



Karachi Climate  
Action Plan  
**Annexures**



**Climate Action  
Planning**



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



# Annexures

## Karachi Climate Action Plan

## Annex – A

### Activity Data Sources for GHG Emissions Inventory of Karachi City 2022

#	Activities	Data description	Source	Name of Source
1	City Information	Population	National Bureau of Statistics	Statistical Yearbook
2	City information	Name and Area of City	National Bureau of Statistics	Statistical Yearbook
3	Fuel Combustion Activities	Natural Gas, Kerosene, HSD, furnace Oil usage data, by GPC sub-sectors	Bureau of Statistics Sindh & HDIP	Directly reported in Sindh Development Statistics Report & Pakistan Energy Yearbook 2021-22
4	Fuel Combustion Activities	LPG usage data, by GPC sub-sector	Hydrocarbon Development Institute of Pakistan	Published in Annual Reports "Pakistan Energy Yearbook". The report needs to be acquired.
5.	Fuel Combustion Activities	Crude Oil use by GPC sub-sectors	Hydrocarbon Development Institute of Pakistan	Published in Annual Reports "Pakistan Energy Yearbook". The report needs to be acquired.
6.	Electricity Generation	Use of Coal, Gas, and RFO for Electricity generation	National Electric Power Regulatory Authority	Published in State of Industry Report 2023 and NTDC Power System Statistics 47th Edition,
7.	Electricity Consumption	Electricity used from grid	National Electric Power Regulatory Authority	Published in State of Industry Report 2023 and NTDC Power System Statistics 47th Edition,
8.	Fuel use in On Road Transport	Fuel Sales Data for On Road Transport	Oil Companies Advisory Council	Pakistan Oil Report 2021-22
9.	Fuel Use in Railways	Fuel Use Data for Railways	Oil Companies Advisory Council and Transport Department	Contact Data Providers
10	Solid Waste	Solaid Waste Disposal and Open Burning	Sindh Solid Waste Management Board	Published Tender Documents
11	Waste Water	Wastewater Treatment and Discharge.	Urban Resource Centre	Karachi Master Plan
12	Informal Economy	Diesel Oil Combustion	Reuters	<a href="https://www.reuters.com/world/more-iranian-fuel-being-smuggled-pakistan-petroleum-dealers-say-2023-05-09/">https://www.reuters.com/world/more-iranian-fuel-being-smuggled-pakistan-petroleum-dealers-say-2023-05-09/</a>

## Annex – B

# Proposed Key Projects

Project # 01: Solar Park and Green Space – Gutter Baghicha (SP-GB-001)

Project # 02: Sewerage Treatment - Gutter Baghicha (ST-GB-001)

Project # 03: Sewerage Treatment - Imtiyaz – Qayyumabad (ST-IQ-002)

Project # 04: Wetlands at Lyari River (WL-LR-001)

Project # 05: Ibrahim Hyderi Bio-Digester Project (SWM-CC-002)

Project # 06: Katchi Abadi Upgradation: Nusrat Bhutto Colony (KA-001)

Each project proposal highlights the potential impact of these projects on mitigating risks such as urban flooding, coastal storms, urban heat, drought, and air pollution, further advancing Karachi's efforts toward sustainability and climate resilience.

## Project # 01: Solar Park and Green Space – Gutter Baghicha (SP-GB-001)

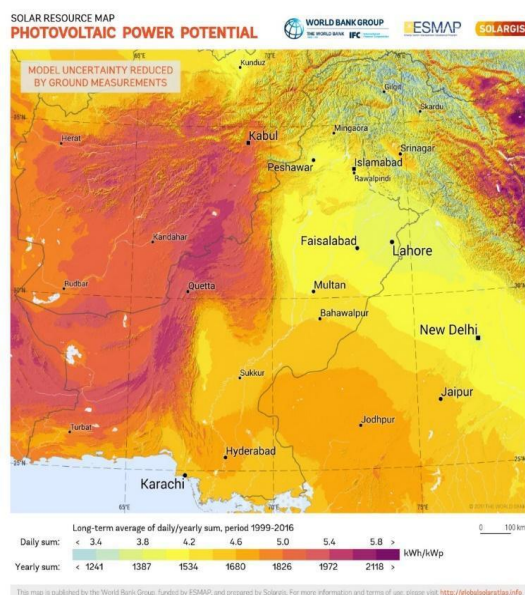
### Introduction:

Renewable energy includes energy generation from solar, wind, biomass and hydro etc. As Karachi has potential for solar energy. So, solar park at Gutter Baghicha is a viable option. Pakistan possesses considerable potential for solar energy generation, although this potential varies significantly across different regions of the country. Solar power production, on average, ranges from approximately 1,250 to 1,850 kWh/kWp annually, with a plant capacity factor falling between 16 and 22 percent for solar installations with fixed inclination<sup>1</sup>.

### Solar Energy Potential:

According to the data available at Global Solar Atlas, the annual specific yield of the Karachi is about 1677.8 kWh/kWp with a daily specific yield of 4.597 kWh/kWp. This specific yield of site (24.902310197985845, 67.01133908415987) is very good and indicates that it is feasible place for solar system installation. The specific yield map of Pakistan is shown in the adjacent figure.

These Specific yield values measured in kWh/kWp, are utilized to evaluate performance of solar systems of different sizes. It describes how much energy (in kWh) is generated for every kWp of installed module capacity during a typical timeframe.



<sup>1</sup> Variable Renewable Energy Locational Study World Bank report

Furthermore, detailed solar radiation data such as direct normal, global and diffused horizontal irradiation, and air temperature of the selected site is presented in the table 1 below.<sup>2</sup>

Table: Solar Potential Details (Per Year) – Karachi

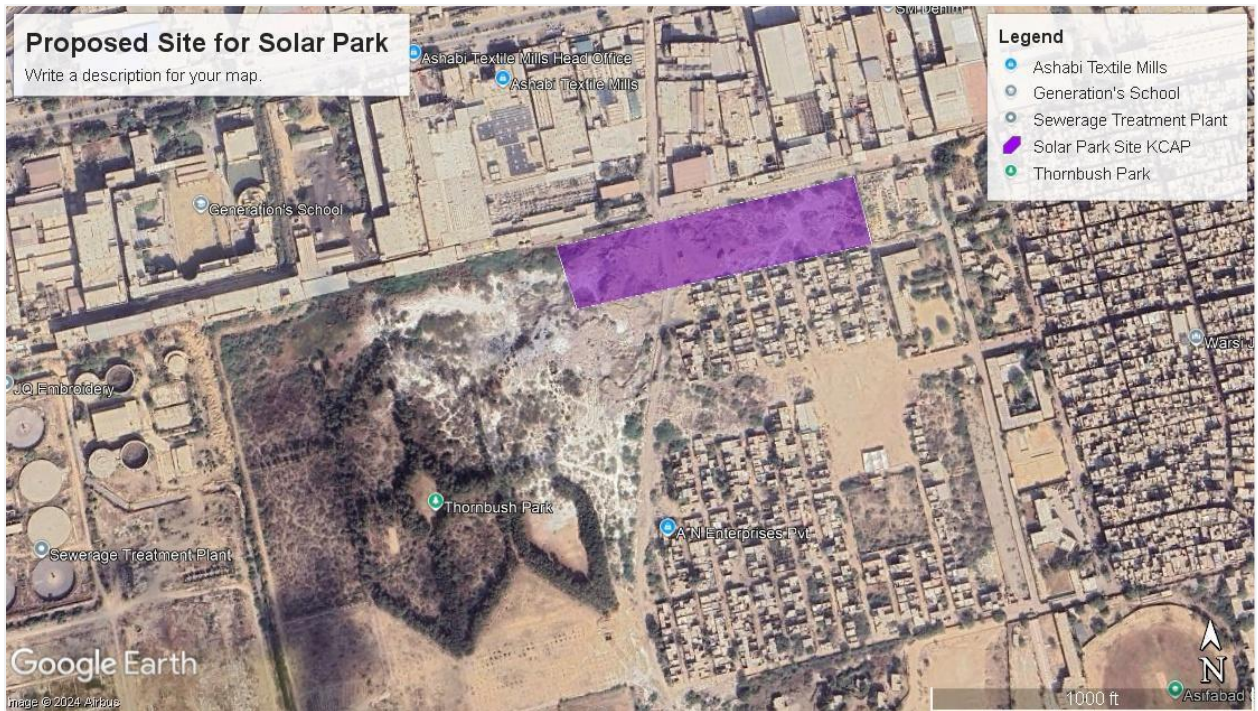
Solar Potential Data (per year)	Value	Unit
Specific Photovoltaic Power Output (PVOUT Specific)	1677.8	kWh/kWp
Direct Normal Irradiation (DNI)	1561	kWh/m <sup>2</sup>
Global horizontal Irradiation (GHI)	1955.1	kWh/m <sup>2</sup>
Diffuse Horizontal Irradiation (DIF)	907.5	kWh/m <sup>2</sup>
Global Tilted Irradiation at Optimum angle (GTI <sub>opta</sub> )	2146.5	kWh/m <sup>2</sup>
Optimum tilt of PV modules (OPTA)	28/180	°
Air Temperature (TEMP)	26	°C
Terrain elevation (ELE)	N/A	m

### Solar Park Estimation:

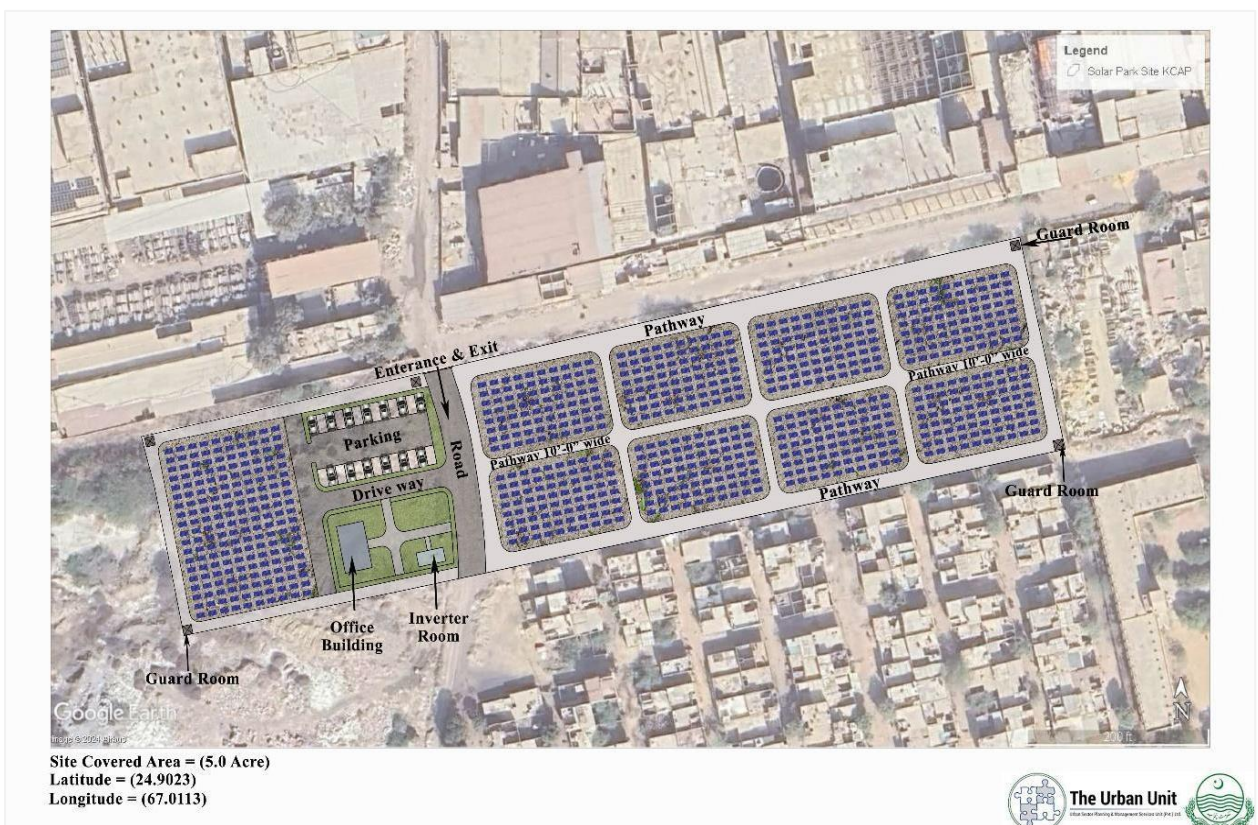
The design and configuration of solar power plants vary from region to region and specific project to project, making it difficult to provide an exact figure for solar system installation on a 5-acre site without detailed planning. However, a rough estimate suggests that a 1 MW solar power plant typically requires up to 5 acres of land. Several factors can influence this estimate. The efficiency of the solar panels plays a role, as higher-efficiency panels generate more electricity in a smaller space, reducing the required land. Light conditions also impact the space needed, with lower sunlight areas potentially requiring more land to achieve the same energy generation. Additionally, the type of mounting system, such as fixed tilt or tracking systems, affects land requirements. Finally, the topography and available space on the site influence the overall installation area. Therefore, a detailed engineering and design analysis is essential when planning a solar power plant. Solar engineers and design teams can provide precise area estimates and recommendations based on specific site conditions and project goals.

The total area available for the development of a solar park at this site is estimated to be around 5 acres which is equivalent to approximately 217,800 square feet, which can be seen in figure no 2 which is Google satellite imagery. The potential site available for solar system installation is approximately 125,256 square feet and the remaining area will be used for inverter room, office building, and roads for the cleaning of the solar panels. The proposed layout of the solar system is illustrated in figure no 3. Based on the suitability of the site, it is anticipated that a solar system with a capacity of approximately 1.25 megawatts (MW) can be installed here. This strategic use of space in Gutter Baghicha not only optimizes land resources but also supports the integration of renewable energy into Karachi's existing infrastructure.

<sup>2</sup> [Global Solar Atlas](#)



Proposed Site for Solar Park



Proposed Layout for Solar System for Gutter Baghicha Park

**Load Estimation of Public Facilities in Gutter Baghicha:**

Gutter Baghicha includes various facilities such as a Solar Park, Green Community Space, Rainwater Harvesting Well, and an Urban Forest Park. The energy generated from the

proposed solar park can be utilized in the Green Community Space and Urban Forest Park, each of which comprises several units. The Green Community Space includes a cafeteria, toilet block, and fountain, along with street and garden lights to be installed along the main road and pathways.

Similarly, the Urban Forest Park contains an information center, administrative office, lake, children's play area, cafeteria, toilet block, and rest house, all requiring electricity. Moreover, street and garden lights on the main road and pathways will account for a significant portion of the energy usage.

For general road and garden lighting, given that the road width is 20 feet, the poles can be 20 feet tall. <sup>3</sup> Based on the rule of thumb that the spacing between poles should be 2.5 to 3 times their height, the distance between poles is estimated to be 60 feet. <sup>4</sup> Based on the conceptual design the detailed information about the facilities in the Urban Forest Park and Green Community Space given in figure , including potential components, estimated load, annual energy consumption (kWh), and annual energy costs, is provided in the tables.

Table: Rough Load Estimation and Energy Consumption of Urban Forest Park

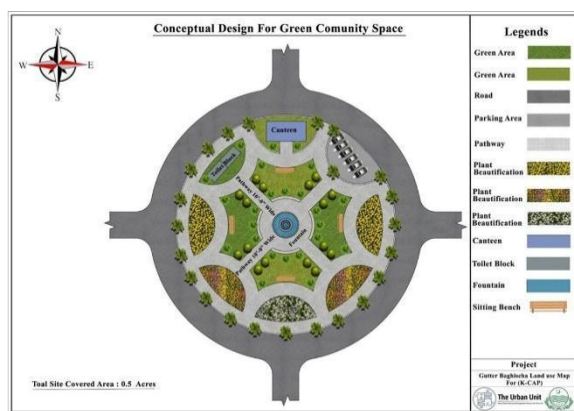
Park Facilities	Estimated Components	Estimated Load Watts	Energy Consumption per year (kWh)	Energy Bills per Year (@ 35 Rs/kWh)
Street lights for main road	19 Street lights on main road	5730	20,915	732,008
Garden light	81 Garden Lights	12150	31,043	1,086,514
Information center	15 lights, 10 fans, 3 (1.5 ton) inverter AC	7000	20,440	715,400
Admin Office	10 lights, 4 fans and 1 hp Water Pump	5000	12,000	420,000
Children Play Area	Auxiliary Load	5000	13,500	472,500
Cafeteria	30 lights, 10 fans, 3 (1.5 ton) inverter AC	7000	20,440	715,400
Toilet Block	10 lights, 4 fans and 1 hp Water Pump	1500	3,285	114,975
Rest House	25 lights, 10 fans, 3 (1.5 ton) inverter AC	7000	18,900	661,500
Lake	2 water pumps (1 hp each)	2000	1,080	37,800
<b>Total</b>		<b>52380</b>	<b>141,603</b>	<b>4,956,096</b>

<sup>3</sup> Solar street light pole height and distance calculation and Standard (luxmanlight.com)

<sup>4</sup> The Guide to Light Pole Spacing & Coverage - Lightmart.com

Table: Rough Load Estimation and Energy Consumption of Green Community Space

Components	Estimated components	Estimated Load	Energy Consumption per year (kWh)	Energy Bills per Year (@ 35 Rs/kWh)
Streetlights for the main road	9 Street lights on the main road	2500	9,125	319,375
Garden light	16 Garden Lights	4000	11,680	408,800
Cafeteria	30 lights, 10 fans, 2 1.5 ton inverter AC	5500	16,060	562,100
Toilet Block	10 lights, 4 fans and 1 hp Water Pump	1500	3,285	114,975
Fountain	3 water pumps (1 hp each)	2500	6,388	223,563
<b>Total</b>		<b>16000</b>	<b>46,538</b>	<b>1,628,813</b>



Conceptual design of Green Community Space

Conceptual design of Urban Forest Park

The table shows the energy demand and costs for two facilities. The Green Community Space has an estimated load of 16,000 kW, consuming 46,538 kWh annually with an electricity cost of Rs 1,628,813. The Urban Forest Park, with a larger load of 52,380 kW, consumes 141,603 kWh per year, costing Rs 4,956,096. In total, both facilities have a combined load of 68,380 kW, with annual energy consumption of 188,141 kWh, resulting in a total electricity cost of Rs 6,584,909.

Table: Total Energy Consumption and estimated Electricity Bill

Public Facility	Estimated Load	Energy Consumption per year (kWh)	Electricity Cost per Year (@ 35 Rs/kWh)
Green community Space	16,000	46,538	1,628,813
Urban Forest Park	52,380	141,603	4,956,096
<b>Total</b>	<b>68,380</b>	<b>188,141</b>	<b>6,584,909</b>

Table below shows that a 1.25256 MW solar system installed at Gutter Baghicha will generate 1,878,840 kWh annually. The park's facilities, requiring 188,141 kWh per year, will consume 10.01% of this energy, the cost of this energy used will be Rs 6,584,909 at 35 Rs/kWh. The remaining 89.99% of the generated energy will be supplied to the grid, indicating that most of

the solar power produced will exceed the park's needs and contribute to the surrounding electricity grid.

