Alexandria Green City Action Plan

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EBRD GREEN CITIES

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Foreword

Alexandria has always been a pioneering city since its establishment in 322 BC, serving as one of the earliest models of urbanization and modernity. It has been a centre for trade, economy, science, and cultural diversity since ancient times and continues to be a key contributor to Egypt's economy.

Under the leadership of President Abdel Fattah El-Sisi, Alexandria has witnessed major efforts and projects aimed at achieving sustainable development. The commitment of the presidency to accelerating local and urban climate action to meet the goals of the Paris Agreement and the Sustainable Development Goals was demonstrated through Egypt's hosting of the United Nations Climate Change Conference (COP27) and the Twelfth World Urban Forum (WUF12). This commitment continues to grow through international cooperation.

As the Governor of Alexandria, I bear a great responsibility in presenting the city's Green City Action Plan (GCAP) as part of our commitment to sustainable development. Given the challenges the city faces due to climate change, a series of effective plans and measures have been designed and implemented to address this challenge, ensuring the preservation and improvement of the quality of life for our citizens and future generations in harmony with nature.

The implementation of this plan will ensure that Alexandria continues to evolve as a sustainable and climate-resilient city through targeted and feasible investments. I extend my sincere gratitude to our local and international partners who have contributed to the development of this plan, which serves as a roadmap towards a more sustainable future for Alexandria.

Vice Admiral /Ahmed Khaled Hassan Saeed

2025

Governor of Alexandria

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Abbreviations

Abbreviation	Description
ADSCO	Alexandria Distribution Company
APTA	Alexandria Public Transport Authority
ASB	Advisory for Small and Medium Business
AWCO	Alexandria Water Company
BRT	Bus Rapid Transit
CapEx	Capital Expenditure
CAPW	Construction Authority for potable water and Wastewater
EBRD	European Bank of Reconstruction and Development
EEAA	Egyptian Environmental Affairs Agency
EEHC	Egyptian Electricity Holding Company
Egypt ERA	Egyptian Electric Utility and Consumer Protection Regulatory Agency
ESCO	Energy Service Company
EU	European Union
EV	Electric Vehicle
EWRA	Egyptian Water Regulatory Agency
EWS	Early Warning System
G&EI	Gender and Economic Inclusion
GCAP	Green Cities Action Plan
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEFF	Green Economy Finance Facility
GHG	Greenhouse Gas
ICA	Industrial Control Authority
ICZM	Integrated Coastal Zone Management Plan
IDA	Industrial Development Authority
IDB	Indicators Database
IGES	Institute for Global Environmental Strategies
IMP	Impact Monitoring Plan
IoT	Internet of Things
IT	Information Technology
ITS	Integrated Transport System
LTRA	Land Transport Regulatory Authority
LTRA	Land Transport Regulatory Authority
MDB	Multilateral Development Bank
MOHUUC	Ministry of Housing and New Urban Communities
MoEA	Ministry of Environmental Affairs
MoERE	Ministry of Electricity and Renewable Energy
MoHP	Ministry of Health and Population
MoHUUC	Ministry of Housing, Utilities and Urban Communities
MoI	Ministry of Interior
MoLD	Ministry of Local Development
MoT	Ministry of Transport
MoTI	Ministry of Trade and Industry
MoWRI	Ministry of Water Resources and Irrigation
NBS	Nature-based Solutions
NDC	National Determined Contributions
NGO	Non-governmental Organisation
NMT	Non-motorised transport
NREA	New and Renewable Energy Agency
NRW	Non-Revenue Water
NUCA	New Urban Communities Authority
PMP	Progress Monitoring Plan
PPP	Public and Private Partnership
PV	Photovoltaic
RE	Renewable Energy
RTI	Rela-time Information System
SCADA	Supervisory Control and Data Acquisition
SDG	Sustainable Development Goals
SuDS	Sustainable Urban Drainage Schemes
SUMP	Sustainable Urban Mobility Plan
SUP	Strategic Urban Plan
SWM	Solid Waste Management
SWM	Solid Waste Management
TPP	Thermal Power Plants
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WTP	Water Treatment Plan
WWTP	Wastewater Treatment Plant

Executive Summary

Green Cities Programme

In May 2023, the Governorate of Alexandria (the Governorate) launched the development of a Green City Action Plan (GCAP), as a commitment to systematically assess Alexandria's environmental and infrastructure challenges and support its transition to a green, low-carbon and resilient future.

The Alexandria GCAP offers the opportunity to align the Governorate's long term development goals with an aspirational green growth agenda and provide a roadmap of long-term investments that will generate benefits across multiple sectors.

Existing Conditions in Alexandria Governorate

Alexandria (the City) is one of the oldest cities in the world and as such offers a complex urban structure developed over the years. Its ancient history makes it a vibrant cultural hub boasting heritage sites and educational institutions. Alexandria is also the second largest city in Egypt with a population of around 5.6 million residents and host to the second largest urban economy in Egypt, with industries ranging from textiles and chemicals to construction, tourism, and shipping.

Given the Governorate's national significance and growth, the City's surface area has doubled over the past 30 years and is expected to continue to expand as population is forecast to reach 6.8 million by 2030. Constrained by its geography, Alexandria developed along the coast across 85 km on a T-shaped peninsula, located between the sea, lagoons and former lakes, having a significant impact on these areas.

Alexandria sits within a sensitive ecological environment with agricultural land surrounding the urban core, and critical nature like Lake Mariut and the El-Nakheil Island Protected Area. These ecological assets are adversely impacted by the City's rapid growth and insufficient infrastructure provision, especially in relation to solid waste management (SWM) and wastewater management, as well as heavy industry. Additionally, air pollution is worsening due to growing industrial activities and increasing traffic.

At the same time climate change is a decisive factor in Alexandria's development. The City is highly vulnerable facing a number of climate challenges which will significantly shape its future development trajectory. Flooding of urban areas through extreme rainfall patterns, increasingly high temperatures contributing towards urban heat extremes, sea-level rise and coastal erosion which intensify soil salinity affecting local ecosystems and biodiversity, and water scarcity provide a complicated context for future development.

Infrastructure Provision

Considerable efforts have been made to improve infrastructure provision over time, however, significant opportunities remain to tackle the following challenges:

Land use - Over a third of the urban area is increasingly becoming vulnerable to coastal flooding. Unplanned development outside the urban core and presence of heavy industry across several locations adversely impact the environment and significantly constrain the ability to provide adequate infrastructure, while a highly dense urban core with limited green and open spaces makes it difficult to address climate related risks.

Transport - There is heavy reliance on individual car-based transport with ageing car fleet causing heavy pollution, congestion, and lack of public transport modes integration that lead to inefficiencies in travel.

Industry - The industrial sites in Alexandria developed with limited planning, and zoning impacting a growing city while there is high use of energy, fossil fuel consumption and limited industrial waste and wastewater disposal and treatment, which pollutes the City's environmental and water assets.

Energy - Frequent power outages occur due to an outdated distribution network, overloading of cables. While Alexandria is prioritising local energy production and diversification to transition to a low-carbon electricity sector there are limited opportunities due to the current institutional framework.

Water - Water availability is a key challenge caused by the limited and distant raw water and aggravated by climate change. The water supply and wastewater management system are generally in good condition but requires some modernisation to improve environmental standards and efficiencies. At the same time there is a need to develop new sources of water and promote reuse

Solid Waste - Waste is collected, however treatment is insufficient with disposal at an open dumpsite and illegal sorting and recycling occurring post-disposal. There is potential for improved collection of waste preventing it from ending up in open land or being burnt openly.

Priority Challenges

To maximise the City's potential there are four key challenges and that will need to be addressed: climate change, water scarcity and environmental and air pollution. The actions of this GCAP aim to address these through targeted investments.

Environmental Pollution
Urban growth in combination with aging wastewater and solid waste infrastructure, and heavy industry, leads to pollution of Alexandria's agricultural land and environmental assets, such as Lake Mariut and El-Nakheil Protected Site.

Air quality
Alexandria houses more than 50% of Egypt's industrial activity, coupled with high levels of traffic, this leads to poor air quality.

Water Scarcity
Drinking water is becoming increasingly scarce in Alexandria due to a combination of a decrease of overall rainfall and flows through the Nile, increasing demand and pressure from saline intrusion.

Climate Change

Alexandria is facing interconnected climate risks that are exacerbating existing urban challenges, for example, increased severity of urban smog due to air pollution during hot days.

Heat
As temperatures rise, the dense urban fabric with limited green space becomes at risk of Urban Heat Islands, exposing more people to extreme heat.

Sea-level rise
Alexandria is at high risk of sea level rise, impacting its coastal infrastructure and leading to coastal erosion and flooding.

Pluvial flooding
Climate change leads to more frequent and severe storms. The City floods regularly when heavy rain overwhelms the drainage system with events seen to be increasing because of climate change.

Alexandria Green City Action Plan

In developing the GCAP, the Governorate have engaged in extensive stakeholder consultation to develop a clear understanding and agreement on the priority challenges facing Alexandria and help articulate a clear vision and a politically and economically feasible plan of investments and policies to support its delivery. To support the development of the GCAP, the Alexandria Strategic Urban Plan has been used as a foundation, building upon its strategic outlook for the City and its future sustainable development.

Vision Statement

> *"Alexandria will strive to be a global exemplar for cities facing intricate urban challenges amidst a worsening climate change context. Committed to responsible and sustainable growth, while remaining dedicated to safeguarding the well-being of its people, natural resources and historic significance, Alexandria will work towards a future proofed coastal urban living".*

The vision is supported by clear and measurable sectoral strategic goals that have guided the development of actions and investments in Alexandria.

Sectoral Strategic Goals

Reduce Alexandria's vulnerability to pluvial and coastal flooding, enhance local preparedness and capacity to respond to climate change.

Optimise land use to control unplanned growth through the delivery of brownfield redevelopment and multipurpose spaces that enhance urban resilience and promote sustainable urban development.

Expand and enhance Alexandria's public transportation system to support modal shift through improvement of the level and quality of service provision, promote low carbon alternatives, improve traffic flow and widen options for active travel.

Improve the ecological quality of Alexandria's surface water bodies and enhance water conservation through reduced consumption and increased re-use.

Improve Alexandria's Energy and Industry sectors by accelerating the transition to renewable energy sources and fostering sustainable energy practices.

Improve SWM across Alexandria, prioritising provision of facilities for effective waste collection and reduction, treatment, recycling, and energy recovery, in alignment with the waste management hierarchy.

Given the complexity of issues Alexandria is facing, this GCAP pays particular attention to the interdependencies arising from climate change risks within an already highly fragile environmental ecosystem and their role in magnifying existing vulnerabilities in the future. Throughout the GCAP, nature is considered a critical asset that needs to be safeguarded. The proposed interventions are targeting at protecting the environment from further pollution, reversing biodiversity loss, and introducing Nature-Based Solutions where possible.

The GCAP takes a spatial approach to development. The key objective is to reflect the specific characteristics of the areas and prioritise the most pressing challenges.

This approach allows to consider synergies and inter-dependencies between actions in a specific location, as well disruptions and knock-on effects from their implementation that would require careful planning and coordination. GCAP actions are organised around two focus areas: Alexandria Urban Core and Lake Mariut & Al Ameriyah Growth area. In addition, to the two focus areas, some GCAP actions are governorate-wide given their remit across the area. For each of these areas a set of short, medium, long-term actions are developed, as well as selected high impact policies.

The GCAP actions were developed considering opportunities to deploy smart applications to improve efficiency. They also include gender and social considerations ensuring that with implementation benefits are generated for the whole community. Alexandria faces gender disparities in workforce participation and high youth unemployment. Refugees and vulnerable groups struggle with overcrowding, limited access to housing, services, and infrastructure as well as exposure to climate risks.

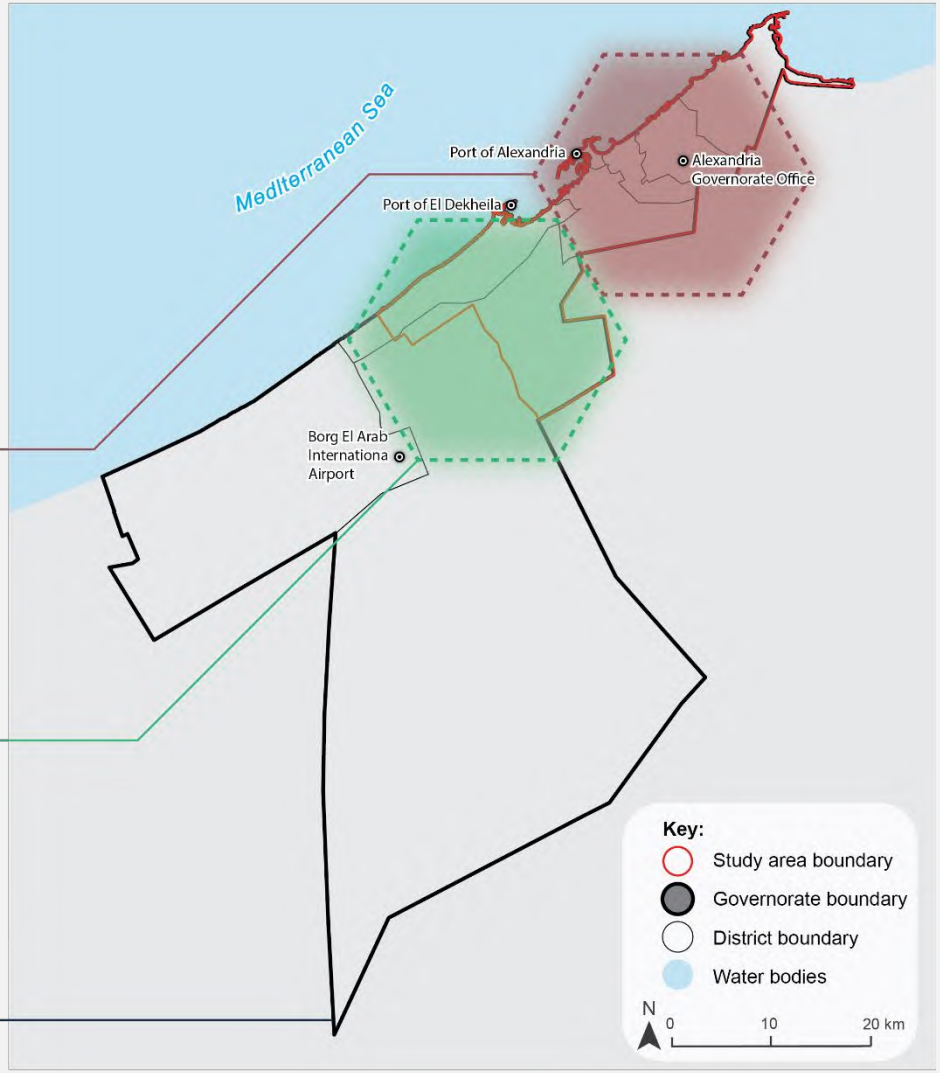
FOCUS AREA 1

Alexandria Urban Core
Challenges:
- Pluvial flooding & coastal protection;
- Water scarcity;
- Increasing traffic and the compounding effect of worsening air quality and heat; and
- lack of open spaces.

FOCUS AREA 2

Lake Mariut &
Al Amreya Growth Area
Challenges:
- Reversing environmental pollution in the area;
- Providing critical connections and interventions in addressing wider water scarcity; and
- Supporting the sustainable development of Al Amreya urban expansion as the new growth area of Alexandria Governorate.

Governorate Wide



Summary of Projects

The table below provides an overview of GCAP actions by spatial focus area including estimated costs and phasing of implementation as indicated by the colour coded classification. The total investment need of the GCAP actions that can be costed is approximately € 506.38 million (EGP 26,903.97 million), taking the average where cost ranges are indicated[1].

- Short term – 1-3 years
- Medium term – 3-5 years
- Long term – 5-10 years

Table - Overview of GCAP Actions

Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
Focus Area I – Alexandria City		**€ 105.50 million / EGP 5,605.22 million**		
CR2 - Sustainable Drainage	A programme of investments combining green and grey stormwater management approaches to address increasing flooding risks. These include: • Sustainable Urban Drainage schemes across the City; • Pilot restoration of Mahmoudia Canal; • Expansion of city drainage network; • Creating retention basins or small reservoirs to increase storage capacity.	Improve stormwater management, additional open/ green spaces also generate further benefits in terms of recreation, cooling, and biodiversity. Opportunity to significantly improve conditions for poor and marginalised groups in the City by reducing flood risk in low-income neighbourhoods.	€ 35 million	EGP1,860 million
TR1 - Sustainable Urban Mobility Plan & Priority Transport Investments	The project will implement critical transport investments in Alexandria to manage traffic and decongest the centre while enhancing pedestrian accessibility. These are: • **1st investment:** Replanning the transverse roads (six links) linking the Corniche Road and Mahmoudia to alleviate traffic in the urban core; • **2nd investment:** Expanding the Traffic Management System established by the Alexandria Traffic Department; and • **3rd investment:** Sidewalks and pedestrian paths are an integral part of SUMP as people move to, from, and between transport stops, stations, and hubs. To support the implementation of these projects in a holistic way, a Sustainable Urban Mobility Plan (SUMP) will first need to be developed. The SUMP includes policies, traffic model development, software procurement, and measures to address multimodal transport across the entire urban agglomeration, including public and private operators, passenger and freight, zoning and parking, and door-to-door mobility.	Improve the efficiency and cost-effectiveness of the transport network, reduce the impact of transport on the environment through a reduction in GHG emissions and improve air quality. It will ensure accessible transport options for all citizens and personal safety and security within the transport system and improve the overall quality of life for the citizens.	SUMP: €0.5 – 2 million, 1st Investment – tbc. 2nd Investment: € 3-6 million 3rd Investment – tbc.	SUMP: EGP 26.5 – 106.3 million, 1st Investment – tbc. 2nd Investment: EGP 160 -318 million 3rd Investment – tbc.

[1] The real total investment need is likely higher because some of the actions require further studies to estimate their costs.

Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
TR2 – Decarbonisation of Public Transport Fleet	This investment will support and replace the APTA fleet by purchasing and operating 100 new buses in the short term that are equipped with modern amenities, facilities, and systems. The project will promote improved mobility, enhance user experience and ridership of the bus fleet, increase energy efficiency, and reduce emissions from public transport. The investment will consider the most appropriate option (CNG or electric) at feasibility stage. In the medium term, the investment will be extended to purchase and operate 300 more buses to replace about 2/3 of APTA Fleet. This action will also consider the expansion and/or upgrade of existing required infrastructure.	Reduce tailpipe emissions from public transport in Alexandria. It will further improve air and soil quality. This project will benefit vulnerable residents suffering from respiratory diseases by improving air quality, while also enhancing safety, security, and access to basic services. It will promote social equity by ensuring these improvements are accessible to all.	€ 40 million for 100 buses (based purchase of electric buses. CAPEX for CNG buses will be lower) € 0.5 million (charging)	EGP 2,577 million EGP 26.5 million (charging)
TR7 - Replacement Services Needs Identification and Implementation	Alexandria will benefit from considerable investments that are already underway to upgrading the Abu Qir Metro and the Al Raml Tram with replacement services provided by the private sector. This action will look to plan and provide for similar services under future planned upgrades with a view of incorporating these services on a semi-permanent basis during seasonal peaks in the summer.	Provide replacement services across carefully planned routes to minimise disruption during construction phase.	Requires further detailed study	Requires further detailed study
TR8 – Metro 2 & Future Tram Upgrades	In the long term, there will be need to further improve and expand the network to support modal shift as the population increases. These will include Alexandria line 2 to connect coastal zone (phase 1) and future EET station at Carrefour commercial zone (phase 2). Additionally, there is potential to rehabilitate other tram lines and suburban services and increasing restrictions on private vehicles, including potential restrictions and rerouting of freight away related to industrial and port areas away from urban areas and rationalising minibuses routes. This action relates to investment required for feasibility studies and preliminary design for the agreed alignments. It is expected that projects would be implemented in the long term.	Support further modal shift through expanded public transportation coverage	Requires further detailed study	Requires further detailed study
TR9 - Developing a Green Corridor Under the Abu Qir Metro Viaduct	With the upgrade of the Abu Qir Metro line, there is an opportunity to develop a green corridor under the Metro viaduct. The spaces under the viaduct and around metro stations could be used for community and commercial uses to enhance social cohesion and provide opportunities for new jobs. The action will require a feasibility and concept design study (urban layout, social infrastructure, green landscaping, etc).	Enhance provision of social infrastructure with the opportunity for improving local livelihoods and increased provision of green and opens spaces.	Requires further detailed study	Requires further detailed study
TR4 - Integrated Public Transport Network Ticketing (Electronic Fare Payment System)	This investment involves developing and implementing an integrated ticketing system, real-time tracking, and a unified timetable across all public transport modes. APTA introduced the electronic ticketing system on some buses by adding electronic devices for ticket processing. This action will look to build on initial efforts by to develop a system including for the Metro and tram lines to provide	Promote efficient, environmentally friendly, user-friendly, comfortable, and well-connected public transport and make it the transport of choice. It will encourage people to choose public	Requires further detailed study	Requires further detailed study

Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
	passengers with improved access to flexible and easy multimodal travel and enhance user experience and ridership.	transport over private cars and thereby reduce GHG emissions, improve air quality and reduce congestion.		
TR6 - Implementation of the BRT corridors	The BRT is planned to run on two main corridors: the first along the Corniche Road and the second along the Mahmoudia axis. This investment will support the development of dedicated bus lanes, bus stops, and other infrastructure supporting the transport system. An intelligent transport system (ITS) will be implemented, including real-time bus tracking, traffic management, and fare collection through smart cards or mobile apps. Implementing the system will require capacity-building programs to train the drivers, operators, and staff and to raise awareness about the benefits of the BRT system among the public.	Improve mobility, reduce traffic congestion, improve air quality, provide a safe, efficient, reliable, affordable, sustainable mass transit system, and create jobs during the construction and operation of the BRT system.	Two bus rapid corridors € 20 million	Two bus rapid corridors EGP 1,062.5 million
WW3 - Expansion of Sewerage Network	Investment to expand sanitation provision to unserved areas and new planned areas in Al Ameriyah growth area and Alexandria Urban Core.	Increase the coverage of the sewerage network while improving sanitation services aimed to promote public health and environmental sustainability through various activities related to wastewater management, cleanliness, and hygiene.	Requires further detailed study	Requires further detailed study
LU1 - Mina El Basal/Mahmoudia Canal Development	Regeneration of the industrial heritage site of Minal El Basal to create a mixed-use development in the heart of the City reducing the demand for out of town development, connect with the existing transport infrastructure, and expand the tourist trail. It can also be combined with the nearby Mahmoudia Canal Restoration which further enhances urban resilience in terms of climate risks.	Urban regeneration and employment opportunities, new tourist area, increased connectivity and active travel opportunities. Additionally potential to increase supply of housing including affordable housing.	Requires further detailed study	Requires further detailed study
Focus Area II – Lake Mariut/Al Ameriyah Growth Area		**€ 273.63 million/ EGP 14,537.96 million**		
E1 - Sludge to Energy	Investment in the development of a sludge to energy facility, utilising anaerobic digestion to produce biogas for use by a combined heat and power plant, at the Al Ameriyah WWTP.	Help to deal with the increased level of sludge produced because of wastewater treatment and reduce the amount being discharged into the local environment there by improving its quality. Improved water, air and soil quality, benefitting vulnerable residents suffering from respiratory diseases.	€ 30 million	EGP 1,594 million
E2 - Solar Plant	Scaling up the existing small-scale solar farms across the 9N site and additional solar energy systems to produce clean energy for four water treatment plants at Manshia 2, Alseyouf, Maamoura and Nozha, and the pressure booster at Abu Qir station.	Potential to produce 106,000 MWh of renewable energy, reduction of around 44,200 tonnes of CO_2e annually. This would help to reduce the reliance on	€ 33 million	EGP 1,753 million

Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
		fossil fuels and increase climate resilience. The project has the opportunity to promote gender diversity by ensuring equal opportunities for women in PV development, construction, and operations, while providing training accessible to all. It should support women entrepreneurs and ensure equal participation in decision-making, creating equitable opportunities across the PV value chain.		
WW2 - Small Scale Desalination Plants	In addition to the national level programme, two desalination plants with a capacity of 50,000 m3/day each will be required to accommodate future population growth. This action considers the investment for the development of these plants. For full GHG emissions offset, a solar PV system of at least 30 MWp size is also considered as a requirement.	Diversify water sources and reducing dependency and pressure on traditional freshwater supplies. The desalination plants will improve access to clean water, prioritising underserved communities and enhancing water availability for all residents.	€ 50 million (excluding cost of Solar PV at 16.5 million)	EGP 2,656.5 million (excluding cost of Solar PV at 877 million)
TR5 - Public Transportation Connection between Al Ameriyah and Alexandria City	This action is to invest in dedicated transport services (buses) between Alexandria City and the Al Ameriyah growth area. Currently, the two parts of the City have limited mass transport options and people rely on private cars to commute between them. This investment will form part of the Sustainable Urban Mobility Plan, which considers investing in dedicated transport services between the two areas, including bus corridors and park-and-ride facilities.	Improve mobility, reduce traffic congestion, improve air quality, provide a safe, efficient, reliable, affordable, sustainable mass transit system, and create jobs during the construction/operation of the system.	€ 100 million for 2 bus corridors	EGP 5,333 million for 2 bus corridors
E3 - Sustainable Energy Residential Compound Package	This project aims to support residential compound developers in investing in a carefully selected bundle of renewable energy and energy efficiency technologies, in addition to smart distribution networks. These include: • Installation of solar PV system on roofs; • Use of solar hot water systems; • Smart grid application and smart meters (due to residential compounds large area, they typically have their own distribution networks); and Energy/cost-efficient district cooling applications, relying on large chillers which are more efficient than individual Air Conditioning units.	The integration of renewable energy sources and energy-efficient technologies in residential compounds can significantly reduce GHG emissions. The project will also contribute to climate adaptation by reducing the city's overall energy use thus its vulnerability to energy shortages caused by climate change.	€ 0.17 – 0.63 million (per unit)	EGP 9 – 33.5million
WW4 - Upgrade of Wastewater Treatment Plants	There are currently 6 WWTPs serving the Alexandria Governorate. This action is for an investment to vertically expand the capacity of 3 existing WWTPs, including: • Hanovil (50,000 to 100,000 m3/day);	Increase pollution control by reducing the amount of untreated effluent	€ 60 million	EGP 3,188 million

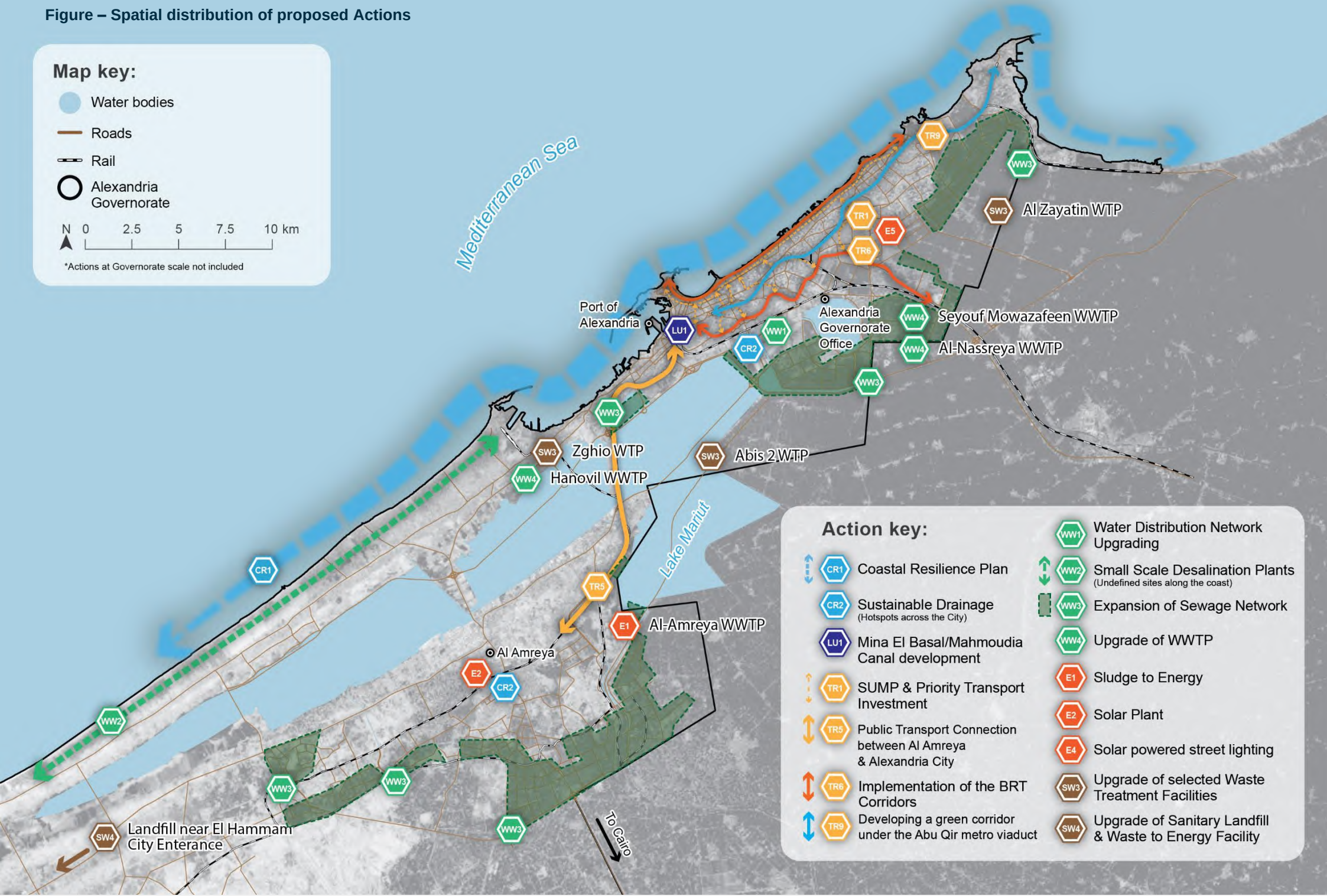
Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
	• Seyouf Mowazafeen (from 7,000 to 10,000 m3/day); and • Al-Nassreya from (3,000 to 8,000 m3/day).	reaching the environment. Increased health and hygiene for residents.		
WW5 - Industrial Water & Wastewater Management	This action considers the potential for industrial facilities to invest in on-site wastewater treatment (to meet the national code for wastewater quality) and include integrated treatment units, recycling of water, sensors, water conservation, and reduction of pollution load on sewers to prevent mixing with municipal wastewater, thereby improving the effectiveness of WWTP.	Increase pollution control by reducing the amount of untreated industrial effluent reaching the environment.	Requires further detailed study.	Requires further detailed study.
WW6 - Treated Sewage Effluent Use in Industry	There is potential for Treated Sewage Effluent to be used in Industry. This action is for the development of a study to define the project and end users with a view of replicating elsewhere in the Governorate.	Optimise water use and helping to conserve fresh water sources through water reuse. Increase pollution control.	Requires further detailed study	Requires further detailed study
Governorate Wide Actions			**€ 127.25 million / EGP 6760.79 million**	
CR1 - Coastal Protection	Investment to address the risks of sea-level rise and coastal erosion through a series of coastal protection infrastructure, designed as a mix of traditional hard engineering, and more nature-based approaches. The project will link closely with the *Enhancing Climate Change Adaptation in the North Coast and Nile Delta Regions of Egypt* project and associated Integrated Coastal Zone Management. Investments will include: • Beach Nourishment to address significant ongoing beach loss and associated loss of protection; • Rehabilitation of sea walls and revetments; • Submerged reefs to reduce the impact of waves and storm surges while supporting biodiversity.	Increase protection of coastal area of the city and key infrastructure. Enhance social and environmental value of beaches and marine environment.	€ 40 million	EGP 2,125 million
CR3 - EWS and Local Preparedness Plan	There is an existing local preparedness plan but no system of early warning for coastal and flood hazards. This action will enhance the local preparedness plan so that it incorporates climate risks and is supported by a multi-hazard early warning system. This will include a review and refresh of the plan to identify how climate-related hazards can be incorporated and the existing alert system strengthened. It will link the current system with planned development of a multi-hazard warning system under the EU MedEWS project[2], and identify what additional investments in the current hydrometeorological system are needed,	The City will be better prepared for extreme events and climate-related hazards, with a particular focus on reducing impacts on vulnerable groups.	Plan: € 0.25 million, Hydromet improvements: € 0.5 - 1 million	Plan: EGP 13.3 million, Hydromet improvements: EGP 26.5 – 53 million
CR4 - Cool Street Design	This action comprises retrofitting existing streets to enhance their greening and promote resilience. This involves updating and modifying the street infrastructure to enhance cooling and permeability in areas where heat stress will be more pronounced.	Improved resilience to increasing temperatures.	€ 5 million	EGP 265.6 million

[2] medewsa.eu

Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
WW1 - Water Distribution Network Upgrading	Upgrading the water distribution network, to minimize leakage including the replacement of old asbestos pipes to mitigate health risks and improve the durability of the system. The investment includes: • Implementation of advanced leak detection technologies; • Upgrade of the water supply network in areas suffering from low pressure and low water velocities by installing larger diameter pipes and pressure-boosting stations; • Replacement of damaged pipes and pump stations to meet the urban demands. • Completion of 2 District Meter Zoning; and • Implementation of SCADA systems for the existing 40 pumping stations.	Increasing the availability of potable water through reduced non-revenue water aimed at a reduction from 24% to 21%. Reduced leakage and contamination of water dure to the drawing of pollutants through leaks in the network. Increase in quality through the removal and replacement of old asbestos pipes. Reduced GHG emissions through reduced NRW and energy demands associated with disinfecting water. The project would improve water quality and access to potable water via safe connections, benefitting vulnerable residents, for example, people with disabilities and those suffering from long term illnesses.	€ 26 million	EGP 1,381 million
SW1 - Solid Waste Study	Undertaking a study to better understand and address not only current challenges and opportunities within the waste sector but also future, including those related to new urban growth areas across the Governorate. This will be a comprehensive study which will (based on a forecast on waste generation and composition) assess the whole waste management system (collection, sorting/processing, recycling, treatment and final disposal) based on a multi-criteria analysis in order to assess the needs for future investment components for different waste streams.	The study will help to further develop and improve the SWM across the Governorate that will identify opportunities to reduce environmental pollution and emissions.	€ 0.4 million	EGP 21.25 million
E4 - Automated solar powered street lighting for public places and roads	Installation and maintenance of solar-powered lighting units along the new west and east corridor to cover 60 km in total. Each unit, equipped with a 60-200 Watt solar panel, will be a solution for road lighting eliminating the need for extensive and costly infrastructure such as transformers and cables.	Reduce energy consumption. The use of sensors/digital control switches extends the lifetime of the lamps/batteries and reduces the size of the solar panel/battery required, leading to significant cost savings. The project will enhance energy efficiency and public safety, particularly for women, by improving street and road lighting, reducing crime, and increasing security. It will promote gender equality by ensuring women's participation in all stages, ensuring equitable benefits across all community sectors.	€ 1.6 million	EGP 85 million.

Action name	Description	Action impacts/benefits	CAPEX (EUR (€))	CAPEX (EGP)
TR3 - Expansion of EV Charging Infrastructure	Existing private car EV charging stations within the city are insufficient and need to be expanded. There are currently only four points across the Governorate. This action considers the potential for the private sector to invest in and provide EV charging points across the City and how the Governorate can facilitate this investment.	Reduce GHG emissions from public transport in Alexandria. It will further improve air and soil quality.	1 charging station for cars: € 5,000	1 charging station for cars: EGP 265,600
SW2 - Decentralised Transfer Stations	The action seeks to develop additional transfer stations across Alexandria with an intended capacity of handling around 500 tonnes of waste per day. Additional transfer stations will improve SWM and help create a more efficient collection and waste transfer process while reducing the distances collection vehicles must travel to dispose of waste.	Improve solid waste management systems, limiting environmental impacts.	€ 3 million	EGP 159.4 million
SW3 - Upgrade of Waste Treatment Facilities	This investment would follow on from the Solid Waste Study to upgrade existing facilities in appropriate locations and combine waste sorting, recycling, composting, and where appropriate energy generation from waste.	Improve solid waste management systems, limiting environmental impacts and potential for emissions reduction.	€ 50 million	EGP 2,656.5 million
SW4 - Upgrade of Sanitary Landfill and Waste to Energy	This investment would follow on from the Solid Waste Study to upgrade the sanitary landfill with a potential waste to energy facility while also upgrading the site to an EU-compliant landfill with all the necessary equipment.	Help to reduce the impact of the landfill on the local environment, promote sustainable waste management and contribute to energy generation while promoting a shift away from fossil fuels.	Requires further detailed study	Requires further detailed study

Figure – Spatial distribution of proposed Actions




Murano
vivo
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1. Introduction

Egypt has committed to local action and the COP27 Presidency launched the Sustainable Urban Resilience for the Next Generation (SURGe) Initiative – with the objective to enhance and accelerate local and urban climate action contributing to achieving the Paris Climate Goals and Sustainable Development Goals.

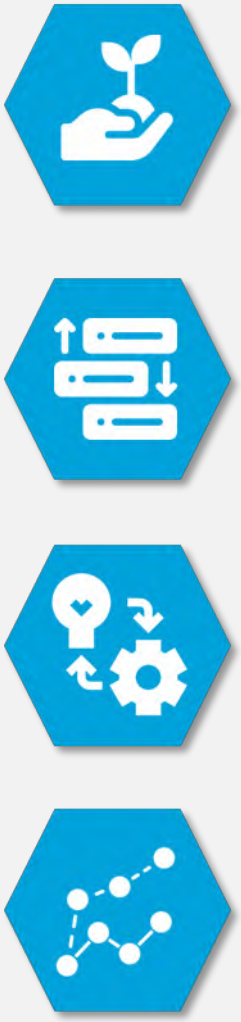
Cities are particularly vulnerable to climate change and natural disasters as well as drivers of pollution and pressure on natural resources. There is an increasing need for a systematic approach to cities, covering the broad range of environmental challenges and linking these to economic and social objectives to provide a comprehensive set of solutions which can translate into investable projects.

In May 2023, the Governorate of Alexandria launched its Green City Action Plan as part of the EBRD Green Cities programme, supported by the Ministry of Planning, Economic Development and International Cooperation in Egypt. This step demonstrates the Governorate's commitment to address its environmental concerns and infrastructure challenges and to support the transition to a green, low-carbon and resilient future.

The Alexandria GCAP offers the Governorate the opportunity to align their long-term development goals with an aspirational green growth agenda. This will provide long term investment benefits for Alexandria Governorate across multiple sectors, demonstrating tangible outcomes for its residents.

1.1. Purpose of the GCAP

The Alexandria GCAP was developed as a systematic approach to identify and prioritise environmental and infrastructure challenges and to define infrastructure investments and policies addressing the most pressing issues the Governorate faces. The development process involves four steps:



1. Establishing a Green City Baseline and Priority Setting

which includes measuring the current status of environmental challenges in the City based on circa 70 core indicators and identifying the priority environmental challenges that need to be addressed.

2. Developing a Green City Action Plan

which includes preparing a document that articulates the City's vision, strategic objectives and priority actions and investments to address priority environmental challenges and meet the objectives.

3. Implementation

The implementation of the GCAP includes:

- Implementation of policy and investment actions;
- Facilitating cooperation between stakeholders and Steering Committee;
- Securing financing for actions from different sources; and
- Advancing enabling policy to facilitate action implementation.

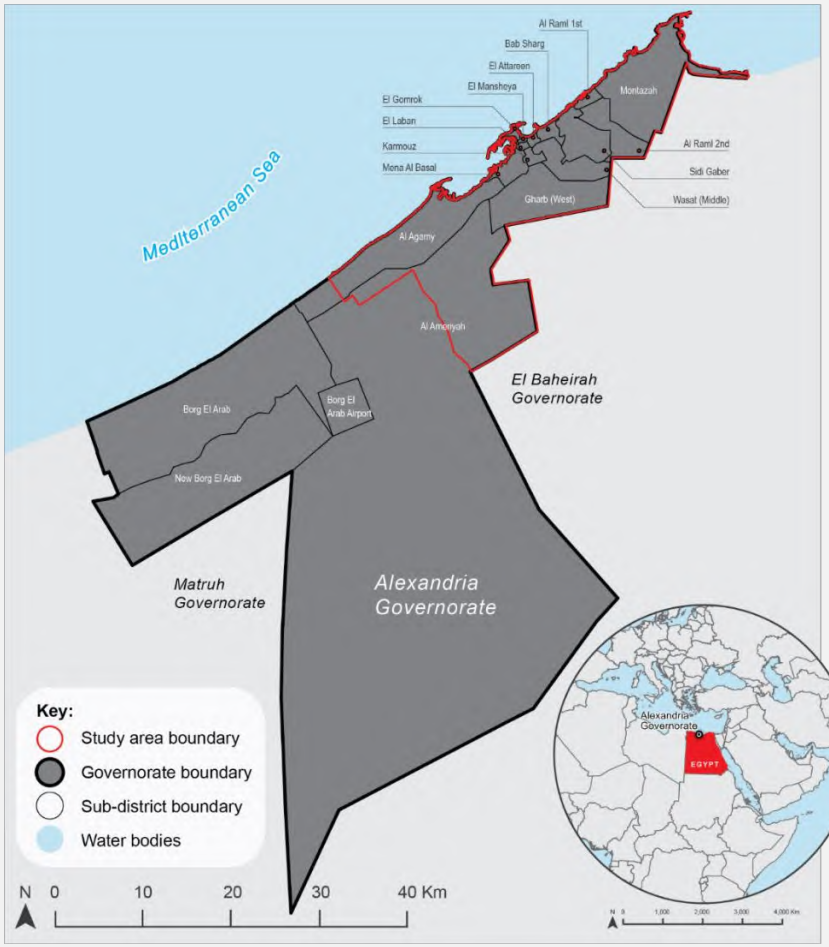
4. Monitoring and Evaluation

Of the GCAP results and updating the GCAP, as necessary.

1.2. GCAP Focus Area

The GCAP focuses on Alexandria City, the urban area within Alexandria Governorate, see Figure 1-1**.** While the GCAP's focus is on Alexandria City, consideration is also given to relevant issues across the Governorate as urban dynamics of Alexandria extend beyond its immediate boundaries.

Figure 1-1 – Map of Alexandria Governorate



Source: AtkinsRéalis

1.3. Engagement Process

The Governorate have engaged in extensive stakeholder involvement to develop a clear understanding and agreement on the priority challenges facing the City. This engagement process included two workshops with over 100 city stakeholders, as well as a series of internal city workshops. These internal sessions involved sector experts and senior officials from the Governorate and private sector. These workshops have helped articulate a clear vision and define actionable interventions that reflect local circumstances.

1.4. Structure of the Document

Following this introductory chapter, the rest of the document is structured as follows:

- **Section 2** - presents the City Profile covering the local and regional development context as well as the demographic and socio-economic context.
- **Section 3** - presents the baseline review of the City covering the climate profile, environmental and sectoral review, and the priority Green City Challenges.
- **Section 4** - outlines the Alexandria GCAP framework covering the GCAP Vision, Sectoral Roadmaps and Strategic Objectives, Spatial Framework for Development, and an overview of co-benefits.
- **Sections 5 – 9** - expand on the Land Use, Energy, Buildings and Industry, Water and Wastewater, and Solid Waste roadmaps, key actors and stakeholders involved in the actions, and a summary of the supporting studies and policies.
- **Section 10** - sets out the implementation plan for the GCAP including the Monitoring, Evaluation and reporting requirements, and Costs and funding sources. The section also sets out the next steps of the GCAP.

The document is also accompanied by Appendix A which provides detailed information on key projects and Appendix B which provides a high-level overview of medium to long-term projects.

Figure 1-2 – Photos from stakeholder engagement events

Source: AtkinsRéalis

Alexandria City Profile

2. City Profile

Alexandria is one of the oldest cities in the world and as such offers a complex urban structure developed over the years. Its ancient history makes it a vibrant cultural hub boasting heritage sites and educational institution. The City is on the UNESCO heritage list with a multicultural atmosphere often called "The Pearl of the Mediterranean".

Alexandria is also one of Egypt's strategic urban economic centres. Due its location on the Mediterranean Sea and in the Nile Delta. This section provides a concise profile of the City covering its urban development and its socio-economic context.

2.1. Urban Development Context

The City is the capital of the Alexandria Governorate and has nine administrative districts: Al Ameriyah, Al Ameriyah Tany, Al Agami, Sharq, Wasat, Gomrok, Garb, Montaza Awal and Montazah Tany, as well as 16 sub-districts.

The City's surface area has doubled over the past 30 years. Constrained by its geography, Alexandria developed along the coast across 85 km on a T shaped peninsula and located between the sea, lagoons and former lakes. Urbanisation pressures have resulted in a gradual loss of important agricultural areas.

The expansion has led to the development of different urban patterns that have different requirements for investment. These also affect the feasibility and design of key infrastructure interventions. The Alexandria Strategic Urban Plan (Alexandria SUP) identifies six distinctive urban areas and key urban fabric patterns as illustrated in Figure 2-1.

The Alexandrian Urban Core Area reflects the City's ancient heritage. The urban fabric in areas like Wassat and Gomrok is a blend of historic landmarks, deteriorating structures and ageing infrastructure, reflecting both the City's significant heritage and the need for revitalisation and regeneration. This is especially visible in Wassat, where key cultural institutions like the Bibliotheca Alexandria are located and the Gomrok, the historic centre of the City with the deteriorating medina. Architectural styles range from the Ptolemaic era to European influences in the 19th and mid-20th centuries[3]. It is a vibrant area hosting key economic activities and institutions and characterised by high densities, lack of green spaces, and frequent severe traffic congestion. Any upgrade of infrastructure requires careful planning.

Outside of the Urban Core Area, the key urban areas are:

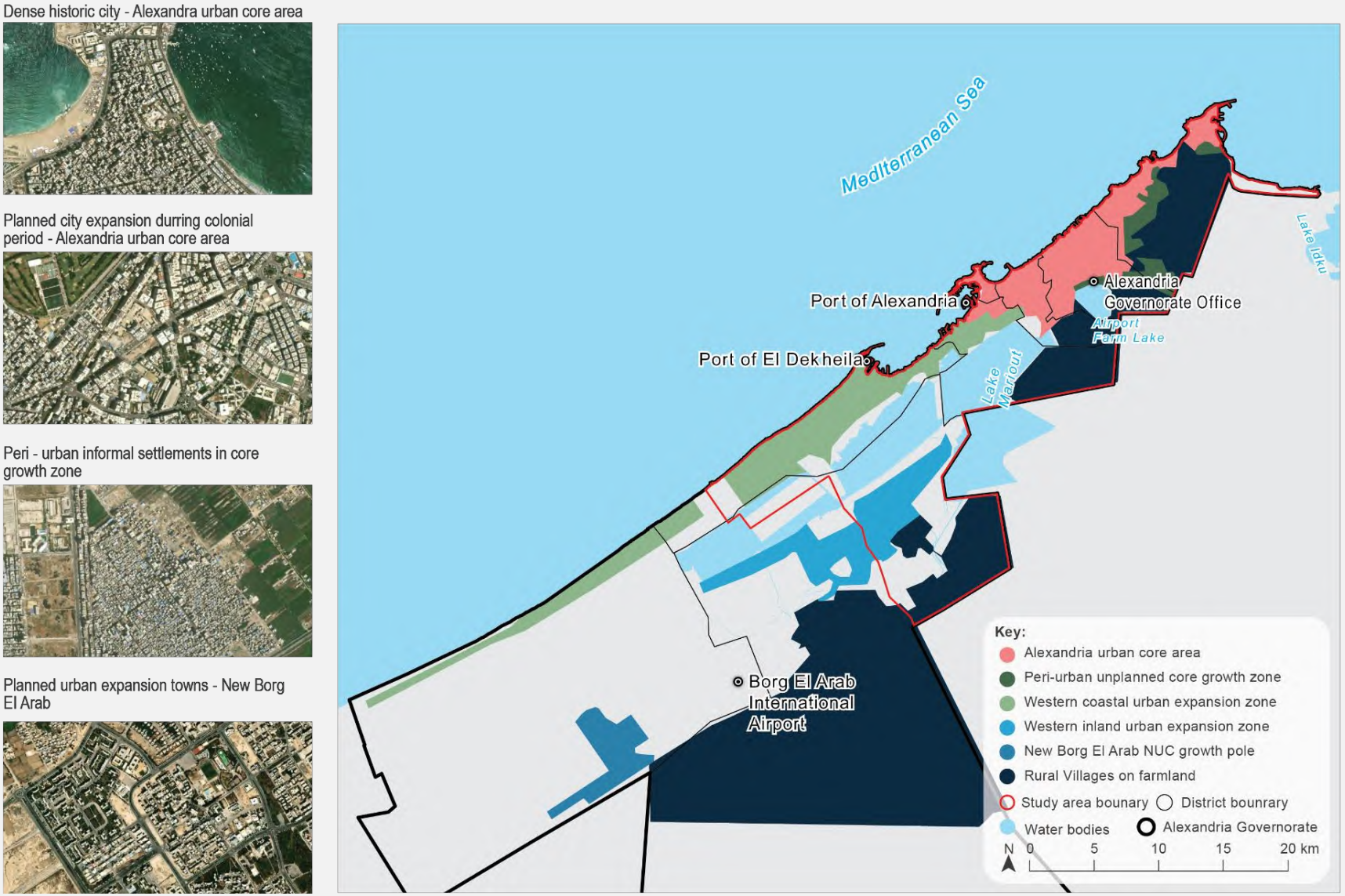
- the peri-urban unplanned growth zone which is encroaching farmland and is not fully serviced;
- the western coastal expansion zone with high value residential areas exposed to flood risk from sea level rise;
- the western inland expansion zone which includes the rapidly growing Al Ameriyah area with less planned development
- the Borg El Arab New urban community which has an estimated current population of 150,000 below NUCA's target population of 570,000 inhabitants. Borg El Arab have been oversupplied with infrastructure but suffers from low quality service provision due to inadequate demand as people choose to reside closer to Alexandria city.

