the ongoing projects that are in their implementation phase; as integral members of the Climate Change Board (CCB), responsible departments and agencies will be mandated to provide detailed updates of their respective projects. This collaborative approach will ensure transparency and accountability in data collection efforts. Any challenges arise in obtaining requisite data, the MER department will consult CCB, which will leverage its authority for both vertical integration within departments and horizontal coordination across different sectors of Karachi city. This strategic oversight will streamline information flow and address any obstructions promptly, thereby facilitating the accurate and timely gathering of data.

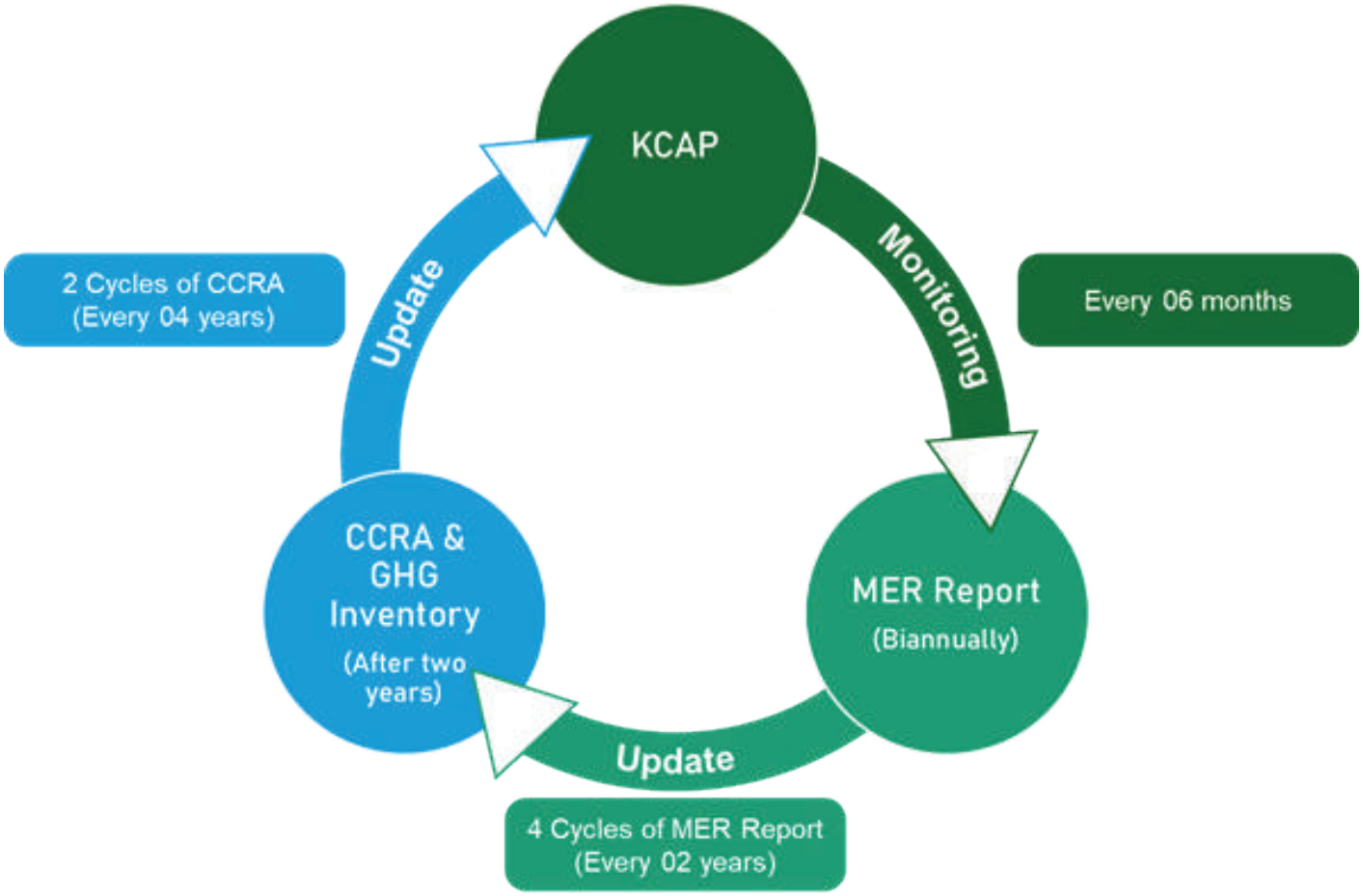
C40 MER Indicator Matrix

The indicator matrix provided by the C40 framework offers intervention logic for commonly used adaptation and mitigation actions across various sectors such as buildings, energy, industry, transport, urban planning, waste, air quality, and cross-sector initiatives. For each category, the matrix outlines urban-specific actions along with their corresponding outputs, outcomes, and predicted impacts. This comprehensive approach enables the MER Department to tailor their adaptation strategies effectively, ensuring alignment with local needs and challenges. Overall, by leveraging the KCAP MER Matrix tool in (Annex-C) and its structured framework, the MER Department can facilitate evidence-based decision-making, foster accountability, and support the scaling up of successful adaptation and mitigation efforts.

6.2: Evaluation

The progress of KCAP targets will be evaluated against the identified KPIs, with progress monitored according to the project timeline. This evaluation process will be conducted biannually to assess the projects' advancement towards their targets. Twice a year, the MER indicator matrix will be monitored and evaluated to ensure all aspects of the projects are aligned with the established goals and timelines.