Table: Percentage of Energy Supplied to Grid and Gutter Baghicha

System size that can be installed (MW)	Units Generation Annually (kWh)	Energy Consumption per year in Gutter Baghicha (kWh)	Electricity Cost per Year (@ 35 Rs/kWh)	% of Energy Consumed by Park	% of Energy Supplied to grid
1.25256	1,878,840	188,141	6,584,909	10.01	89.99

### Technical Calculations:

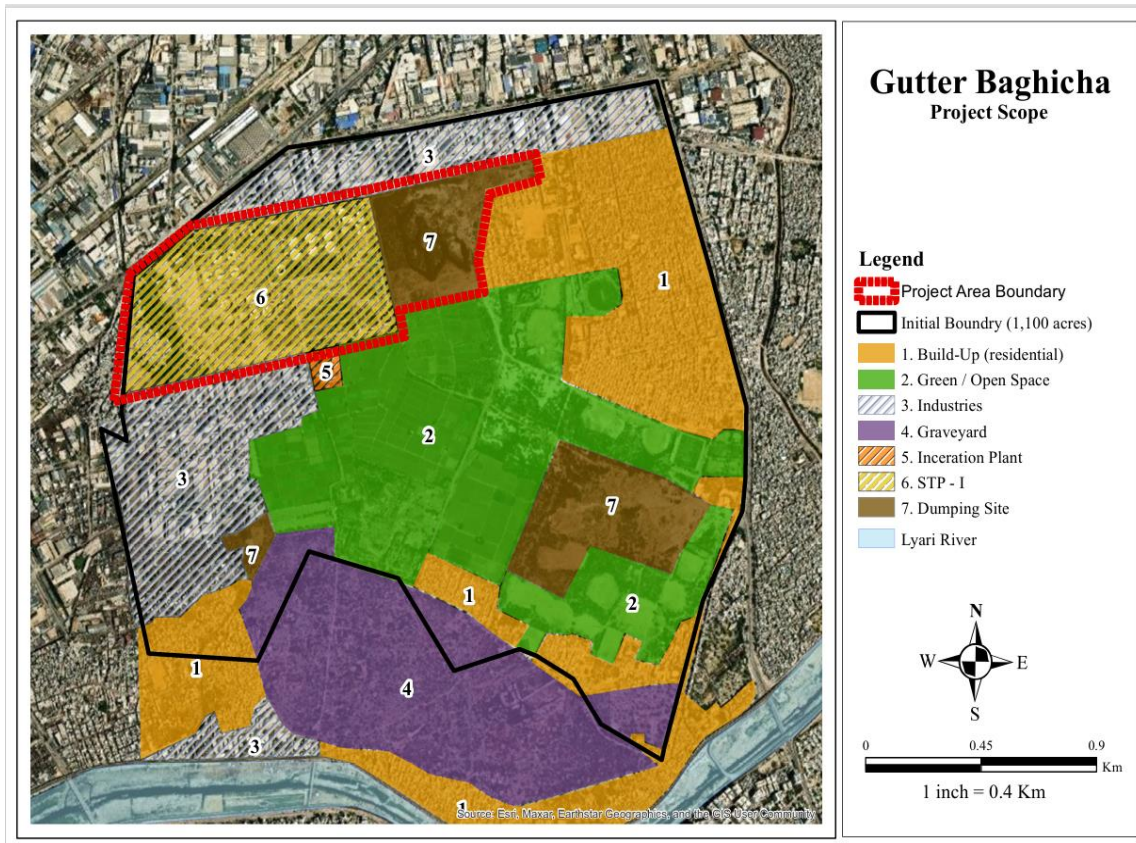
Estimated details for solar system installation are shown in the table no 2 along with pertinent information such as the estimated area that is currently available (in square feet), the estimated solar system size (in kilowatts), the yearly units generation (in kilowatt-hours), and the CO<sub>2</sub> savings (in kg per kilowatt-hour). These details are necessary in order to assess the viability and advantages of installing solar energy systems at the various locations.

For proposed area of 5 acres (217,800 sq ft), it is estimated that 2.88 acres (125,256 sq ft) can be used for installation of solar plates, remaining area will be allocated for office buildings, inverter room, and road for cleaning of solar system. The size of solar system (in kW) is being calculated by dividing the total available area by 100 sq ft, as per general rule of thumb 100 sq ft supports 100kW. Regarding annual units generation it is assumed that solar system will operate for 300 sunny days with an average sunshine of 5 hours per day. According to Center for Research on Energy and Clean Air (CREA) Study titled "CO<sub>2</sub> emissions from Pakistan's Energy Sector" the average CO<sub>2</sub> emission per unit of electricity produced in Pakistan is 816g/kwh. This average encompasses values of 992g/kWh for coal-based power generation, 495g/kWh for gas-based power generation, and 961g/kWh for oil-based power generation.<sup>5</sup>

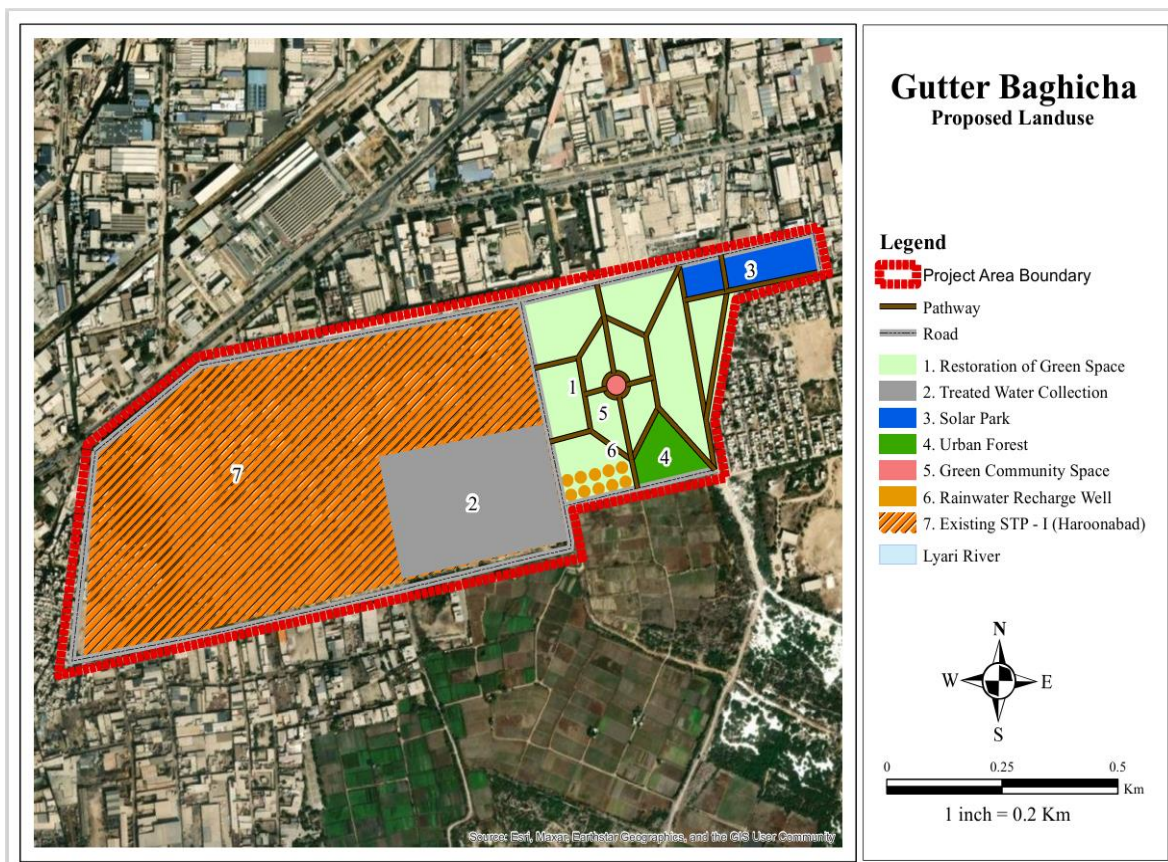
Table. Solar Park Estimated Size

Area (acres)	Area Available (ft <sup>2</sup> )	Estimated System size that can be installed (kW)	Units Generation Annually (kWh)	Co2 Savings kg/kWh	Rough Cost Million
2.88	125,256	1,252.56	1,878,840	1,533,133	

<sup>5</sup> CO<sub>2</sub> Emissions from Pakistan's Energy sector ([energyandcleanair.org](http://energyandcleanair.org))



Project Scope



Proposed Land use

## Project # 02: Sewerage Treatment - Gutter Baghicha (ST-GB-001)

### Project Description

This project aims to develop a sustainable wastewater treatment mechanism to treat industrial waste at STP-1, Haroonabad, Gutter Baghicha. The focus will be on using advanced treatment technologies to ensure the treated water meets environmental standards and can be safely discharged or reused.

### Project Objectives

The objectives of the project are as follows;

- Upgrade and revitalize the existing Sewerage Treatment Plant - I, Haroonabad, to enhance its capacity and efficiency.
- Implement advanced treatment technologies to improve the quality of treated water.
- Reduce the discharge of untreated industrial waste into the Lyari River.
- Incorporate eco-friendly and sustainable practices in the treatment process.
- Utilize renewable energy sources to power the upgraded plant, reducing its carbon footprint.
- Eliminate harmful contaminants from industrial wastewater to protect public health.
- Ensure treated water meets environmental standards and is safe for reuse, reducing reliance on freshwater sources.
- Support the Karachi City Administration Plan (KCAP) by improving urban infrastructure and environmental quality.
- Integrate the upgraded plant with existing urban planning initiatives for long-term community benefits.
- Engage local communities and stakeholders in the upgrade process to ensure transparency and foster support.
- Provide training and educational programs to raise awareness about the importance of sustainable wastewater management.
- Secure funding from diverse sources, including government allocations, international grants, and public-private partnerships.
- Explore opportunities for generating revenue through the sale of treated water for industrial and agricultural use.
- Establish robust monitoring and maintenance systems to ensure the plant's continuous and efficient operation.

### Link with KCAP

This project will be contributing to following KCAP mitigation and adaptation goals identified under deliverable E;

- **Adaptation Goal 3:** Sewage infrastructure is Improved & separated from storm water drainage infrastructure. It is improved and enhanced to cater for future floods.
- **Adaptation Goal 8:** Additional urban green space and shade provided in public parks by increasing park space, planting additional trees, and shade at bus-stops in heat risk areas of Karachi.

- **Adaptation Goal 4:** Solid waste management services is improved, not allowed to create blockages in sewage and storm water drainage channels.

## Project Location



*Sewerage Treatment Plant - I, Haroonabad*

## Project Scope

The project encompasses a comprehensive upgrade and expansion of the existing treatment facilities. Key components include:

- Conducting detailed environmental impact assessments to identify potential environmental and social impacts and develop mitigation strategies.
- Upgrading and expanding the treatment plant to enhance its capacity and efficiency.

- Installing advanced treatment technologies, such as biological treatment, chemical coagulation, and membrane filtration, to ensure high-quality effluent.
- Developing supporting infrastructure, including pipelines for effluent transport, storage facilities, and access roads.
- Implementing sustainable practices, such as the use of renewable energy sources like solar power, to minimize the plant's environmental footprint.
- Engaging local communities and stakeholders through awareness programs, training, and participation in the planning and implementation phases.

## Project Details

The Green Space and Solar Park at Gutter Bagicha will start with a detailed site assessment, including a land survey to understand the area's topography, soil quality, and existing vegetation, followed by an Environmental Impact Assessment (EIA) to evaluate and mitigate potential environmental effects.

Site preparation will involve clearing debris, old structures, and invasive plants. The green space will feature landscaped areas with native trees, shrubs, and flowers to boost biodiversity, alongside walking paths and trails for recreation. Additionally, playgrounds and recreational areas will be developed to provide enjoyable spaces for the community.

## Project Design

### Conceptual Design:

The Sewerage Treatment - Gutter Baghicha project is focused on upgrading and revitalizing Sewerage Treatment Plant - I (STP-1) located in Haroonabad, Gutter Baghicha, Karachi, with a primary objective of enhancing industrial wastewater treatment capabilities. The conceptual design phase will outline the scope of the project, emphasizing increased treatment capacity to meet growing demands and ensuring improved effluent quality suitable for safe discharge or reuse. This phase sets the foundation for subsequent detailed engineering and environmental designs.

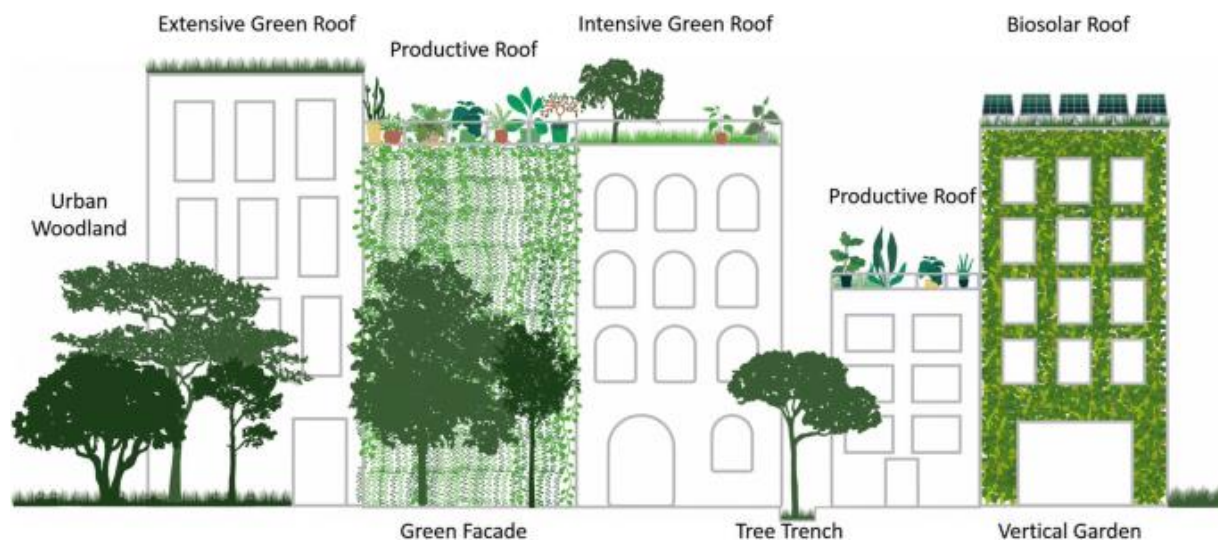
### Engineering Design:

Detailed engineering design will be crucial for the successful implementation of the project. It will include the development of comprehensive layouts and engineering drawings for all upgraded treatment facilities. This encompasses the design and specification of treatment units such as biological treatment processes, chemical coagulation systems, and membrane filtration units. Additionally, the design will cover the installation of essential infrastructure including pipelines for effluent transport, storage facilities, access roads, and supporting systems to ensure efficient operation and compliance with environmental standards.

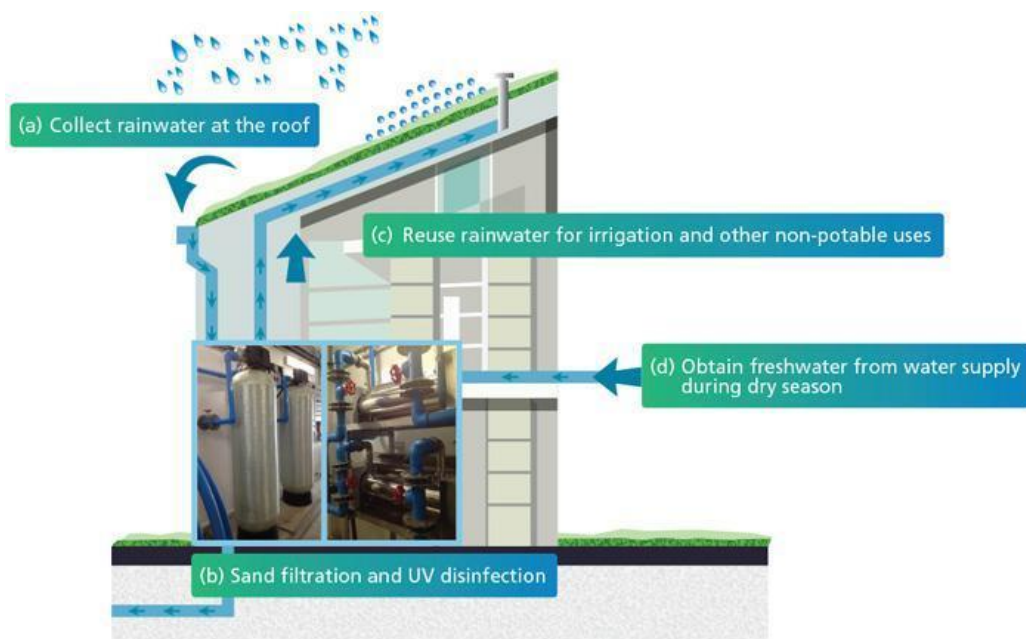
### Environmental Design:

Sustainable practices and environmental compliance will be integrated into the project design to minimize its ecological footprint and enhance environmental performance. This phase will focus on incorporating green infrastructure elements such as green roofs and rainwater harvesting systems to promote water conservation and reduce runoff. Moreover, the design will prioritize the use of renewable energy sources like solar panels to power operational needs, thereby reducing carbon emissions. Ensuring adherence to local environmental

regulations and standards will be paramount to mitigating potential environmental impacts and ensuring the project's sustainability.



Possible options for green roof infrastructure



Proposed rainwater harvesting design for sewerage treatment building structure.

### Safety and Security:

Safety and security considerations are integral to the project's design to safeguard both personnel and infrastructure. This phase will entail the implementation of stringent safety protocols and hazard mitigation strategies throughout the construction and operational phases. Measures will include the installation of safety features in design elements and the implementation of security systems to prevent unauthorized access and ensure the protection of critical infrastructure.

## Project Phases:

The project will be executed in several phases to ensure systematic implementation and operational readiness. The planning and design phase will initiate with feasibility studies and site assessments to validate technical, financial, and environmental viability. Following this, the construction phase will commence with ground preparation and civil works, followed by the installation of treatment units, pipelines, and associated infrastructure. The commissioning and testing phase will validate the operational efficiency and performance of the entire system, while the operation and maintenance phase will establish protocols for routine maintenance and continuous improvement to optimize treatment processes and sustain long-term operational efficiency.

## Project Budget\*

Budget Category	Subcategories	Allocation (PKR)
Preliminary Studies and Design	Feasibility Studies	27,000,000
	Site Assessments	27,000,000
	Engineering Design	54,000,000
	Environmental Impact Assessments	27,000,000
Construction and Installation	Ground Preparation	135,000,000
	Civil Works	540,000,000
	Treatment Units Installation	1,080,000,000
	Pipelines and Infrastructure	540,000,000
	Monitoring Systems	135,000,000
Equipment and Technology	Biological Treatment Systems	540,000,000
	Chemical Coagulation Units	270,000,000
	Membrane Filtration Systems	405,000,000
	Monitoring and Control Equipment	135,000,000
Training and Capacity Building	Staff Training Programs	81,000,000
	Capacity Building Initiatives	54,000,000
Contingency and Miscellaneous	Unforeseen Expenses	135,000,000
	Miscellaneous Costs	135,000,000
<b>Total Estimated Budget</b>		<b>4,590,000,000**</b>

\* Tentative budgeting

\*\*Tax of 23% will be added to the project cost.

## Project Feasibility

The feasibility of the Sewerage Treatment - Gutter Baghicha project has been thoroughly assessed across multiple dimensions to ensure its successful implementation and long-term sustainability.

### Technical Feasibility:

Comprehensive feasibility studies have been conducted to confirm the availability of the required technologies and expertise for the project. The chosen advanced treatment technologies, such as biological treatment, chemical coagulation, and membrane filtration, are well-established and proven to be effective in treating industrial wastewater. Additionally, the integration of renewable energy sources like solar power will enhance the technical robustness of the treatment plant, ensuring its efficient and sustainable operation.