While these urban extensions are necessary to accommodate the growing population, infrastructure and transport provision has not caught up with demand. This has adversely impacted the environmental assets in the City and its hinterland.

Bibliotheca Alexandrina opened in 2002.

[3] Arab Walled Cities: investigating peripheral patterns in historic Cairo, Damascus, Alexandria, and Tripoli (Mohareb & Kronenburg, 2012)

Figure 2-1 - Overview of urban development characteristics in Alexandria



Source: AtkinsRéalis based on Alexandria Strategic Urban Plan 2032 and Esri

2.2. Socio-Economic Context

Alexandria is the second largest city in Egypt with a population of around 5.6 million residents expected to reach 6.8 million by 2030. The vast majority resides live in the urban core, peri urban areas and western coast and inland expansion areas.

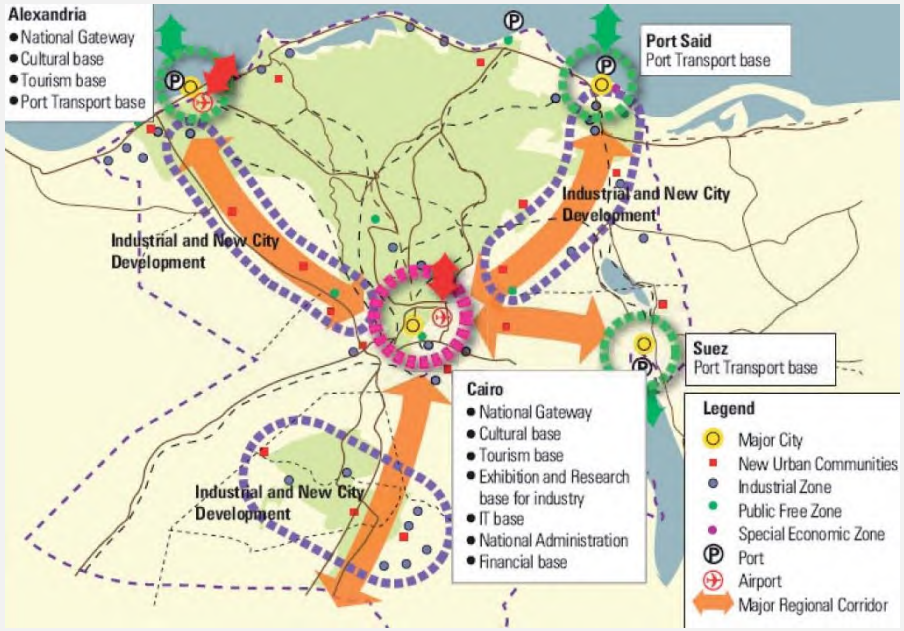
Alexandria is host to the second largest urban economy in Egypt, with industries ranging from textiles and chemicals to construction, tourism, and shipping. The port of Alexandria has been Egypt's most important port for more than 2,000 years. Through the Nile, the port links the interior of Africa with the Mediterranean Sea. Today, the biggest portion of the country's imports and exports are managed here.[4] This strategic positioning has made Alexandria a focal point for development and investment, providing central service functions for the region.

Key economic sectors include:

- **Trade and Logistics -** Since the late 18th century, Alexandria has been one of the most important trading centres in the world. Still today, Alexandria has a strong trade sector with 60% of Egypt's foreign trade passing through the ports of Alexandria, from where it takes only 3-5 days by ship to reach European markets[5]. Alexandria's two airports, good highway and rail links connect the City well with the rest of Egypt and neighbouring countries.
- **Industry** - Alexandria's Economy is heavily industrial supported by its own natural gas and oil pipeline infrastructure running from Suez[6]. There are two major industrial zones in Alexandria (in Al Ameriya, and New Borg El Arab) and further eight industrial zones in the Governorate of Alexandria, namely Ajami, Mergham, Al Nahda, Al Nasseria, Ohm Zagheo, New Manshia, Seibco and the K31 Desert Road Zone[7]. Alexandria has a diverse range of different activities including salt and tanning industries, oil refinery, cement works, and limestone quarries.
- **Tourism** - Alexandria is famous for its role as the Hellenic Roman Capital of Egypt and a world centre of culture and civilization attracting visitors from around the world seeking culture and history[8]. The City's unique archaeological and cultural heritage from different eras make up its rich urban fabric and modern landmarks. The Bibliotheca Alexandrina alone attracts one million visitors per annum[9]. While the City attracts many local tourists, only 3% of Egypt's international visitors visit Alexandria each year.
- **Educational and cultural centre**, boasting a rich history and heritage, including landmarks such as the Qaitbay Citadel, the Roman Theatre, and the Alexandria Library. The presence of Alexandria University further solidifies the City's status as an educational centre.

It is estimated that over 20% of the City's labour force is informal. Activities in the informal sector include general trading, car and electronics repairs, waste collection, manufacturing or food processing, tailoring, detergent mixing, simple farming, animal husbandry, and fishing.[10]

Figure 2-2 – Regional role of Alexandria Governorate in relation to Port Said and Cairo



Source: Alexandria SUP 2032

[4] Ibid
[5] Africa 2013 - Oxford Business Group - Africa 2013 - Oxford Business Group
[6] Alexandria - Wikipedia
[7] - Africa 2013 - Oxford Business Group
[8] Alexandria City Development Strategy, 2004-2008
[9] Ibid.
[10] Ibid.

2.3. Gender, Economic and Social Inclusion

The Governorate shows a relative balance in gender percentages among male and female inhabitants with 50.24% of population being males and 49.76% being females (2023). However, as is the case nationally, there are clear and large disparities in access to education between men and women. Gender challenges are also represented in low employment rates for women (around 30% of females are not employed, compared to 8% of men), employment in the informal sector and underrepresentation in science, technology, engineering, and mathematics (STEM) fields. A predominant issue is the cultural perception of women in employment and despite government initiatives aimed at increasing female participation in the workforce, women still face significant barriers when seeking employment particularly in engineering sector in fields like energy, wastewater treatment, and manufacturing.

In a national comparison, the Governorate's population is relatively older with only 56% of the population under the age of 25, relative to 61% at the national level. This ageing population dynamic has been a historic challenge for Alexandria driven by unemployment among the youth.

Additionally, Alexandria is home to a significant number of refugees who face additional challenges related to housing and services. Many refugees live in overcrowded conditions and rely on humanitarian assistance for basic needs, which can be insufficient due to funding limitations. As of 2024, Egypt hosts over 760,000 registered refugees and asylum-seekers from 62 nationalities, with Alexandria being one of the main urban areas where these individuals reside (66,720 Refugees and Asylum Seekers live in Alexandria). The largest groups include Sudanese and Syrian refugees, along with those from South Sudan, Eritrea, Ethiopia, Yemen, Somalia, and Iraq.

Alexandria faces significant challenges related to housing and essential services, impacting its diverse population. These challenges stem from rapid urbanisation and overcrowding in many areas, economic pressures, and inadequate infrastructure.

In Alexandria, the transport system poses significant challenges for women and underserved groups, including issues of safety, accessibility, and affordability. Women, particularly those in low-income households, often face increased risks of harassment and violence on public transportation, discouraging their use of these services. Additionally, the lack of well-maintained and accessible transportation infrastructure makes it difficult for women, the elderly, and people with disabilities to navigate the city and access essential services such as healthcare and education. This exacerbates gender and social inequalities, limiting the mobility and independence of vulnerable groups.[11]

People with disabilities in Alexandria also encounter numerous barriers when accessing public transportation and urban spaces. Lack of accessible transport options and infrastructure, such as ramps and elevators, severely restrict their ability to move freely around the city. This exclusion limits their participation in daily activities, including employment, education, and social interactions, further entrenching their marginalisation. Moreover, without proper disability-friendly policies and facilities, people with disabilities face significant challenges to social inclusion, which hinders their ability to lead independent lives.

In urban planning and climate resilience efforts, it is crucial to engage local communities, particularly women, in decision-making processes. Ensuring their participation in urban planning can lead to more inclusive and effective solutions that address the specific needs of diverse groups, including women, people with disabilities, and underserved communities. By encouraging the involvement of these groups in shaping their environment, cities can foster more equitable, accessible, and sustainable urban spaces that benefit everyone.

The cost of living in Alexandria has been increasing, leading to a growing demand for affordable housing options. Access to essential services such as healthcare and education can be limited for low-income families and those living in informal settlements. Many residents face barriers in obtaining necessary documentation to access public services, which hinders their ability to improve their living conditions.

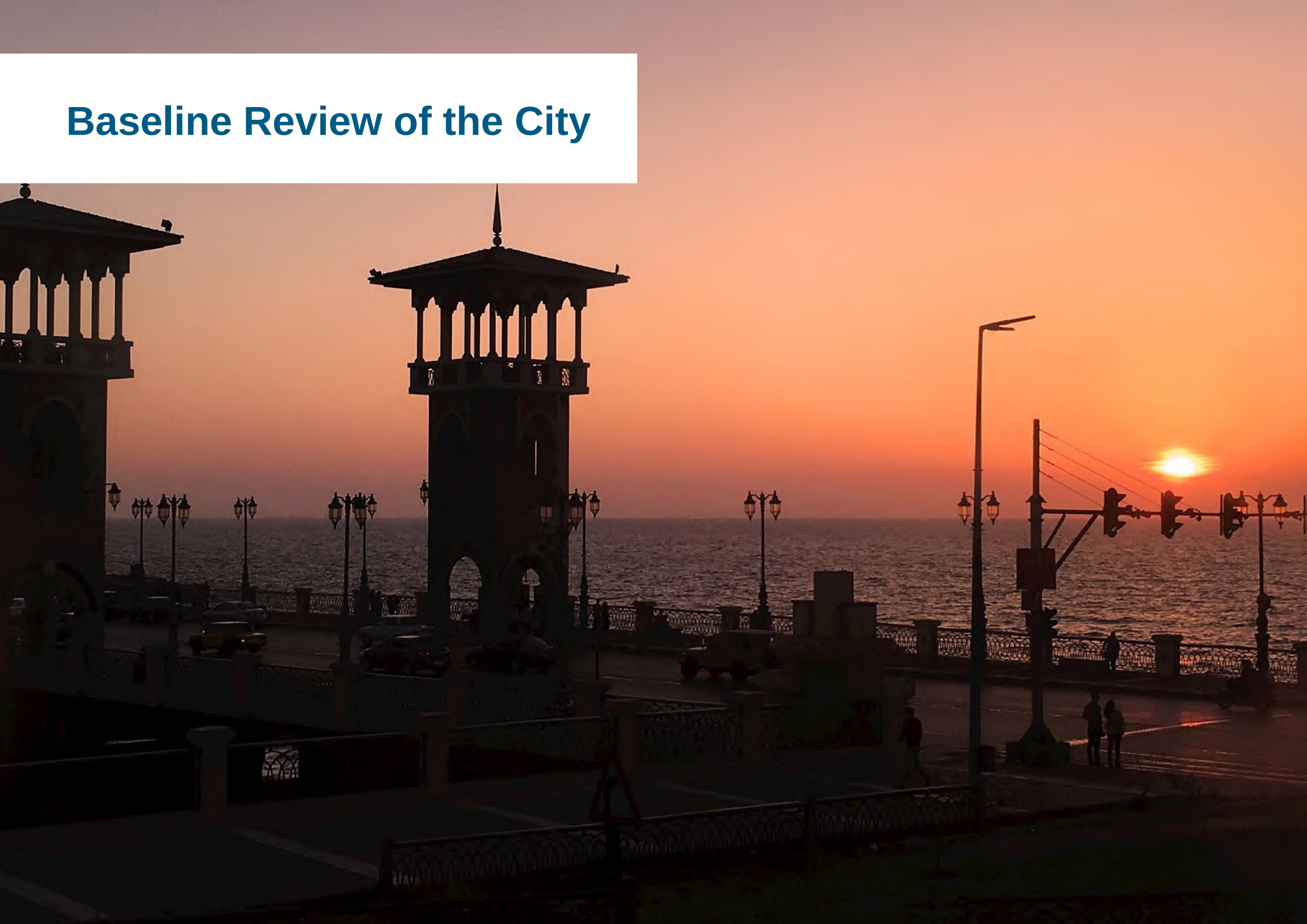
[11] Challenges and Opportunities for Gender-Equitable Transport in Cairo, Egypt, 2023, available at: Challenges and Opportunities for Gender-Equitable Transport in Cairo, Egypt - Institute for Transportation and Development Policy

The City's infrastructure struggles to keep pace with population growth. Public transportation systems are often inadequate, making it difficult for residents to commute to work or access services efficiently. This situation is further complicated by the manifestation of climate change impacts such as flooding, with the most vulnerable groups being most affected and at risk of losing livelihoods and access to infrastructure and services.

The development of the GCAP has given attention to these challenges with the aim to define projects that support breaking down barriers to opportunities and access to quality infrastructure for marginalised groups. Its implementation will need to:

- Encourage local communities, particularly women, to engage in urban planning can lead to more inclusive and effective solutions to climate challenges;
- Ensure infrastructure equitable provision for underserved areas, particularly in water and energy sectors;
- Develop targeted strategies to improve access to public transportation for all supporting greater economic activity;
- Address increasing demand for services due to rising in-migration including refugees;
- Raise awareness and foster greater participation of the community in water and waste management issues; and
- Integrate informal sector in employment opportunities that arise, such as in the waste management sector.

Baseline Review of the City



3. Baseline Review

3.1. Introduction

The GCAP is shaped by a comprehensive assessment of environmental conditions and infrastructure provision in the Governorate. This assessment, in collaboration with local stakeholders, identified the City's most pressing challenges which are further elaborated below.

3.2. Climate Risk Profile and Potential for Low Carbon Development

3.2.1. Climate Risk Identification

Climate change is a decisive factor in Alexandria's development. The City is highly vulnerable facing a number of climate challenges which will significantly shape its future development trajectory:

Flooding: Most immediately, there is an ongoing and increasing risk of pluvial flooding as rainfall events associated with storms become more frequent. Alexandria's surface water drainage infrastructure is inadequate to cope with such shocks and there are several vulnerable areas around the City, including key infrastructure.

Sea-level rise and coastal erosion: Projections show that in the absence of further coastal protection measures significant areas of the City will be at risk of regular coastal flooding by 2050. The combination of land subsidence, sea-level rise, and disruption to coastal dynamics and sediment replenishment due to ongoing development poses a major threat to the City's economy, people, and environment, including major assets such as significant threat to the effective functioning of the Port.

Water scarcity is a key challenge in Alexandria, and this will be exacerbated by anticipated increases in water demand from a growing population. The City is almost entirely dependent on the Nile River and groundwater aquifers, which do not meet the increasing water demand. In the future likely reductions in supply because of climate change, as well an increasing pressure on its aquifers from salinisation driven by sea-level rise, will further constrain resources.

Urban Heat: Extreme heat is not currently a significant issue in the City, but climate change will drive an increasing number of heatwaves and heat extremes, beyond those which the City has previously experienced. While temperatures will remain more moderate relative to the rest of Egypt, heat as an emerging risk should not be ignored, and there is a need to proactively build the City's resilience.

Additional risks include increasing saltwater intrusion and increasing soil salinity resulting from the increase of evaporation due to high temperatures. This contributes to a reduction in the quality of the groundwater and soil, which in turn adversely impacts agricultural lands and food crop production. Saltwater intrusion also poses significant risks to the City's biodiversity, including the ecosystems of the lakes.

3.2.2. Mitigation Opportunities

At the national level, GHG emissions in Egypt are relatively low. The country emissions profile for Egypt outlines annual national level CO_2 per capita emissions as 3.5 tonnes per capita[12]. However, as noted by the Carnegie report on Climate Change opportunities and obstacles, GHGs are rose rapidly over the past few years. The energy (Electricity and heating) and transport sectors had the greatest levels of GHG emissions followed by manufacturing and construction. In particular, the transport sector saw one of the largest emission increases (76 percent) between 2005 and 2019, with road transport being the largest GHG contributor. At the local level and in the absence of any emissions inventory Alexandria is expected to broadly have a similar emissions profile as the national level.

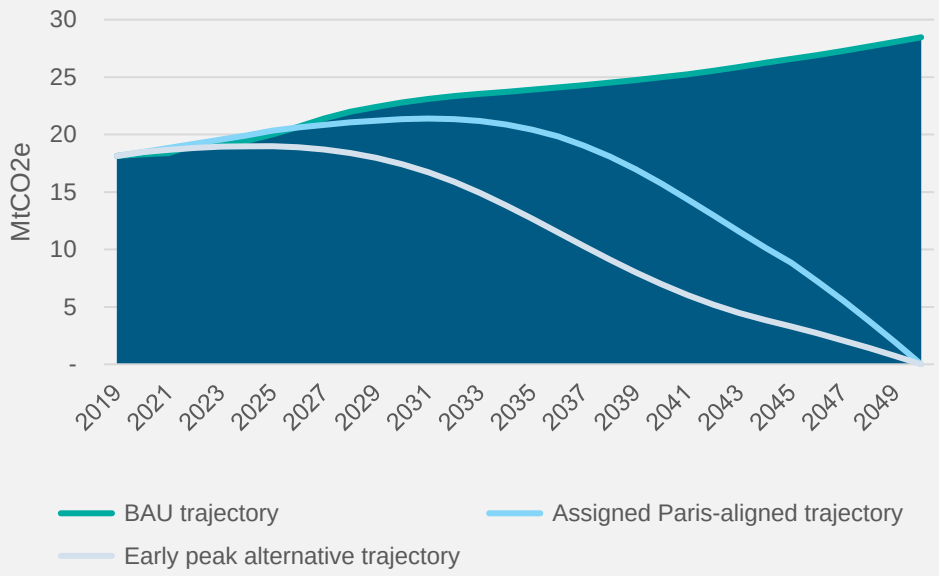
The Nationally Determined Contributions (NDC) outline the country's ambition to accelerate the development and deployment of renewable energy. In the updated NDC document, (June 2023), Egypt set a target of 42 percent for renewables adoption by 2030. Furthermore, Egypt has committed to local action and the COP27 Presidency launched the Sustainable Urban Resilience for the Next Generation (SURGe) Initiative – with the objective to enhance and accelerate local and urban climate action contributing to achieving the Paris Climate Goals and Sustainable Development Goals.

[12] Henrique Morgado Simões and Branislav Stanicek, "Egypt's Climate Change Policies: State of Play Ahead of COP27," European Parliament, October 2022

The below graph presents a business-as-usual and 'Paris aligned' emissions trajectory between 2019 and 2050 for Alexandria, highlighting the level of ambition required to keep within a global 1.5 ºC temperature rise above pre-industrial levels.

Alexandria's emissions are projected to decrease from 3.5 MtCO2e per capita in 2019 to 2.8MtCO2e per capita in 2050 under a business-as-usual emissions scenario. The assigned Paris-aligned trajectory for Alexandria, i.e. full decarbonisation in 2050, requires an annual emissions reduction of 6% against the business-as-usual scenario, based on an assessment of the fair share contribution that Alexandria should aim to make towards long-term emissions reductions. An earlier and more proactive strategy to decarbonise (early peak trajectory) is associated with a annual emissions reduction of 24% against business-as-usual scenario.

Figure 3-1 – Summary of Alexandria GHG trajectories



Source: AtkinsRéalis

The opportunities for greatest GHG reduction in Alexandria come from:

- **Energy Sector:** through the development of renewable energy projects, however due to the centralised nature of the sector the most impactful actions will be delivered at national scale;
- **Transport Sector:** through projects and policies that promoted modal shift and support low carbon alternatives; and
- **Waste Sector:** through implementation of strategies that can reduce the volume of waste going to landfill through recycling and circularity and contribute towards renewable energy production.

3.3. Environmental Review

Table 3-1 below summarises the environmental performance and key challenges that were identified, based on qualitative indicators and technical expert advice. This excludes climate resilience and GhG emissions which have been discussed separately above. The table also outlines the main linkages with the urban sectors and indicates how activities within these sectors contribute to environmental performance.

Alexandria sits within a sensitive ecological environment with agricultural land surrounding the urban core, and natural areas like Lake Mariut and the El-Nakheil Island Protected Area. These ecological assets are adversely impacted by the City's rapid growth and insufficient infrastructure provision, especially in relation to solid waste management (SWM) and wastewater management, as well as heavy industry. Additionally, air pollution is worsening due to growing industrial activities and increasing traffic.

Table 3-1 – Environmental Review

Environmental Indicators	Evaluated Benchmark	Key Findings and Challenges
Air quality		Alexandria's air quality is poor, especially in the western region of the City. The City's proximity to industrial zones and heavy traffic contributes to elevated levels of pollutants such as SOx, NOx, PM2.5 and PM10. ***Key contributors & linkages to infrastructure provision*** • **Transport** - The inefficient public transport links in Alexandria contribute to increased car usage, which in turn leads to higher emissions of pollutants. Improving public transport infrastructure could help reduce these emissions and improve air quality. • **Industry** - Inefficient industrial facilities in the City consume large amounts of electricity and fossil fuels, leading to high emissions per unit of industrial GDP. The City's proximity to industrial zones contributes to poor air quality, particularly in the western region.
Water quality and availability		Alexandria's raw water quality is low, with water security being a significant challenge. The City's water supply, primarily from the Nile River and its canals, is treated by local purification plants and meets Egyptian drinking water quality standards, but ensuring sufficient quantities given climate-driven reductions in availability, and increasing demand, is a significant challenge. ***Key contributors & linkages to infrastructure provision*** • **Industry** - Industrial facilities in Alexandria consume large amounts of water exacerbating the City's water scarcity issues. • **Land use and Industry** - Increasing urban growth, industrial activity, and agricultural activity in Alexandria are putting pressure on the City's water supply. • **Water** - Water availability in Alexandria is a challenge due to the limited and distant raw water sources, and anticipated reductions in Nile flow due to climate change. • **Climate change risks** - Increasing saltwater intrusion due to sea level rise and increasing soil salinity resulting from the increase of evaporation also contribute to a reduction in the quality of the groundwater especially in the west of Alexandria;

Soil quality

Alexandria's soil quality appears generally good, with the City's soils primarily consisting of alluvial and marine deposits. However, the City faces increasing challenges related to soil contamination and increased salinity affecting biodiversity and food crop production which is likely going to change the assessment of this environmental asset in the future without further action.

Key contributors & linkages to infrastructure provision

- **Solid waste and Industry** - Less than 80% of the total industrial waste produced in Alexandria is recycled, indicating a potential risk to soil quality due to the disposal of untreated waste. Agricultural activities in Alexandria can also impact soil quality through the use of chemicals and pesticides.
- **Wastewater** - All sludge from wastewater treatment plants (WWTP) in Egypt, including Alexandria, receives some form of initial treatment and is then used in agricultural lands without adequate treatment.
- **Industry** - Industrial sectors in Alexandria can significantly degrade soil quality.
- **Transport** - Vehicular traffic in Alexandria, like in many urban areas, contribute to soil contamination.
- **Climate change risks** - Saltwater intrusion, due to increasing sea level rise, also increases soil salinity, impacting agricultural lands and reducing freshwater quality and quantity, thereby affecting food crop production.

Green space

Alexandria has various open and green spaces; however, these spaces are not evenly distributed across the City, with some areas, lacking sufficient green spaces.

Key contributors & linkages to infrastructure provision

- **Land use** - Rapid urbanisation and infrastructure development in Alexandria, particularly in the urban core, have led to the loss of open and green spaces. The construction of residential and commercial buildings often leads to the infringement and misuse of existing green spaces.
- **Industry** - Industrial activities in the City can contribute to the degradation of open and green spaces.
- **Climate change risks** - Coastal erosion and seawater encroachment affect open spaces, particularly in the City's coastal areas

Biodiversity

Alexandria's biodiversity, with natural assets such as the Edku and Mariut Lakes, is under threat due to human activities and pollution, leading to habitat loss and reduced fish production. Recent legislation for wetland and fisheries protection is a positive step, but more efforts are needed for integrated coastal zone management and climate change mitigation. Despite these challenges, Alexandria's biodiversity remains a vital asset that requires protection and enhancement efforts to ensure its sustainability for future generations.

Key contributors & linkages to infrastructure provision

- **Land use** - Rapid urbanisation and infrastructure development in Alexandria is a significant threat to the City's biodiversity, particularly around the Lakes.
- **Industry** - Polluting industrial activities can have a detrimental impact on biodiversity.
- **Climate change risks -** Saltwater intrusion, due to rising sea levels, poses significant risks to the City's biodiversity, including the ecosystems of the lakes. The intrusion of saltwater into freshwater ecosystems can lead to a decrease in biodiversity as the increased salinity can be detrimental to many freshwater species
- **Water** - Inadequate or poorly maintained water infrastructure can exacerbate issues such as saltwater intrusion, which can harm the freshwater ecosystems in the City.

3.4. Sectoral Review

The sector assessment of the GCAP analysed the land use, transport, buildings, energy, industry, water and wastewater and solid waste sectors.