In addition to measuring progress, the evaluation process will also identify any challenges or obstacles encountered. These issues will be communicated to the Directorate of Environment & Climate Change (DoECC), which will take the necessary measures to resolve them. This continuous feedback loop will help maintain momentum, address problems promptly, and ensure that the project remains on track.



6.3: Reporting

The MER Department will be responsible for monitoring the Karachi Climate Action Plan (KCAP) and maintaining the city's Greenhouse Gas (GHG) inventory. The City will monitor the residual emissions by updating GHG modeling in the updates to the plan that will take place every four years. This inventory will assist in updating the Climate Change Risk Assessment (CCRA) every two years; additionally, the department will prepare an updated KCAP every four years. MER Department will prepare the KCAP progress report, one an internal report for the internal stakeholders, which will include the Mayor, DoECC, CCB, and its members, and another an external report for general citizens of Karachi. Both the MER report, internal and external, will be generated biannually, once every six months, evaluating the progress divided into four parts;

KPIs Monitoring:

This section covers the monitoring of the Key Performance Indicators identified for adaptation and mitigation goals, as outlined in heading 6.2.

Actions Monitoring:

This section includes the monitoring of the indicators listed for each adaptation and mitigation action identified under the sectoral themes.

Targets Monitoring:

This section focuses on monitoring projects executed by external stakeholders, as identified in Deliverable E. It evaluates these projects against their committed targets and their impact on the city's environment.