### Financial Feasibility:

The project has a total estimated budget of \$17,000,000, which covers preliminary studies and design, construction and installation, equipment and technology, training and capacity building, and contingencies. Funding will be secured through a combination of government allocations, international grants, public-private partnerships, and potential revenue from the sale of treated water for industrial and agricultural use. This diverse funding strategy ensures financial stability and mitigates risks associated with funding shortfalls.

### Environmental Feasibility:

The environmental benefits of the project are substantial. By significantly reducing the discharge of untreated industrial waste into the Lyari River, the project will improve water quality and benefit the local ecosystem. The use of advanced treatment technologies will ensure that the effluent meets stringent environmental standards, reducing the pollution load on water bodies and contributing to overall environmental conservation. The project also incorporates sustainable practices, such as using renewable energy sources, which will minimize its environmental footprint.

### Social Feasibility:

The project enjoys strong support from local communities and industrial stakeholders due to its positive environmental and health impacts. Public health will be significantly improved as harmful contaminants are removed from industrial wastewater, preventing health hazards associated with polluted water sources. Engaging local communities and stakeholders through awareness programs, training, and participation in the planning and implementation phases will ensure transparency and foster public support. Educational programs will raise awareness about sustainable wastewater management and its benefits, further enhancing social acceptance and cooperation.

Overall, the feasibility assessments demonstrate that the Sewerage Treatment - Gutter Baghicha project is technically sound, financially viable, environmentally beneficial, and socially acceptable. These factors collectively ensure the project's successful implementation and its contribution to sustainable urban development in Karachi.

## Conclusion

The Sewerage Treatment - Gutter Baghicha project represents a critical initiative aimed at enhancing wastewater management capabilities in Karachi. Through meticulous project design, focusing on conceptual clarity, detailed engineering, sustainable practices, and robust safety measures, the project aims to set a benchmark for effective industrial wastewater treatment. By adhering to environmental standards and integrating renewable energy solutions, the project not only aims to improve water quality but also contributes to sustainable urban development in alignment with local regulatory frameworks and community needs.

## Project # 03: Sewerage Treatment - Imtiyaz – Qayyumabad (ST-IQ-002)

### Project Description

The project aims to develop a sustainable wastewater treatment mechanism using natural wetlands to treat the wastewater flowing into the Malir River near the Garbage Transfer Station (GTS) at Imtiyaz - Qayyumabad. This approach leverages the natural filtration and purification capabilities of wetlands to remove contaminants from the sewage, thereby preventing environmental pollution, promoting public health, and enhancing the quality of life for local residents.

### Project Objectives

The objectives of the project are as follows;

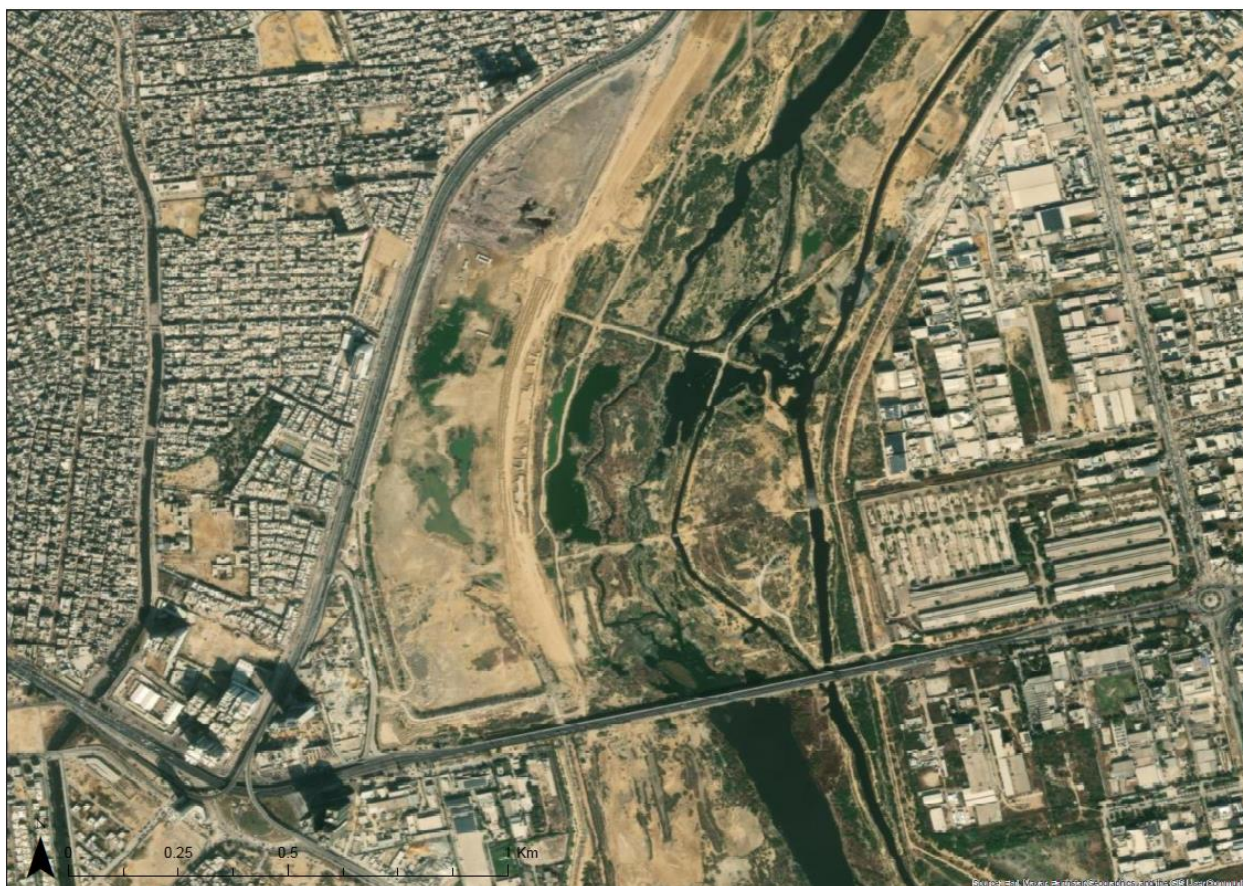
- Reduce the pollution load entering the Malir River by effectively treating wastewater through natural wetlands.
- Minimize health risks associated with untreated sewage by providing clean water through natural treatment processes.
- Implement an eco-friendly treatment solution that requires minimal energy and maintenance compared to conventional treatment plants.
- Involve local communities in the planning and maintenance of the wetlands, fostering a sense of ownership and responsibility.
- Create a habitat for various plant and animal species, promoting biodiversity in the area.

### Link with KCAP

This project will be contributing to following KCAP mitigation and adaptation goals identified under deliverable E;

- **Adaptation Goal 3:** Sewerage infrastructure is Improved & separated from storm water drainage infrastructure. It is improved and enhanced to cater for future floods.
- **Adaptation Goal 8:** Additional urban green space and shade provided in public parks by increasing park space, planting additional trees, and shade at bus-stops in heat risk areas of Karachi.
- **Adaptation Goal 4:** Solid waste management services is improved, not allowed to create blockages in sewage and storm water drainage channels.

## Project Location



*Project Site, Garbage Transfer Station – GTS, Qayyumabad*

## Project Scope

The project encompasses the development of a natural wetlands treatment system over 50 acres. It includes the construction of wetland cells, sedimentation basins, and ancillary infrastructure to support effective wastewater treatment and biodiversity enhancement.

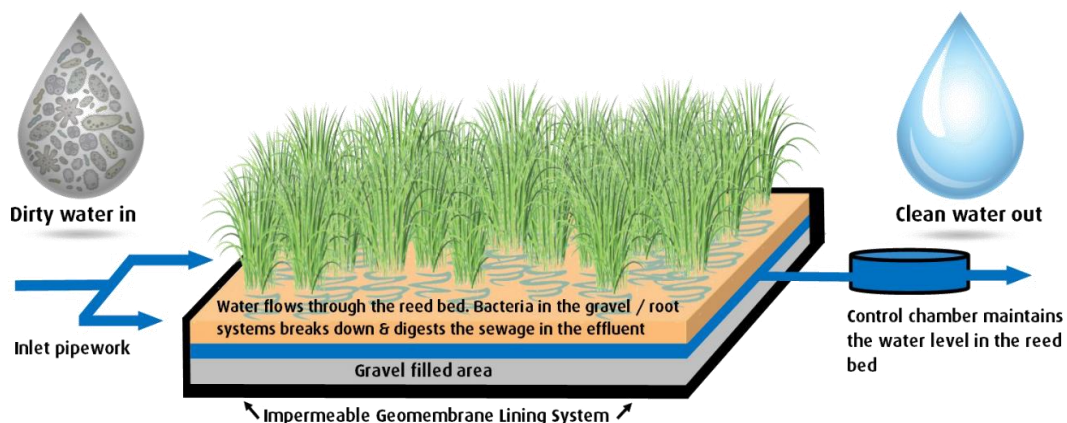
## Project Details

The project will involve several key components, including the construction of wetland cells designed to treat wastewater through natural processes, sedimentation basins to facilitate the settling of solids, and various supporting infrastructure elements such as pathways, observation decks, and educational signage. The project will also feature green spaces and bird-watching areas to attract local wildlife and provide recreational opportunities for the community.

## Project Design

### Conceptual Design:

The conceptual design focuses on integrating natural treatment processes with community recreational needs. The wetland cells will be designed to mimic natural wetlands, using a combination of aquatic plants and soil microorganisms to filter and treat the wastewater. The recreational spaces will be strategically placed to allow visitors to enjoy the natural beauty and observe wildlife without disturbing the treatment process.



Conceptual design for wetland

### Engineering Design:

The engineering design will involve detailed plans for the construction of wetland cells and sedimentation basins. These plans will include specifications for the materials, layout, and dimensions of each component, ensuring that the system is capable of handling the expected volume of wastewater. The design will also address the infrastructure needed to support the wetlands, including pathways, bridges, and observation decks.

### Environmental Design:

The environmental design will prioritize sustainability and biodiversity enhancement. Native plant species will be selected for the wetland cells to ensure compatibility with the local ecosystem. The design will also include measures to protect and enhance habitats for local wildlife, including birds and aquatic species. Additionally, the project will incorporate green spaces and recreational areas to promote environmental education and community engagement.

## Project Phases:

### Phase 1: Site Preparation and Initial Construction

This phase involves clearing and preparing the project site, which includes grading the land and setting up temporary facilities for workers. Initial construction activities will focus on creating the basic infrastructure for the wetland cells and sedimentation basins. This phase will also include the installation of primary water management structures, such as inflow and outflow channels, to control the flow of wastewater into the treatment system.

### Phase 2: Construction of Wetland Cells and Sedimentation Basins

The construction of wetland cells and sedimentation basins will be the primary focus of this phase. Each cell will be constructed according to detailed engineering designs, ensuring they are capable of effectively treating the incoming wastewater. Sedimentation basins will be built to facilitate the settling of solids before the water enters the wetland cells. This phase will also involve planting native aquatic vegetation in the wetland cells to initiate the natural treatment processes.

### Phase 3: Installation of Supporting Infrastructure

In this phase, supporting infrastructure such as pathways, observation decks, and educational signage will be installed.

These elements are crucial for making the site accessible and informative for visitors. Pathways will be designed to guide visitors through the wetlands without disturbing the natural processes, while observation decks will provide vantage points for bird-watching and enjoying the scenery. Educational signage will be placed throughout the site to inform visitors about the wetlands' function and the local ecosystem.

#### Phase 4: Development of Recreational Areas and Green Spaces

This phase focuses on creating recreational areas, including bird-watching spots and green spaces. Landscaping activities will be carried out to enhance the aesthetic appeal of the site and provide areas for community activities. Native trees and plants will be introduced to create green spaces that blend seamlessly with the wetland environment. Bird-watching areas will be strategically located to maximize opportunities for observing local and migratory bird species.



*Biodiversity restoration through development of Wetlands*

#### Phase 5: Final Inspections, Testing, and Commissioning

The final phase involves comprehensive inspections and testing to ensure that all components of the project are functioning as intended. Water quality tests will be conducted to verify the effectiveness of the wetland treatment system. Any necessary adjustments will be made based on the test results. Once the system is fully operational, the site will be officially commissioned, and public access will be granted to the recreational areas and green spaces.

### Project Budget\*

Budget Category	Cost (PKR)
<b>1. Land Preparation and Site Development</b>	
Site clearing and grading	60,000,000
Temporary facilities for workers	15,000,000
Initial water management structures (inflow/outflow channels)	45,000,000
<b>2. Construction of Wetland Cells and Sedimentation Basins</b>	
Construction materials (soil, gravel, liners)	150,000,000
Labor costs	120,000,000
Heavy machinery and equipment rental	60,000,000
Planting native aquatic vegetation	30,000,000

<b>3. Installation of Supporting Infrastructure</b>	
Pathways and bridges	90,000,000
Observation decks	60,000,000
Educational signage	15,000,000
Lighting and safety barriers	30,000,000
<b>4. Development of Recreational Areas and Green Spaces</b>	
Landscaping and planting native trees	60,000,000
Construction of bird-watching areas	45,000,000
Benches and recreational equipment	30,000,000
<b>5. Final Inspections, Testing, and Commissioning</b>	
Water quality testing and system calibration	30,000,000
Final inspections and adjustments	15,000,000
Commissioning and public access setup	15,000,000
<b>6. Contingency and Miscellaneous</b>	
Contingency (10% of total budget)	87,000,000
Miscellaneous expenses	18,000,000
<b>Total Project Budget</b>	<b>975,000,000**</b>

\* Tentative budgeting

\*\*Tax of 23% will be added to the project cost.

## Project Feasibility

### Technical Feasibility:

The technical feasibility of the Sewerage Treatment - Qayyumabad project is grounded in the proven effectiveness of natural wetlands treatment systems. These systems leverage the natural processes of wetland ecosystems to filter and treat wastewater, a method that has been successfully implemented in various locations worldwide. The technical aspects of constructing wetland cells and sedimentation basins are well-documented, and the use of native vegetation ensures compatibility with the local environment. Additionally, the project's design incorporates robust engineering principles to manage the inflow and outflow of wastewater, ensuring the system's efficiency and reliability.

In terms of infrastructure, the project benefits from the existing knowledge and expertise in wetland construction and wastewater management. Local engineers and environmental experts will be engaged to oversee the technical aspects, ensuring that the system is designed and built to meet the specific needs of the Malir River area. The project will also incorporate modern monitoring and maintenance technologies to continuously assess and optimize the performance of the wetland treatment system. This integration of proven techniques and advanced technologies underscores the technical feasibility of the project.

### Financial Feasibility:

Financial feasibility is a critical consideration for the successful implementation of the project. Initial cost estimates suggest that the project is financially viable, given the scope and scale of the development. Funding strategies will include a mix of government grants, private sector investments, and potential community contributions. The project's alignment with environmental sustainability and urban improvement goals increases its eligibility for various funding programs aimed at promoting green infrastructure and water management solutions.

In addition to initial funding, the project includes provisions for long-term financial sustainability. Revenue-generating opportunities, such as eco-tourism activities, educational

programs, and partnerships with environmental organizations, will be explored to support ongoing maintenance and operational costs. The creation of recreational spaces and green areas can also attract sponsorship and donations from local businesses and community members, further enhancing the project's financial stability. A detailed financial plan will be developed to outline all potential income sources and ensure the project's financial health over its operational life.

### Environmental Feasibility:

The environmental feasibility of the Sewerage Treatment - Qayyumabad project would be highly favorable due to its focus on utilizing natural processes for wastewater treatment. The project will significantly reduce the pollution levels in the Malir River, enhancing the water quality and overall health of the river ecosystem. By using native plant species in the wetland cells, the project supports local biodiversity and provides habitats for various wildlife species, including birds, insects, and aquatic organisms.

Furthermore, the creation of green spaces and recreational areas contributes positively to the local environment by promoting the growth of native flora and fauna. These green areas will act as ecological buffers, reducing urban heat island effects and improving air quality in the surrounding areas. The project also aligns with broader environmental goals by demonstrating sustainable water management practices that can serve as a model for similar initiatives in other urban areas. The environmental benefits extend beyond the immediate project site, contributing to the overall ecological resilience of the region.

### Social Feasibility:

Social feasibility is a key component of the project, given its potential to provide significant benefits to the local community. The development of recreational spaces and bird-watching areas offers new opportunities for community engagement and outdoor activities, enhancing the quality of life for residents. By creating educational signage and observation points, the project fosters environmental awareness and knowledge among visitors, promoting a greater understanding of sustainable water management practices.

The project also has the potential to generate local employment opportunities during the construction and operational phases, providing economic benefits to the community. Engaging local stakeholders in the planning and development process will ensure that the project meets the needs and expectations of the community. Additionally, partnerships with local schools, universities, and environmental organizations can enhance the project's social impact by integrating educational and research activities. Overall, the project's social feasibility is underpinned by its potential to deliver tangible benefits to the community while fostering a sense of environmental stewardship.

## Conclusion

The Sewerage Treatment - Qayyumabad beside Malir River Bed project will be represented as a significant step towards sustainable urban water management in Karachi. By developing a natural wetlands treatment system, the project aims to improve water quality that is being discharged untreated, enhance biodiversity, and provide valuable recreational spaces for the community. Aligned with the objectives of the Karachi Climate Area Plan, this project will demonstrate a commitment to environmental sustainability and urban improvement, offering a model for future initiatives in the region.

## Site Visit



*Site Visit near GTS Qayyumabad - I*



*Site Visit near GTS Qayyumabad - II*

## Project # 04: Wetlands at Lyari River (WL-LR-001)

### Project Description

The project aims to develop constructed wetlands along the Lyari River in Karachi to treat wastewater, restore the natural ecosystem, and provide recreational opportunities. The initiative focuses on using natural treatment methods to address the severe pollution issues affecting the river and its surroundings. By implementing constructed wetlands, the project seeks to improve water quality, enhance biodiversity, and create a sustainable, eco-friendly environment. The project will begin with a 13-acre pilot module, which will be replicated across the available open spaces along the Lyari River.

### Project Objectives

The objectives of the projects are:

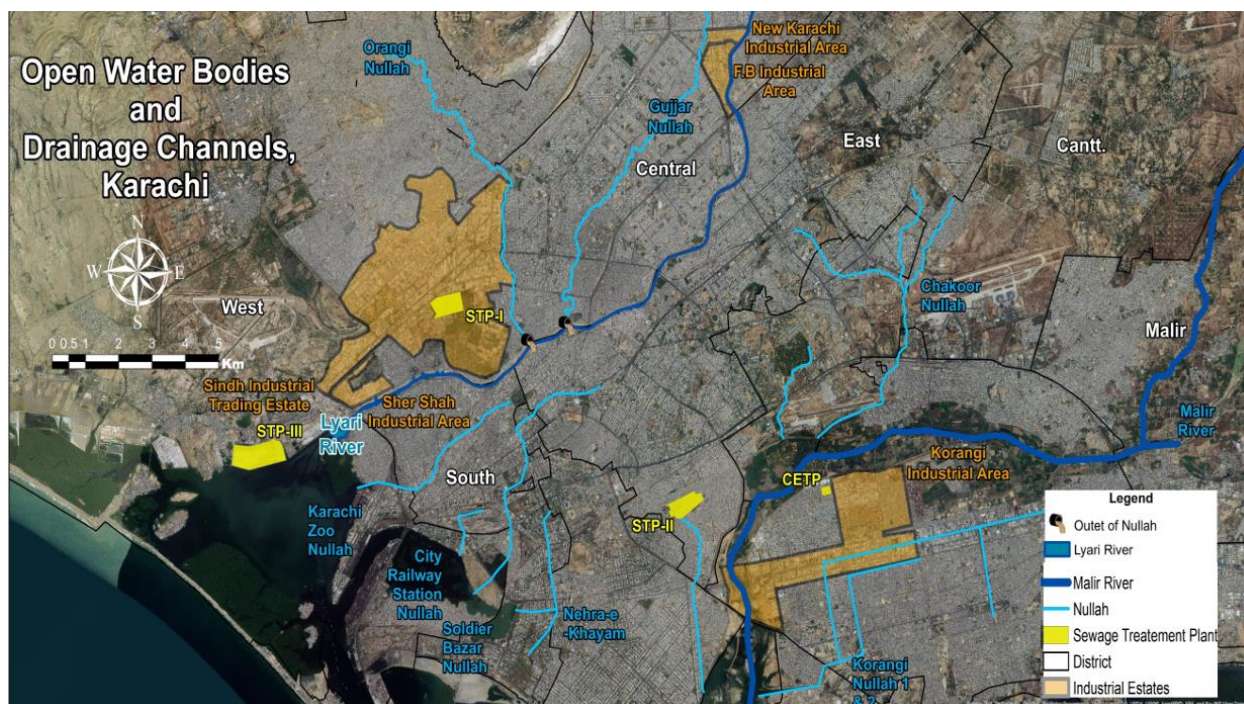
- Utilize constructed wetlands to treat domestic and industrial wastewater before it reaches the Arabian Sea.
- Rejuvenate dilapidated areas along the Lyari River, integrating them into the socio-economic landscape.
- Restore the historical social, economic, and environmental potential of the Lyari River corridor.
- Develop recreational spaces and activities to improve the quality of life for local communities.