There has been significant progress made over recent years and significant investments are planned, for example regarding the Abu Qir Metro rehabilitation. However, there is still room to improve the service provision and to move towards a low-carbon and climate-resilient pathway. The review provides an overview of key areas of concern as a baseline for developing the GCAP actions supporting this transition.

In the following paragraphs, the main gaps in infrastructure provision are identified also highlighting climate change considerations, where appropriate.

Land use -The major land use challenges are (a) extreme flood risk due to location along the coastline, (b) urban growth and heavy industry adversely impacting natural assets (Lake Mariut and Sea), and (c) high densities with limited green space making the City vulnerable to increasing temperatures and heavy congestion. The focus of planned development is on two new growth hubs, preserving natural assets, increasing green space and exploring potentials of transport-oriented development. Regeneration of existing part of the City should be considered as well; along with densification of areas outside the urban centre to avoid unplanned urban sprawl.

Transport - The major transport challenge is a reliance on individual car-based transport in the City with an ageing car fleet causing heavy pollution, congestion, and inefficiencies in travel. Investments need to focus on improving the public transport network and the development of policies that support green choices and investments by individuals, businesses, and local government. A better integration of the transport and land use sector is important to benefit from synergies between the sectors;

Buildings - The buildings sector contributes to 40% of Egypt's total electricity usage. Many buildings in Alexandria have outdated infrastructure provisions and do not comply with building codes and energy efficiency standards, particularly in public buildings and informal settlements. There is ambition in Alexandria to revive vacant buildings. The new growth hubs of Alexandria are planned to reduce informal construction;

Industry - The industrial sites in Alexandria suffer from inefficiency both in terms of planning, zoning and regulation as well as use of energy, fossil fuel consumption and industrial waste and wastewater disposal and treatment, which discourages investors and pollutes the City's environmental and water assets. The Alexandria SUP plans apply modern environmental management systems, the use of less polluting technologies, and promotion of industrial waste recycling;

Energy - In the energy sector, Egypt has made significant strides in extending electricity access to over 99% of households, including remote areas. However, the sector faces challenges, particularly in Alexandria, where frequent power outages occur due to an outdated distribution network, overloading of cables, and faulty workmanship. Alexandria is prioritising local energy production and diversification, aiming to reduce energy consumption and transition to a low-carbon electricity sector;

Water availability is a key challenge caused by the limited and distant raw water sources (Nile River and Mahmoudia Canal) and aggravated by climate change. The water supply and wastewater management system is generally in good condition but requires some modernisation to improve environmental standards and efficiencies. Opportunities include reducing Non-Revenue Water and bypass of wastewater, reusing grey water in non-industrial buildings, special treatment of industrial wastewater and sludge, the production of biogas; and expansion of desalination capacity.

Solid Waste - All waste is collected and disposed of at an open dumpsite, with illegal sorting, treatment, and recycling occurring post-disposal. There is major potential for improved collection of waste preventing it from ending up in open land or being burnt openly. Recycling percentages can increase and there is potential for waste to energy investments and integrating the informal waste collection system into the formal system supporting informal workers.

3.5. Policy Direction & Key Investments

A detailed policy review was undertaken to ensure the GCAP is well aligned with the existing policy context on climate change, environmental issues and urban development and for key infrastructure sectors.

The following policies provide the regulatory and strategic context for the GCAP with specific gaps as outlined below:

Climate change - the National Determined Contributions from 2023 and the National Climate Change Policy 2050 set the framework and strategic direction of climate action in Egypt nationally and locally. In these strategic policies emission reduction targets are set (42 percent reduction by 2030) and high-level mitigation and adaptation measures are proposed. Climate change adaptation is not well mainstreamed into local policy and regulation. Alexandria does not have city-specific strategies or policies for climate mitigation or adaptation.

Environmental protection - The Egypt Environmental Law from 1994 is the key legislation and covers regulations on air quality, wastewater, and biodiversity. Development in Alexandria City is obliged to follow these regulations locally, however, there are no specific environmental regulations for the City. However, to monitor compliance, local environmental data monitoring structures need to be strengthened.

Urban Development - At the national level, polices focus on achieving balanced urbanisation. Egypt has the National Strategic Plan for Urban Development 2052, which provides a guiding framework for urbanisation in Egypt. It aims to accommodate the population increase over the next 40 years through the establishment of new urban areas, such El Borg and supports the containment of unplanned development in Alexandria. At the local level, the Alexandria Strategic Plan for 2032, provides an analysis of the City's urban fabric and outlines an approach to land use development for the future decade. Within the urban infrastructure sectors, additional selected policies include:

- Master Plan for Nationwide Transport System (2012);
- National Energy Efficiency Action Plan and national buildings codes;
- 2030 Egypt Vision Strategy; and
- Law No.203/2014 i.e., "the renewable energy law".

The GCAP aims to map the numerous initiatives and projects that are proposed or are under implementation in Alexandria and seek to build on the knowledge and highlight synergies between these and with the proposed the GCAP interventions. Some key initiatives are included below:

1. EBRD €250 million (13 Billion EGP) loan to finance the first high-capacity metro line in Alexandria, upgrading and electrifying the existing rail line between downtown Alexandria and the town of Abou Qir;
2. Through the Neighbourhood Investment Platform European Investment Bank funded refurbishment and extension of Alexandria's 13.8km Raml light rail line and Alexandria Wastewater Treatment Plant;
3. Adaptation to Climate Change in the Nile delta (including Alexandria) through the integrated Coastal Zone Management Plan (ICZM) implemented by UNDP and Ministry of Water Resources and Irrigation; and
4. Alexandria ICZM implemented by Egyptian Environmental Affairs Agency (EEAA) and World Bank and the recently approved Lake Mariut purification project as well as tourism development studies.

3.6. Priority Challenges

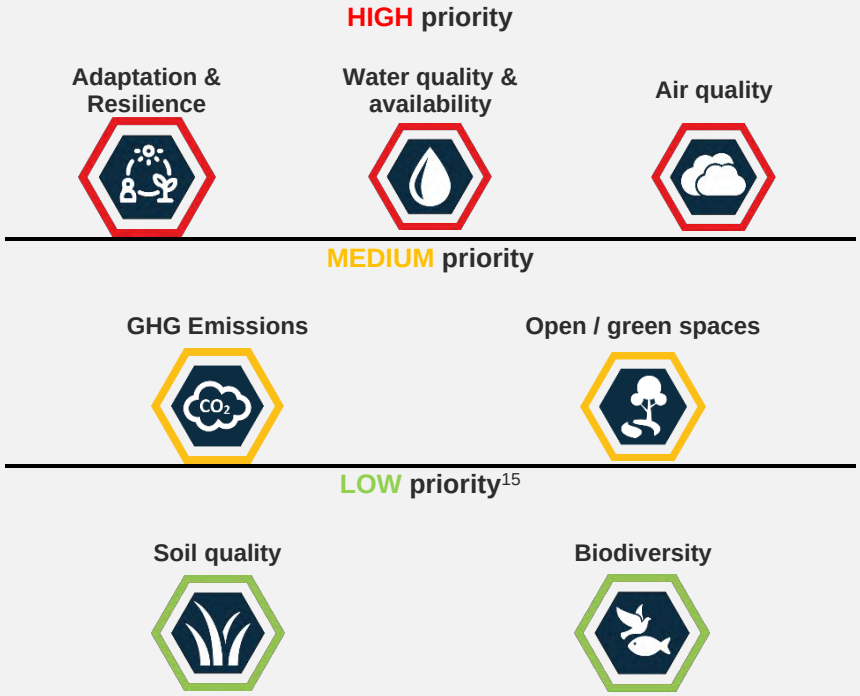
Green City challenges discussed in the previous sections have been prioritised based on the assessment of the climate risk profile, environment performance, urban infrastructure provision and institutional structure.

Together with inputs and feedback gained as part of the second stakeholder engagement workshop in January 2024, the environmental challenges were assessed as high, medium and low priority. The GCAP priority challenges are set based on expert advice from the evidence presented in the Indicator Database (IDB) and stakeholder priority considering all three prioritisation steps set out in Table 3-2. The prioritised environmental challenge areas are illustrated in Figure 3-2 and form the basis of developing the GCAP approach and key interventions.

Table 3-2 – Prioritisation of Green City Challenges

Environmental indicator and priority	Benchmark from IDB	Evaluated Benchmark[13]	Stakeholder perception[14]	Priority Challenge Level
Adaptation and resilience			Medium	High
GHG emissions			High	Medium
Air quality			Medium	High
Water quality and availability			High	High
Soil quality			Low	Low
Green space			Medium	Medium
Biodiversity			Low	Low

Figure 3-2 – Green City Challenges



To maximise the City's potential there are three key challenges and that will need to be addressed: climate change, water scarcity and environmental pollution.

[13] The Evaluated Benchmark represents the conclusions and expert judgment of the Consultant Team based on qualitative evidence and research conducted for the Baseline assessment report.

[14] Based on stakeholder meeting in Jan 2024 with 39 participants (hybrid). The result is based on a survey conducted online and offline with a total of 32 participants.

[15] These environmental indicators have been assessed as low priority. This is not to argue that no challenges exist within these areas, but only to highlight that, when compared to major issues of water availability and quality, soil quality and green spaces, these areas pose lower urgency to the City.

Alexandria Green City Action Plan

4. The Alexandria Action Plan

Following the EBRD methodology, the Governorate have engaged in extensive stakeholder engagement to develop a clear understanding and agreement on the priority challenges facing the City. This collaboration has helped articulate a clear vision and a politically and economically feasible plan of investments and policies to support its delivery.

4.1. GCAP Vision

The following vision takes the form of a Green City strategy statement which provides an image of the City and a general principle that will lead the development of the GCAP and its implementation.

“Alexandria will strive to be a global exemplar for cities facing intricate urban challenges amidst a worsening climate change context. Committed to responsible and sustainable growth, while remaining dedicated to safeguarding the well-being of its people, natural resources and historic significance, Alexandria will work towards a future proofed coastal urban living”.

4.2. Strategic Goals of the GCAP

The vision will be realised through the achievement of the following sectoral strategic goals. The GCAP actions contribute to achieving the strategic goals and the overarching principles of reducing climate risk, water scarcity and pollution.

Reduce Alexandria’s vulnerability to pluvial and coastal flooding, enhance local preparedness and capacity to respond to climate change.

Optimise land use to control unplanned growth through the delivery of brownfield redevelopment and multipurpose spaces that enhance urban resilience and promote sustainable urban development.

Expand and enhance Alexandria's public transportation system to support modal shift through improvement of the level and quality of service provision, promote low carbon alternatives, improve traffic flow and widen options for active travel.

Improve the ecological quality of Alexandria’s surface water bodies and enhance water conservation through reduced consumption and increased re-use.

Improve Alexandria's Energy and Industry sectors by accelerating the transition to renewable energy sources and fostering sustainable energy practices.

Improve SWM across Alexandria, prioritising provision of facilities for effective waste collection and reduction, treatment, recycling, and energy recovery, in alignment with the waste management hierarchy.

Each one of the strategic goals and implementation of subsequent interventions presented further below will need to be centred around two main considerations:

- Climate resilience and nature need to play a central role; and
- Spatial integration and appropriate coordination are critical in such a historic and dense urban context to ensure minimisation of negative impacts during implementation and focused action

4.3. Climate Resilience and Nature

Given the complexity of issues Alexandria is facing, this GCAP is focusing on the interdependencies arising from climate change risks within an already highly fragile environmental ecosystem and their role in magnifying existing vulnerabilities in the future.

The approach to climate resilience through the GCAP is as follows:

1. Key interventions have been identified that specifically address climate risks and will directly help the City to adapt to climate change. These include investments and policy-focused interventions that are targeted at building capacity to manage and respond to climate extremes, as well as activities to build the evidence-base for informed decisions (e.g., early warning system).
2. Integration of climate change and land-use interventions is important and can deliver multiple benefits. There are significant opportunities to use urban development to both enhance the urban fabric and provision of spaces for residents improving their quality of life, while building longer-term resilience. These include identification and use of open spaces for sustainable drainage, and regeneration of Alexandria's historic canal system, and the integration of coastal protection and waterfront development.
3. Addressing water scarcity requires an integrated whole cycle approach to achieve significant impact, including:
    - Reducing water losses
    - Improving water treatment to both alleviate environmental pollution and enable re-use, as well as addressing saltwater intrusion.
    - Enhancing water retention (rainwater) and re-use of treated water practices.
    - Developing new sources through desalination.
4. Proposed actions are assessed against climate risks to ensure future resilience and avoid exacerbating existing challenges.

Throughout this GCAP, nature is considered as a critical asset and the proposed interventions are targeting at protecting the environment from further pollution, reversing biodiversity loss, and introducing Nature-Based Solutions where possible.

4.4. Spatial Development Framework

The GCAP takes a spatial approach to development. The key objective is to reflect the specific characteristics of the areas and prioritise the most pressing challenges. This approach allows for the consideration of synergies and inter-dependencies between actions in a specific location, as well disruptions and knock-on effects from their implementation that would require careful planning and coordination. The GCAP interventions are organised around two focus areas: Alexandria Urban Core and Lake Mariut & Al Ameriyah Growth area. In addition, to the two focus areas, some GCAP actions are Governorate-wide given their remit across the Governorate. For each of these areas a set of short, medium, long-term projects are developed, as well as selected high impact policies.

Figure 4-1 – Spatial focus areas

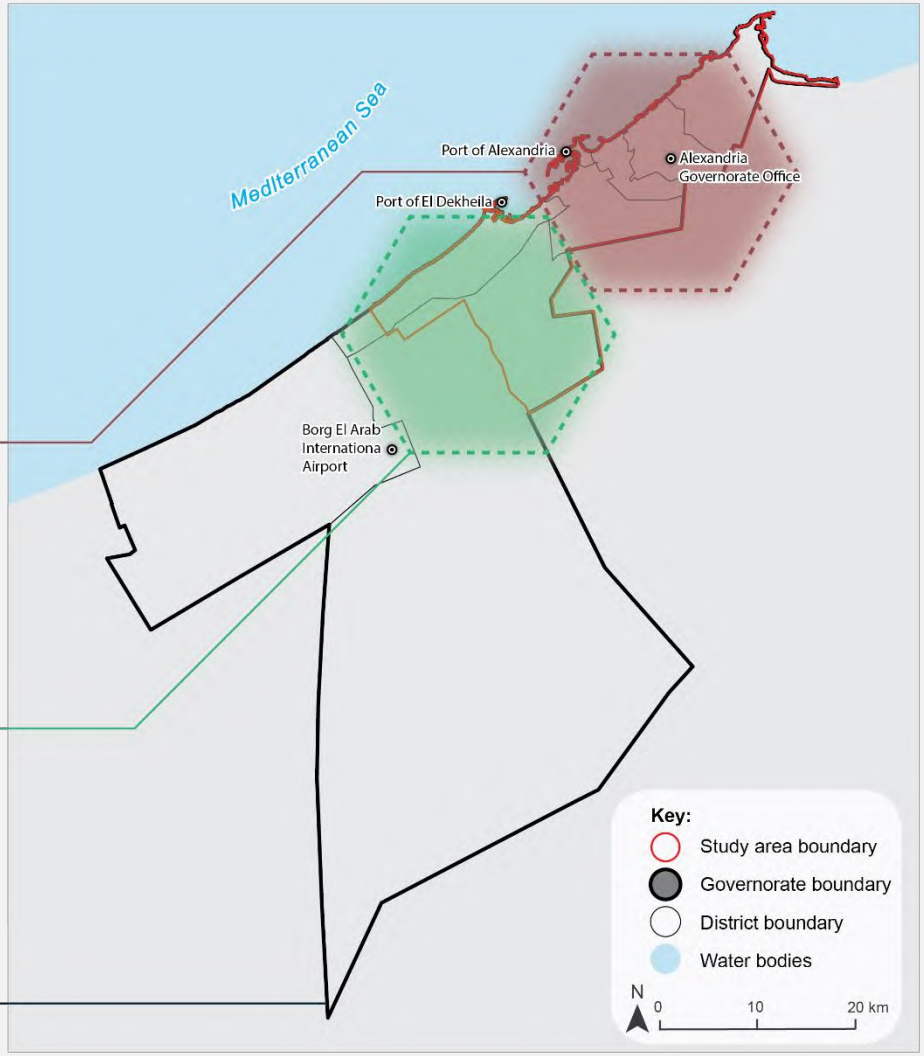
FOCUS AREA 1

Alexandria Urban Core
Challenges:
- Pluvial flooding & coastal protection;
- Water scarcity;
- Increasing traffic and the compounding effect of worsening air quality and heat; and
- lack of open spaces.

FOCUS AREA 2

Lake Mariut &
Al Amreya Growth Area
Challenges:
- Reversing environmental pollution in the area;
- Providing critical connections and interventions in addressing wider water scarcity; and
- Supporting the sustainable development of Al Amreya urban expansion as the new growth area of Alexandria Governorate.

Governorate Wide



Source: AtkinsRéalis

Focus Area I – Alexandria City

The Alexandria City focus area is where most of the population resides. It is also the ancient centre of the Governorate with historic buildings. Protecting the character of this significant area is a priority for both residents and the government in Alexandria. The area grapples with a range of challenges including:

- Risk of pluvial and coastal flooding,
- Ageing infrastructure and water losses,
- Increasing traffic congestion and the compounding effect of worsening air quality and urban heat islands, and
- High densities and lack of open/green spaces.

The GCAP aims to reduce the impact of these challenges and build resilience against climate change.

The GCAP proposes to:

- Reduce flood risk by delivering a mix of green and grey drainage systems across the urban core including stormwater drainage, Sustainable Urban Drainage (SuDS) and open spaces.
- Reduce water loses by upgrading the ageing water distribution network to ensure more efficient use of freshwater resources within the City and collection of stormwater for re-use.
- Improve traffic circulation in the urban core by leveraging major investment in transportation such as the Abu Qir metro and Al Ralm tram.

All three proposed areas of intervention will deliver significant improvements and benefits to the City and protection for the future. However, they are likely also to generate considerable disruption during implementation. To minimise disruption, preparation and implementation of projects need to be fully aligned and coordinated. This is further discussed in the Implementation Chapter.

Focus Area II – Lake Mariut/Al Ameriyah Growth Area

Focus Areas II is south of Alexandria City. It includes the area around Lake Mariut characterised by its many industrial sites, Al Ameriyah town, the western coastal expansion zone in Al Algamy positioned in between the lake and the coast, and Port of El Dekheila. Al Ameriyah is one of Alexandria's major growth hubs. While this urban extension is necessary, development has been unplanned and is lacking key infrastructure. Economic activities and insufficient infrastructure adversely impact the environmental assets, especially Lake Mariut.

Specific challenges in the area include:

- Environmental and water pollution in various water bodies including coastal wetlands such as Lake Mariut;
- Rapid unplanned urban growth Al Ameriyah;
- Lack of adequate connectivity between Al Ameriyah and the urban core which contributes to the increasing use of private transportation; and
- High energy and water consumption from both rapid urbanisation and industrial sites.

The GCAP aims to reduce environmental pollution from activities in the area and establish resilient and low carbon infrastructure that can support the City's growing resource demand.

The GCAP proposes to:

- Provide critical connections and water interventions to reduce the risk of water scarcity and support increasing demand for fresh water across the Governorate.
- Reduce pressure on environmental assets from urban growth by upgrading the wastewater treatment operations.
- Support increasing energy demand through renewable local energy sources as well as incentivising energy efficiency practices for new areas.
- Improve transport connectivity between Al Ameriyah and Alexandria's urban core.
- Increase desalination capacity.

Governorate wide initiatives

Beyond the two focus areas, the GCAP prioritises a range of Governorate-wide actions focused on building long-term resilience, reducing emissions and tackling environmental pollution from waste.

The GCAP proposes to:

- Developing a policy framework for improving long term climate resilience by updating the Local Preparedness Plan and Early Warning System and developing a Coastal Resilience Plan specifically addressing the challenges associated with rising sea level.
- Supporting the electrification of public and private transport by expanding Electric Vehicles (EV) charging Infrastructure and thereby contributing to a reduction in GHG emissions and better air quality.
- Improving SWM in the Governorate through a set of integrated solid waste actions including a Solid Waste Study, Decentralised Transfer Stations, an Upgrade of Waste Treatment Facilities, and an Upgrade of the Sanitary Landfill with facilities for turning waste into energy.

The section below provides an overview of the proposed actions by focus area and phasing.

4.5. Overview of GCAP Actions

The table below provides an overview of GCAP actions by spatial focus area and includes priority phasing and estimated costs. Short term (ST) refers to 1-3 years, medium term (MT) to 3-5 years and long term (LT) to 5-10 years. The total investment need of the GCAP is around € 506.38 million (EGP 26,903.97 million), taking the average where cost ranges are indicated.[16]

Legend

- Reduce vulnerability to flooding/ enhance preparedness.
- Land-use control / brownfield development / multipurpose spaces.
- Expand and enhance Alexandria's public transportation system.
- Improve the ecological quality of Alexandria's surface water / conservation.
- Transition to renewable energy sources / sustainable energy practices.
- Improve Solid Waste Management.

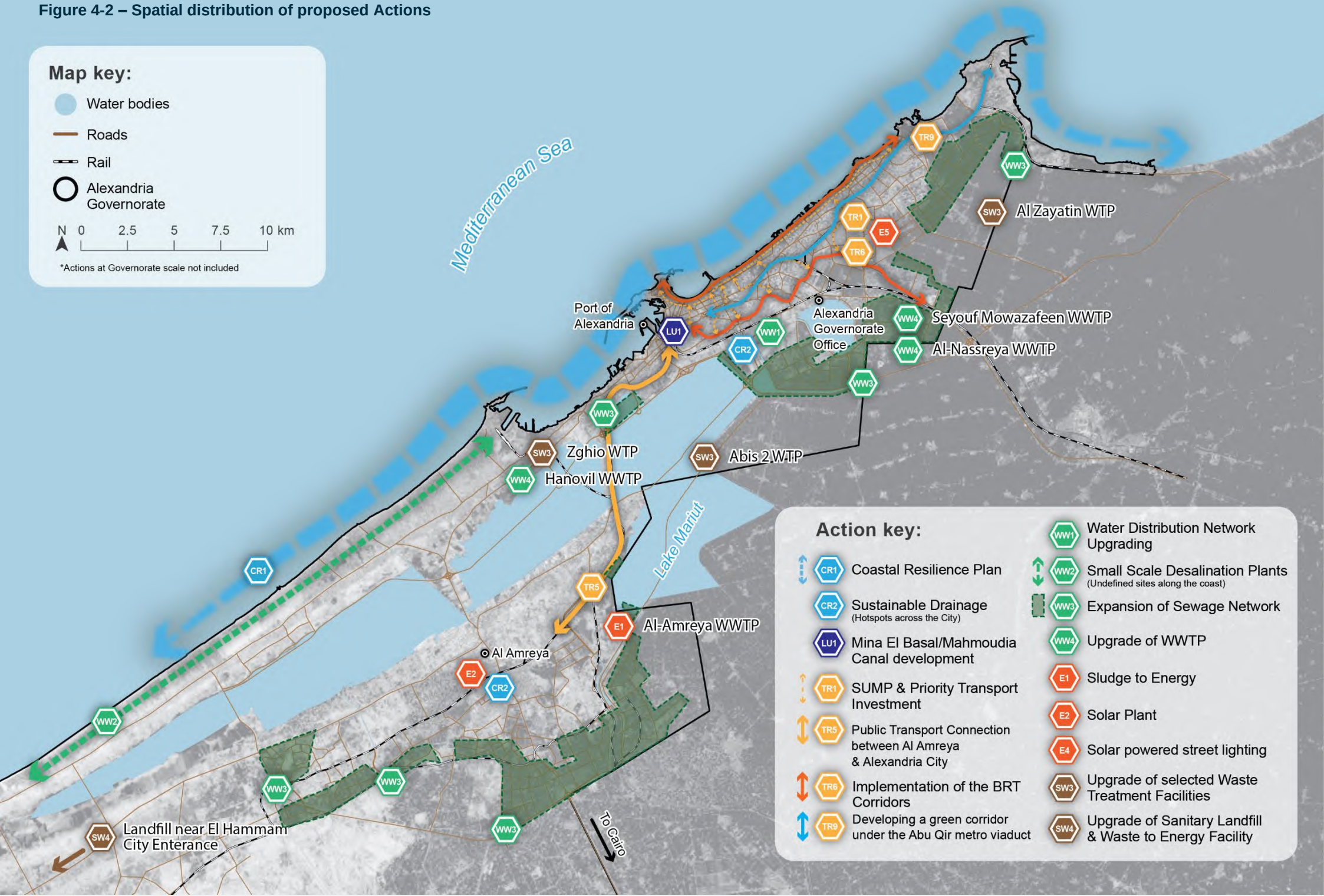
Table 4-1 – Overview of GCAP Actions

Alignment with Strategic Objective	Action code	Action name	Priority & Phasing			CAPEX
			ST	MT	LT	EUR (€) / EGP
		Focus Area I – Alexandria City				**€ 105.50 million / EGP 5,605.22 million**
	CR2	Sustainable Drainage				€ 35 million / EGP1,860 million
	TR1	Sustainable Urban Mobility Plan & Priority Transport Investments				SUMP: € 0.5 – 2 million, (EGP 26.5 – 106.3 million 2nd Investment: € 3-6 million EGP 160 - 318 million
	TR2	Decarbonisation of Public Transport Fleet				€ 40 million (2.1 million EGP) (buses) € 0.5 million (27 million EGP) (charging)
	TR7	Replacement Services Needs Identification and Implementation				Requires further detailed study.
	TR8	Metro 2 & Future Tram Upgrades				Requires further detailed study.
	TR9	Developing a Green Corridor Under the Abu Qir Metro Viaduct				Requires further detailed study.
	WW3	Expansion of the Sewerage Network				Requires further detailed study
	TR4	Integrated Public Transport Network Ticketing (Electronic Fare Payment System)				Requires further detailed study.
	TR6	Implementation of the BRT corridors				Two bus rapid corridors € 20 million (EGP 1,062.5 million)

[16] The real total investment need is likely higher because some of the actions require further studies to estimate their costs.