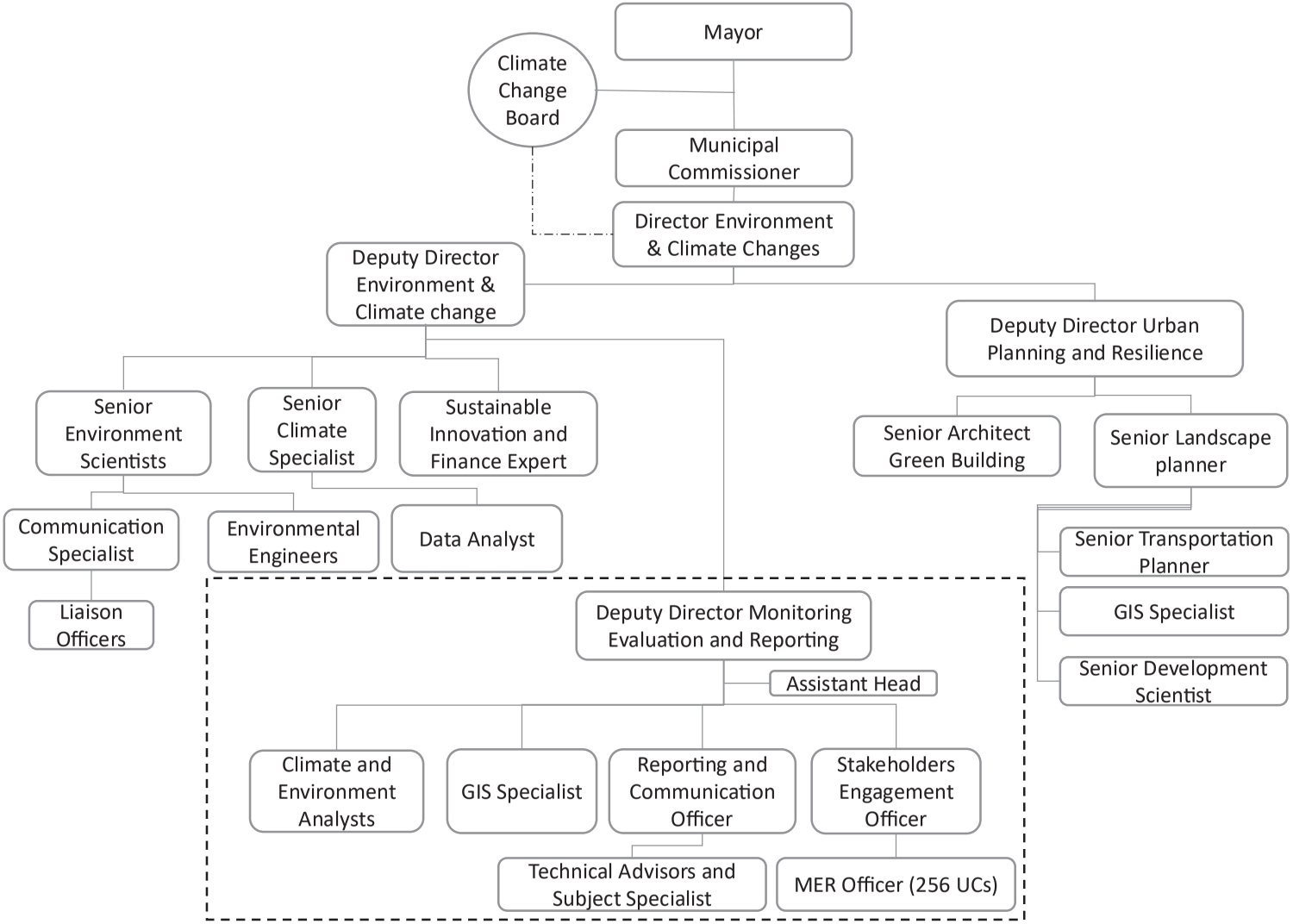


Figure 36: Organizational Structure of MER Department in climate governance

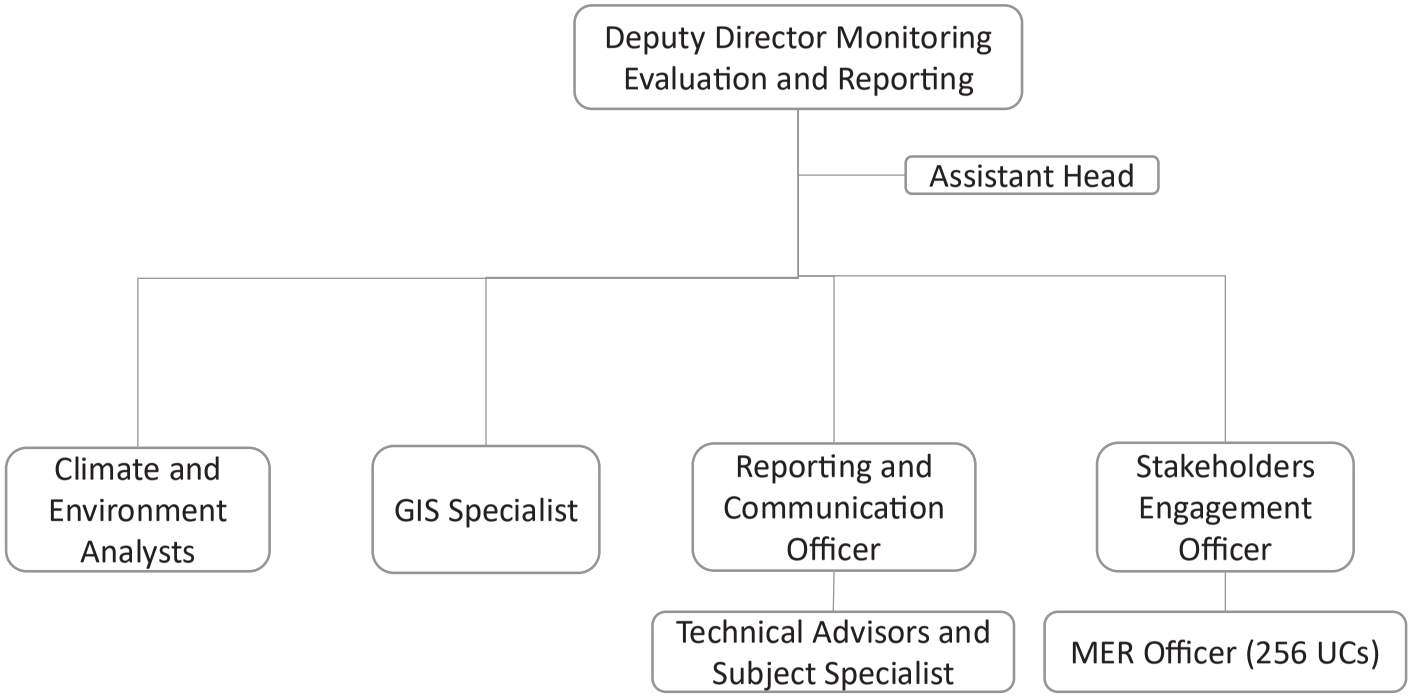


Figure 37: Organizational Structure of MER Department

Challenges and Opportunities:

This section provides an analytical overview of reasons for any underperformance or challenges in meeting targets or closing data gaps related to climate. It also highlights best practices and local initiatives identified by the MER department's field team that have the potential to be scaled up to the city or district level.

The internal report will enable the Directorate of Environment and Climate Change (DoECC) to present a comprehensive analysis to the Climate Change Board (CCB). The CCB will then discuss the report in detail with relevant stakeholders identified in the Climate Governance Framework.

While the external report will comprise only the progress on the monitoring of actions and targets along with the summary of minutes of the CCB discussion, including the strategies and actions that will be taken by the DoECC in the next six months, before the next MER report. The external report will be made publicly available on the KMC website, and social media platforms, such as Facebook, the external report will be accompanied by an online feedback mechanism in the form of comments and detailed forms. This measure will ensure that the citizens of Karachi are kept informed and involved throughout the implementation of KCAP and also provide a publicly accessible document for reference to the progress of KCAP, keeping all stakeholders informed and engaged.

6.4: Way forward for MER Department

In conclusion, the establishment of the Department of Monitoring, Evaluation, and Reporting (MER) under the KCAP Climate Governance framework represents a significant step forward in ensuring the success of the KCAP. The department's emphasis on data management, real-time KPI tracking, and effective communication with stakeholders will not only facilitate evidence-based decision-making but also foster a culture of learning and adaptation. This approach will enable the KMC to address the multifaceted challenges of climate change while staying committed to the goals of resilience and sustainability.