### Link with KCAP

- **Adaptation Goal 01:** Increase resilience to floods in South, East, and Korangi districts.
- **Adaptation Goal 02:** Improve stormwater drainage infrastructure.
- **Adaptation Goal 03:** Improve ecosystem capacity against floods by restoring natural riverbeds.
- **Adaptation Goal 06:** Increase urban green space to build resilience against heat stress.
- **Adaptation Goal 10:** Increase access to water to build resilience against drought.
- **Mitigation Goal 05:** Reduce GHG emissions from solid and sewage waste.

### Project Location

Lyari Riverbed, (Starting point: 25.041361, 67.113046; Ending point: 24.867968, 66.972230)



*Open Water Bodies and Drainage Channels, Karachi (Naz, Arif, Faisal, Amanat & Tariq, 2019)<sup>6</sup>*

## Project Scope

The project encompasses the construction of wetlands, an artificial pond, walking and cycling pathways, and recreational spaces along the Lyari River. It will be executed in multiple phases, starting with a 13-acre pilot module, which will be replicated across other open spaces along the riverbed. The project will include community engagement, continuous monitoring, and maintenance to ensure sustainability and long-term success.

## Project Details

- **Constructed Wetlands:** Develop wetlands on 10 acres to treat wastewater using a combination of plants, soil, and microorganisms to naturally filter and clean the water.
- **Artificial Pond:** Create a 1-acre pond designed to store treated water and provide recreational activities such as boating and fishing.
- **Recreational Spaces:** Utilize 2 acres for parks, playgrounds, picnic areas, and community gardens to enhance the quality of life for local residents.
- **Pathways:** Construct walking and cycling paths to promote accessibility, encourage physical activity, and provide safe routes for commuting.

## Project Design

### Conceptual Design:

The conceptual design focuses on creating an integrated, sustainable environment that combines natural treatment processes with urban green spaces. The design aims to:

<sup>6</sup> Naz, R., Arif, M., Faisal, F., Amanat, M., & Tariq, M. M. (2019). Exploring sustainable solutions for wastewater treatment: A case of Lyari River. NED University of Engineering & Technology, Department of Architecture & Planning, Development Studies Program.

- Incorporate diverse plant species in the wetlands to maximize water treatment efficiency.
- Design water bodies and pathways that enhance the aesthetic appeal and usability of the area.
- Ensure that recreational spaces are accessible and cater to various age groups and activities.

### Engineering Design:

The engineering design addresses the technical specifications required for the construction and operation of the wetlands and associated infrastructure:

- Choose plant species that are effective in filtering pollutants and are resilient to the local climate.
- Use appropriate soil and filtration materials to optimize the purification process.
- Design the layout of the wetlands to maximize water flow and treatment efficiency while ensuring easy maintenance and accessibility.

### Environmental Design:

The environmental design aims to:

- Implement measures to ensure that the treated water meets environmental standards.
- Create habitats for various species of birds, fish, and other wildlife to promote biodiversity.
- Regularly monitor environmental impacts and implement mitigation strategies as needed.

### Safety and Security:

To ensure the safety and security of the area:

- Install fences around sensitive areas and lighting along pathways and recreational spaces.  
  
Implement CCTV and other surveillance measures to monitor the area and deter vandalism and other crimes.
- Develop emergency response plans and conduct regular drills to prepare for potential incidents.

## Project Phases:

### Phase 1: (6 months)

- Construct wetlands and initiate the wastewater treatment process.
- Monitor and adjust the treatment system to ensure optimal performance.

### Phase 2: (6 months)

- Develop recreational spaces, including parks, playgrounds, and pathways.

- Implement community awareness and engagement programs to educate residents about the benefits of the project and encourage their participation.

## Project Budget

Item	Cost (PKR)
<b>Wetlands Construction</b>	1,556,400,000
Artificial Pond	90,000,000
Pathways	840,000,000
Lighting	120,000,000
Miscellaneous Costs	260,640,000
<b>Total Cost per Module</b>	<b>2,867,040,000</b>
Replication (50 Modules)	143,352,000,000

## Annual Operation Cost

Item	Cost (PKR)
Maintenance (per module)	45,000,000
Salaries (per module)	36,000,000
Utilities (per module)	9,000,000
Environmental Monitoring (per module)	6,000,000
Miscellaneous Operational Costs (per module)	3,000,000
<b>Total Annual Operation Cost per Module</b>	<b>99,000,000</b>

\* Tentative budgeting

\*\*Tax of 23% will be added to the project cost.

## Project Feasibility

### Environmental Feasibility

Constructed wetlands offer a sustainable solution by using natural processes to treat wastewater. These wetlands mimic natural ecosystems, where plants and microorganisms work together to filter and clean water. This approach reduces reliance on energy-intensive conventional treatment methods, thereby minimizing the environmental footprint. Additionally, the project focuses on ecological restoration, enhancing biodiversity and improving the ecological health of the Lyari River. By reintroducing native plant species and creating habitats for local wildlife, the project aims to restore the natural balance of the river ecosystem. Moreover, wetlands act as natural buffers against extreme weather events like flooding by absorbing excess rainwater and reducing runoff, which enhances the area's climate resilience.

### Economic Feasibility

The constructed wetlands are a cost-effective alternative to traditional wastewater treatment plants. They have lower initial construction costs and reduced maintenance expenses, making them financially viable for long-term wastewater management. The treated water can be reused for industrial, agricultural, and construction purposes, providing a potential revenue stream that can support the project's maintenance and operation. Additionally, the development of recreational spaces will attract visitors, boosting local businesses and tourism. The project will also create job opportunities during both the construction and operational

phases, contributing to the local economy by employing residents in various roles, from construction workers to maintenance staff and environmental monitors.

### Social Feasibility

Community engagement is a crucial aspect of this project. Educational programs will be conducted to inform the local population about the benefits of wetlands and the importance of proper waste disposal practices. This engagement will foster a sense of ownership and responsibility among residents, encouraging their active participation in the project's design, implementation, and maintenance. The project will also improve the quality of life by creating green spaces, parks, and recreational areas, providing safe and accessible spaces for leisure activities, social interaction, and physical exercise. Transforming neglected and polluted areas into vibrant public spaces will promote social inclusion, as people from different socio-economic backgrounds come together, strengthening community bonds and fostering pride in the local environment.

### Technical Feasibility

Constructed wetlands are a well-established technology for wastewater treatment, proven to be reliable and effective worldwide. The project's modular design, starting with a 13-acre pilot module, allows for scalable implementation, which can be expanded based on success and feedback. This scalability ensures that the project can adapt and grow to meet the needs of the entire Lyari River area. Collaboration with environmental experts, engineers, and urban planners will ensure that the design and implementation are technically sound. Continuous monitoring and evaluation will be conducted to optimize the system's performance and address any technical challenges, ensuring the project's long-term sustainability and success.

## Conclusion

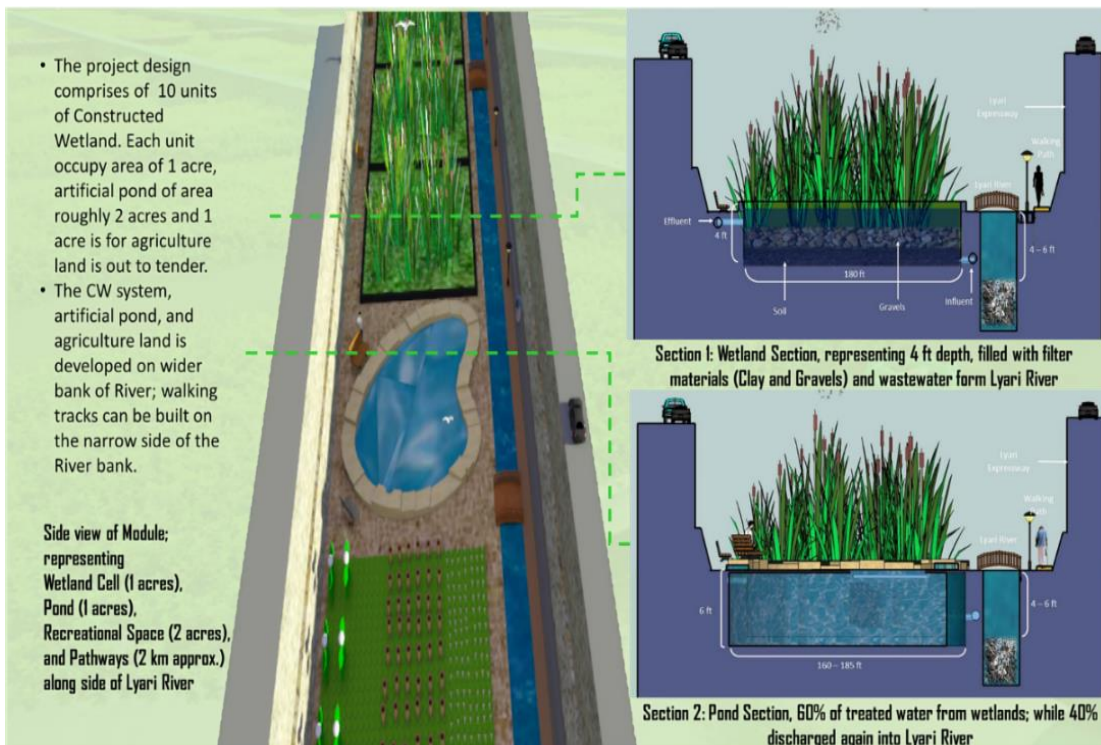
The Wetlands at Lyari River project offers a sustainable and innovative solution to Karachi's severe pollution issues. By leveraging natural treatment methods, the project aims to restore the ecological balance, enhance urban green spaces, and provide valuable recreational opportunities for local communities. The strong alignment with KCAP goals and detailed feasibility studies demonstrate significant environmental, economic, and social benefits for the city. The modular design, starting with a 13-acre pilot module and replicating across other areas, ensures scalability and long-term sustainability, making this project a cornerstone for the future of Karachi's urban environment.

**Project Proposed Design**

**Blowup View of Module, comprising 10 Wetland Cells, 1 Pond, Recreational Space.**



Aerial view of the Module, (Source: Naz, Arif, Faisal, Amanat & Tariq, 2019)

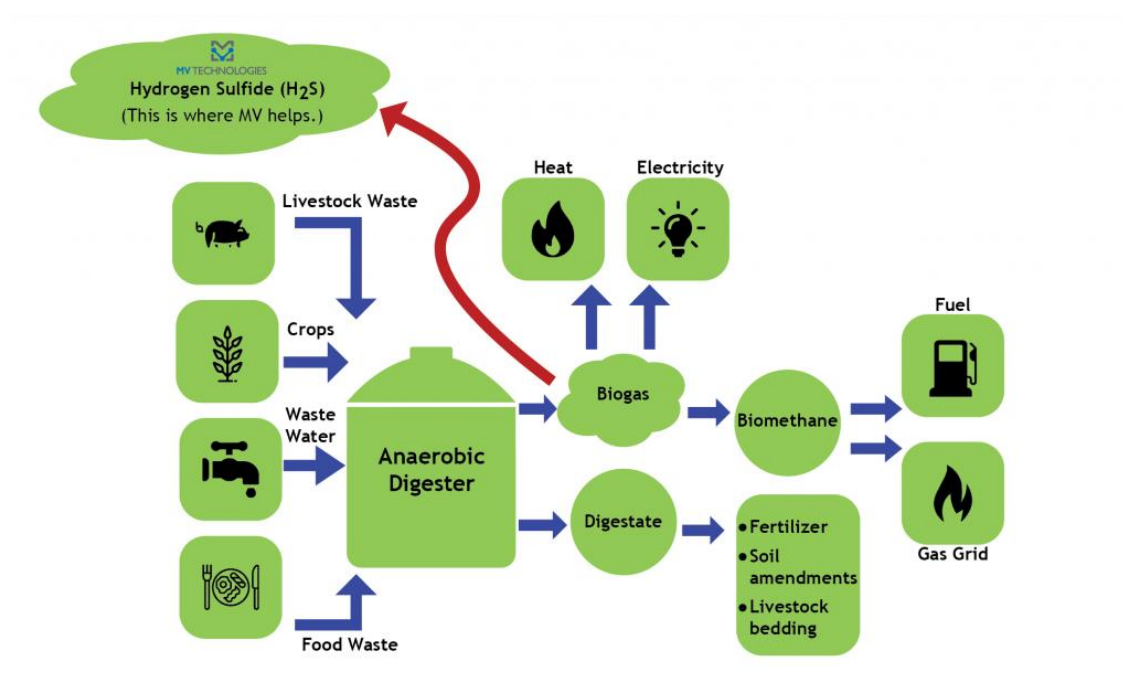


Technical Details of the Proposal, , (Source: Naz, Arif, Faisal, Amanat & Tariq, 2019)

## Project # 05: Ibrahim Hyderi Bio-Digester Project (SWM-CC-002)

### Project Description

The Ibrahim Hyderi Bio-Digester Project aims to establish an anaerobic digestion facility in the Ibrahim Hyderi area of Karachi. This project will focus on converting organic waste, collected from livestock farms, into biogas and organic fertilizer. Biogas will be used as a renewable energy source, providing a cleaner alternative to conventional fuels for cooking, heating, or electricity generation. The project not only addresses the critical issue of waste management but also contributes to energy production and agricultural sustainability.



*Anaerobic Digester Process Flow*

By implementing this project, we aim to tackle the significant environmental challenges posed by improper waste disposal in the region. Organic waste will be processed in a controlled and efficient manner, reducing the environmental footprint and mitigating greenhouse gas emissions. Additionally, the project will generate organic fertilizer as a valuable by-product, promoting sustainable agriculture practices and enhancing soil health in the local community.

### Project Objectives

#### Reduce Environmental Pollution:

- Efficiently process organic waste to minimize environmental impact.
- Reduce greenhouse gas emissions by capturing methane during anaerobic digestion.
- **Produce Renewable Energy:**
  - Convert organic waste into biogas for use as a clean energy source.
  - Decrease reliance on fossil fuels for cooking, heating, and electricity generation.

- **Generate Organic Fertilizer:**
  - Produce high-quality organic fertilizer from digestate.
  - Promote sustainable agriculture by enhancing soil fertility.
- **Improve Public Health:**
  - Manage waste effectively to reduce the prevalence of waste-related diseases.
  - Enhance sanitary conditions in the Ibrahim Hyderi area.
- **Promote Sustainable Practices:**
  - Foster community awareness and education on sustainable waste management.
  - Encourage local adoption of environmentally friendly practices and technologies.
- **Support Economic Development:**
  - Create job opportunities in waste collection, facility operation, and maintenance.
  - Provide additional revenue streams through the sale of biogas and organic fertilizer.

### Link with KCAP

The project will address;

#### Mitigation Goals:

- **Goal 01:** Enhance energy efficiency in the industries sector in Karachi
- **Goal 05:** Reduce GHG emissions from solid and sewage waste

#### Adaptation Goals:

- **Goal 02:** Improve stormwater drainage infrastructure to cope with urban flooding
- **Goal 03:** Improve ecosystem capacity against floods by restoring natural riverbeds
- **Goal 04:** Improve the mangrove forest cover to provide protection against tidal erosion and flooding risk
- **Goal 06:** Build resilience against heat stress by increasing urban green space in heat risk areas of Karachi

## Project Location



## Project Scope

The scope of the Ibrahim Hyderi Bio-Digester Project encompasses the entire lifecycle of waste management, from collection to processing and utilization of by-products. The project will establish a systematic approach for collecting organic waste from various sources within the community, including households, markets, and livestock farms. This collected waste will then be transported to the bio-digester facility for processing.

The bio-digester facility will be designed and constructed to handle the anticipated volume of organic waste, ensuring efficient conversion into biogas and organic fertilizer. The produced biogas will be stored and distributed for local use, providing a renewable energy source for cooking, heating, or electricity generation. Additionally, the project will involve community outreach and education initiatives to promote awareness and adoption of sustainable waste management practices. By encompassing these aspects, the project aims to create a comprehensive and sustainable solution for organic waste management in Ibrahim Hyderi.

## Project Details

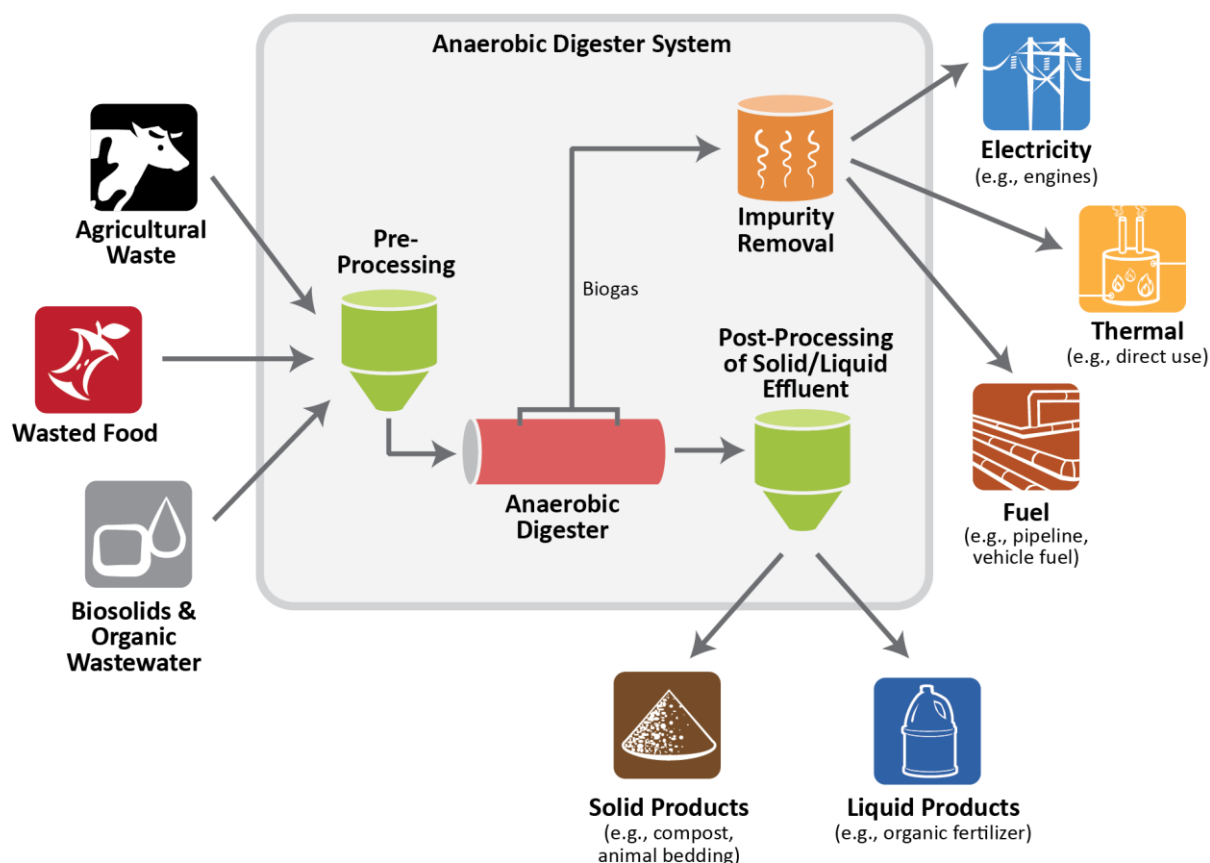
The Ibrahim Hyderi Bio-Digester Project will involve several key components to ensure its successful implementation and operation. Initially, a robust waste collection system will be established, involving the deployment of waste collection points and transportation vehicles. This system will facilitate the efficient gathering of organic waste from households, markets, and livestock farms, ensuring a steady supply of feedstock for the bio-digester.