	LU1	Mina El Basal/Mahmoudia Canal Development	Requires further detailed study.
		Focus Area II – Lake Mariut/Al Ameriyah Growth Area	**€ 273.63 million/ EGP 14,537.96 million**
	E1	Sludge to Energy	€ 30 million (EGP 1,594 million)
	E2	Solar Plant	€ 33 million (EGP 1,753 million)
	E3	Sustainable Energy Residential Compound Package	€ 0.17 – 0.63 million (9 - 33 million EGP)
	WW2	Small Scale Desalination Plants	€ 50 million (excluding cost of Solar PV) (EGP 2,656.5 million)
	WW4	Upgrade of Wastewater Treatment Plants	€ 60 million (EGP 3,188 million)
	WW5	Industrial Water & Wastewater Management	Requires further detailed study.
	WW6	Treated Sewage Effluent Use in Industry	Requires further detailed study.
	TR5	Public Transportation Connection Between Al Ameriyah and Alexandria City	€ 100 million for 2 bus corridors (EGP 5,333 million)
		Governorate Wide Actions	**€ 127.25 million / EGP 6760.79 million**
	CR1	Coastal Protection	€ 40 million (EGP 2,125 million)
	CR3	EWS and Local Preparedness Plan	Plan: € 0.25 million (EGP 13.3 million,) , Hydromet improvements: € 0.5 - 1 million (EGP 26.5 – 53 million)
	CR4	Cool Street Design	€ 5 million (EGP 265.6 Million)
	E4	Automated solar powered street lighting for public places and roads	Requires further detailed study**.**
	WW1	Water Distribution Network Upgrading	€ 26 million (EGP 1,381 million)
	SW1	Solid Waste Study	€ 0.4 million (EGP 21.25 Million)
	TR3	Expansion of EV Charging Infrastructure	1 charging station for cars: € 5,000 (EGP 265,000)
	SW2	Decentralised Transfer Stations	€ 3 million (EGP 159.4 Million)
	SW3	Upgrade of Waste Treatment Facilities	€ 50 million (EGP 2,656.5 million)
	SW4	Upgrade of Sanitary Landfill and Waste to Energy	Requires study to estimate costs.

Figure 4-2 – Spatial distribution of proposed Actions



4.6. Sector Roadmaps

To enable implementation the proposed projects are further elaborated in the following chapters and presented by Sector in the form of a roadmap. Specific sector roadmaps have been developed for:

- **Climate Change and Land Use;**
- **Transport;**
- **Water and Wastewater;**
- **Energy; and**
- **Solid Waste.**

The roadmaps translate the spatial development framework into sector specific investment plans designed to deliver the agreed-upon ‘Vision’ and guide the City's development over the next 10 to 15 years.

Each roadmap discusses key considerations covering sectoral and cross-sectoral synergies, replicability, challenges and/or requirements for implementation. It further includes information on the key actors and stakeholders and their role in the development of the sector.

A brief overview of actions is presented in each sector with more detailed project information for priority actions to be delivered in the short term contained in Appendix A.

Where relevant, the roadmap sets out specific examples to help showcase the benefits of the proposed actions. This is particularly important in the case of the Integrated Roadmap for Climate Change and Land Use.

The roadmaps further include supporting studies and enabling policies – policies concerned with legislation, regulation and standard setting measures, development and approval of implementation of strategic documents, institutional capacity building and enhanced governance processes relating to Green City areas.

The sector roadmaps in the following sections indicate in which spatial focus area each of the actions is located and the timeline for their implementation.

Climate Resilience Roadmap

Sector goals:

Reduce Alexandria's vulnerability to pluvial and coastal flooding and enhance local preparedness and capacity to respond to climate change; and

Optimise land use to control unplanned growth through the delivery of brownfield redevelopment and multipurpose spaces that enhance urban resilience and promote sustainable urban development.

Specific Targets include:

- Reducing proportion of households and infrastructure at risk from climate change;
- Ensuring economic damages from natural disasters are minimised due to enhanced preparedness;
- Increasing the provision of open and multifunctional spaces; and
- Increasing brownfield development that support sustainable development and promote key economic activities.

Relevant SDGs:

5. Climate Resilience and Land use Roadmap

5.1. Introduction

Alexandria is already experiencing the effects of climate change, and impacts relating to sea-level rise, coastal erosion, heavy rainfall, water scarcity and high temperatures will intensify in the period to 2050 and beyond. This roadmap sets out a series of actions to address short-term challenges while at the same time building the foundations for longer-term resilience. These actions are critical to social inclusion as quite often vulnerable and marginalised groups are those most exposed to and worst affected by climate change.

Building on ongoing initiatives, including initial drainage improvements undertaken, and targeted coastal protection measures around the Citadel of Qaitbay and others, the actions outlined in this roadmap seek to provide an integrated approach to address the multiple challenges faced by the City.

While some risks are clearly addressed through specific investments in climate adaptation, others, and in particular those to address risks from water scarcity and heat, are best addressed through integration across other sectors. Land-use interventions have been incorporated into this roadmap to highlight the critical importance of using urban development to address heat and flood risk while at the same time enhancing the urban fabric for residents of the City.

The proposed actions presented in this roadmap are outlined below and are also followed by a summary of the Water sector actions which are designed to Alexandria's water security. Key climate resilience actions focus on:

- Addressing the critical risk of sea-level rise and coastal inundation by investing in a comprehensive set of measures outlined in **CR1: Coastal Protection,** including a mixture of investments in traditional coastal protection measures and softer measures such as beach nourishment and artificial reefs. At the same time there is a need for the city development policy to be aligned with the principles outlined in the Integrated Coastal Zone Management Plan that is currently being developed, as there is a risk that present development priorities could exacerbate existing coastal challenges and undermine the effectiveness of the planned investments.
- Reducing flood risk through investment in a suite of green and grey drainage measures as highlighted in **CR2: sustainable drainage**. This includes the introduction of SuDS features to increase the permeability of the City, restoration of stretches of the canal network to enhance drainage, and targeted investments to improve drainage capacity. Preparedness for the risks from flooding and coastal hazards will also be increased by supporting the implementation of an early-warning system for the City, under **CR3: EWS and Local Preparedness Plan**

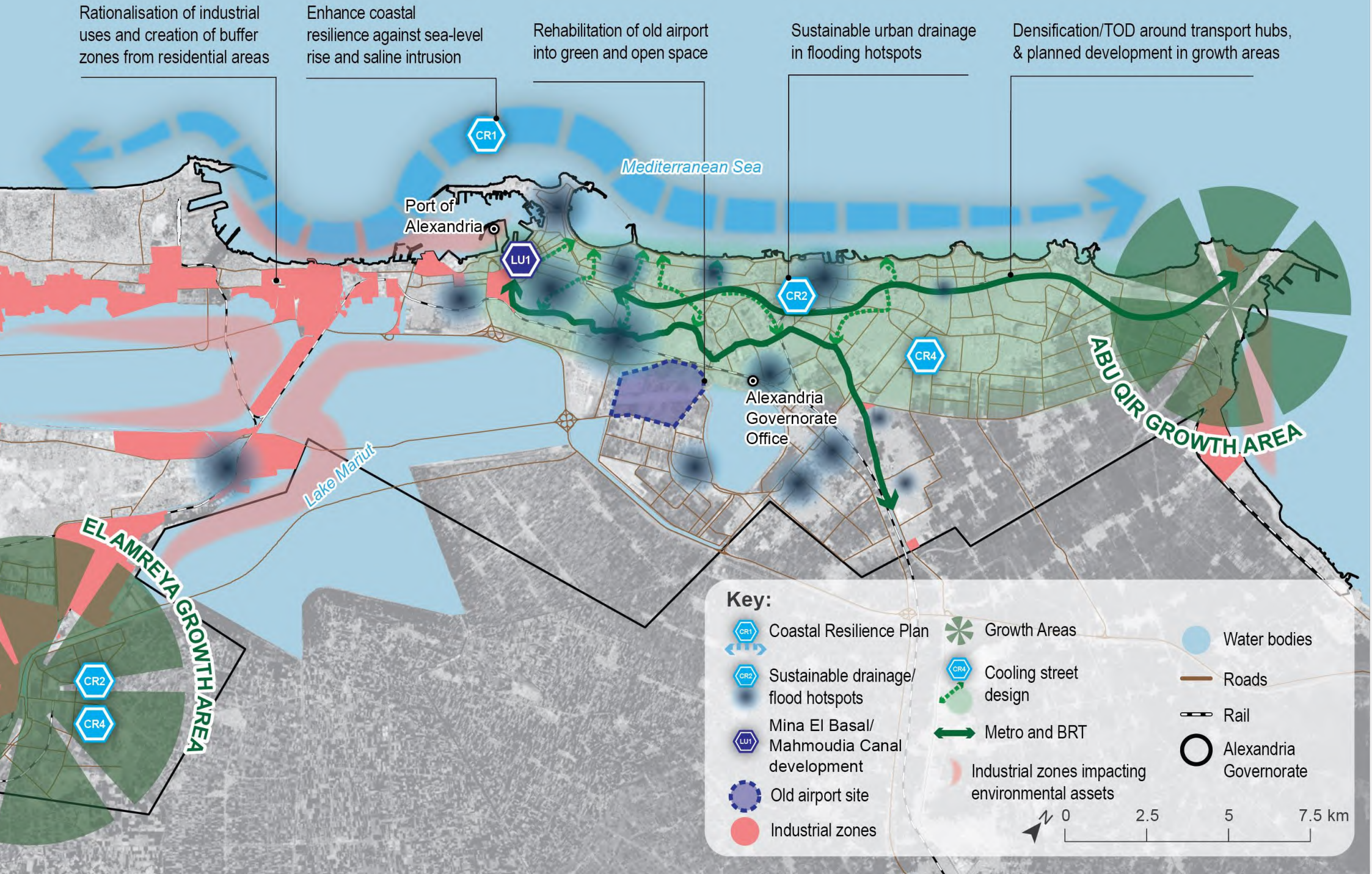
Further actions which provide both opportunities for urban regeneration, and will support the creation of a cooler urban fabric to address the emerging risk from heat extremes include:

- **Minal El Basal Industrial Heritage Regeneration** to develop a plan for a centrally located area with important heritage that is currently left to deteriorate. The regeneration of Minal El Basal would generate significant benefits for Alexandria, create a mixed-use development in the heart of the City reducing the demand for out of town development, connect with the existing transport infrastructure, and expand the tourist trail. It can also be combined with the nearby Mahmoudia Canal Restoration which further enhance urban resilience against climate risks.
- **Densification around new transport hubs/lines** to reduce the demand for unplanned urban expansion; and integration of design for cool streets into the redevelopment of transversal road links between the Corniche and Mahmoudia, and the transport corridors along the Corniche, and Mahmoudia Canal.
- **Rehabilitation of the old airport site,** providing an opportunity to develop green and open spaces in Alexandria while creating neighbourhoods showcasing principles for urban cooling and drainage.

The Water Sector roadmap incorporates a number of investments that will help to address the risk posed by water scarcity to the City. Specifically, **WW1** to **Rehabilitate and upgrade the potable water network** through replacement of damaged infrastructure, improving network pressure, and installing leak detection technology and the implementing advanced leak detection technology will reduce NRW losses, and the **development of two additional desalination plants (WW2)** with a capacity of 50,000 m3/day will help reduce the pressure on existing water resources. Additionally, water management and reuse actions under **WW5** and **WW6** will also support a more resilient water sector for Alexandria.

Salinisation is not specifically targeted through the investments in this GCAP, but the actions it contains will reduce existing pollution and pressures.

Figure 5-1 – Climate Resilience and Land Use Roadmap



Key Considerations	
Synergies	• The close integration of climate resilience and land use is reflected in their inclusion together in this roadmap, with particular importance in ensuring that investments for urban regeneration integrate measures to improve drainage and reduce heat island effects where possible. • There are also synergies with proposed investments under the Transport sector roadmap, in particular the need for integration of both sustainable drainage and urban cooling measures into planned transport investments including investments in transversal roads and sidewalks under **TR1: Sustainable Urban Mobility Plan & Priority Transport Investments,** and the development of BRT corridors along the Corniche and Mahmoudia Canal outlined in **TR6: Implementation of the BRT corridors**, which provides an opportunity to enhance coastal resilience. • As outlined above the water sector roadmap contains a number of investments to both reduce NRW, develop alternative water sources, and increase water reuse which are critical for addressing the growing risk of water scarcity. • **Energy, and Solid Waste** – For actions in these sectors there is a need for climate risks to be assessed at the level of the investment, as well as ensuring that development does not exacerbate existing challenges relating to flood and coastal resilience, water scarcity and heat, such as reducing the flood absorption capacity of green space, or the City's waterways.
Replicability	• **CR1** – **Coastal Protection** - Investments to enhance coastal resilience will be targeted initially, and as such there is an opportunity to expand to these to further areas as opportunities become available. • **CR2** – The investments that will be implemented from CR2: Sustainable Drainage will be replicable across wider areas of the City, and in particular there is potential to scale up the restoration of the canal network as and when this becomes an appropriate option for the City. • The principles for design of cool streets and neighbourhoods can be replicated across the City.
Challenges and precursors to implementation	• Existing development practice in the City is in some ways actively undermining its resilience, for example destruction of beaches through the expansion of the Corniche Road, or the disruption to the canal system. If Alexandria is to successfully meet its climate challenges there is a need for a coordinated approach to resilience, and for investments and development across all sectors in the City to consider their impact on coastal erosion, flooding, water scarcity and heat extremes. The development of the regional Integrated Coastal Zone Management plan provides an important opportunity to address this lack of coordination for coastal issues, but the City also needs a framework for managing its wider risks. • Coastal investments suggested in CR1 Coastal Protection, and CR2 Sustainable Drainage investments in CR2 will require specific feasibility studies in order to determine the best combination of measures. Building the supporting evidence base for both coastal and flood risks and ensuring this is available to a wide range of stakeholders, is a key part of preparing the City for change. • An environmental impact assessment will need to be included in each project to evaluate the ability and the degree of natural variability and stability of the area's environment, focusing on the ecological risks and determining critical elements, including cumulative impacts.

5.2. Key Actors and Stakeholders

Climate Resilience and land Use key actors and stakeholders	
Ministry of Local Development (MoLD)	The Ministry of Local Government is overseeing local development initiative. MoLD is a key stakeholder to be consulted and informed on key proposal with involvement mainly through Alexandria Governorate as local representation.
Alexandria Governorate	Alexandria Governorate is responsible for proposing, planning, setting, and implementing plans, programs, and policies for establishing urban areas within Markaz, Cities, Districts, and villages within the Governorate, including setting rules for land use. The Urban Planning Department is a key stakeholder for LU1 – Mina El Bassal / Mahmoudia Canal Development. The Risk and Disaster Department is a key stakeholder for CR2 - Sustainable Drainage and CR3 - EWS and Local Preparedness Plan.
Ministry of Housing, Utilities and Urban Communities (MoHUUC)	MoHUUC is the Ministry responsible for the construction, and infrastructure of urban communities and utilities. Holding Company for wastewater, Construction Authority for Potable Water & Wastewater, and Alexandria Sanitary Drainage Company (Operation and Maintenance of Drainage System) are key stakeholder for CR2 - Sustainable Drainage.
Alexandria Sanitation and Drainage Company (ADSCO)	The Alexandria Sanitation & Drainage Company is a key stakeholder for CR2 - Sustainable Drainage.
Ministry of Water Resources and Irrigation (MoWRI)	The Shore Protection Authority is part of the Ministry of Water Resources and Irrigation (MoWRI) and main planning and decision making entity for Coastal Protection.
Ministry of Environment Affairs (MoEA)	The Meteorological Authority is a key stakeholder for developing an early warning system as part of CR3 - EWS and Local Preparedness Plan. The Coastal Research Institute is key knowledge partner for the CR1 - Coastal Protection .
Egypt Meteorological Department	Key stakeholder for CR3 - EWS and Local Preparedness Plan regarding the development of an early-warning system.
Alexandria University	The University of Alexandria is a key knowledge partner for all of the climate change and land use actions.

Legend

Short term – 1-3 years	Governorate Wide
Medium term – 3-5 years	Alexandria Urban Core
Long term – 5-10 years	Lake Mariut & Al Ameriya Growth Area

5.3. Summary of Actions and Policies

Actions					CAPEX
Action		**Technical Description**	**Action impact / benefit**	**Action Owner**	**EUR (€) / EGP**
CR1 – Coastal Protection		This project addresses the risks of sea-level rise and coastal erosion through a series of coastal protection investments and will be designed as a mix of traditional hard engineering, and more nature-based approaches. The project will link closely with the *Enhancing*	Increase protection of coastal area of the City and key infrastructure through reduced damage from storm surges and reduced	MoWRI	€ 40 million / (EGP 2,125 million)

	Climate Change Adaptation in the North Coast and Nile Delta Regions of Egypt project, and associated ICZM national plans. Investments will include: • **Beach Nourishment** to address significant ongoing beach loss and associated loss of protection. Initial investments will focus on beaches lost due to Corniche expansion. • **Rehabilitation of sea walls and revetments** – current infrastructure is in poor repair and less effective than planned. Investments will rehabilitate and enhance existing defences, in particular linked to the expansion of the Corniche Road. Living sea wall technology will be piloted. • **Submerged reefs** to reduce the impact of waves and storm surges while supporting biodiversity. Environmental, long-term impact, effectiveness and socio-economic assessment will be carefully investigated for each approach. Lessons learned from previous national projects and studies will be taken into account when choosing the tools and methodology to be applied. For example, evidence shows that beach nourishment can be applied without major damage to coastal ecosystems (Vacchi et al. 2020). It can enhance the natural landscape of the coast, promote a leasing environment, and provide a large space for recreational and tourism activities. Although beach nourishment helps dissipate wane energy, it does not prevent coastal erosion; the beach naturally erodes, requiring regular re-nourishment.	disruption. Enhance social and environmental value of beaches and marine environment, and improve attractiveness of the shoreline contributing to economic development.		
CR2 – Sustainable Drainage	With a very limited drainage network, and increasing flood risk from climate change, the City will not be able to manage flooding effectively. This programme of investment combines green and grey stormwater management approaches and includes: • **Programme of SuDs schemes across the city –** initial investments targeted at flooding hotspots identified by AWCO and transport investments in historic core of the City. Increasing permeability will reduce run-off during flash flood events. • **Pilot restoration of Mahmoudia Canal** to increase flood capacity, targeted initially at the area close to Minal al Basal. The restoration of the canal will improve flood storage, enhance biodiversity, mitigate water pollution and improve connectivity in the City, as well as enhancing land values.	Improved stormwater management, but additional open/ green spaces also generate further benefits in terms of recreation, cooling, and improving biodiversity. Also provides opportunity to significantly improve livelihoods for poor and marginalised groups in the City by reducing flood risk in low-income neighbourhoods	AWCO; ADSCO; MoLD	€ 35 million / EGP 1,860 million

	• **Expansion of city drainage network** which is currently inadequate and in need of significant upgrading to meet the City's needs. **Creating retention basins or small reservoirs to increase storage capacity.** Public spaces can be designed in order to provide flood storage capacity during heavy rainfall events and extreme storms of the sort that lead to flooding in Alexandria. Storage can be above or below ground, and water can be reused after proper treatment for irrigation of open space.			
CR3 – EWS and Local Preparedness Plan	There is an existing local preparedness plan but no system of early warning for coastal and flood hazards. This action will enhance the local preparedness plan so that it incorporates climate risks and is supported by a multi-hazard early warning system. This will include a review and refresh of the plan to identify how climate-related hazards can be incorporated and the existing alert system strengthened. It will link the current system with planned development of a multi-hazard warning system under the EU MedEWS project[17], and identify what additional investments in the current hydrometeorological system are needed.	The City is better prepared for extreme events and climate-related hazards, with a particular focus on reducing impacts on vulnerable groups.	Governorate; EMD, MoEA	Plan refresh € 0.25 million. (EGP 13.3 million) Hydromet improvements: € 0.5 - 1 million (EGP 26.5 - 53 million)
CR4 – Cool Street Design	This action comprises retrofitting existing streets to enhance their greening and promote resilience against environmental, social and infrastructure challenges. This involves updating and modifying the street infrastructure to enhance cooling and permeability. Streetscape enhancements are integrated within transport sector investments in the urban core; however, this action comprises investments focused on Al Ameriya and similar inland developments where heat stress will be more pronounced.	Improved resilience to increasing temperatures	Governorate	Requires further study (EGP 265.6 million)
LU1 - Minal El Basal Canal Development	The regeneration of Minal El Basal would generate significant benefits for Alexandria, creating a mixed-use development in the heart of the City reducing the demand for out-of-town development, connect with the existing transport infrastructure, and expand the tourist trail. Implementation of such a project could considerably enhance the attractiveness of the City and increase investment flows and job creation. Provision of affordable housing and accommodating existing compatible uses sensibly, can ensure equitable access to generated benefits without displacement effects. The project can also be combined with the nearby Mahmoudia Canal Restoration which further enhance urban resilience in terms of climate risks.	Urban regeneration, new tourist area, increased connectivity and active travel opportunities	MoHUUC,	Requires further detailed study

[17] medewsa.eu

5.4. Proposed Policies

Beyond the specific projects set out above, the Governorate can use strategic land use planning and ICZM policies to incentivise urban development that reduces pressure on the environment and contributes to long-term resilience. The following policies could be considered:

Densification around new transport hubs/lines - The Alexandria Strategic Urban Plan 2032 addresses the challenge of density in the City Centre as a core element of the plan. It aims to redistribute population away from the urban core to a new growth pole at Al Ameriyah and the new urban community of New Borg El Arab. However, both settlements need to grow in line with infrastructure capacity and connectivity. To take pressure of these new hubs and to avoid urban sprawl into agricultural land, the government could guide densification along the key transport hubs and lines, by setting minimum densities and scales and providing enabling infrastructure (as needed) in designated areas while restricting development elsewhere for example, along the planned BRT route along the Mahmoudia Canal.

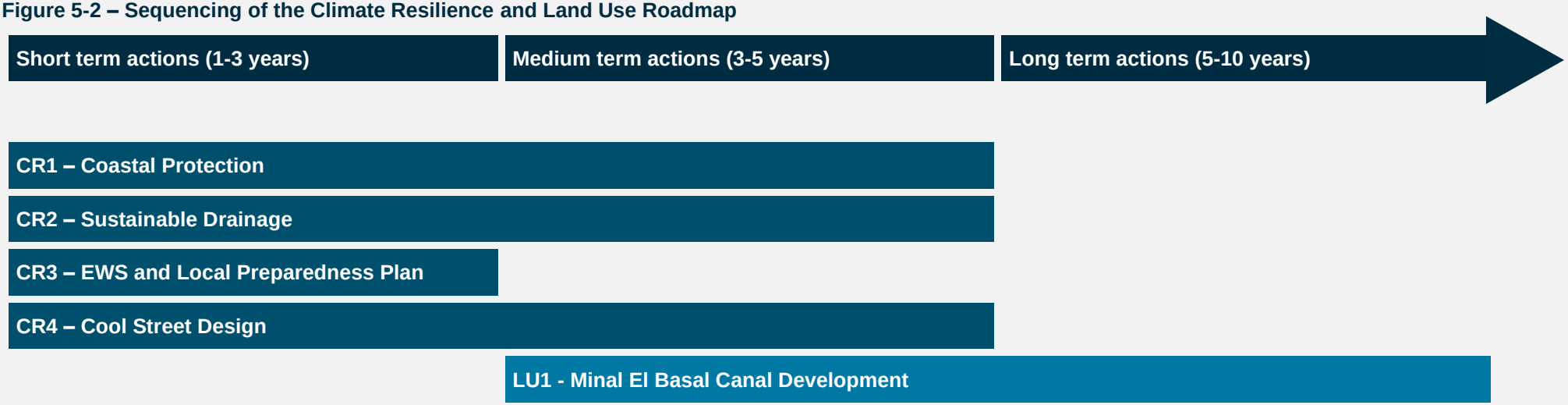
Rehabilitation of the old airport site – Similarly to above, the Governorate could develop guidelines and incentivise environmentally sensitive partial development of the old airport site to generate revenue that could be utilised to re-plan and maintain the remaining site as a critical urban park. The old airport site sits in a prime location between Lake Mariut and the Airport Farmlake, with a small area of agricultural land on its eastern and southern border and a dense neighbourhood to its north. An initial study could assess the opportunity for developing the 2,500,000 m² large site into a public park. Income generating measures, such as leasing sections of the park or including private residential developments on its fringes, should be considered in order to access funding. To give an example, the City of Berlin has developed its old airport "Tempelhof" into one of the largest inner-city parks world-wide. With its field-like character, the park provides ample of space for walking/cycling and hosts many outdoor sports facilities. The old airport buildings are used for cultural events. Sections of the park are reserved for temporary uses like community gardens, religious dialogues, pop up cafes and restaurants and educational projects.