As the MER Department takes on the responsibility of gathering, analyzing, and reporting on climate data, it serves as a crucial link between the Directorate of Environment & Climate Change (DoECC), the Climate Change Board (CCB), and the public. The department's regular evaluations and reports will provide valuable insights into the progress of KCAP, allowing for timely adjustments and strategic refinements. The MER Department's work will be instrumental in driving Karachi toward a more sustainable and climate-resilient future, ensuring that the city's climate actions are both impactful and enduring.

Chapter 07

Post Climate Action Plan Launch

Post Climate Action Plan Launch

The successful launch of K-CAP marks the beginning of a transformative journey for Karachi, setting the stage for sustainable urban development and climate resilience. Central to this launch is a strategic blend of institutional reforms, stakeholder engagement, and continuous communication efforts. The K-CAP Launch Event will be a one-go event where all stakeholders will be invited under the leadership of Mayor Karachi.

A comprehensive multimedia campaign will be rolled out to introduce K-CAP's vision, targets, and benefits to the public, utilizing TV, radio, print, and digital platforms to ensure broad reach. The campaign will focus on the benefits of K-CAP, such as improved air quality, reduced flooding, and job creation through green initiatives, highlighting how the plan will positively impact the community and the environment.

The launch of the KCAP is the starting point for a long-term communications campaign about the city's climate action, which must be continued throughout

K-CAP

implementation. The Karachi city must monitor success in reaching key audiences and the CAP's impact, making adjustments as needed.

7.1 Establishment of Necessary Departments for KCAP Implementation

Under the Sindh Local Government Act (SLGA), 2013, the Directorate of Environment and Climate Change (DoECC) and the Climate Change Board (CCB) will be established. These bodies will consolidate governance and oversight of environmental and climate-related matters within the Karachi Metropolitan Corporation (KMC), ensuring effective implementation and sustainability of K-CAP.

7.2 Suggested Amendments in the SLGA, 2013

To enhance climate governance, proposed amendments to the SLGA, 2013, will empower KMC by reinstating the climate mandate as a local government subject. This will provide the DoECC and CCB with enhanced authority, resources, and mandates to effectively address emerging environmental challenges and climate impacts.