The bio-digester facility itself will be designed with advanced anaerobic digestion technology to efficiently convert organic waste into biogas. The produced biogas will be captured and stored in specially designed storage tanks, ready for distribution to local users. Additionally, the digestate, a by-product of the anaerobic digestion process, will be processed to produce high-quality organic fertilizer. This fertilizer will be made available to local farmers, promoting sustainable agriculture practices and improving soil health. The project will also include continuous monitoring and maintenance to ensure optimal performance and address any operational challenges.

## Project Design

### Conceptual Design:

The conceptual design phase will involve developing a layout plan for the bio-digester facility, identifying key components and their spatial arrangement. This phase will consider factors such as site accessibility, proximity to waste generation points, and integration with existing infrastructure. The conceptual design will also outline the biogas storage and distribution systems, ensuring seamless integration with local energy needs.



*Conceptual Design of Anaerobic Digester*

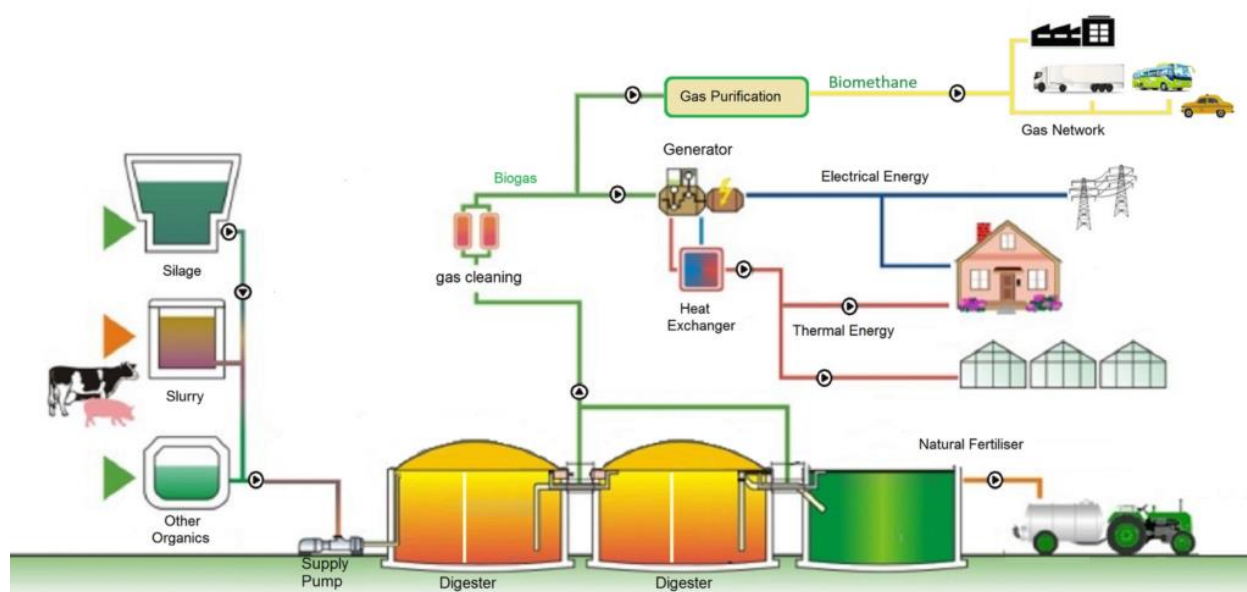
The design will incorporate community-friendly features, promoting engagement and participation in waste management activities. Educational signage and demonstration areas will be included to raise awareness about the benefits of anaerobic digestion and sustainable waste management. The conceptual design will serve as a blueprint for the subsequent detailed engineering and construction phases, ensuring a well-planned and efficient facility.

### Engineering Design:

The engineering design phase will involve detailed technical specifications for the bio-digester and associated infrastructure. This includes designing the anaerobic digestion units, pipelines, storage tanks, and processing equipment. The design will adhere to industry standards and best practices, ensuring safety, efficiency, and durability of the facility.

Special attention will be given to integrating safety measures and quality control systems, addressing potential risks associated with biogas production and storage. The engineering

design will also consider environmental factors, incorporating features to minimize emissions and pollution. Detailed engineering drawings and specifications will guide the construction phase, ensuring accurate implementation of the project design.



*Bio-Gas Plant layout*

### Environmental Design:

The environmental design phase will focus on assessing and mitigating the project's environmental impact. This includes conducting environmental impact assessments (EIAs) to identify potential risks and implementing measures to address them. The design will incorporate features to minimize greenhouse gas emissions, such as efficient biogas capture and utilization systems.

Proper handling and disposal of by-products, including digestate, will be a key consideration in the environmental design. The project will adhere to environmental regulations and best practices, ensuring minimal impact on the surrounding ecosystem. Additionally, the environmental design will include monitoring and reporting mechanisms to track the project's environmental performance and ensure compliance with sustainability goals.

### Safety and Security:

Ensuring the safety and security of the bio-digester facility and its operations is a top priority. The project will comply with safety standards and regulations, incorporating measures to prevent accidents and protect personnel. This includes designing emergency response plans and providing training to staff on safety protocols and procedures.

Security measures will also be implemented to safeguard the facility from unauthorized access and potential threats. This includes perimeter fencing, surveillance systems, and access control mechanisms. The project will maintain a focus on continuous safety and security monitoring, addressing any issues promptly to ensure the well-being of personnel and the surrounding community.

## Project Phases:

The project will be implemented in several phases to ensure systematic and efficient progress

- **Phase 1** will involve planning and feasibility studies, including site selection, environmental assessments, and community consultations.
- **Phase 2** will focus on design and procurement, developing detailed engineering plans and securing necessary equipment and materials.
- **Phase 3** will involve construction and installation of the bio-digester facility and associated infrastructure.
- This phase will be followed by **Phase 4**, which includes commissioning and testing to ensure the facility operates as intended.
- **Phase 5** will involve the operation and maintenance of the facility, with continuous monitoring and optimization to ensure long-term success.

## Project Budget

Item	Estimated Cost (PKR)	Notes
<b>Initial Setup Costs</b>		
Land Acquisition	5,000,000	
Construction of Plant	20,000,000	
Equipment Purchase	1,000,000	
<b>Operational Costs</b>		
Maintenance	1,000,000	Annual cost
Labor	12,000,000	Annual cost
Utilities (Water, Electricity)	6,000,000	Annual cost
<b>Additional Costs</b>		
Environmental Assessment	10,000,000	One-time cost
Safety Measures	1,000,000	Initial setup and training
Contingency Fund	16,800,000	
<b>Total Amount</b>	<b>72,800,000</b>	

\* Tentative budgeting

\*\*Tax of 23% will be added to the project cost.

## Project Feasibility

### Environmental Feasibility

The environmental feasibility of the Ibrahim Hyderi Bio-Digester Project is highly favorable. The project will significantly reduce environmental pollution by processing organic waste in a controlled manner, preventing harmful emissions and leachate. By converting organic waste into biogas, the project will mitigate greenhouse gas emissions, contributing to climate change mitigation efforts.

Additionally, the production of organic fertilizer from digestate will promote sustainable agriculture practices, enhancing soil health and reducing the need for chemical fertilizers. The project will adhere to environmental regulations and best practices, ensuring minimal impact on the surrounding ecosystem. Regular environmental monitoring and reporting will be conducted to track the project's performance and ensure compliance with sustainability goals.

### Economic Feasibility

The economic feasibility of the project is promising, with several potential revenue streams and cost-saving benefits. The biogas produced can be used as a renewable energy source, reducing reliance on expensive fossil fuels and lowering energy costs for the local community. The sale of organic fertilizer will generate additional revenue, providing a sustainable income stream for the project.

A cost-benefit analysis indicates that the project will provide significant long-term economic benefits, outweighing the initial investment. The project will also create job opportunities in waste collection, facility operation, and maintenance, contributing to local economic development. Financial sustainability will be ensured through effective budgeting, financial management, and the potential for additional funding or grants from environmental and sustainability organizations.

### Social Feasibility

The social feasibility of the project is strong, with widespread community acceptance and support anticipated. The project addresses critical public health issues by managing waste effectively, reducing the prevalence of waste-related diseases. By involving local residents in waste collection and management, the project fosters a sense of ownership and responsibility towards environmental conservation.

Community outreach and education initiatives will raise awareness about the benefits of anaerobic digestion and sustainable waste management, promoting behavior change and community engagement. The project will also contribute to social development by creating job opportunities and enhancing the quality of life for residents in Ibrahim Hyderi. Social impact assessments will be conducted to ensure the project meets the needs and expectations of the community.

### Technical Feasibility

The technical feasibility of the Ibrahim Hyderi Bio-Digester Project is supported by the availability of advanced anaerobic digestion technology and expertise. The project will leverage proven technologies and best practices to ensure efficient and reliable operation of the bio-digester facility. Technical challenges, such as feedstock variability and process optimization, will be addressed through careful planning and engineering design.

Regular maintenance and operational monitoring will ensure the facility operates at optimal performance, with measures in place to address any technical issues that may arise. The project will also include capacity-building initiatives to train local personnel in the operation and maintenance of the bio-digester, ensuring technical sustainability and resilience.

## Conclusion

The Ibrahim Hyderi Bio-Digester Project presents a viable and sustainable solution for managing organic waste in the region. By converting waste into valuable resources, the project supports environmental, economic, and social objectives, aligning with the Karachi Climate Action Plan. The successful implementation of this project will reduce environmental pollution, produce renewable energy, and generate organic fertilizer, contributing to a cleaner and more sustainable future for the community.

Through community engagement and education, the project will foster awareness and adoption of sustainable waste management practices, promoting long-term behavior change. The Ibrahim Hyderi Bio-Digester Project serves as a model for similar initiatives in other parts of Karachi and beyond, demonstrating the potential for innovative solutions to address environmental challenges and improve the quality of life for local residents.

## Project # 06: Katchi Abadi Upgradation: Nusrat Bhutto Colony (KA-001)

### Project Description

This project focuses on the comprehensive upgradation of the Nusrat Bhutto Colony (Mustafabad) in Karachi, a Katchi Abadi characterized by poorly constructed infrastructure, inadequate waste management, and a lack of public amenities. The project will aim to improve the living conditions of the residents through the enhancement of urban infrastructure, provision of green spaces, introduction of sustainable waste management practices, and the implementation of energy-efficient solutions such as water purification facilities, low-carbon brick production, and street lighting upgrades.

### Project Objectives

- **Infrastructure Improvement:** Upgrade roads and lanes to enhance accessibility and mobility.
- **Environmental Enhancements:** Develop green spaces, implement sustainable waste management solutions, improve air quality, and reduce greenhouse gas emissions.
- **Housing and Livability:** Improve the structural integrity of residential buildings, ensuring adequate natural light and ventilation while promoting the use of low-carbon construction materials.
- **Energy Efficiency:** Establish renewable energy solutions, including the installation of solar-powered systems and energy-efficient streetlights.
- **Water Purification:** Install water purification facilities to supply safe drinking water to residents.
- **Community Engagement:** Foster community involvement in the planning and implementation phases to ensure the project meets local needs.

### Link with KCAP

This project is aligned with KCAP's objectives of reducing greenhouse gas emissions, enhancing climate resilience, and improving urban infrastructure. The project contributes to KCAP's goals by:

#### Housing and Livability:

- **KCAP Urban Heat Risk Strategy:** Improving the structural integrity of residential buildings with low-carbon materials and ensuring adequate natural ventilation directly supports KCAP's strategy to mitigate urban heat risks. This aligns with efforts to reduce the urban heat island effect and improve livability in vulnerable communities.
- **KCAP Target 5.1:** The use of sustainable construction practices and materials in housing upgrades will contribute to the goal of enhancing urban resilience to heat stress, in line with KCAP's target to enforce resilient building designs in heat-prone areas by 2027.

#### Energy Efficiency:

- **KCAP Energy and Emissions Reduction Strategy:** The installation of solar-powered systems and energy-efficient streetlights aligns with KCAP's broader strategy to

reduce greenhouse gas emissions. This project will contribute to the city's overall goal of achieving significant reductions in carbon emissions by implementing renewable energy solutions at the community level.

- **KCAP Adaptation Goal 2:** The emphasis on energy efficiency and renewable energy in the project supports the KCAP goal of improving energy infrastructure to reduce carbon footprints and enhance resilience to climate change.

### Water Purification:

- **KCAP Water Management Strategy:** Installing water purification facilities ensures safe drinking water for residents, contributing to KCAP's objectives of improving water management in flood-prone areas and reducing the health risks associated with contaminated water sources during floods.

## Project Location

Nusrat Bhutto Colony (Mustafabad), Karachi

- Located in a densely populated area with limited access to basic amenities.
- The site is currently characterized by poor road infrastructure, inadequate housing, environmental hazards, and a lack of clean water.

## Project Scope

The project will address multiple aspects of urban development within Nusrat Bhutto Colony, including:

- **Infrastructure Development:** Road repairs and proper lanes, and utility service enhancements, including renewable energy installations.
- **Environmental Improvements:** Creation of green spaces, park development, green belts under the flyover, waste management systems, and installation of energy-efficient streetlights.
- **Housing Upgradation:** Renovation and reconstruction of residential buildings using low-carbon bricks to ensure structural safety and improve living conditions.
- **Public Safety:** Enhancement of public safety through better lighting, and provision of safe drinking water through water purification facilities.
- **Renewable Energy Solutions:** Implementation of solar-powered systems for energy-efficient street lighting and renewable electricity generation for community use.

## Project Design

### Conceptual Design:

The conceptual design will focus on creating a livable, sustainable, and resilient urban environment. Key components include:

- **Green Spaces:** Upgradation of nearby park and green belts under the flyover to remove illegal parking and drug addict presence.
- **Pedestrianization:** Development of walkable streets and pathways.
- **Water Purification:** Establishment of facilities for safe drinking water.



Neighborhood Park near Nusrat Bhutto Colony

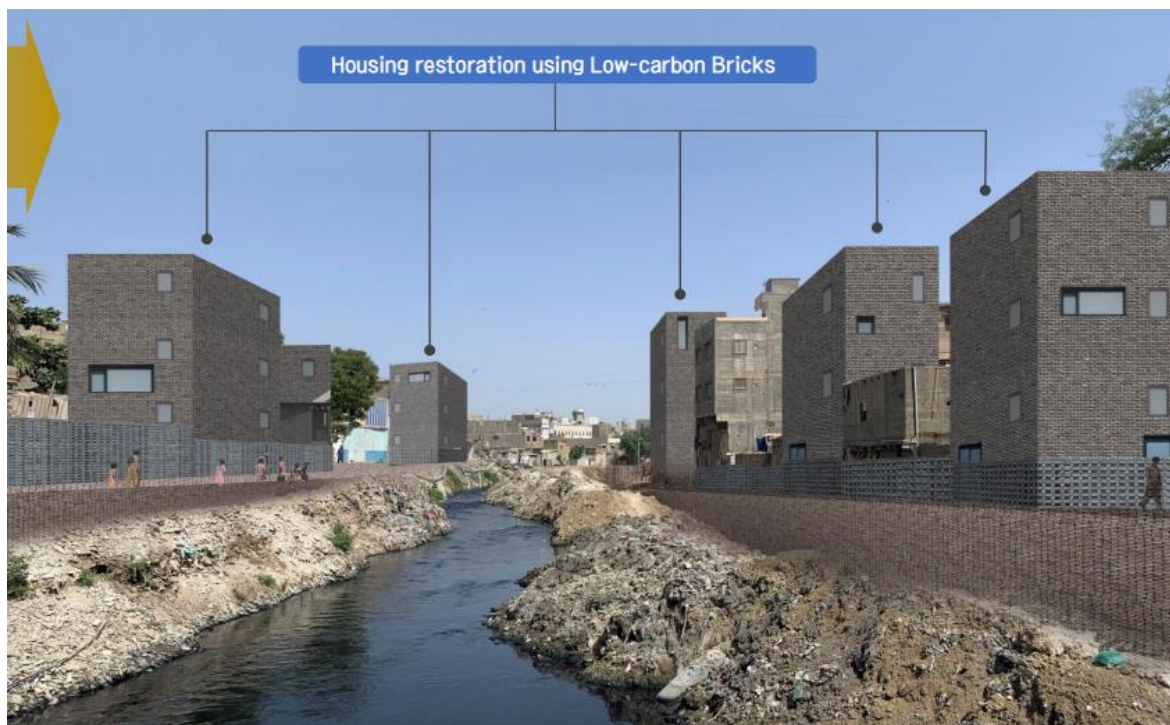


Illegal Garbage Transfer Station (GTS) at the entrance of Park.



*Proposed Water Purification facility for the community*

### Engineering Design:



*Proposed Housing restoration with low-carbon bricks*

- **Road Infrastructure:** Reconstruction of main roads and side streets, widening lanes where feasible.