Improving sustainability of industrial sites - Many of Alexandria's industrial sites are located around Lake Mariut. These sites use water and energy resources inefficiently and contribute to environmental pollution, e.g., by discharging wastewater into the lake without treatment. The government can develop regulations to improve the sustainability of industrial sites. Starting point for doing so, is a study to identify potential to minimise impacts from industrial activities in Alexandria such as re-location of existing light industrial facilities, redevelopment of disused industrial premises and provision of incentives and regulations to concentrate new industrial development away from residential areas or providing appropriate buffer zones where possible to separate industrial from residential areas.

5.5. Sequencing of the Roadmap

The sequencing of the actions can be seen in Figure 5-2 below.

Figure 5-2 – Sequencing of the Climate Resilience and Land Use Roadmap



Source: AtkinsRéalis

Transport Sector Roadmap

Sector goals:

Expand and enhance Alexandria's public transportation system to support modal shift through improvement of the level and quality of service provision, promote low carbon alternatives, improve traffic flow and widen options for active travel.

Specific Targets include:

- Improving residents' access to various public transportation options that run on alternative fuel; and
- Minimizing congestion and improve air quality through careful management of traffic and provision for non-motorised transport options.

Relevant SDGs:

6. Transport Sector Roadmap

6.1. Introduction

The major transport challenge in Alexandria is ageing infrastructure and heavy reliance on individual car-based transport and private diesel minibuses causing congestion and inefficiencies in travel. In its current state, the transport sector is a major contributor to poor air quality and GHG emissions in the City.

Recognising the necessity to upgrade public sector transport infrastructure, there are currently major ongoing investments to rehabilitate the Abu Qir Metro and Al Raml Tram lines. However, there is a need to further improve the public transportation offer, focusing on decarbonisation of the sector, better integration of different modes and promoting ease of movement including non-motorised transportation. These projects have the potential to improve the safety and accessibility of the transport sector particularly for women and people with disabilities. This is also a priority identified by the Sustainable Urban Transport Study conducted a few years ago.

The proposed GCAP projects within the sector aim to build on the ongoing infrastructure upgrades, address the existing gap in provision and set the basis for further future improvements focusing on:

- developing a long term **sustainable urban mobility strategy (TR1)** that considers in detail integration of modes including non-motorised transport provision, starting with the **implementation of priority transport investments** in changing road hierarchy and traffic management to ease movement;
- gradual replacement of polluting public transportation vehicles with the procurement of **100 new buses (TR2) on key routes** along with required charging infrastructure;
- promoting the circulation of electric vehicles through the **expansion of EV charging stations (TR3)**;
- incentivising use of public transportation through further investment in **TR4 - Integrated Public Transport Network Ticketing (Electronic Fare Payment System)**; and
- investing in enhanced services between key urban areas **(TR5 Public Transportation Connection Between Al Ameriyah and Alexandria City)** and dedicated bus lanes **(TR6 Implementation of the BRT corridors)** to support modal shift over the medium term.

These projects are considered as critical to address key challenges in the Governorate. Their scope has been defined building on existing initiatives and demand for their implementation has been discussed in detail with key stakeholders.

Beyond these projects there is a need to consider potential further upgrades and improvements to the network as the City and other urban areas in the Governorate expand including:

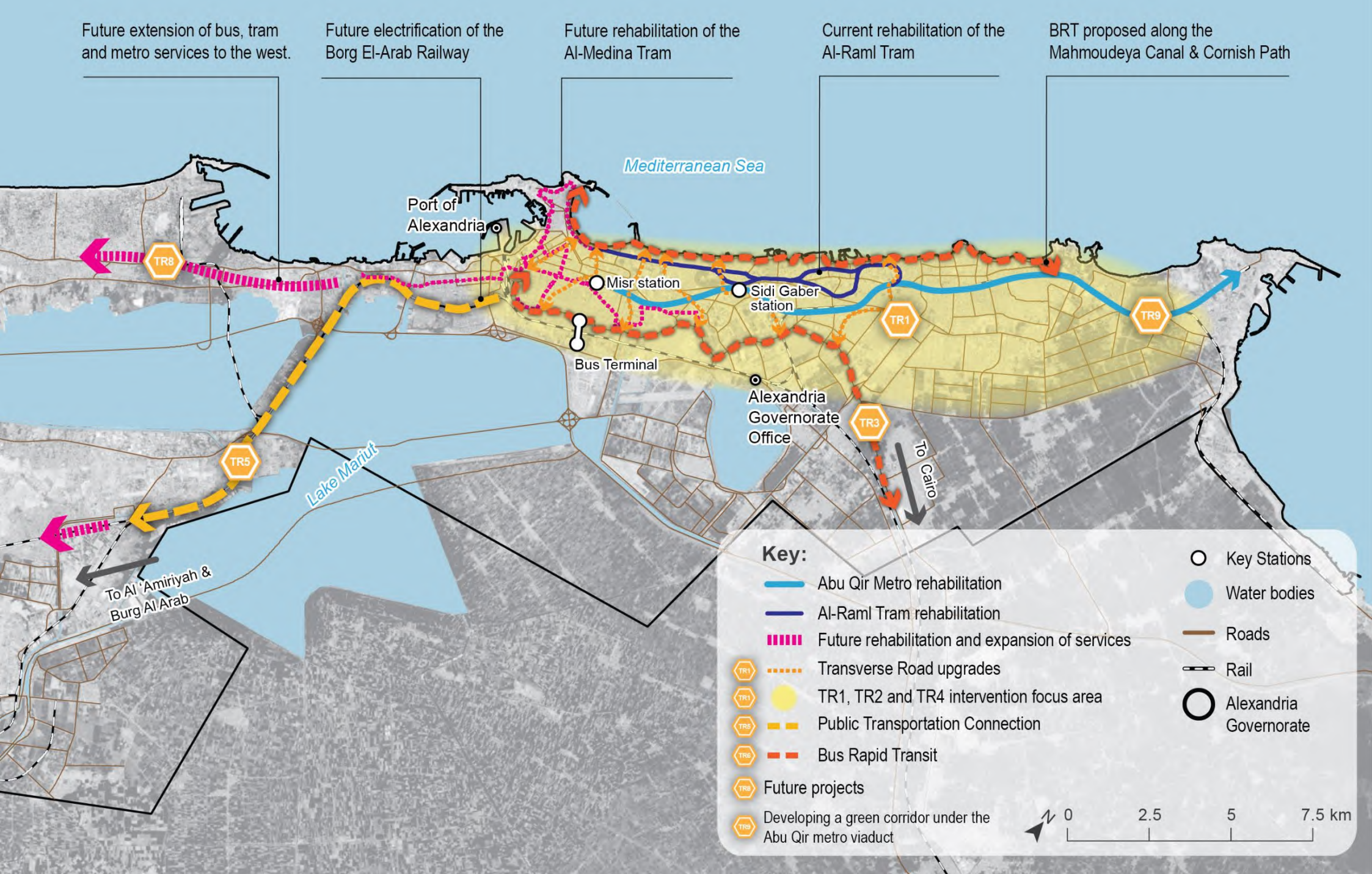
- Metro line 2 following the completion of the Abu Qir Metro line;
- rehabilitation of other tram lines and suburban services;
- increasing restrictions on private vehicles in key areas once sufficient alternative public transportation options are established, including potential restrictions and rerouting of freight away related to industrial and port areas away from urban areas and rationalising minibus routes.

The following map shows how the proposed projects fit within the existing transportation network.

Key considerations for the implementation of the projects are provided further below while an outline of each investment is set out in the following table.

Further information for key projects is included in A.2.

Figure 6-1 – Transport Sector Roadmap



Key Considerations	
Synergies	Transportation actions are closely linked to the climate resilience and land use sector and their implementation would generate significant benefits if considered in tandem: • **TR1** - Sustainable Urban Mobility Plan & Priority Transport Investments, in particular investment on replanning transverse roads connecting arterial roads to ease movement within Alexandria provides an opportunity to consider appropriate streetscape design (**CR2** and **CR4**) to mitigate against flooding and urban heat risks. • Implementation of the BRT corridor along the Corniche Road can support the decongestion and improvement of the waterfront, a key asset for the City and promote potential uses integrated with coastal protection. Similarly, the Mahmoudia Canal corridor provides an opportunity to support Transit-Oriented Development with densification around key stations, in particularly those integrating various transport modes such as the Muharram Bek El Mowkaf El Gedid Mobility Hub and potential regeneration of the Mina El Basal area. • System resilience will be a critical across all projects given the increasing climate related risks of urban and coastal flooding.
Replicability	There are a number of actions that can be expanded or replicated in the Governorate or in similar urban areas across the country: • **TR2 -** Decarbonisation of Public Transport Fleet covers the purchase and operation of 100 electric buses. This action could be scaled to replace the entire bus fleet of 600 operated by the Alexandria Public Transport Authority. • **TR3** - Expansion of EV Charging Infrastructure, the number of charging stations can be increased according to demand. • **TR7** – Replacement Services Needs Identification and Implementation - Short-Term Transport Services Provision Plan during Upgrading the Abu Qir Metro and the Al Raml Tram can be set out as model for future upgrades of the existing public transportation system in Alexandria and in other cities. • **TR6** – establishing of dedicated bus lanes/BRT corridors can be expanded into suburban services to accommodate increasing commuting patterns between Alexandria City and growth areas such as Al Ameriya.
Challenges and precursors to implementation	There are three main areas for consideration: • There is a need to develop a detailed sustainable urban mobility plan (SUMP) that builds on the recently completed Alexandria Transport study. The previous study focused mainly on definition and evaluation of options for transport projects covering part of the urban transport system. The SUMP will expand to include a long-term holistic approach to sustainable mobility in the Governorate, incorporating non-motorised transportation, rationalisation of public and private operators' services, freight, zoning and parking and guide the phased development of the network. • The institutional structure of the sector is highly complex with several entities at both national and local level playing a key role on the various projects – these are noted in the following table. Implementation of the proposed investments will require significant coordination between key stakeholders and there is a potential to set out a committee to allow for better collaboration ensuring smooth delivery. This is further considered in the Implementation chapter. • Alexandria is currently faced with significance disruption from ongoing transport upgrades. Some of the proposed projects within the sector, such as the replanned transverse road scheme while essential it will further contribute construction work in the City. Furthermore, other proposed actions such as the upgrade of the water supply network (presented in the following chapter) will also focus on similar spatial areas. Coordination of implementation of projects across various sectors will be critical to mitigate against extended and considerable disruption during construction phase.

6.2. Key Actors and Stakeholders

Transport Sector key actors and stakeholders	
Ministry of Local Development (MoLD)/Alexandria Governorate	The Ministry of Local Government is overseeing local development initiative. MoLDis a key stakeholder to be consulted and informed on key proposal with involvement mainly through Alexandria Governorate as local representation.
Ministry of Transport (MoT)	The Ministry of Transport (MoT) is the policy-setting authority overseeing the transport sector in Alexandria. The key departments relevant to the GCAP transport actions are the National Authority for Tunnels (NAT) and the General Authority for Roads and Bridges Land Transportation, which is responsible for the design and implementation of roads. NAT plays a key role as the implementation authority for the rehabilitation of Abu Qir Metro line.
Alexandria Traffic Department of the Governorate	Alexandria Governorate Traffic Department is involved in planning and organising local transport infrastructure, particularly in relation to the roads and public transport networks. They will be responsible for leading on approvals, land allocation and provision for the GCAP transport actions.
Alexandria Public Transport Authority (APTA)	APTA operates Trams and public buses in Alexandria Governorate. APTA will be leading the implementation and operation of the transport actions of the GCAP.
Ministry of Interior (MoI)	In the Ministry of Interior (MoI), the General Directorate of Traffic and the Intelligent Transportation Systems Department are relevant stakeholders for the GCAP transport actions. The latter in particular is a key stakeholder for the expansion of the Traffic Management System in collaboration with the Alexandria Traffic Department.
Alexandria Distribution Company (ADSC)	Alexandria Distribution Company (ADSC) owns and operates the low and medium-voltage electricity network, selling electricity to, and collecting tariffs from the consumers.
Private Operators	Private operators will play a key role in the supporting efforts in rationalising services across the Governorate. Additionally, under this category is other private sector entities which will support the expansion of EV charging infrastructure.

6.3. Summary of Actions and Policies

Legend:

Short term – 1-3 years	Governorate Wide
Medium term – 3-5 years	Alexandria Urban Core
Long term – 5-10 years	Lake Mariut & Al Ameriya Growth Area

Actions				CAPEX
Action	**Technical Description**	**Action impact / benefit**	**Action Owner**	**EUR (€) / EGP**
TR1 - Sustainable Urban Mobility Plan & Priority	The project will implement critical transport investments in Alexandria to manage traffic and decongest the centre while enhancing pedestrian accessibility. These are: :	Improve the efficiency and cost-effectiveness of the transport network, reduce the impact of	APTA MoT (enabler)	Study – € 0.5 - 2 million

Transport Investments		• **1st investment:** Replanning the transverse roads (six links) linking the Corniche Road and Mahmoudia to alleviate traffic in the urban core; • **2nd investment:** Expanding the Traffic Management System established by the Alexandria Traffic Department; and • **3rd investment**: Develop sidewalks and pedestrian paths to facilitate movement of people to, from, and between transport stops, stations, and hubs. To support the implementation of these projects in a holistic way, a Sustainable Urban Mobility Plan (SUMP) will first need to be developed. The SUMP includes policies, traffic model development, software procurement, and measures to address multimodal transport across the entire urban agglomeration, including public and private operators, passenger and freight, zoning and parking, and door-to-door mobility.	transport on the environment through a reduction in GHG emissions and improve air quality. It will ensure accessible transport options for all citizens and personal safety and security within the transport system and improve the overall quality of life for the citizens.		SUMP: € 0.5 – 2 million, (27 -106 million EGP) 2nd Investment: € 3 - 6 million (159 - 319 million EGP) 3rd Investment – tbc.
TR2 - Decarbonisation of Public Transport Fleet		This investment will support and replace the APTA fleet by purchasing and operating 100 new buses in the short term, that are equipped with modern amenities, facilities, and systems. The project will promote improved mobility, enhance user experience and ridership of the bus fleet, increase energy efficiency, and reduce emissions from public transport. The investment will consider the most appropriate option (CNG or electric) at feasibility stage. In the medium term, the investment will be extended to purchase and operate 300 more electric buses to replace about 2/3 of APTA fleet. This action will also consider the expansion and/or upgrade of existing infrastructure. This includes charging either 'in-route' - or 'off-duty" and will consider the space requirements, charging rates, and grid capacity.	Reduce tailpipe emissions from public transport in Alexandria. It will further improve air and soil quality.	APTA: Implementation and operator MoT (Enabler)	Buses - € 40 million (EGP 2,577 million) (buses) (based on purchase of electric buses. CAPEX for CNG buses will be lower). Electric buses charging infrastructure – € 0.5 million (EGP 27 Million) (charging) per charging facility
TR3 - Expansion of EV Charging Infrastructure		Existing private car EV charging stations within the City are insufficient and need to be expanded. There are currently only 4 points across the Governorate. This action considers the potential for the private sector to invest in and provide EV charging points across the City and how the Governorate can facilitate this investment.	Reduce GHG emissions from public transport in Alexandria. It will further improve air and soil quality.	Governorate: Approvals Private sector	Electric vehicle charging infrastructure – cars € 5,000 (EGP 265,000) each.

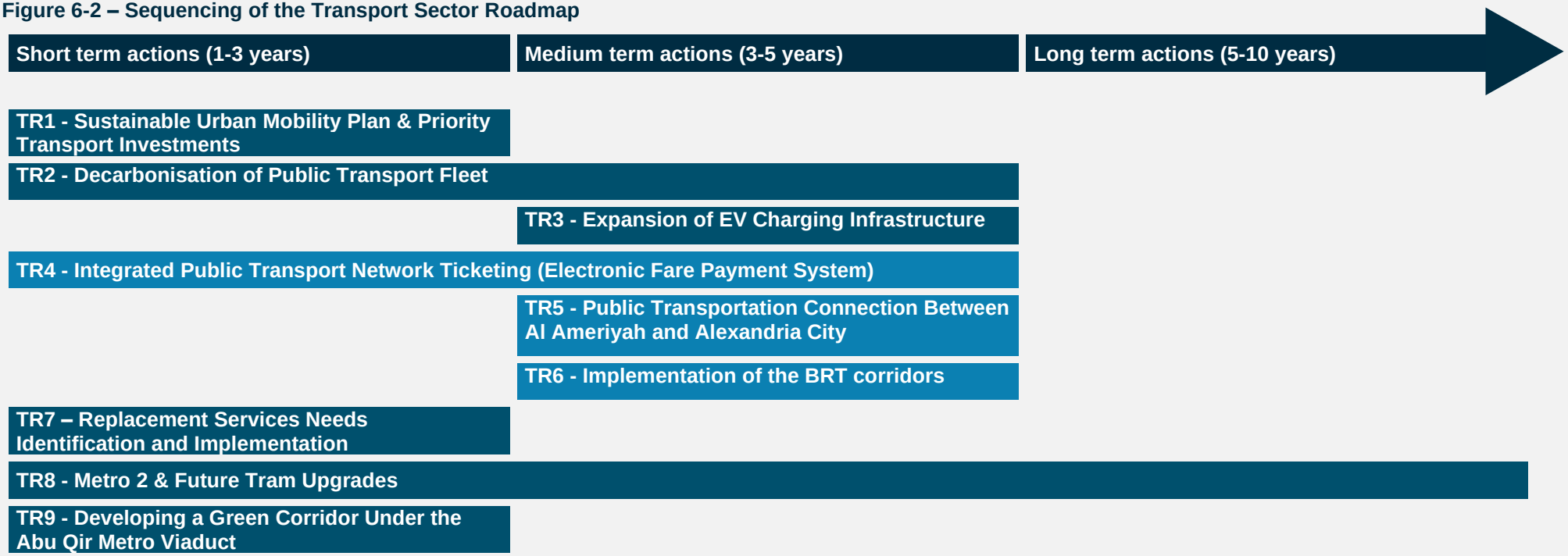
TR4 - Integrated Public Transport Network Ticketing (Electronic Fare Payment System)		This investment involves developing and implementing an integrated ticketing system, real-time tracking, and a unified timetable across all public transport modes. APTA introduced the electronic ticketing system on some buses by adding electronic devices for ticket processing. This action will look to build on initial efforts by developing a system including for the Metro and tram lines to provide passengers with improved access to flexible and easy multimodal travel and enhance user experience and ridership.	Promote efficient, environmentally friendly, user-friendly, comfortable, and well-connected public transport and make it the transport of choice. It will encourage people to choose public transport over private cars and thereby reduce GHG emissions, improve air quality and reduce congestion.	APTA: Implementation and operator MoT: Enabler	Requires further detailed study
TR5 - Public Transportation Connection Between Al Ameriyah and Alexandria City		This action is to invest in dedicated transport services (buses) between Alexandria City and the Al Ameriyah growth area. Currently, the two areas have limited mass transport options and people rely on private cars to commute between them. This investment will form part of the Sustainable Urban Mobility Plan, which considers investing in dedicated transport services between the two areas, including bus corridors and park-and-ride facilities.	Improve mobility, reduce traffic congestion, improve air quality, provide a safe, efficient, reliable, affordable, sustainable mass transit system, and create jobs during the construction and operation of the public transportation system.	APTA MoT: Enabler	€ 100 million for two bus corridors (EGP 5,331 million)
TR6 - Implementation of the BRT corridors		The BRT is planned to run on two main corridors: the first along the Corniche Road and the second along the Mahmoudia axis. This investment will support the development of dedicated bus lanes, bus stops, and other infrastructure supporting the transport system. An intelligent transport system (ITS) will be implemented, including real-time bus tracking, and traffic management. Implementing the system will require capacity-building programs to train the drivers, operators, and staff and to raise awareness about the benefits of the BRT system among the public.	Improve mobility, reduce traffic congestion, improve air quality, provide a safe, efficient, reliable, affordable, sustainable mass transit system, and create jobs during the construction and operation of the BRT system.	APTA: MoT: Enabler	€ 20 million (EGP 1,062.5 million)
TR7 – Replacement Services Needs Identification and Implementation		Alexandria will benefit from considerable investments that are already underway to upgrading the Abu Qir Metro and the Al Raml Tram with replacement services provided by the private sector**.** This action will look to plan and provide for similar services under future planned upgrades with a view of incorporating these services on a semi-permanent basis during seasonal peaks in the summer.	Provide replacement services across carefully planned routes to minimise disruption during construction phase.	APTA MoT: Enabler	Requires further detailed study
TR8 - Metro 2 & Future Tram Upgrades		In the long term, there will be need to further improve and expand the network to support modal shift as the population increases. These will include Alexandria line 2 to connect the coastal zone (phase 1) and future HSR station at Carrefour commercial zone (phase 2). Additionally, there is potential to rehabilitate other tram lines and suburban services. This will support increasing restrictions on private vehicles, including potential restrictions and rerouting of freight related to industrial and port areas away from urban areas and rationalising minibuses routes.	Support further modal shift through expanded public transportation coverage	MoT	Requires further detailed study

	This action relates to investment required for feasibility studies and preliminary design for the agreed alignments.			
TR9 - Developing a Green Corridor Under the Abu Qir Metro Viaduct	With the upgrade of the Abu Qir Metro line, there is an opportunity to develop a green corridor under the Metro viaduct. The spaces under the viaduct and around metro stations could be used for community and commercial uses to enhance social cohesion and provide opportunities for new jobs.	Enhance provision of social infrastructure with the opportunity for improving local livelihoods and increased provision of green and open spaces.	Governorate: Approvals Private sector	Requires further detailed study

6.4. Sequencing of the Roadmap

The sequencing of the actions can be seen in Figure 6-2 below.

Figure 6-2 – Sequencing of the Transport Sector Roadmap



Source: AtkinsRéalis

Water and Wastewater Sector Roadmap

Sector goals:

Improve the ecological quality of Alexandria's surface water bodies and enhance water conservation through reduced consumption and increased re-use.

Specific Targets include:

- Reducing the amount of non-revenue water and improve aging infrastructure;
- Increasing availability of alternative fresh water source, i.e., through desalination, rainwater harvest and water reuse; and
- Increasing coverage of sewerage networks to unserved areas; and
- Increasing operational capacity of wastewater to reduce the impact of wastewater on the local environment.

Relevant SDGs:

7. Water and Wastewater Sector Roadmap

7.1. Introduction

Like the rest of Egypt, Alexandria suffers from water scarcity which will be exacerbated by climate change, making efficient use of available water resources critical. Main water supply comes from surface water from the River Nile via two canals, the Al-Mahmoudia and Al-Nubaria, and groundwater resources. This water is then purified at one of the 11 water treatment plants (WTP) and piped through the potable water network. This potable water network is in overall good condition; however, some sections suffer from low water pressure with others falling into disrepair due to ageing infrastructure, including, asbestos pipes.

At the same time, increased population and urbanisation will continue to apply further pressure onto existing water resources which will require the identification on new sources as well as reuse.

The governorate benefits from a complex nature ecosystem, incorporating lakes, marine life and agricultural areas. These are currently under threat by increasing pollution from industrial and municipal waste. Wastewater is collected and treated at 6 WWTP found across Alexandria, however, the sewerage network does not cover the whole of Alexandria with some new developments missing connections. The majority of wastewater is treated to appropriate standards. After treatment it is then discharged into Lake Mariut of the Mediterranean Sea, in some cases, the wastewater is used for irrigation of agricultural land. Some industrial zones and buildings lack appropriate wastewater treatment and discharge effluent directly into the environment, which contributes to water and soil pollution.

A further major challenge facing water resources in Alexandria is sea level rise and an increased threat from coastal erosion. Saline intrusion is putting increased pressure on available water resources as well treatment.