7.3 Establishing Monitoring Cell

Monitoring teams will be established at the Union Council level for decentralized environmental oversight, alongside a centralized monitoring cell for data collection and analysis. These cells will facilitate real-time data collection, analysis, and reporting on MER parameters, enabling prompt interventions and localized initiatives aligned with broader environmental and climate policies at the city level.

7.4 Bi-annual Stakeholder Meetings Based on MER Report

The DoECC will convene bi-annual meetings with all relevant stakeholders, guided by the Monitoring and Evaluation Report (MER). These meetings will serve as platforms to review progress, address challenges, and strategize future actions in alignment with Karachi's Climate Action Plan and other environmental initiatives. The outcomes from these biannual meetings will be presented to the City Climate Board (CCB), ensuring transparency, accountability, and continued engagement with stakeholders. This process will help track the progress of key climate goals, integrate feedback from diverse sectors, and align the city's response to climate change with evolving needs. The MER matrix will also inform future decisions, ensuring that all government departments are held accountable for their climate actions and committed to meeting set targets.

7.5 Deliver Information Material and Conduct Outreach Activities

Information material will be created for the general public and specific priority audiences including hard-to-reach groups, translated into commonly spoken languages, and made accessible to visually impaired people. This material will highlight Karachi's climate action approach and actionable steps residents can take, drawing inspiration from successful campaigns like #LeedsByExample by Leeds City Council.

The awareness messages will be tailored for specific audiences, such as:

Youth:

It will be engaged through school programs, eco-clubs, and gamification of climate actions to foster a sense of responsibility and active participation in climate solutions. To improve educational outreach, educational institutions will be partnered to integrate K-CAP's themes into curricula, fostering climate awareness from an early age.

Businesses:

Public-private partnerships and incentives (market-based instruments) will provide opportunities for green investments and sustainable practices, emphasizing the economic and environmental benefits of transitioning to a green economy.

Hard-to-Reach Communities:

Community leaders, local CBOs, and NGOs/civil societies will be engaged to connect with the hard-to-reach group and to ensure inclusivity, providing these communities with accessible information and encouraging their active involvement in climate actions.

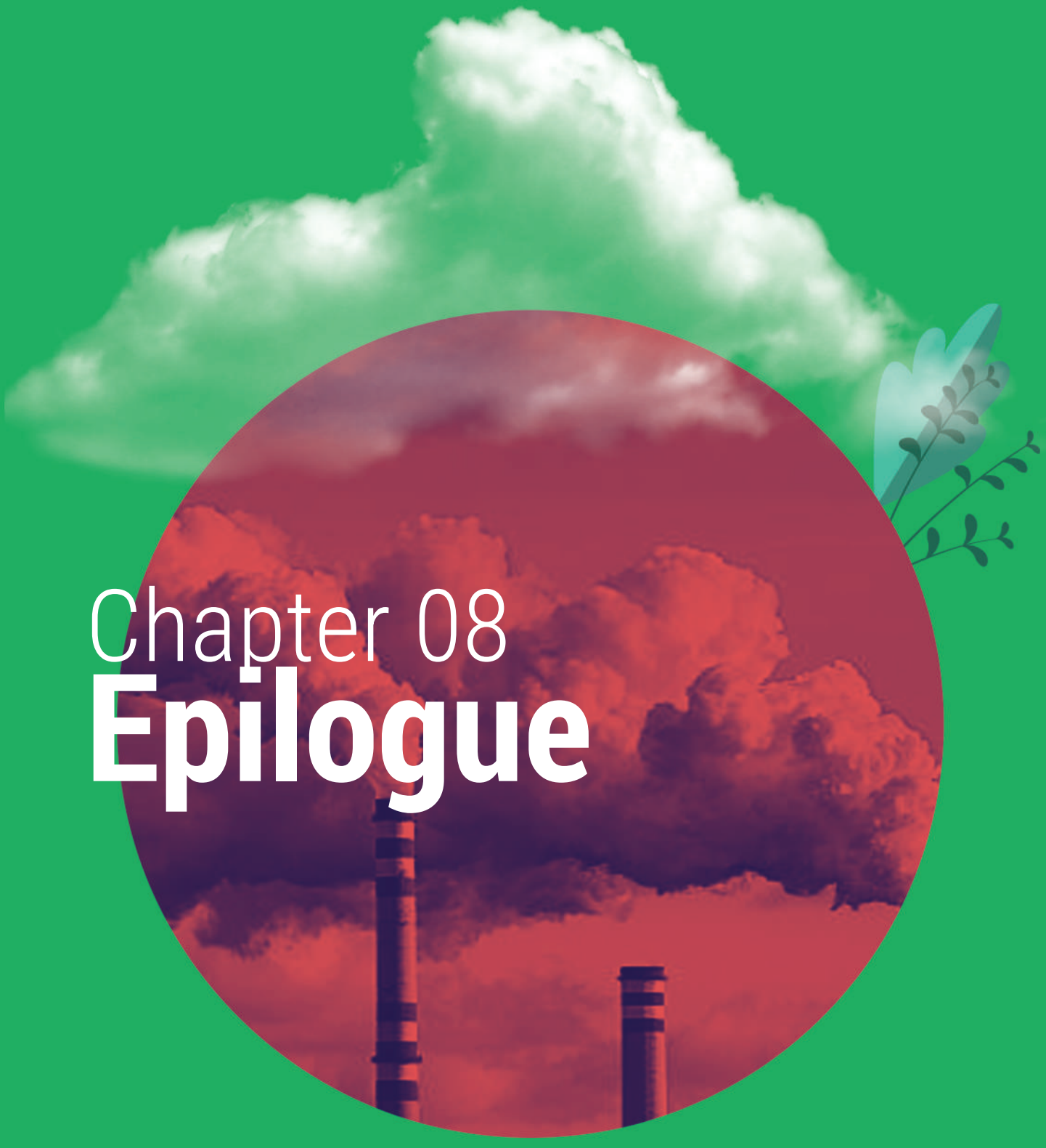
Success stories of stakeholder participation from similar C40 cities will be highlighted to inspire action and demonstrate the impact of collaborative efforts in climate initiatives.