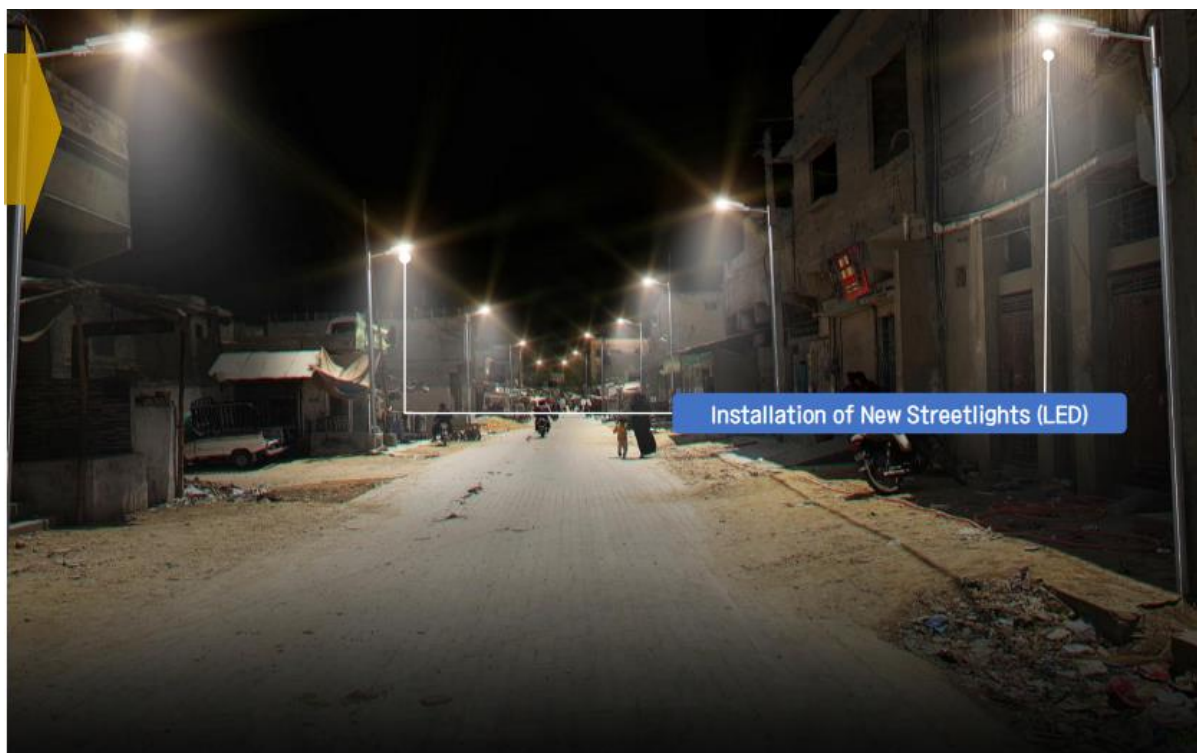
- **Building Reinforcement:** Strengthening of existing residential structures using low-carbon bricks to meet safety standards.

### Environmental Design:

- **Waste Management:** Establishment of a community-led waste collection and recycling program, including the removal of the Kachra Kundi near Qalandaria Park.
- **Green Space Development:** Conversion of underutilized areas into parks and recreational spaces, including the enhancement of Qalandaria Park by removing the garbage dump. Establishment of green belts under the Naya Nazimabad flyover to improve air quality and reduce the heat island effect.
- **Energy Efficiency:** Installation and replacement of energy-efficient streetlights, and supply of renewable energy using solar power.

### Safety and Security:

- **Lighting:** Installation of streetlights in poorly lit areas to improve safety at night.



*Proposed Installation of street light to improve area aesthetics*

### Project Phases:

- **Phase 1: Planning and Community Engagement:** Detailed planning, community consultations, and design finalization.
- **Phase 2: Infrastructure Upgradation:** Road repairs, utility enhancements, and installation of water purification and renewable energy systems.
- **Phase 3: Housing and Public Space Development:** Renovation of residential buildings and creation of green spaces.
- **Phase 4: Environmental Management and Monitoring:** Implementation of waste management systems, environmental monitoring, and maintenance of green spaces.

## Project Budget

A detailed budget will be developed based on the specific requirements of each project phase. This will include:

- **Infrastructure Costs:** Road construction, utility upgrades, and installation of water purification facilities.
- **Housing Renovation:** Costs for materials, labor, and design, including the use of low-carbon bricks.
- **Green Space Development:** Land acquisition, landscaping, and park amenities, including green belts under the flyover.
- **Waste Management:** Equipment, training, and operational costs.
- **Public Safety:** Installation of lighting.
- **Energy Solutions:** Costs related to renewable energy installations, such as solar power systems and energy-efficient street lighting.

(\*Budget specifics to be developed in collaboration with financial experts and based on detailed site surveys and material costs.) Project Feasibility

- **Technical Feasibility:** The project will leverage existing infrastructure where possible, and new technologies for sustainable construction, water purification, and waste management will be utilized.
- **Economic Feasibility:** The project aims to be cost-effective by using local materials and labor, and seeking funding from governmental and international sources.
- **Social Feasibility:** Strong community engagement and support, with residents involved in decision-making processes.
- **Environmental Feasibility:** The project aligns with environmental sustainability goals, reducing the ecological footprint, enhancing urban resilience, and mitigating the heat island effect.

## Conclusion

The upgradation of Nusrat Bhutto Colony (Mustafabad) is a critical step towards improving the quality of life for its residents while contributing to Karachi's broader climate action goals. By addressing infrastructure, housing, environmental, energy, and health challenges, this project will create a safer, healthier, and more sustainable community, serving as a model for future Katchi Abadi upgradation projects. The inclusion of green spaces, water purification facilities, renewable energy solutions, and low-carbon construction materials will not only enhance the urban environment but also improve air quality, water safety, and energy efficiency, contributing to a more resilient and sustainable Karachi

### Proposed Solar System For Gutter Baghicha Park



Site Covered Area = (5.0 Acre)  
Latitude = (24.9023)  
Longitude = (67.0113)



### Conceptual Design Of Urban Forest Park



**Components**

- A- Information Center
- B- Admin Office
- C- Bird Cage
- D- Poly Bag Nursery
- E- Bed Nursery
- F- Scatter Plantation
- G- Orchidarium
- H- Lake
- I- Children Play Area
- J- Cafeteria
- K- Toilet Block
- L- Rest House

**Legends**

	Green Area
	Green Area
	Road
	Parking Area
	Natural soil
	Pathway

**Plantation**

	Acacia nilotica (Kikar)
	Morus Alba (Shahoot)
	Cassia Fistula (Golden Shower)
	Ziziphus Nummularia (Ber)

**Project**

Gutter Baghicha Land use Map For (K-CAP)

**Total Site Covered Area : (4.0 Acres)**



## Annex – C

### KPIs - MER Indicator Matrix

#### Energy

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>a. Increase share of renewable energy in the energy mix</b>									
1	Develop a long-term generation capacity expansion plan for K-Electric to increase share of renewable energy in generation mix to at least 90% by 2050	Drafted and approved long-term generation capacity expansion plan.	<ul style="list-style-type: none"> <li>- Plan completion date</li> <li>- Stakeholder consultations held</li> <li>- Approval by relevant authorities</li> </ul>	Increased focus on renewable energy in K-Electric's future projects.	<ul style="list-style-type: none"> <li>- Percentage of planned capacity from renewable sources</li> <li>- Number of renewable energy projects initiated</li> </ul>	Gradual increase in the share of renewable energy in K-Electric's energy mix.	<ul style="list-style-type: none"> <li>- Yearly increase in renewable energy share</li> <li>- Reduction in fossil fuel-based energy generation</li> </ul>	Significant reduction in carbon emissions from the energy sector.	<ul style="list-style-type: none"> <li>- Percentage reduction in carbon emissions by 2050</li> <li>- Increase in energy security and sustainability</li> </ul>
<b>b. Improve T&amp;D infrastructure to achieve greater efficiency</b>									
2	Develop an accelerated grid enhancement and efficiency improvement plan	Drafted and approved grid enhancement and efficiency improvement plan.	<ul style="list-style-type: none"> <li>- Plan completion date</li> <li>- Number of consultations with grid operators</li> <li>- Budget allocated for implementation</li> </ul>	Improved efficiency and reliability of the grid infrastructure.	<ul style="list-style-type: none"> <li>- Reduction in transmission and distribution losses</li> <li>- Number of grid upgrades implemented</li> </ul>	Enhanced energy efficiency and reduced energy losses across the grid.	<ul style="list-style-type: none"> <li>- Percentage reduction in energy losses</li> <li>- Increase in grid reliability and stability</li> </ul>	Reduced energy wastage and improved energy availability for consumers.	<ul style="list-style-type: none"> <li>- Reduction in energy loss percentage</li> <li>- Increase in energy delivered to consumers</li> </ul>
3	Install energy efficient transformers	Procurement and installation of energy-efficient transformers.	<ul style="list-style-type: none"> <li>- Number of energy-efficient transformers installed</li> </ul>	Improved energy efficiency in the transmission	<ul style="list-style-type: none"> <li>- Reduction in transformer energy losses</li> <li>-</li> </ul>	Lower operational costs and reduced energy	<ul style="list-style-type: none"> <li>- Reduction in T&amp;D losses</li> <li>- Decrease in operational and</li> </ul>	Long-term reduction in energy consumption and	<ul style="list-style-type: none"> <li>- Reduction in overall energy loss</li> </ul>

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
			- Total capacity of transformers upgraded	and distribution network.	Improvement in power quality and stability	wastage in the T&D network.	maintenance costs	environmental impact.	- Increase in grid efficiency
<b><i>c. Improve resource efficiency and scale up industrial decarbonization to reduce emissions from the manufacturing sector</i></b>									
<b>4</b>	<b>Monitor achievement of textile companies that have signed the Net-Zero pledge</b>	Established monitoring framework for Net-Zero achievements.	<ul style="list-style-type: none"> <li>- Number of companies monitored</li> <li>- Frequency of monitoring reports</li> <li>- Compliance rate with Net-Zero targets</li> </ul>	Improved tracking and transparency of industrial decarbonization efforts.	<ul style="list-style-type: none"> <li>- Percentage of companies on track to meet Net-Zero targets</li> <li>- Number of corrective actions taken</li> </ul>	Accelerated progress towards Net-Zero emissions in the textile sector.	<ul style="list-style-type: none"> <li>- Reduction in greenhouse gas emissions from monitored companies</li> <li>- Increase in energy efficiency in textile production</li> </ul>	Significant reduction in carbon emissions from the textile industry.	<ul style="list-style-type: none"> <li>- Percentage reduction in industry-wide emissions</li> <li>- Enhanced sustainability reputation of the textile sector</li> </ul>
<b>5</b>	<b>Set up an Industrial Decarbonization Directorate/ Cell in 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</b>	Established and operational Industrial Decarbonization Directorate/Cell.	<ul style="list-style-type: none"> <li>- Date of establishment</li> <li>- Number of SMEs supported</li> <li>- Number of initiatives launched</li> </ul>	Increased adoption of renewable energy (RE) and energy efficiency (EE) technologies in manufacturing.	<ul style="list-style-type: none"> <li>- Percentage of SMEs adopting RE/EE technologies</li> <li>- Number of RE/EE projects supported</li> </ul>	Reduction in energy consumption and emissions in the manufacturing sector.	<ul style="list-style-type: none"> <li>- Percentage reduction in energy consumption</li> <li>- Decrease in industrial emissions</li> </ul>	Long-term reduction in industrial carbon footprint and enhanced competitiveness.	<ul style="list-style-type: none"> <li>- Overall reduction in industrial sector emissions</li> <li>- Increase in the number of green-certified industries</li> </ul>
<b>6</b>	<b>Mandatory energy audits of large</b>	Development and	- Number of industries audited	Identification and	- Percentage reduction in	Enhanced energy	- Reduction in energy	Significant reduction in	- Decrease in industrial

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
	<b>energy consuming industries and companies</b>	implementation of mandatory energy audit regulations.	<ul style="list-style-type: none"> <li>- Frequency of audits</li> <li>- Compliance rate with audit recommendations</li> </ul>	implementation of energy-saving measures in large industries.	<ul style="list-style-type: none"> <li>- energy consumption in audited industries</li> <li>- Number of energy efficiency improvements made</li> </ul>	efficiency and reduced operational costs in large industries.	<ul style="list-style-type: none"> <li>- consumption</li> <li>- Increase in energy savings achieved</li> </ul>	industrial energy demand and carbon emissions.	<ul style="list-style-type: none"> <li>- sector energy use</li> <li>- Reduction in overall carbon footprint</li> </ul>
<b>7</b>	<b>Develop regulations for cap and trade schemes and carbon levies for industrial emissions</b>	Drafted and approved regulations for cap and trade schemes and carbon levies.	<ul style="list-style-type: none"> <li>- Date of regulation approval</li> <li>- Number of stakeholders consulted</li> <li>- Compliance rate with new regulations</li> </ul>	Implementation of cap and trade schemes and carbon levies in the industrial sector.	<ul style="list-style-type: none"> <li>- Percentage of industries participating in cap and trade schemes</li> <li>- Amount of revenue generated from carbon levies</li> </ul>	Reduction in industrial emissions through market-based mechanisms.	<ul style="list-style-type: none"> <li>- Reduction in emissions in industries subject to cap and trade</li> <li>- Decrease in carbon emissions due to levies</li> </ul>	Long-term reduction in industrial greenhouse gas emissions and promotion of clean technologies.	<ul style="list-style-type: none"> <li>- Overall reduction in industrial sector emissions</li> <li>- Increase in investments in clean technologies</li> </ul>
<b><i>d. Improving efficiencies in the building sector by switching to energy-efficient appliances, increasing the share of rooftop Solar PV, and improving building designs</i></b>									
<b>8</b>	<b>On-bill financing for NEECA labeled Energy Efficient appliances to replace old/inefficient cooling appliances with energy labeled products: - 5 Star Energy</b>	Launched an on-bill financing program. Replacement of old appliances with energy-efficient ones.	<ul style="list-style-type: none"> <li>- Number of households participating</li> <li>- Number of appliances replaced</li> <li>- Total financing provided</li> </ul>	Increased adoption of energy-efficient appliances in households.	<ul style="list-style-type: none"> <li>- Percentage reduction in household energy consumption</li> <li>- Increase in sales of energy-efficient appliances</li> </ul>	Lower energy bills and reduced environmental impact from household energy use.	<ul style="list-style-type: none"> <li>- Reduction in household energy costs</li> <li>- Decrease in household carbon footprint</li> </ul>	Long-term reduction in residential energy demand and enhanced energy security.	<ul style="list-style-type: none"> <li>- Overall reduction in residential energy consumption</li> <li>- Increase in household energy savings</li> </ul>

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
	labeled fans - NEECA labeled energy efficient refrigerators and air conditioners with low-GWP refrigerants								
9	Develop a roadmap for installation of solar PV and retrofitting low-income and informal housing with energy-efficient equipment by 2035	Drafted and approved roadmap for solar PV installation and retrofitting.	<ul style="list-style-type: none"> <li>- Roadmap completion date</li> <li>- Number of stakeholder consultations</li> <li>- Budget allocation for implementation</li> </ul>	Increased access to solar PV and energy-efficient retrofits in low-income and informal housing.	<ul style="list-style-type: none"> <li>- Percentage of targeted households with solar PV installed</li> <li>- Number of homes retrofitted with energy-efficient equipment</li> </ul>	Improved energy access and reduced energy costs for low-income households.	<ul style="list-style-type: none"> <li>- Reduction in energy bills</li> <li>- Increase in energy security for low-income families</li> </ul>	Long-term reduction in energy poverty and increased resilience of low-income housing.	<ul style="list-style-type: none"> <li>- Reduction in energy costs for low-income households</li> <li>- Increase in solar PV capacity in residential areas</li> </ul>
10	Specify minimum standard of 5-star NEECA labelled cooling appliances (Fans, Air conditioners and Refrigerators) in Provincial Public Procurement Guidelines	Updated public procurement guidelines to include energy efficiency standards.	<ul style="list-style-type: none"> <li>- Date of guideline update</li> <li>- Number of government agencies informed</li> <li>- Compliance rate with new guidelines</li> </ul>	Increased procurement of energy-efficient appliances by government agencies.	<ul style="list-style-type: none"> <li>- Percentage of procurement contracts specifying 5-star appliances</li> <li>- Number of energy-efficient appliances purchased</li> </ul>	Reduction in energy consumption and operational costs in public buildings.	<ul style="list-style-type: none"> <li>- Reduction in energy use in public buildings</li> <li>- Increase in government energy savings</li> </ul>	Long-term reduction in public sector energy consumption and carbon emissions.	<ul style="list-style-type: none"> <li>- Overall reduction in public sector energy use</li> <li>- Decrease in government carbon footprint</li> </ul>

## Building

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>c. Improve resource efficiency and scale up industrial decarbonization to reduce emissions from the manufacturing sector</b>									
1	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 .	Developed and launched awareness campaigns. Conducted training sessions and pilot demonstrations .	Number of campaigns launched. Number of training sessions conducted. Number of participants.	Increased awareness and knowledge among textile manufacturers on sustainable practices.	Percentage of manufacturers participating. Participant feedback and knowledge retention scores.	Adoption of sustainable practices by textile manufacturers.	Percentage of manufacturers implementing practices. Reduction in resource usage (e.g., water, energy).	Improved environmental performance and sustainability in the textile industry.	-Reduction in environmental footprint (e.g., carbon emissions, waste). Compliance with environmental standards.  - Improvement in compliance with environmental standards
<b>d. Improving efficiencies in the building sector by switching to energy efficient appliances, increasing share of rooftop Solar PV and improving building designs</b>									
2	Introduce energy-efficient design considerations in residential building bylaws to improve new residential building designs: 1) New house construction to	Updated building bylaws. Dissemination of new design standards.	- Number of bylaws amended  - Number of workshops/awareness sessions held  - Number of stakeholders engaged (e.g., builders, homeowners)	Increased adoption of energy-efficient building practices in residential construction.	- Percentage of new constructions following energy-efficient codes  - Number of existing houses with enhanced insulation  - Percentage of	Improved energy efficiency in residential buildings.	- Reduction in energy consumption (kWh) per household  - Decrease in energy bills for homeowners  - Improvement	Reduced energy demand and lower greenhouse gas emissions from the residential sector.	- Reduction in residential energy consumption  - Lowered carbon footprint from housing  - Increase in market value

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
follow energy-efficient building codes (wall insulation, roof insulation, etc) 2) Enhance roof insulation of existing houses 3) Replace windows with double-glaze				compliance checks passed		in thermal comfort ratings		of energy-efficient homes
<b>3</b> Bulk replacement of old/inefficient cooling appliances with 5-star labeled models in public buildings	Inventory of old appliances. Procurement and installation of new 5-star labeled appliances.	<ul style="list-style-type: none"> <li>- Number of old appliances replaced</li> <li>- Number of 5-star appliances installed</li> <li>- Number of buildings participating</li> </ul>	Improved energy efficiency in public buildings.	<ul style="list-style-type: none"> <li>- Reduction in energy consumption (kWh)</li> <li>- Percentage decrease in energy bills</li> <li>- Improvement in indoor air quality and comfort</li> </ul>	Lower operational costs and reduced energy usage in public buildings.	<ul style="list-style-type: none"> <li>- Percentage reduction in electricity bills</li> <li>- Decrease in maintenance costs</li> <li>- Increase in the lifespan of cooling systems</li> </ul>	Reduced overall energy demand and carbon emissions from public buildings.	<ul style="list-style-type: none"> <li>- Reduction in public sector energy usage</li> <li>- Decrease in carbon emissions</li> <li>- Improvement in public perception and government sustainability ratings</li> </ul>

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
4	Amend building bylaws to mandate energy and water-efficient equipment, and energy-efficient insulation in new commercial building designs	Updated building bylaws. Communication and implementation of new standards.	- Number of bylaws amended - Number of enforcement actions - Number of educational workshops for architects/builders	Increased use of energy and water-efficient technologies in new commercial buildings.	- Percentage of new buildings complying with updated bylaws - Number of green building certifications obtained (e.g., LEED, EDGE) - Increase in investments in energy-efficient technologies	Enhanced resource efficiency in new commercial buildings.	- Reduction in energy and water usage (kWh, liters) - Improvement in operational efficiency metrics - Decrease in utility costs for businesses	Lower environmental impact and operational costs in the commercial sector. - Reduction in resource consumption - Decrease in operational expenses - Improved environmental ratings for commercial properties
5	Establish a mandate to improve the envelope technology of existing buildings, incorporating state-of-the-art insulation solutions to minimize cooling load	Development of new guidelines and standards. Implementation in existing buildings.	- Number of buildings retrofitted - Number of insulation technologies adopted - Total investment in retrofits	Enhanced thermal efficiency in existing buildings.	- Percentage of buildings complying with new standards - Reduction in cooling energy consumption (kWh) - Increase in indoor temperature stability	Reduced cooling load and energy consumption.	- Reduction in energy required for cooling - Decrease in cooling system wear and tear - Improved occupant satisfaction	Decreased energy consumption and environmental impact from existing buildings. - Reduction in cooling energy demand - Lower carbon emissions - Increase in property values due to energy efficiency improvements