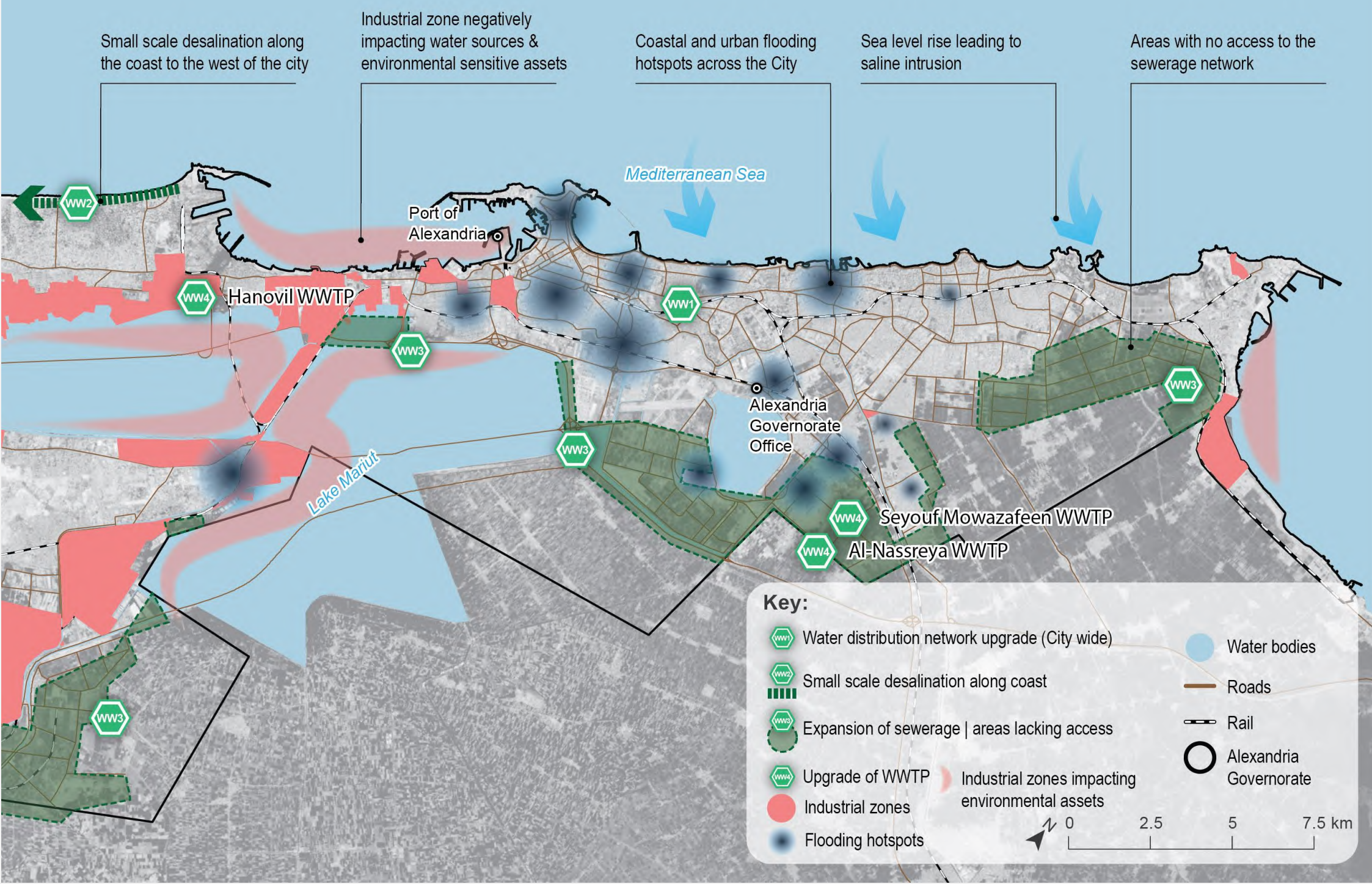
The Water and Wastewater Sector Roadmap has been developed with an integrated water resource management approach to support Alexandria unlock new water resources while rationalising existing water resources through the better use of existing fresh and grey water resources while also reducing the impact of wastewater on the local environment through enhance treatment processes:

- **Water Distribution Network Upgrading (WW1)** by implementing advanced leak detection technology, installing necessary buster stations in areas which suffer from low pressure, replacing damaged and ageing infrastructure (for example, old asbestos pipes), implementing further smart meters and Supervisory Control and Data Acquisition (SCADA) system to monitor the network. This will help to improve the network as well as reduce NRW;
- Increase the availability of alternative water sources by developing two additional **desalination plants (WW2)** with a capacity of 50,000 m^3/day which will help reduce the pressure on existing surface water resources;
- **Expansion of the Sewerage Network (WW3)** to underserviced areas while also **upgrading three existing WWTP (WW4)** to increase the amount of wastewater collected and treated to an appropriate standard and reduce the amount of effluent being released into the local environment;
- Enhance **Industrial Water and Wastewater Management (WW5)** to increase the levels of effluent treatment from industrial processes through the investment into integrated treatment units while also promoting the recycling and reuse of water to improve resource conservation efforts; and
- Undertake further studies for the possible reuse of **Treated Sewerage Effluent Use in Industries (WW6)** to further reduce freshwater consumption and increase the availability of water resources.

Supporting policies have been identified which are aimed at reducing the consumption of fresh water and increasing water resources across Alexandria, for example, through introducing water use restrictions during droughts and peak demand, improved building codes and customer awareness for new and existing developments to reduce water consumption and awareness raising regarding water saving measures.

The proposed actions in water and wastewater sectors will enhance access to services in underserved areas, while creating jobs for women, youth, and marginalised groups in maintenance, green energy, and management roles, fostering social equity and economic growth.

Figure 7-1 – Water and Wastewater sector Roadmap



Key Considerations	
Synergies	There are significant linkages between the water sector and proposed actions in other sectors: • **Addressing water scarcity** is directly related to climate resilience and the approach taken to ensure efficient use and reuse of water including how retention basins and drainage networks (CR2 – Sustainable Drainage) can capture water for other uses, and potential for replenishing ground water resources; and • **Potential for energy production** utilising byproducts from the WWTPs through proposed Sludge to Energy project (E1). Furthermore, there is potential to consider Solar PV for the energy intensive desalination plants proposed in the GCAP.
Replicability	• **WW1** – Water Distribution Network Upgrading the action to reduce NRW as well as replace ageing infrastructure can be replicated across the whole of Alexandria and beyond; • **WW2** – Small Scale Desalination Plants - the necessity to develop desalination plants to provide potable water for an increasing population and reduce the stress on existing water resources. Moreover, the onset of climate change may result in the further need for additional water sources, such as desalination, as other sources diminish over time; • **WW3** – Expansion of the Sewerage Network - although the work to expand the sewerage network is targeted to currently unserved areas of the City, new areas which are developed across the City should also be connected to the sewerage network while other areas should undergo maintenance and possible renovation if needed; • **WW4** – Upgrade of Wastewater Treatment Plants - with the presence of 6 WWTP in Alexandria there is a possibility to expand the action in the future and increase the capacity, or renew the other WWTP to ensure their capacity is sufficient to accommodate future populations and that they have a positive effect on the local environment; and • **WW5 and WW6** – could be replicated across the different industrial zones found in Alexandria, as well as the rest of Egypt, to ensure wastewater from the industrial activities is properly treated and where possible reused to optimise water resources.
Challenges and precursors to implementation	As noted in the previous sectoral roadmap, Alexandria is currently faced with significance disruption from ongoing transport upgrades. It will be critical to ensure coordination during implementation of projects that would require construction in the same areas across the transportation sector and in particular those actions in the water and wastewater sector that require construction. This will mitigate against prolonged and considerable disruption. Industry in Alexandria is a major consumer of water as well as a major source of pollution. Engagement with Industrial zones and provision of appropriate incentives will be required to achieve both improvement of quality for critical water resources and promotion of water reuse measures. Similarly, incentives and better building controls for new developments will be required during inception to ensure water efficiency measures (including grey water reuse) are integrated. This will be particularly important to avoid worsening of existing conditions, where demand pressures are increasing from population growth.

7.2. Key Actors and Stakeholders

Water and Wastewater key actors and stakeholders	
Ministry for Housing, Utilities and Urban Communities (MOHUUC)	The MOHUUC holds a pivotal role in the water and wastewater sector. It is tasked with overseeing the entire sector, ensuring that operations align with the nation's broader objectives. The Ministry sets the general vision for the sector, formulating policies that guide the development, management, and sustainability of water and wastewater services.
Construction Authority for potable water and Wastewater (CAPW)	The Construction Authority for potable water and Wastewater (CAPW) is the implementing arm of MOHUUC responsible for infrastructure construction in the water and wastewater sector, including Alexandria.
Holding Company for Water and Wastewater	The Holding Company under MHUCC owns and operates water and wastewater plants through its affiliated water service companies set up in the Governorates.
Alexandria Water Company (AWCO)	AWCO is the implementing agency focusing on operations and maintenance of water projects in the Governorate.
Alexandria Drainage and Sewage Company (ADSCO)	ADSCO is the implementing agency focusing on operation and maintenance of drainage and wastewater projects in the Governorate.
Egyptian Water Regulatory Authority (EWRA)	The Construction Authority for potable water and Wastewater (CAPW) (EWRA) regulates the water and wastewater sector.
Ministry of Environmental Affairs (MoEA) & local branch	The Ministry of Environmental Affairs sets rules and regulations for the sector and enforces laws.
Ministry of Health and Population (MoPH)	The MoPH monitors municipal water quality and the potability of water resources including water wells. It also enforces drinking water standards.
Governorate	The Governorate is responsible for approvals, land allocation and permits. Very limited involvement of the governorate as they neither own or operate the plants nor set policies
Ministry of Water Resources and Irrigation (MoWRI))	The Ministry of Water Resources and Irrigation is the ministry in charge of managing the water resources in Egypt mainly the Nile. It also manages major irrigation projects in in the Nile Delta.
Ministry of Trade and Industry (MoTI)	The Ministry of Trade and Industry (MoTI) controls and manages water supply for the industrial sector.
Industrial Development Agency (IDA)	IDA represents Alexandria’s industrial Zones.

7.3. Summary of Actions and Policies

Legend:

Short term – 1-3 years	Governorate Wide
Medium term – 3-5 years	Alexandria Urban Core
Long term – 5-10 years	Lake Mariut & Al Ameriya Growth Area

Actions					CAPEX
Action		**Technical Description**	**Action impact / benefit**	**Action Owner**	**EUR (€) / EGP**
WW1 - Water Distribution Network Upgrading		Upgrading the water distribution network, to minimise leakage including the replacement of old asbestos pipes to mitigate health risks and improve the durability of the system. The investment includes: • Implementation of advanced leak detection technologies to identify and repair leaks in the water supply network, thereby reducing NRW and improving the efficiency of the network; • Upgrade of the water supply network in areas suffering from low pressure and low water velocities by installing larger diameter pipes and pressure-boosting stations. This would improve water pressure and flow rates and reduce the risk of pipe breakage due to increased pressure; • Replacement of damaged pipes and pump stations to meet the urban demands; • Completion of two District Meter Zoning areas; and • Implementation of SCADA systems for the existing 40 pumping stations.	Increasing the availability of potable water through reduced non-revenue water aimed at a reduction from 24% to 21%. Reduced leakage and contamination of water due to the drawing of pollutants through leaks in the network. Increase in quality through the removal and replacement of old asbestos pipes. Reduced GHG emissions through reduced NRW.	AWCO: Implementing MOHUUC through CAPW Governorate – approvals, prioritisation of areas, coordination of entities for implementation.	€ 26 million / EGP 1,381 million
WW2 - Small Scale Desalination Plants		In addition to the national level programme, requirement for two desalination plants with a capacity of 50,000 m3/day each. This action considers the investment for the development of these plants. For full GHG emissions offset, a solar PV system of at least 30 MWh size is also considered as a requirement. Environmental aspects will need to be carefully managed to ensure any potential impacts are properly mitigated.	Aimed at helping to diversify water sources and reducing dependency and pressure on traditional freshwater supplies.	AWCO: Implementing. MOHUUC through CAPW for PPP. MoE: Approvals and Consultation. Governorate: Approvals.	€ 50 million EGP 2,656.5 million (excluding cost of Solar PV)

WW3 - Expansion of the Sewerage Network		This action is an investment to expand sanitation provision to unserved areas and new planned areas in Al Ameriyah growth area. The action is also proposed for the Alexandria Urban core area.	Increase the coverage of the sewerage network while improving sanitation services aimed to promote public health and environmental sustainability through various activities related to wastewater management, cleanliness, and hygiene.	ASDCO: Implementing. MoHUUC through CAPW Governorate: Approvals, prioritisation of areas, coordination of entities for implementation.	Requires further detailed study.
WW4 - Upgrade of Wastewater Treatment Plants		There are currently 6 WWTPs serving the Alexandria Governorate. This action is for an investment to vertically expand the capacity of 3 existing WWTPs including: • Hanovil (50,000 to 100,000 m3/day), • Seyouf Mowazafeen (from 7,000 to 10,000 m3/day), and • Al-Nassreya from (3,000 to 8,000 m3/day)	Increased pollution control by reducing the amount of untreated effluent reaching the environment. Increased health and hygiene for residents.	ASDCO: Implementing. MOHUUC through CAPW	€ 60 million / EGP 3,188 million
WW5 - Industrial Water & Wastewater Management		This action considers the potential for industrial facilities to invest in on-site wastewater treatment (to meet the national code for wastewater quality) and include integrated treatment units, recycling of water, sensors, water conservation, and reduction of pollution load on sewers to prevent mixing with municipal wastewater, thereby improving the effectiveness of WWTP.	Increase pollution control by reducing the amount of untreated industrial effluent reaching the environment.	Industrial Development Authority (IDA). Industrial facilities and zones.	Requires further detailed study.
WW6 - Treated Sewage Effluent Use in Industry		There is potential for Treated Sewage Effluent to be used in Industry. This action is for the development of a study to define the project and end users with a view of replicating elsewhere in the Governorate.	Optimising water use and helping to conserve fresh water sources through water reuse. Increase pollution control.	Industrial Development Authority (IDA). Industrial facilities and zones.	Requires further detailed study.

7.4. Proposed Policies

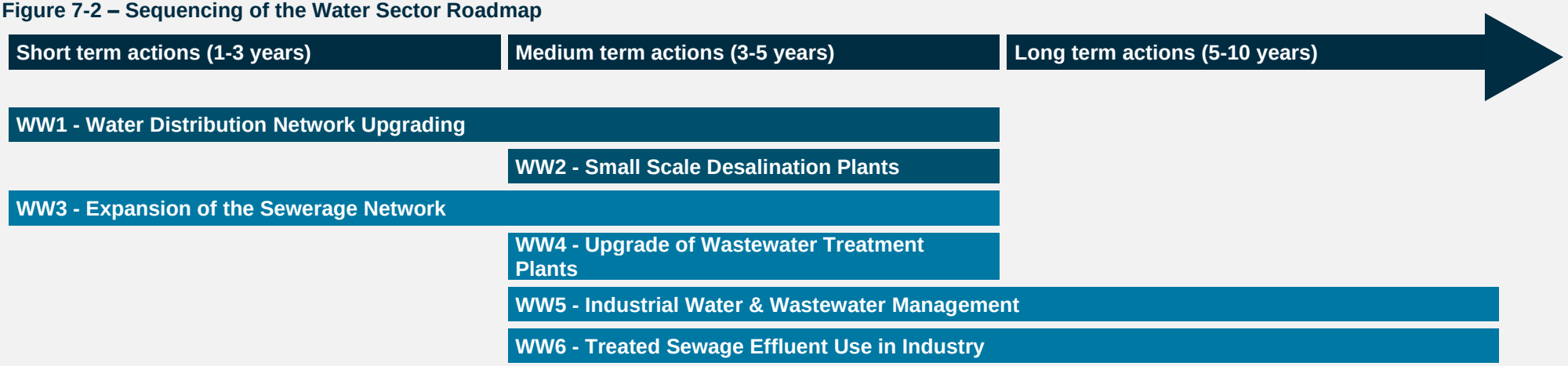
In additional to the proposed investments, development of the sector will require the implementation of targeted policies to optimise water resource management. These include:

- **Water conservation**: There is a need to prioritise water conservation given future water scarcity issues in Egypt. The Governorate and AWCO could actively promote and incentivise investments in water-saving technologies, especially in high-consumption areas like shopping centres, restaurants, and commercial zones. These properties could be encouraged to adopt modern water-efficient fixtures and practices. Similarly, for residential areas and compounds, the Governorate could encourage the use of advanced drip irrigation systems, for green spaces, which not only conserve water but also ensure optimal water usage for plants, contributing to a greener urban environment. To further strengthen water conservation efforts, the Governorate could introduce and enforce regulations that set limits on water consumption, ensuring sustainable water use. Alongside these measures, a Governorate-wide awareness campaign could be launched, educating residents about the importance of water conservation and offering guidance on how they can contribute to this cause;
- **Wastewater reuse:** The Governorate could pursue sustainable water management through innovative reuse strategies. This includes promoting the recycling of grey water, harnessing air conditioning drain water as a potential source of distilled water and re-using backwashing water in water treatment plants. Excess treated water can also be directed towards landscaping and maintaining green spaces. This approach not only conserves freshwater resources but also enhances green spaces. This policy aligns with broader water conservation efforts, ensuring that the Governorate proactively addresses its future water needs in the face of future water scarcity risks; and
- **Building and development codes:** Ensure that all new buildings and developments are connected to the potable water and sewerage network, fitted with smart meters and water-saving devices to ensure optimal water use while reducing water loss.

7.5. Sequencing of the Roadmap

The sequencing of the actions can be seen in Figure 7-2 below.

Figure 7-2 – Sequencing of the Water Sector Roadmap



Source: AtkinsRéalis

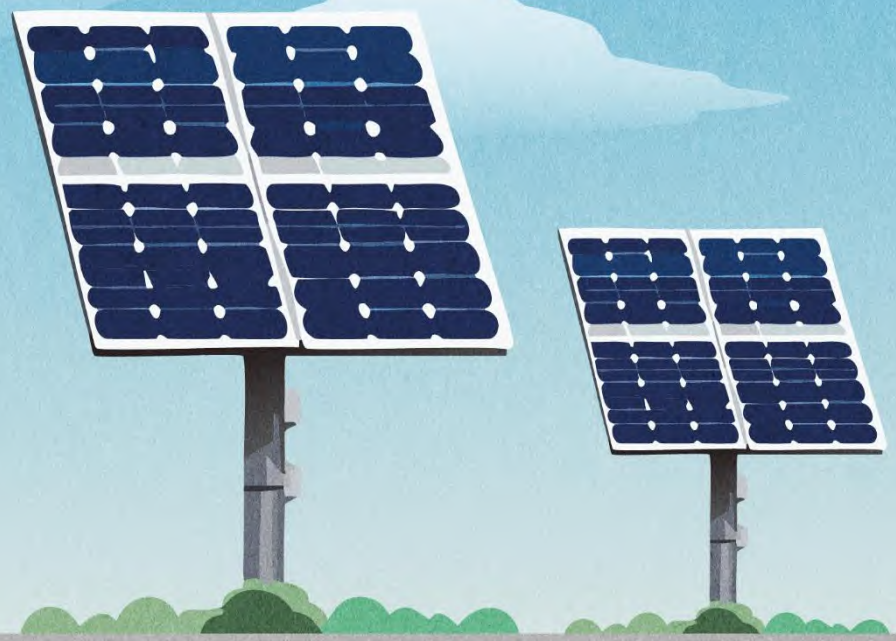
Energy Sector Roadmap

Sector goals:

Improve Alexandria's energy and Industry sectors by accelerating the transition to renewable energy sources and fostering sustainable energy practices.

Specific Targets include:

- Increasing alternative energy generation capacity through the use of sludge from wastewater treatment processes; and
- Increasing the number of small-scale solar plants found in Alexandria to increase renewable energy generation capacity.



Relevant SDGs:

8. Energy Sector Roadmap

8.1. Introduction

Egypt has set ambitious targets for decarbonising the energy sector, such as achieving 42% renewable electricity by 2040, as part of its Sustainable Integrated Energy Strategy. Egypt's Vision 2030 and the Updated NDCs have set specific targets to reduce transmission and distribution losses from 15% to 8% by 2030 and achieving a 10% decline in GHG emissions within the energy sector by the same year. One of the specific national projects already identified for achieving these targets is the replacement of the Abu Qir power station in Alexandria.

The energy sector is centralised and progress within the sector is dependent on national level activity and investment.

However, the Alexandria Strategic Plan highlights the opportunity to provide locally led interventions where possible. For instance, Alexandria only has small-scale distributed solar PV systems which, have a total capacity of 5.3 MWp based on the latest estimates by Egypt ERA (June 2023).

The roadmap for the Energy sector focuses on four main investments that have been discussed with stakeholders and chosen for their readiness for implementation and their potential to deliver renewable energy generation locally through:

- developing a **Sludge to Energy facility** at Al Ameriyah WWTP, which will beyond the generation of power it will address a key environmental issue locally with the closure of the sludge landfill at site N9;
- utilising disused site N9 to expand the existing small scale **solar plant** to support energy requirements for at least four water treatment plants;
- installing **solar-powered lighting units** on the City's main roads while introducing smart lighting in the process; and
- promoting the integration of **renewable energy and energy efficiency technologies**, into new residential compounds as the City expands, providing a leasing model for solar PV systems.

Additionally, it would be important to consider necessary upgrades to the transmission network in collaboration with the Ministry of Electricity and Renewable Energy.

Similar to the transport sector, the industry sector is a high GHG emitter. The Governorate hosts nearly half of Egypt's industrial base, including energy intensive heavy industries. It will be necessary to consider potential measures to support industrial facilities to transition to a low carbon path and the Governorate could play a role championing this initiative given the sector's damaging effect on the local environment.

The energy roadmap aims to improve access to reliable, sustainable energy, particularly in underserved areas, while creating job opportunities for women, youth, and marginalised groups in the green energy sector, driving both social inclusion and economic growth.

Some additional policies and initiatives on these aspects are considered further below.

Key Considerations	
Synergies	• **Water and Wastewater:** There are strong linkages between the energy and water/wastewater sectors as the main opportunities for renewable energy generation are currently reliant on supporting the Sludge to Energy Facility, the conversion of the previously sludge landfill into a solar plant and powering of the proposed desalination plants. • **Industry:** There is great potential to support this nationally significant economic sector located in the Governorate. Working with Industry can generate considerable benefits at both local and national level. • **Climate resilience and Land Use:** The promotion and integration of renewable energy and energy efficiency technologies, including green building design measures can be used to incentivise appropriate land use development to counteract existing unplanned growth across the Governorate.

Replicability	• There is potential to replicate the sludge to energy facility across other WWTPs in the region and beyond; • Solar plants can be introduced across other areas in the Governorate employing lessons learnt from the introduction of existing solar plants; and • The installation and maintenance model of solar-powered lighting units developed through this project can be replicated in other parts of the Governorate, particularly in areas where establishing traditional grid-connected lighting may be challenging or costly.
Challenges and precursors to implementation	• Lack of appropriate incentives to support shift: The development of certain interventions is hindered by the existing tariff structure and subsidies making them financially unviable and unaffordable. This includes the Sludge to Energy project as well as efforts on water conservation measures such as grey water treatment and reuse. An increase in the feed-in tariff, which is currently set at 1.03 EGP/kWh according to Decree No.41 of 2019, is critical for the bankability of sludge to energy projects and to guarantee a profitable revenue for private investors. • Supply chain challenges: A reliable supply of materials, especially for projects that involve specialised components, like solar PV systems, may be challenging. Identifying and managing the supply chain for materials and ensuring that projects are not delayed due to supply chain issues will be important. • Capacity and capability: Implementing projects that involve new technologies, such as smart distribution networks and automated solar-powered street lighting, may encounter challenges due to a lack of local expertise and capabilities. It is important to ensure that there is sufficient knowledge and skill to manage and maintain these technologies. • Affordability challenge: Consideration is required on how support can be provided to low-income households to ensure wider benefit from key measures, such as the replacement of old appliances to energy-efficient ones.

8.2. Key Actors and Stakeholders

Energy sector key actors and stakeholders	
Alexandria Governorate	Limited involvement of the Governorate which is confined to approvals for cable laying and building aerial power lines.
Alexandria Distribution Company (ADSC)	Alexandria Distribution Company (ADSC) owns and operates the low and medium-voltage electricity network, selling electricity to, and collecting tariffs from the consumers.
West Delta Electricity Distribution Company	The West Delta Distribution is involved in electric power generation, including operating power plants like the Abu Qir power plant.
Ministry of Housing, Utilities and Urban Communities (MOHUUC)	Under the MOHUUC, the Holding Company for Water and Wastewater and Alexandria Sanitation and Drainage Company are key stakeholders for E1 – Sludge to Energy Plant as they are in charge of sewerage and wastewater management.
Ministry of Electricity and Renewable Energy (MoERE)	The Ministry of Electricity and Renewable Energy (MoERE) oversees the sector and sets policy and strategies. The ministry coordinates its activities with other national-level entities through the Supreme Energy Council (SEC) as well as the cabinet of ministers. Egyptian Electricity Holding Company (EEHC) implements the strategy set by MoERE in coordination with the Egyptian Electric Utility and Consumer Protection Regulatory Agency (EgyptERA). Egyptian Electricity Transmission Company owns and operates the transmission network acts as a single buyer for electricity and sells electricity to large industries.
National Renewable Energy Authority (NREA)	The National Renewable Energy Authority (NREA) is responsible for developing Renewable Energy (RE) projects on the large scale, medium and small-scale levels including providing land for developing these projects as well as for projects which are not carried out by NREA.