7.6 Prepare for Queries and Concerns

The KMC will anticipate likely queries and concerns, establishing a dedicated channel or contact person to handle these queries. Relevant teams and individuals will be equipped with the necessary information to respond appropriately, ensuring a clear route to the DoECC for support if challenges arise.

7.7 Continued Engagement Post-Launch

After the launch of the Karachi Climate Action Plan (K-CAP), continuous stakeholder engagement will be pivotal for its success. Government departments will be involved in regular follow-ups to ensure effective implementation, monitor progress, and address any challenges in real time. Non-governmental actors and community groups will play a critical role in activities such as awareness campaigns, local tree planting, and waste management initiatives, fostering collaboration on the ground. The private sector will be engaged, especially in projects that require public-private partnerships (PPP), to support sustainable solutions and innovation. Regular feedback loops will be established to ensure all stakeholders are involved in decision-making, ensuring K-CAP's long-term effectiveness.



Chapter 08
Epilogue

Epilogue

The Karachi Climate Action Plan stands as a monumental step towards securing a sustainable, climate-resilient future for the city. This plan, grounded in global best practices and aligned with the Paris Agreement, reflects Karachi's unwavering commitment to addressing the pressing challenges posed by climate change. Through a carefully structured planning process, K-CAP charts a course for emission reductions, adaptation strategies, and robust governance that will guide Karachi toward becoming a low-carbon, resilient urban hub.

The establishment of the Directorate of Environment and Climate Change (DoECC) and the Climate Change Board (CCB) provides the institutional foundation needed for effective implementation, ensuring climate action remains central to Karachi's development agenda. The detailed greenhouse gas emissions inventory, climate change risk assessment, and targeted mitigation and adaptation goals set a clear path for transforming the city's vulnerabilities into strengths.

K-CAP's vision extends beyond immediate climate action, aiming for a future where Karachi thrives sustainably, with improved infrastructure, better air quality, and a resilient population. The plan prioritizes the well-being of the city's communities, particularly vulnerable groups, ensuring that climate action leads to enhanced public spaces, improved health outcomes, and greater social equity. Access to better air quality, green spaces, and climate-resilient infrastructure will provide long-term benefits to all residents, fostering a healthier and more inclusive environment.

This plan, underpinned by strong political will, inclusive stakeholder engagement, and continuous monitoring, paves the way for future generations to live in a healthier, more equitable city. By embracing the K-CAP, Karachi not only commits to its own transformation but also sets a powerful example for other cities of Pakistan to follow, demonstrating that bold climate action is both necessary and achievable.

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