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
6	<b>Create a retrofit accelerator program for commercial buildings with energy labeled efficient appliances along the lines of global best practices</b>	Development and launch of the retrofit program. Outreach to commercial building owners.	<ul style="list-style-type: none"> <li>- Number of buildings participating</li> <li>- Number of retrofits completed</li> <li>- Total energy savings achieved (kWh)</li> </ul>	Accelerated adoption of energy-efficient technologies in commercial buildings.	<ul style="list-style-type: none"> <li>- Percentage of participating buildings achieving energy efficiency goals</li> <li>- Increase in market share for energy-efficient appliances</li> <li>- Number of positive case studies published</li> </ul>	Increased energy efficiency across the commercial building sector.	<ul style="list-style-type: none"> <li>- Reduction in energy consumption by retrofitted buildings</li> <li>- Improvement in building performance ratings</li> <li>- Reduction in operational costs</li> </ul>	Significant energy savings and environmental benefits from widespread retrofits.	<ul style="list-style-type: none"> <li>- Reduction in overall energy demand in the commercial sector</li> <li>- Decrease in carbon emissions</li> <li>- Improved reputation of businesses participating in the program</li> </ul>
7	<b>Mandatory energy audits for public and private commercial buildings</b>	Establishment of energy audit requirements. Conducting energy audits.	<ul style="list-style-type: none"> <li>- Number of energy audits completed</li> <li>- Number of buildings audited</li> <li>- Total energy inefficiencies identified</li> </ul>	Identification of energy inefficiencies and opportunities for improvement.	<ul style="list-style-type: none"> <li>- Percentage of buildings implementing audit recommendations</li> <li>- Amount of energy savings identified (kWh)</li> <li>- Number of follow-up audits conducted</li> </ul>	Improved energy performance of audited buildings.	<ul style="list-style-type: none"> <li>- Reduction in energy consumption post-audit (kWh)</li> <li>- Increase in energy efficiency ratings</li> <li>- Reduction in operational costs</li> </ul>	Enhanced energy efficiency and reduced emissions from commercial buildings.	<ul style="list-style-type: none"> <li>- Reduction in commercial sector energy use</li> <li>- Lowered carbon footprint</li> <li>- Increased long-term sustainability of buildings</li> </ul>

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
8	Promote voluntary certifications such as EDGE Green buildings, BRI and LEED	Awareness campaigns for certification programs. Support for certification applications.	<ul style="list-style-type: none"> <li>- Number of buildings obtaining certifications</li> <li>- Number of awareness campaigns conducted</li> <li>- Increase in demand for certification services</li> </ul>	Increased adoption of green building certifications.	<ul style="list-style-type: none"> <li>- Percentage of new and existing buildings obtaining certifications</li> <li>- Improvement in building energy and water efficiency ratings</li> <li>- Number of businesses promoting their certification status</li> </ul>	Improved sustainability and market competitiveness of certified buildings.	<ul style="list-style-type: none"> <li>- Percentage reduction in resource consumption by certified buildings</li> <li>- Increase in property values</li> <li>- Enhanced tenant/occupant satisfaction</li> </ul>	Widespread adoption of sustainable building practices.	<ul style="list-style-type: none"> <li>- Increase in number of green-certified buildings</li> <li>- Reduction in overall resource consumption</li> <li>- Positive impact on local environmental goals and policies</li> </ul>

## Transport

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>a. Accelerating E-Vehicle transition for 2-wheelers and 3-wheelers</b>									
1	<b>Introduce financing scheme for 2-wheeler EVs</b>	Developed and launched financing scheme for 2-wheeler EVs.	- Date of scheme launch - Number of financial institutions involved - Number of loans approved	Increased affordability and adoption of 2-wheeler EVs.	- Percentage increase in 2-wheeler EV sales - Number of new EV owners - Percentage reduction in upfront costs for buyers	Higher penetration of EVs in the 2-wheeler market.	- Market share of 2-wheeler EVs - Reduction in sales of conventional 2-wheelers	Significant reduction in urban air pollution and greenhouse gas emissions from the 2-wheeler segment.	- Decrease in CO2 emissions from 2-wheelers - Improvement in urban air quality indices
2	<b>Develop a plan to establish network of charging stations</b>	Drafted and approved plan for EV charging station network.	- Date of plan completion - Number of locations identified - Number of stakeholders consulted	Expansion of EV charging infrastructure.	- Number of charging stations established - Geographic coverage of charging stations - Utilization rate of charging stations	Increased convenience and adoption of EVs.	- Increase in EV registrations - Reduction in range anxiety among EV users	Accelerated transition to electric mobility.	- Percentage increase in EVs on the road - Reduction in fossil fuel dependency
3	<b>Pilot EV chargers integrated with streetlighting infrastructure</b>	Implemented pilot project for EV chargers integrated with streetlights.	- Number of chargers installed - Number of locations piloted - User feedback on pilot	Demonstrated feasibility and user acceptance of integrated EV chargers.	- Percentage of users satisfied with charging experience - Number of charging sessions recorded	Scaled deployment of integrated EV charging solutions.	- Increase in the number of integrated chargers installed - Expansion of pilot project to other areas	Improved accessibility to EV charging, fostering higher EV adoption.	- Reduction in EV charging gaps - Increase in the number of EV users

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
4	Conduct assessment of feasibility and market potential for battery swapping stations and charged battery rentals	Completed feasibility study and market assessment for battery swapping stations.	- Date of assessment completion - Number of stakeholders engaged - Feasibility report findings	Informed decision-making on battery swapping and rental solutions.	- Number of recommendations adopted - Interest from private sector investors	Development of battery swapping infrastructure.	- Number of battery swapping stations established - Increase in usage of swapping services	Enhanced convenience and reduction in downtime for EV users.	- Percentage reduction in EV downtime - Increased user satisfaction
5	Develop a plan to replace all department owned 2-wheelers with EVs	Drafted and approved plan for replacing department-owned 2-wheelers with EVs.	- Date of plan approval - Number of 2-wheelers targeted for replacement - Budget allocation for replacement	Transition to electric 2-wheelers in government departments.	- Number of 2-wheelers replaced - Percentage reduction in fuel consumption by departments	Government leadership in promoting EV adoption.	- Decrease in government fleet emissions - Increase in public sector EV usage	Set an example for private sector EV adoption and reduce public sector emissions.	- Reduction in government operational emissions - Improved public perception of government sustainability efforts
6	Introduce program for replacement of old 3-wheelers with EV models	Launched program for replacing old 3-wheelers with EV models.	Date of program launch - Number of old 3-wheelers replaced - Number of participants in the program	Increased adoption of EVs in the 3-wheeler segment.	- Percentage of 3-wheeler market transitioned to EVs - Reduction in emissions from 3-wheelers	Reduction in urban pollution and fuel consumption from 3-wheelers.	- Decrease in CO2 and particulate emissions - Increase in fuel savings for drivers	Improved air quality and lower operating costs for 3-wheeler operators.	- Reduction in urban air pollution levels - Economic benefits for 3-wheeler owners
7	Offer incentives for 2-wheeler and 3-wheeler EVs such as reduced tolls and taxes	Introduced incentive program for 2-wheeler and 3-wheeler EVs.	- Number of incentives offered - Number of EVs benefitting from incentives - Amount of tax revenue impacted	Increased attractiveness of EVs in the 2-wheeler and 3-wheeler segments.	- Increase in EV registrations - Percentage of users availing incentives	Accelerated transition to electric mobility in urban areas.	- Percentage reduction in conventional vehicle use - Increase in EV market share	Long-term reduction in emissions and dependence on fossil fuels.	- Reduction in vehicular emissions - Decrease in urban congestion due to improved EV usage

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>b. Expanding E-bus network</b>									
8	Develop a plan to expand the fleet of E-buses and expand the network	Drafted and approved an expansion plan for the E-bus fleet and network.	- Date of plan completion - Number of new E-buses planned - Budget allocated for expansion	Increased availability and coverage of E-bus services.	- Number of E-buses added to the fleet - Number of routes expanded - Increase in daily ridership	Enhanced public transport sustainability and reduced emissions.	- Percentage reduction in public transport emissions - Increase in public satisfaction with E-bus services	Improved urban air quality and reduced reliance on fossil fuels in public transport.	- Reduction in public transport-related emissions - Increase in public transport usage
<b>c. Vehicle emissions monitoring and regulation</b>									
9	Build a network of vehicle monitoring inspection centers	Established a network of vehicle inspection centers.	- Number of inspection centers built - Geographic coverage of inspection centers - Number of vehicles inspected	Improved monitoring and regulation of vehicle emissions.	- Percentage of vehicles inspected annually - Number of vehicles failing emission tests	Reduction in non-compliant vehicles on the road.	- Percentage reduction in high-emission vehicles - Number of vehicles repaired or retired	Significant reduction in vehicle emissions and improved air quality.	- Decrease in overall vehicle emissions - Improvement in urban air quality indices
10	Develop regulations for annual inspection and certification of vehicles that are more than 5 years old, including penalties for vehicles that exceed emission limits	Drafted and approved regulations for vehicle inspection and certification.	- Date of regulation approval - Number of vehicles subject to inspection - Compliance rate with regulations	Increased compliance with emission standards for older vehicles.	- Percentage of vehicles passing inspections - Number of penalties issued for non-compliance	Reduction in emissions from older vehicles.	- Reduction in emissions from vehicles >5 years old - Increase in vehicle repairs or upgrades	Long-term reduction in vehicle-related air pollution.	- Improvement in urban air quality - Decrease in health issues related to air pollution

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<i>d. Switching to cleaner fuels</i>									
11	Develop regulation to introduce cleaner fuels for vehicles	Drafted and approved regulations for cleaner vehicle fuels.	- Date of regulation approval - Number of fuel suppliers complying - Number of vehicles using cleaner fuels	Increased availability and use of cleaner fuels.	- Percentage of fuel sales from cleaner options - Number of vehicles transitioned to cleaner fuels	Reduction in vehicle emissions due to cleaner fuel usage.	- Reduction in CO2 and other harmful emissions - Improvement in fuel efficiency metrics	Long-term reduction in transportation-related emissions and improved public health.	- Reduction in vehicular emissions - Improvement in urban air quality and public health outcomes

## Waste

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>a. Minimize plastic consumption to lower emissions and plastic waste</b>									
1	<b>Enforce regulations to ban use of single use plastic bags in Karachi</b>	Regulations for banning single-use plastic bags implemented in Karachi.	- Date of regulation enforcement - Number of inspections conducted - Compliance rate	Reduction in the use of single-use plastic bags.	- Percentage reduction in plastic bag usage - Number of businesses complying with the ban	Decrease in plastic waste generated in Karachi.	- Reduction in plastic waste in landfills - Improvement in urban cleanliness	Lower emissions and environmental impact from reduced plastic waste.	- Decrease in CO2 emissions related to plastic production and disposal - Improved environmental health
2	<b>Campaign for awareness raising to reduce plastic consumption, littering and improve hygiene</b>	Public awareness campaigns launched to reduce plastic consumption and littering.	- Number of campaigns conducted - Number of participants engaged - Public awareness levels	Increased public awareness and reduction in plastic consumption and littering.	- Decrease in plastic waste in public areas - Increase in proper waste disposal practices	Cleaner urban environment with reduced plastic waste.	- Reduction in plastic litter - Improvement in hygiene standards	Long-term reduction in plastic waste and improved public health.	- Decrease in plastic waste generation - Improved urban cleanliness and health outcomes
3	<b>Develop waste-free and single use plastic free zones in public areas to demonstrate and increase awareness among citizens</b>	Designated public areas are established as waste-free and plastic-free zones.	- Number of zones established - Public engagement and participation rates	Increased public awareness and adoption of waste-free and plastic-free practices.	- Number of visitors adopting waste-free practices - Reduction in plastic waste in designated zones	Expansion of waste-free practices to other areas in Karachi.	- Increase in waste-free zones - Decrease in plastic waste in urban areas	Significant reduction in plastic waste and promotion of sustainable practices.	- Reduction in plastic waste citywide - Improved urban environmental health
<b>b. Improve waste collection, processing, and recycling infrastructure</b>									
4	<b>Develop waste management</b>	Waste management	- Date of guideline publication	Improved waste	- Percentage of waste	Increased efficiency in	- Reduction in contamination	Enhanced waste	- Improvement in recycling

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
	guidelines for improved segregation of waste (with emphasis on monitoring and enforcement)	guidelines for segregation were developed and implemented.	- Number of training sessions conducted - Compliance rates	segregation at source.	properly segregated - Number of Compliance checks conducted	waste processing and recycling.	of recyclables - Increase in recycling rates	management and reduced environmental impact.	rates - Reduction in landfill waste
5	Develop a framework and guidelines for waste segregation at the household level	Framework and guidelines for household waste segregation developed and disseminated.	- Number of households reached - Compliance rates - Number of training sessions conducted	Increased adoption of waste segregation practices at the household level.	- Percentage of households practicing waste segregation - Reduction in mixed waste collected	Improvement in overall waste management and recycling rates.	- Increase in recyclable waste collection - Decrease in landfill waste	Long-term reduction in waste generation and improved recycling efficiency.	- Reduction in total waste generated - Improvement in environmental sustainability
6	Awareness campaigns to educate citizens on the benefits of waste segregation and composting at the household level	Awareness campaigns on waste segregation and composting launched.	- Number of campaigns conducted - Number of participants engaged - public awareness levels	Increased public understanding and participation in waste segregation and composting.	- Percentage of households practicing composting - Reduction in organic waste in landfills	Increase in composting practices and reduction in organic waste.	- Increase in compost production - Decrease in organic waste in landfills	Improved soil health and reduction in landfill waste.	- Reduction in methane emissions from landfills - Increase in organic waste recycling

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
7	Develop new land fill sites to reduce load at Jam Chakro and Govind pass	New landfill sites identified and developed to alleviate load on existing sites.	- Number of new landfill sites developed - capacity of new sites - Reduction in waste load at Jam Chakro and Govind Pass	Improved waste management and reduced pressure on existing landfill sites.	- Percentage Reduction in waste load at existing sites - Increase in landfill capacity	Reduced environmental and health risks from overburdened landfill sites.	- Improvement in landfill management practices - Decrease in landfill-related health issues	Long-term improvement in waste management infrastructure and environmental protection.	- Increase in sustainable waste disposal - Reduction in environmental impact of landfills
8	Develop framework for extended producer responsibility (EPR)	EPR framework developed and implemented.	- Date of framework implementation - Number of producers engaged - Compliance rates	Increased producer responsibility for waste management.	- Percentage of products covered under EPR - Reduction in waste from covered products	Improvement in recycling rates and reduction in waste from producers.	- Increase in producer-led recycling initiatives - Decrease in waste generation	Enhanced sustainability in product lifecycle management.	- Reduction in waste and emissions from production - Increase in circular economy practices
9	Conduct techno-economic assessment for adoption of methane capture technology at land fill sites (considering potential revenue from voluntary carbon markets)	Techno-economic assessment for methane capture at landfills conducted.	- Date of assessment completion - Number of stakeholders engaged - Feasibility report findings	Informed decision-making on methane capture technology adoption.	- Number of landfill sites selected for methane capture - Potential revenue from carbon markets	Adoption of methane capture technology at landfill sites.	- Volume of methane captured - Increase in revenue from carbon credits	Reduction in greenhouse gas emissions and additional revenue streams from carbon markets.	- Decrease in methane emissions - Increase in carbon credit revenue

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>10</b>	<b>Conduct feasibility assessment for Organic fertilizer production from sewage for domestic and farming use</b>	Feasibility assessment for organic fertilizer production conducted.	- Date of assessment completion - Number of stakeholders consulted - assessment findings	Informed decision-making on organic fertilizer production.	- Number of sewage treatment plants selected - Potential production Volume	Adoption of organic fertilizer production from sewage.	- Volume of organic fertilizer produced - Increase in fertilizer usage in agriculture	Reduction in chemical fertilizer usage and improved soil health.	- Decrease in chemical fertilizer demand - Improvement in agricultural sustainability
<b>11</b>	<b>Replace large water pumps/ motors with IE3 / IE4 motors</b>	Replacement of large water pumps/motors with IE3/IE4 motors initiated.	- Number of motors replaced - energy savings from replacements - Reduction in operational costs	Improved energy efficiency in water supply systems.	- Percentage Reduction in energy consumption - Increase in operational efficiency	Reduced energy consumption and operational costs in water management.	- Decrease in CO2 emissions from water management - Increase in energy savings	Long-term energy efficiency and sustainability in water supply infrastructure.	- Reduction in water supply-related emissions - Improved sustainability of water infrastructure
<b><i>c. Improve efficiencies and bottlenecks in water supply and sanitation</i></b>									
<b>12</b>	<b>Conduct assessment for potential of Methane capture from improved sewage treatment</b>	Assessment for methane capture from sewage treatment conducted.	- Date of assessment completion - Number of sewage treatment plants assessed - Potential methane capture identified	Informed decision-making on methane capture from sewage treatment.	- Number of plants selected for methane capture - Estimated Volume of methane capture	Adoption of methane capture technology in sewage treatment plants.	- Volume of methane captured - Increase in renewable energy generation	Reduction in greenhouse gas emissions and enhanced energy recovery from waste.	- Decrease in methane emissions - Increase in renewable energy contribution
<b>13</b>	<b>Develop and implement plan to disaggregate sewerage and drainage system</b>	Plan to disaggregate sewerage and drainage systems	- Date of plan approval - Number of systems disaggregated - Budget allocation	Improved separation of sewerage and drainage systems.	- Reduction in sewerage overflows - Improvement	Enhanced water quality and reduced contamination risks.	- Decrease in waterborne diseases - Improvement	Long-term improvement in water management and public health.	- Reduction in water contamination - Improvement

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
		developed and implemented.			in drainage efficiency		in public health		in urban water infrastructure
<b>14</b>	<b>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</b>	Community health awareness program launched.	<ul style="list-style-type: none"> <li>- Number of programs conducted</li> <li>- Number of participants engaged</li> <li>- public awareness levels</li> </ul>	Increased public awareness and participation in health and environmental initiatives.	<ul style="list-style-type: none"> <li>- Percentage of citizens practicing better waste management</li> <li>- Reduction in indoor air pollution</li> <li>- Increase in recycling rates</li> </ul>	Improvement in community health and environmental practices.	<ul style="list-style-type: none"> <li>- Decrease in GHG emissions</li> <li>- Improvement in indoor air quality</li> <li>- Reduction in waste-related health issues</li> </ul>	Long-term improvement in public health and environmental sustainability.	<ul style="list-style-type: none"> <li>- Reduction in pollution levels</li> <li>- Increase in sustainable living practices</li> </ul>

## Adaptation

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator	
<b>Urban Flood Risk</b>									
1	Integrate nature-based flood mitigation features in Strategic Development plan for restoration and addition of public parks	Nature-based flood mitigation features incorporated into Strategic Development Plan.	- Number of flood mitigation features integrated - Area of parks restored or added	Improved flood resilience through enhanced public park networks.	- Reduction in flood-prone areas - Increase in park areas serving as flood mitigation zones	Reduced flood risk in urban areas.	- Decrease in flood-related damages - Improvement in urban resilience	Long-term reduction in flood risk and enhanced urban sustainability.	- Reduction in economic losses from flooding - Improvement in urban environmental health
2	Integrate parks and open public spaces with stormwater drainage to create retention areas	Parks and public spaces connected with stormwater drainage systems.	- Number of parks integrated - Volume of water retained	Improved water retention capacity in urban areas.	- Decrease in urban flooding incidents - Increase in stormwater retention	Enhanced flood management and water conservation.	- Reduction in flood-related disruptions - Increase in groundwater recharge	Sustainable urban water management and reduced flood risk.	- Reduction in flood severity - Improvement in urban water sustainability
3	Develop plan to undertake conversion of footpaths and suitable open spaces to permeable surface material in high-flood risk zones	Conversion plan for permeable surfaces in high flood-risk zones developed.	- Number of footpaths and open spaces converted - Area covered with permeable materials	Improved permeability and reduced surface runoff in flood-prone areas.	- Reduction in surface runoff - Increase in water absorption rates	Mitigation of flood risk through enhanced surface permeability.	- Decrease in flood frequency in targeted zones - Improvement in urban drainage	Long-term flood risk reduction and sustainable urban infrastructure.	- Reduction in urban flooding - Improvement in stormwater management

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
4	Identify feasible locations to integrate street-side landscape with storm drainage network	Feasible locations for integrating street-side landscape with storm drainage identified.	- Number of locations identified - Area of landscape integrated	Enhanced storm drainage and landscape integration in urban areas.	- Increase in drainage capacity - Reduction in waterlogging incidents	Improved stormwater management and urban resilience.	- Decrease in flood-related traffic disruptions - Improvement in public safety	Enhanced urban infrastructure and reduced flood risk.	- Reduction in urban flooding - Improvement in public infrastructure
5	Undertake infrastructure development for drainage of sewage and stormwater in high flood risk zones	Infrastructure for sewage and stormwater drainage developed in high flood-risk zones.	- Kilometers of drainage infrastructure developed - Number of flood-prone zones covered	Improved drainage capacity and reduced flood risk in high-risk zones.	- Decrease in flood incidents - Increase in drainage efficiency	Enhanced urban flood resilience and public safety.	- Reduction in flood-related health issues - Improvement in urban infrastructure	Long-term reduction in flood risk and improved public health.	- Reduction in flood-related damages - Improvement in urban living conditions
6	Develop plan to restore natural riverbeds of Malir and Lyari rivers by removing the encroachment in catchment area and planting vegetation cover	Plan for riverbed restoration and vegetation cover developed.	- Area of riverbed restored - Number of encroachments removed - Area planted with vegetation	Restoration of natural riverbeds and increased vegetation cover.	- Improvement in river flow - Reduction in encroachment-related flooding	Enhanced flood management and ecological restoration.	- Decrease in flood risk - Improvement in urban green cover	Long-term ecological restoration and flood risk reduction.	- Reduction in flood incidents - Improvement in urban biodiversity
<b>Coastal Risk</b>									
7	Undertake mapping exercise to identify land	Land availability for mangrove expansion	- Area of land identified - Number of	Increased land availability for mangrove restoration.	- Percentage Increase in mangrove forest cover	Enhanced coastal protection through	- Decrease in coastal flood incidents - Improvement	Long-term coastal resilience and	- Increase in mangrove cover - Reduction in coastal erosion

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
	availability to expand mangrove forest cover	mapped and identified.	stakeholders consulted		- Reduction in coastal erosion	mangrove restoration.	in coastal biodiversity	ecological sustainability.	
8	Allocate budget for mangrove ecosystem restoration and plantation	Budget allocated for mangrove restoration and plantation activities.	- Amount of Budget allocated - Number of restoration projects funded	Increased financial support for mangrove restoration.	- Area of mangrove forest restored - Increase in mangrove plantation activities	Enhanced coastal resilience through restored mangrove ecosystems.	- Decrease in coastal flood risk - Improvement in coastal biodiversity	Long-term protection and restoration of coastal ecosystems.	- Increase in coastal green cover - Reduction in coastal environmental degradation
9	Develop land use planning, zoning and building codes for coastal buildings and enforce regulations prohibiting new construction in high-risk areas	Land use plans, zoning, and building codes for coastal areas developed and enforced.	- Date of regulation enforcement - Number of new constructions prohibited - Number of Compliance checks	Improved land use planning and reduced construction in high-risk coastal areas.	- Decrease in new construction in high-risk areas - Increase in Compliance with regulations	Enhanced coastal resilience and protection of human life and property.	- Reduction in coastal flood risk - Improvement in public safety	Long-term reduction in coastal risk and sustainable coastal development.	- Decrease in coastal damages - Improvement in coastal living conditions
<b>Urban Heat Risk</b>									
10	Allocate budget for urban green development	Budget allocated for urban green development projects.	- Amount of Budget allocated - Number of projects funded	Increased financial support for urban greening initiatives.	- Area of urban green spaces developed - Increase in green cover	Mitigation of urban heat island effect through expanded green spaces.	- Reduction in urban heat - Improvement in air quality	Long-term urban climate resilience and improved livability.	- Reduction in urban temperatures - Improvement in public health
11	Integrate green roofs and green walls as pilot	Pilot projects for green roofs and green walls	- Number of buildings with green roofs/walls	Increased adoption of green	- Reduction in building energy consumption	Mitigation of urban heat island effect	- Reduction in urban temperatures	Long-term reduction in urban heat and	- Decrease in energy consumption

Annexures: Karachi Climate Action Plan (K-CAP)

Action	Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
initiatives in public buildings	launched in public buildings.	- Area covered by green roofs/walls	infrastructure in urban buildings.	- Improvement in urban aesthetics	and enhancement of urban aesthetics.	- Improvement in building energy efficiency	promotion of sustainable building practices.	- Improvement in urban climate resilience
12	Prepare a heat response plan with focus on precautionary measures, early warning systems and emergency response protocols	Heat response plan developed and implemented.	- Date of plan implementation - Number of early warning systems installed - Number of emergency response drills conducted	Improved readiness and response to extreme heat events.	- Reduction in heat-related incidents - Increase in public awareness	Enhanced public safety and resilience to urban heatwaves.	- Decrease in heat-related mortality and morbidity - Improvement in public health	Long-term resilience to urban heat and improved public health outcomes. - Reduction in heatwave impacts - Improvement in community preparedness
13	Install clean drinking water facilities in public parks, prioritizing high heat risk zones	Clean drinking water facilities installed in public parks.	- Number of water facilities installed - Percentage of high heat risk zones covered	Improved access to clean drinking water in public parks.	- Increase in park visitors using water facilities - Reduction in heat-related health issues	Enhanced public health and safety during heatwaves.	- Decrease in dehydration and heatstroke incidents - Improvement in public park usage	- Reduction in heat-related health emergencies - Increase in public satisfaction with park facilities
14	Update public procurement guidelines to specify only 5-star energy labeled fans	Public procurement guidelines updated to include 5-star energy labeled fans.	- Date of guideline implementation - Number of fans procured under new guidelines	Increased use of energy-efficient fans in public facilities.	- Reduction in energy consumption - Increase in procurement of 5-star labeled fans	Improved energy efficiency and reduction in urban heat.	- Decrease in public facility energy costs - Improvement in building comfort levels	Long-term reduction in energy consumption and urban heat mitigation. - Reduction in electricity demand - Improvement in energy efficiency
15	Implement program for provision of energy labeled DC fans to	Program to provide energy-labeled DC fans to vulnerable	- Number of DC fans distributed - Percentage of vulnerable	Improved access to energy-efficient cooling	- Reduction in heat-related health issues - Increase in energy savings	Enhanced public health and energy efficiency for	- Decrease in heat-related mortality and morbidity - Improvement	Long-term improvement in public health and energy resilience for - Reduction in heatwave impacts - Increase in energy savings

Annexures: Karachi Climate Action Plan (K-CAP)

Action		Interim output	Indicator	Output	Indicator	Outcome	Indicator	Impact	Indicator
	vulnerable populations	populations implemented.	households covered	for vulnerable populations.	for vulnerable households	vulnerable groups.	in household energy consumption	vulnerable communities.	for vulnerable populations
16	Develop plan to retrofit all public education and health facilities in Karachi with improved heat insulation	Retrofit plan for public education and health facilities developed.	- Number of facilities retrofitted - Area of facilities insulated	Improved heat insulation in public education and health facilities.	- Reduction in energy consumption - Increase in indoor comfort levels	Enhanced resilience of public facilities to urban heat.	- Decrease in heat-related health incidents - Improvement in learning and health outcomes	Long-term reduction in heat vulnerability and improvement in public services.	- Reduction in energy costs - Improvement in public health and education outcomes
<b>Drought Risk</b>									
17	Identify opportunities for recycle and reuse of water utilizing both nature-based solutions (e.g. constructed wetlands) and infrastructure development (e.g. rainwater harvesting)	Opportunities for water recycling and reuse identified and documented.	- Number of opportunities identified - Volume of water recycled/reused	Increased adoption of water recycling and reuse practices.	- Reduction in water demand - Increase in water availability	Improved water sustainability and drought resilience.	- Decrease in water shortages - Improvement in water conservation	Long-term reduction in drought vulnerability and sustainable water management.	- Increase in water recycling and reuse - Improvement in urban water sustainability
18	Develop plan to build rainwater harvesting capacity in public buildings	Rainwater harvesting capacity plan developed for public buildings.	- Number of buildings with rainwater harvesting systems - Volume of rainwater harvested	Increased rainwater harvesting in public buildings.	- Reduction in municipal water demand - Increase in water availability during droughts	Enhanced drought resilience and water conservation in urban areas.	- Decrease in water shortages - Improvement in urban water sustainability	Long-term improvement in urban water management and drought resilience.	- Increase in rainwater harvesting - Reduction in drought impacts

## Proposed outcome indicators: all sectors

Sector	Indicator	Method	Data source
<b>Buildings</b>	Increased awareness and knowledge among textile manufacturers on sustainable practices.	Surveys and training evaluations	Industry surveys, training feedback
<b>Buildings</b>	Increased adoption of energy-efficient building practices in residential construction.	Adoption rate analysis	Building permits, construction data
<b>Buildings</b>	Improved energy efficiency in public buildings.	Energy audits	Energy consumption records
<b>Buildings</b>	Increased use of energy and water-efficient technologies in new commercial buildings.	Technology adoption tracking	Commercial building data, technology sales
<b>Buildings</b>	Enhanced thermal efficiency in existing buildings.	Thermal performance assessments	Retrofitting records, energy bills
<b>Buildings</b>	Accelerated adoption of energy-efficient technologies in commercial buildings.	Technology uptake analysis	Technology sales data, industry surveys
<b>Buildings</b>	Identification of energy inefficiencies and opportunities for improvement.	Energy benchmarking	Benchmarking tools, energy audits
<b>Buildings</b>	Increased adoption of green building certifications.	Certification tracking	Green building certification bodies
<b>Energy</b>	Increased focus on renewable energy in K-Electric's future projects.	Strategic plan analysis	Utility project plans, public announcements
<b>Energy</b>	Improved efficiency and reliability of the grid infrastructure.	Grid performance monitoring	Grid operation data, reliability indices
<b>Energy</b>	Improved energy efficiency in the transmission and distribution network.	Efficiency assessments	T&D loss records, energy audits
<b>Energy</b>	Improved tracking and transparency of industrial decarbonization efforts.	Emission tracking tools	Industrial emission data, carbon reports
<b>Energy</b>	Increased adoption of renewable energy (RE) and energy efficiency (EE) technologies in manufacturing.	Adoption rate analysis	Technology sales, industry surveys
<b>Energy</b>	Identification and implementation of energy-saving measures in large industries.	Energy audits, case studies	Industry energy audits, case studies
<b>Energy</b>	Implementation of cap and trade schemes and carbon levies in the industrial sector.	Policy analysis, implementation reviews	Regulatory records, industry reports
<b>Energy</b>	Increased adoption of energy-efficient appliances in households.	Market penetration analysis	Appliance sales data, household surveys
<b>Energy</b>	Increased access to solar PV and energy-efficient retrofits in low-income and informal housing.	Access tracking, adoption studies	Solar PV sales, retrofit program data
<b>Energy</b>	Increased procurement of energy-efficient appliances by government agencies.	Procurement tracking	Government procurement records
<b>Transport</b>	Increased affordability and adoption of 2-wheeler EVs.	Market analysis, adoption rate studies	EV sales data, market surveys
<b>Transport</b>	Expansion of EV charging infrastructure.	Infrastructure mapping, project tracking	Charging station data, utility reports
<b>Transport</b>	Demonstrated feasibility and user acceptance of integrated EV chargers.	Pilot project evaluations	Pilot project reports, user surveys
<b>Transport</b>	Informed decision-making on battery swapping and rental solutions.	Feasibility studies, market analysis	Feasibility study reports, market data

Annexures: Karachi Climate Action Plan (K-CAP)

Sector	Indicator	Method	Data source
Transport	Transition to electric 2-wheelers in government departments.	Adoption tracking, policy review	Government vehicle records, adoption reports
Transport	Increased adoption of EVs in the 3-wheeler segment.	Market analysis, adoption rate studies	EV sales data, market surveys
Transport	Increased attractiveness of EVs in the 2-wheeler and 3-wheeler segments.	Incentive program analysis, market surveys	Incentive program data, sales records
Transport	Increased availability and coverage of E-bus services.	Service expansion tracking, adoption studies	E-bus fleet data, ridership statistics
Transport	Improved monitoring and regulation of vehicle emissions.	Emission monitoring studies, regulation compliance checks	Emission data, regulatory records
Transport	Increased compliance with emission standards for older vehicles.	Compliance checks, regulation enforcement reports	Inspection records, emission data
Transport	Increased availability and use of cleaner fuels.	Fuel market analysis, adoption tracking	Fuel sales data, market surveys
Waste	Reduction in the use of single-use plastic bags.	Regulation enforcement tracking, public surveys	Retail data, survey reports
Waste	Increased public awareness and reduction in plastic consumption and littering.	Awareness campaign evaluations, public surveys	Campaign reports, littering data
Waste	Increased public awareness and adoption of waste-free and plastic-free practices.	Awareness campaign evaluations, behavior change studies	Campaign reports, public surveys
Waste	Improved waste segregation at source.	Waste segregation studies, monitoring reports	Waste management data, household surveys
Waste	Increased adoption of waste segregation practices at household level.	Household surveys, adoption tracking	Household survey data, waste collection records
Waste	Increased public understanding and participation in waste segregation and composting.	Public surveys, participation tracking	Survey reports, composting program data
Waste	Improved waste management and reduced pressure on existing landfill sites.	Landfill usage tracking, waste management studies	Landfill site data, waste collection records
Waste	Increased producer responsibility for waste management.	EPR program evaluations, industry surveys	EPR program data, industry reports
Waste	Informed decision-making on methane capture technology adoption.	Feasibility studies, techno-economic assessments	Feasibility study reports, market data
Waste	Informed decision-making on organic fertilizer production.	Feasibility studies, market analysis	Feasibility study reports, market data
Waste	Improved energy efficiency in water supply systems.	Energy audit, system performance evaluations	Energy audit reports, utility records
Waste	Informed decision-making on methane capture from sewage treatment.	Feasibility studies, market analysis	Feasibility study reports, market data
Waste	Improved separation of sewerage and drainage systems.	Infrastructure assessment, project tracking	Infrastructure data, project reports

Annexures: Karachi Climate Action Plan (K-CAP)

Sector	Indicator	Method	Data source
Waste	Increased public awareness and participation in health and environmental initiatives.	Awareness campaign evaluations, public surveys	Campaign reports, public health data
Adaptation	Improved flood resilience through enhanced public park networks.	Flood risk assessments, park development tracking	Flood risk data, park development records
Adaptation	Improved water retention capacity in urban areas.	Infrastructure assessment, project evaluations	Infrastructure data, project reports
Adaptation	Improved permeability and reduced surface runoff in flood-prone areas.	Surface permeability studies, infrastructure project tracking	Infrastructure data, flood risk assessments
Adaptation	Enhanced storm drainage and landscape integration in urban areas.	Infrastructure project evaluations, landscape studies	Project reports, urban landscape data
Adaptation	Improved drainage capacity and reduced flood risk in high-risk zones.	Infrastructure assessments, flood risk tracking	Infrastructure data, flood risk reports
Adaptation	Restoration of natural riverbeds and increased vegetation cover.	Riverbed restoration studies, vegetation monitoring	River restoration data, vegetation cover records
Adaptation	Increased land availability for mangrove restoration.	Land use mapping, feasibility studies	Land use data, restoration project reports
Adaptation	Increased financial support for mangrove restoration.	Budget analysis, project tracking	Government budget data, project reports
Adaptation	Improved land use planning and reduced construction in high-risk coastal areas.	Land use planning studies, zoning enforcement tracking	Zoning data, land use records
Adaptation	Increased financial support for urban greening initiatives.	Budget allocation tracking, project evaluations	Financial reports, project data
Adaptation	Increased adoption of green infrastructure in urban buildings.	Adoption rate analysis, project tracking	Building data, project reports
Adaptation	Improved readiness and response to extreme heat events.	Heat response plan evaluations, emergency response tracking	Emergency response data, plan reviews
Adaptation	Improved access to clean drinking water in public parks.	Facility assessments, water quality testing	Facility data, water quality reports
Adaptation	Increased use of energy-efficient fans in public facilities.	Procurement tracking, installation records	Procurement records, installation data
Adaptation	Improved access to energy-efficient cooling for vulnerable populations.	Program evaluations, distribution tracking	Program data, household surveys
Adaptation	Improved heat insulation in public education and health facilities.	Insulation improvement tracking, energy audits	Facility data, energy audit reports
Adaptation	Increased adoption of water recycling and reuse practices.	Adoption rate analysis, project tracking	Project data, market surveys
Adaptation	Increased rainwater harvesting in public buildings.	Installation tracking, water collection data	Installation records, water usage reports

## Annex D

# Project Brief: Solid Waste Emergency & Efficiency Project (SWEEP)

Budget: USD 100 million

The SWEEP project responds to the Karachi government request to reduce flood risk in Karachi by:

- a) Improved emergency response in case of floods
- b) Mitigate health and economic impacts
- c) Address World Bank cross-cutting theme of “ending extreme poverty, promoting shared prosperity”

The project will address institutional gaps, undertake physical infrastructure improvement, and undertake one-time cleaning of the accumulated solid waste in natural draining channels (nullahs).

The budget allocations are as follows:

### · USD 11 million:

- o Cleaning of solid waste from water channels
- o Disposal of collected solid waste from cleaning
- o Removal of any obstructions to the flow of water
- o Communication and awareness for communities living near drainage channels

### · USD 84 million:

- o Purchase of critical equipment, including personal protective equipment for staff, trucks, containers
- o Upgrading of 30 existing waste collection sites
- o Construction of an additional 50 waste collection sites
- o Construct new sanitary landfill site at Jam Chakro
- o Support waste-picker community at the Jam Chakro site
- o Methane capture at landfill sites
- o Design and construction of waste treatment solutions

### · USD 10 million:

- o Capacity building of implementing agencies
- o Identify and remove barriers for private sector involvement

## GHG emissions reduction

Since 44% of Karachi’s 5.1 million tons per year waste is organic, improved waste treatment, methane capture will reduce GHG emissions by 1.25 million tons of CO<sub>2e</sub> per year and 28 million tons of CO<sub>2e</sub> cumulatively by 2040 are expected wider benefits generated by this project.

The World Bank estimates a carbon finance potential ranging from USD 795 million to USD 1.64 billion up to the year 2040 with these GHG emissions reductions.

## Annex – E KCAP Project Team

### K-CAP Project Team



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