Energy Service Company (ESCO)

For the **E3**- Sustainable Energy Residential Compound Package, performance contracting with a private energy service company (ESCO) could be considered for managing large and complex projects including solar PV and district cooling. Energy cost savings can be used to cover the entire cost of the projects, and any surplus savings can be divided between the contracting organisation (e.g., the compound developer) and ESCO; and Energy Service Company.

8.3. Summary of Actions and Policies

Legend:

Short term – 1-3 years	Governorate Wide
Medium term – 3-5 years	Alexandria Urban Core
Long term – 5-10 years	Lake Mariut & Al Ameriya Growth Area

Actions					CAPEX
Action		**Technical Description**	**Action impact / benefit**	**Action Owner**	**EUR (€) / EGP**
E1 - Sludge to Energy		Investment in the development of a sludge to energy facility, utilising anaerobic digestion to produce biogas for use by a combined heat and power plant, at the Al Ameriyah WWTP.	Such a facility will help to deal with the increased level of sludge produced as a result of wastewater treatment and reduce the amount being discharged into the local environment there by improving its quality.	ASDCO: Implementing agency.	€ 30 million / EGP 1,594 million
E2 - Solar Plant		Upscaling the existing small-scale solar farms across the 9N site and additional solar energy systems to produce clean energy for four water treatment plants at Manshia 2, Alseyouf, Maamoura and Nozha, and the pressure booster at Abu Qir station.	Potential to produce 106,000 MWh of renewable energy, reduction of around 44,200 tonnes of CO2e annually. This would help to reduce the reliance on fossil fuels and increase climate resilience.	Ministry of housing, utilities and urban communities	€ 33 million / EGP 1,753 million
E3 - Sustainable Energy Residential Compound Package		This project aims to support residential compound developers in investing in a carefully selected bundle of renewable energy and energy efficiency technologies, in addition to smart distribution networks. Alexandria has many residential compounds, which provide an opportunity for various sustainable and green applications, such as: • Installation of solar PV system on roofs; • Use of solar hot water systems; • Smart grid application and smart meters (due to a residential compounds large	The integration of renewable energy sources and energy-efficient technologies in residential compounds can significantly reduce GHG emissions. The project will also contribute to climate adaptation by reducing the City's overall energy use thus its vulnerability to energy shortages caused by climate change.	The project will be implemented by compound developers or by Energy Service Companies (ESCO).	The expected cost for a 5-7 kWp PV system ranges from € 4,000 - 6,300. A typical 300-litre solar hot water system would cost from € 1,700 - 2,600. Total CAPEX is € 0.17 – 0.63 million (EGP 9 – 33.5million) based on the

	area, they typically have their own distribution networks); and • Energy and cost-efficient district cooling applications, which relies on large chillers which are much more efficient than individual Air Conditioning units.			implementation of 7 kWp PV systems or 300-litre solar hot water units in 100 properties.
E4 - Automated solar powered street lighting for public places and roads	The investment involves the installation and maintenance of solar-powered lighting units along the new west and east corridor to cover a distance of 60 km in total. Each unit, equipped with a 60-200 Watt solar panel, will be a solution for road lighting eliminating the need for extensive and costly infrastructure such as transformers and cables.	The action will reduce energy consumption in the City. The use of sensors and digital control switches extend the lifetime of the lamps and batteries and reduces the size of the solar panel and battery required, with potential to result in significant cost savings.	Governorate	€ 1.6 million (EGP 85 million)

8.4. Proposed Policies

Several potential initiatives and polices have been identified which should be explored alongside the implementation of the above investments in order to optimise energy resource management and the energy sector, these include:

- **Energy network modernisation and futureproofing:** Undertake a comprehensive assessment of the electricity network across Alexandria Governorate to determine the need for maintenance and futureproofing of the network, through the replacement of ageing infrastructure and modernisation of equipment, to reduce the frequency of electrical outages and network losses;
- **Implementation of demand side management and peak chopping (Industry focused):** An initiative designed to manage energy demand by implementing peak clipping in the industrial sector. By investing in communication systems and data loggers, the Electricity Distribution Company can coordinate with factories to modulate peak production, thereby alleviating grid stress**;**
- **Enhanced Energy management:** Enforce the Electricity Law, mandating industrial facilities to maintain an energy register and appoint an Energy Manager, with the aim that industries actively monitor their energy consumption and implement demand-side management programs. Moreover, industries could be encouraged to frequently monitor their efficiency, with a particular focus on boiler analysis and emission assessments from industrial processes;
- **Industrial Zones Eco Operations and Sustainable Shared Infrastructure**: Encourage industrial developers and park operators to invest in centralised green shared infrastructure and services. Potential components of this action include distributed solar systems, centralised energy distribution solutions, energy management systems, and specific energy-saving technologies.
- **Urban Energy Efficiency Initiative:** This initiative involves the Governorate raising awareness and promoting the use of energy-efficient appliances to replace outdated ones, aiming to reduce energy consumption and save long-term costs for households. In addition, a Governorate-wide awareness campaign would educate residents about energy-efficient technologies in various sectors, with a focus on energy efficient buildings and operations. A key aspect of the policy is advocating for energy performance contracts in new developments, integrating energy efficiency into the City's growth. A recent initiative in Alexandria is showcased below.

Case Study: SOLE in Egypt: energy rehabilitation intervention in the Faculty of Engineering, Alexandria University

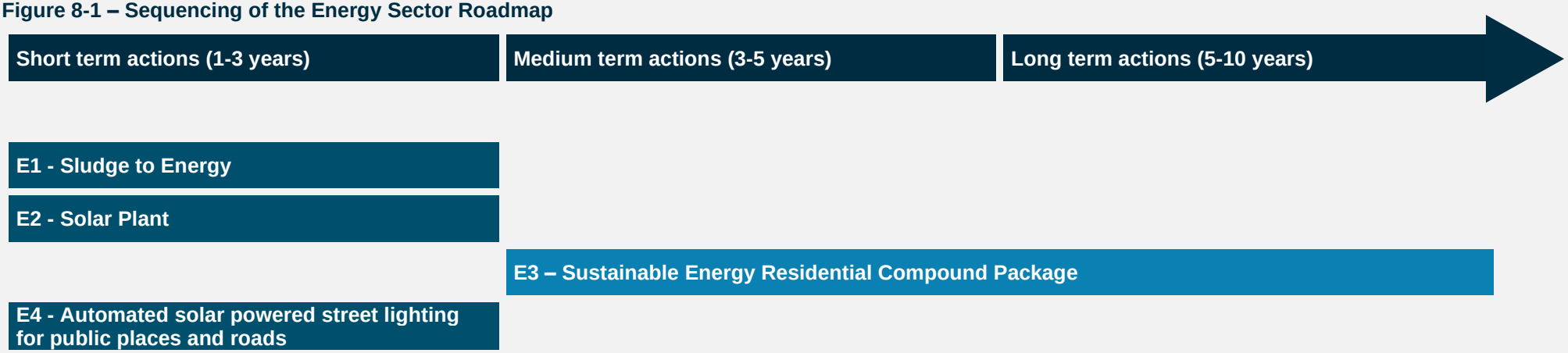
- The SOLE project focuses on the energy efficiency improvements of public buildings in the Mediterranean adopting energy rehabilitation strategies and increasing the use of renewable energies.
- Through the project, the Alexandria Chamber of Commerce and Confederation of Egyptian European Business Associations (CEEBA) in Egypt are working to rehabilitate the administration building of the faculty of engineering at the University of Alexandria improving its energy consumption system.
- The intervention will primarily focus on installing photovoltaic panels on the rooftop and at the façade of the two upper floors of the building with a capacity of 150 kWh covering the building's electrical and mechanical systems. The PV modules at the façade will also have an additional shading effect for the upper floors. A standby battery will be added covering the electricity needs of the elevators which will improve the building's safety measures.
- Additionally, the lighting system will be replaced with LED and fluorescent (compact lamps) lights providing the same amount of light at 10% reduction of the current electricity consumption. The overall estimated electricity savings from the intervention are equal to 27,000 kWh per month which will reduce CO2 emissions by 6.000 to 11.000 tonnes per month. The estimated monthly financial savings are 39,000 EGP (roughly € 2,100) per month.
- This initiative will rehabilitate the building into a more efficient, green building and will act as a flagship for promoting future professional and educational projects. The aim is to create a behavioural change in the energy consumption of the users and encourage public authorities and policy makers to replicate the project throughout the country.

The funding for the intervention will amount to € 250,000 of which 90% is funded by the ENI CBC MED Programme and the remaining 10% is financed through the Alexandria Chamber of Commerce.

8.5. Sequencing of the Roadmap

The sequencing of the Energy Roadmap is shown in Figure 8-1 below.

Figure 8-1 – Sequencing of the Energy Sector Roadmap



Source: AtkinsRéalis

Solid Waste Sector Roadmap

Sector goals:

Improve solid waste management across Alexandria, prioritising provision of facilities for effective waste collection and reduction, treatment, recycling, and energy recovery, in alignment with the waste management hierarchy.

Specific Targets include:

- Increasing share of segregated recyclables and organic matter in the waste stream through enhanced segregation, collection and treatment of waste;
- Reducing the amount of waste entering landfill; and
- Upgrading current landfill to EU compliant standards and introduce a waste to energy facility.

Relevant SDGs:

9. Solid Waste Sector Roadmap

9.1. Introduction

In terms of Solid Waste Management (SWM) across Alexandria, while waste is regularly collected, the City lacks proper waste processing and disposal facilities which undermines the effectiveness and efficiency of the sector. Most waste is collected in mixed form, with little at-source segregation, and disposed of at open dumpsites, thereafter the waste is often sorted, treated and recycled illegally at the site. There is one landfill in the City near El Hammam City which receives more than 3,000 tonnes of waste per day.

These inefficiencies in the SWM process have been shown to have a negative impact on the local environment, in particular water and soil quality. Development in the sector is further constrained as there are challenges in allocating space for transfer stations due to high levels of urbanisation and population growth. This results in further inefficiencies across the SWM process.

Therefore, the Solid Waste Sector Roadmap has been developed to tackle these issues by:

- Helping to further understand and address these identified challenges while enabling the development of a comprehensive plan for further investment through a **Solid Waste Study (SW1);**
- Increasing the number of transfer stations across the City by developing **Decentralised Transfer Stations (SW2)** will help to improve the collection and transfer of waste to appropriate facilities for further treatment, processing and appropriate disposal;
- **Upgrade of Waste Treatment Facilities (SW3)** by investing in existing facilities to introduce the missing step of waste treatment and processing, this would include developing combined waste sorting, recycling, composting and where appropriate waste-to energy facilities to deliver comprehensive and holistic SWM process; and
- **Upgrade of Sanitary Landfill** and Waste to Energy **(SW4)** to an EU-compliant landfill with all the necessary equipment and facilities, alongside the introduction of a waste-to-energy facility, to reduce the impact of the landfill on the local environment, promote sustainable waste management practices.

A number of policies have also been proposed which aim at increasing awareness and capacity relating to SWM processes, including the recycling, composting and the circular economy, while also blustering policy, enforcement of laws and improving the effectiveness of the SWM sector across Alexandria.

With the implementation of the proposed actions and enabling policies, as part of this roadmap, the impact of solid waste on the local environment will be reduced.

The solid waste roadmap seeks to improve waste management systems, particularly in underserved areas, by promoting recycling, composting, and waste-to-energy initiatives. This will create job opportunities for women, youth, and marginalised groups in waste collection, sorting, and recycling, fostering environmental sustainability and social inclusion, including incorporating the existing informal activity in the sector.

Key Considerations	
Synergies	**Energy Sector** – through the potential to incorporate waste to energy facilities within existing SWM facilities that will provide additional non-fossil fuel energy generation capacity and reduce GHG emissions.
Replicability	• **SW1** – the solid waste study will identify further investment to improve the solid waste sector, this type of study can be replicated in other urban centres across Egypt; • **SW2** – as the need arises further decentralised transfer stations can be developed, for example in newly expanded areas of the City, to ensure efficient, sustainable, and reliable waste management practices; • **SW3** – potential to undertake the upgrade of other treatment facilities across Alexandria and beyond; and

	• **SW4** – potential to upgrade other landfills in other urban centres to EU-compliant landfills as well as the introduction of waste to energy facilities as needed using appropriate technology for the given scenario and urban area.
Challenges and precursors to implementation	• Integration of Informal Waste Pickers: Integrating them into the waste management system without disrupting their livelihoods or social structures can be a complex challenge. • Affordability issues: Careful consideration is needed to ensure Door-to-door waste collection is Governorate-wide with appropriate support provided to lower-income households. • Public Participation and Behaviour Change: Ensuring consistent and effective segregation of waste at the source, and maintaining this practice over the long term, can be challenging and will require ongoing public education and engagement

9.2. Key Actors and Stakeholders

Solid Waste sector key actors and stakeholders	
Ministry for Housing and Utilities and Urban Communities (MOHUUC)	The Ministry for Housing and Utilities and Urban Communities is responsible for the collection and transport of solid wastes in new urban communities. It also provides and allocates hazardous waste disposal sites.
Ministry of Environmental Affairs (MoEA)	The Ministry of Environmental Affairs sets rules and regulations for SWM and enforces laws.
Ministry for Population and Health (MoHP)	The Ministry for Population and Health assumes the responsibilities related to environmental health management, environmental protection and all related activities such as medical waste management.
Ministry of Agriculture and Land Reclamation (MoRLA)	The Ministry of Agriculture and Land Reclamation (MoRLA) is concerned with agricultural hazardous waste such as pesticides and fertilisers.
Ministry of Electricity and Renewable Energy (MERE)	The Ministry of Energy is the main body that formulates rules and regulations governing the waste sector. It also plays an active role in enforcing environmental laws to ensure compliance.
Governorate	The main decisions regarding DWM are taken at the Governorate level. Implementation of contracts is supervised through the Environmental Mentoring and Control Department. The Governorate outsources their SWM duties to Nahdet Misr.
Nahdet Misr Environmental Services	SWM has been outsourced by the Governorate to Nahdet Misr and therefore they are the entity who have been undertaking all aspects of SWM in Alexandria.
Industrial Development Authority (IDA)	The Industrial Development Authority in addition to the Environmental Affairs Agency, is responsible for ensuring that factories take into account the optimal handling of waste, as stipulated as part of the requirements for obtaining an industrial license.
Industrial Control Authority (ICA)	The Industrial Control Authority (ICA) ensures that waste is dealt with in a manner that conforms to industrial requirements. The role of the ICA is limited to industrial license renewal, while the role of the ICA extends to factory operation, where its supervisory role is considered a continuous one.

9.3. Summary of Actions and Policies

Legend:

Short term – 1-3 years	Governorate Wide
Medium term – 3-5 years	Alexandria Urban Core
Long term – 5-10 years	Lake Mariut & Al Ameriya Growth Area

Actions				CAPEX
Action	**Technical Description**	**Action impact / benefit**	**Action Owner**	**EUR (€) / EGP**
SW1 - Solid Waste Study	Undertaking a study to better understand and address not only current challenges and opportunities within the waste sector but also future, including those related to new urban growth areas across the Governorate. The study will be based on a forecast of waste generation and composition, assessing the whole waste management system (collection, sorting/processing, recycling, treatment and final disposal) and analysis to assess the needs for future investment components for different waste streams. This will enable future interventions, ensuring that they are both technically feasible and economically viable, environmentally beneficial, and socially inclusive	The study will help to further develop and improve the SWM across the Governorate.	MoLDGovernorate	€ 0.4 million / EGP 21.25 million
SW2 - Decentralised Transfer Stations	The action seeks to develop additional transfer stations across Alexandria with an intended capacity of handling around 500 tonnes of waste per day.	Additional transfer stations will improve SWM and help create a more efficient collection and waste transfer process while reducing the distances collection vehicles must travel to dispose of waste.	Governorate provides approvals for studies, land allocation, provision, the PPP contracts, monitor compliance with environmental regulations. MoE approval for PPP Private sector borrower and implementation	€ 3 million / EGP 159.4 million
SW3 - Upgrade of Waste Treatment Facilities	This investment would follow on from the Solid Waste Study to upgrade existing facilities in appropriate locations and combine waste sorting,	Implementation will improve waste sorting and recycling rates, reduce the amount of waste going to landfills promote principles of the circular	As above.	€ 50 million / EGP 2,656.5 million

	recycling, composting, and where appropriate energy generation from waste.	economy, and support energy generation from waste.		
SW4 - Upgrade of Sanitary Landfill and Waste to Energy	This investment would follow on from the Solid Waste Study to upgrade the sanitary landfill with a potential waste to energy facility while also upgrading the site to an EU-compliant landfill with all the necessary equipment.	Help to reduce the impact of the landfill on the local environment, promote sustainable waste management and contribute to energy generation while promoting a shift away from fossil fuels.	As above.	Requires further detailed study.

9.4. Proposed Policies

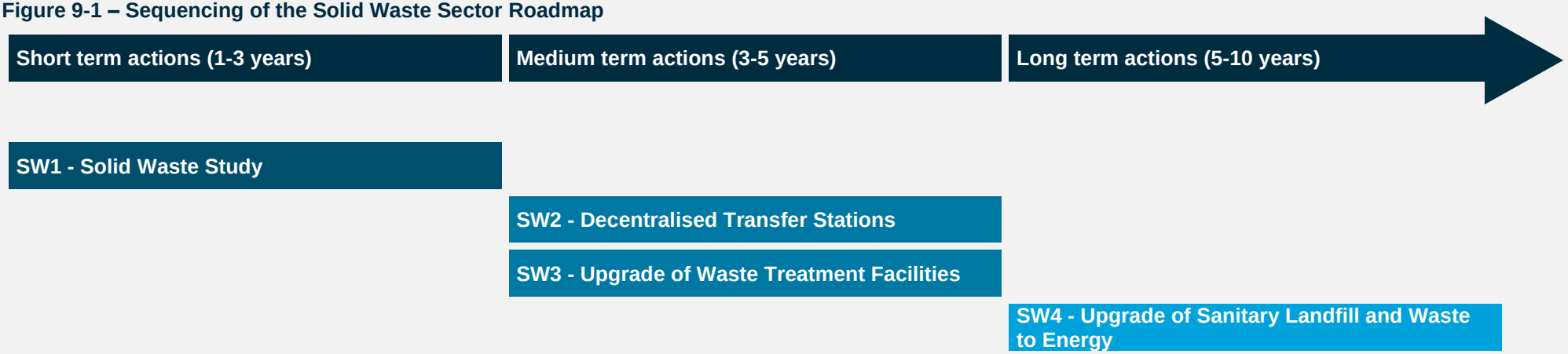
Several policies have been identified which should be explored alongside the implementation of the above actions to optimise the solid waste sector, these include:

- **Enforce recycling of construction waste on construction companies:** As there is high volume illegal disposal of construction and demolition waste across Alexandria there should be enhanced enforcement of laws relating to this such as a legislation to divert the construction materials to a local material reuse/recycle facility, in order to effectively promote the recycling of the construction waste. Polluters should be identified and appropriately fined which would help with curbing illegal dumping. Moreover, efforts should be made to reduce the amount of construction and demolition waste entering the local environment, for example by providing a dedicated disposal site. Establishing a market for secondary raw materials coming from processing and recycling of waste, will support recycling of construction waste taken into consideration the cost of transportation of the raw construction material from outside the Governorate
- **Eco-Industrial Development:** The Governorate, should, together with IDA and the Ministry of Environment, encourage eco-friendly industrial practices, such as the implementation of eco-industrial park operational principles and the promotion of industrial symbiosis. Industrial operators will be tasked with developing roadmaps for environmentally friendly industrial parks, and areas designated for recyclers in industrial zones should be expanded.
- **Introduce policy which minimises single-use plastics and improves waste sorting:** Introducing policies such as restricting the use of plastic bags and introducing sustainable alternatives, e.g., bags for life, as well as limiting the use of single-use plastics among large retailers will help to reduce the amount of plastic waste entering landfill and the local environment. In addition, develop policies and infrastructure to champion at-source sorting of waste;
- **Awareness raising campaigns and education:** Developing and launching awareness raising and information campaigns to promote circular economy principles among residents of Alexandria while targeting specific groups in society, for example, young children at schools, to inspire the younger generation to be more conscious about where their waste ends up and recycling. Knowledge regarding sustainable SWM practices among residents and businesses has been one of the main challenges in enforcing laws, therefore undertaking such an activity would result in increased knowledge and capacity regarding sustainable SWM practices.

9.5. Sequencing of the Roadmap

The sequencing of the actions can be seen in Figure 9-1 below.

Figure 9-1 – Sequencing of the Solid Waste Sector Roadmap



Source: AtkinsRéalis

Implementation of the GCAP

10. Implementation Plan

10.1. Introduction

The Implementation Plan provides a strategic framework for implementing the identified GCAP projects. It emphasises the important role of strong urban governance and the need for both vertical and horizontal coordination across all sectors, to address the complexities of urban project implementation. In addition, the Implementation Plan provides an overview of potential funding sources and financing mechanisms, to plan for the sustainability and feasibility of the proposed projects.

10.2. Partnerships and Institutional Structures

The strength of urban governance is one of the critical components enabling cities to respond to major environmental challenges. Regardless of the level of autonomy and decentralisation a city enjoys, successful implementation of urban projects is characterised by proactive and effective multi-level governance:

1. Vertical governance refers to the strength of coordination across multiple levels of government at national and local levels; and
2. Horizontal governance refers to the coordination of activities across different sectors of society from local governments to the private sector, civil society, academia, and grassroots organisations.

Additionally, integrated planning that can support the sustainability of projects requires technical departments within city authorities to collaborate on the design and implementation of projects to ensure synergies, efficiencies and maximisation of benefits are achieved.

The development of this GCAP reflects a collaboration between different levels of governance. Implementation will need to built on the platform that was established during the development of the plan which included:

Governorate Level coordination

For the purposes of the GCAP a Project Working Group was established consisting of representatives from the Governorate's key departments including those reporting to Ministries and chaired by the Deputy Governor.

Vertical governance

In the case of Alexandria, and in Egypt more widely, vertical governance is critical as most projects implemented locally are planned and financed centrally by the relevant Ministries. Ministries have local representation within the Governorate which supports vertical coordination. Table 10-1 provides an overview of responsibilities by sector.

Horizontal governance

The implementation of the GCAP will be dependent on critical links with interested parties and key stakeholders in the Governorate. This will be important to consider cross-cutting issues of investment, decarbonisation and resilience, and social development aspects for implementation. Key organisations include:

- The Alexandria Port Authority
- Real Estate Developers and Commercial real estate developers
- Academia and universities (University of Alexandria has been a key technical collaborator)
- Private sector companies active in the sectors (Industrial Parks Developers, energy, waste management, transportation, etc)
- Local business associations and private sector representative bodies (Alexandria Business Association and Alexandria Chamber of Commerce)

Table 10-1 – Responsibilities by sector

Legend
- Governorate/MoLD
- Ministry
- Governorate team reporting to Ministry

GCAP Sector	Plan	Finance	Manage	Notes
Climate Resilience	Ministry	Ministry	Governorate team reporting to Ministry	MWRI is the main agency related to coastal protection while MoHUUC is responsible for drainage. Implementation and operations are then passed on to the local Ministerial representation that sits within the Governorate structure i.e. Alexandria Drainage and Wastewater Company.
Land Use	Governorate/MoLD	Ministry	Governorate/MoLD	MoLD in collaboration with GOPP (MoHUUC) are in charge for the development of spatial local plans while management of implementation falls under the Governorate. For key sites, such as Minal Al Basal, all responsibilities sit with Central Government.
Transport	Ministry	Ministry	Governorate team reporting to Ministry	Planning and financing of projects are driven by different central government agencies such as MoT, NAT, MoI depending on the nature of project. Management and operations are then passed on to local Ministerial teams.
Energy	Ministry	Ministry	Ministry	The Energy sector is driven by activity Ministerial level. However smaller scale projects such as the proposed solar plant ownership sits with the landowner/promoter of the project, in this case ADWCO.
Water and Wastewater	Ministry	Ministry	Governorate team reporting to Ministry	MoHUUC is responsible for water and wastewater. Implementation and operations are then passed on to the local Ministerial representation that sits within the Governorate structure i.e. Alexandria Drainage and Wastewater Company and Alexandria Water Company.
Solid Waste	Governorate/MoLD	Governorate/MoLD	Governorate/MoLD	The Solid Waste sector is the only sector where the Governorate has full responsibility with the involvement/advice of different Ministries such as MoE. However, it is common practice for sectoral projects to be led and financed by the private sector through appropriate agreements.

10.3. Investment Plan

The following provides a summary of CAPEX estimates for the GCAP Actions by sector. The figures in this section should be treated as preliminary at this stage due to the lack of detailed feasibility studies.

The cost estimates have been determined by drawing on knowledge of similar domestic (if available and international projects, and local expert knowledge of appropriate adjustments that need to be made, for example regarding the cost of local materials and labour. Cost estimates have been discussed with the Governorate and key stakeholders, with feedback incorporated into final cost estimates as applicable.

It is important to note that these costs do not include various cost items including land acquisition, design and planning (unless stated, where this could reflect 10% to 30% of the CAPEX costs). Inflation and optimism bias have not been included at this stage, where this would uplift the cost estimates. There will also often be sizeable operational expenditure which will need to be factored in where this is not indicated already.

The total CAPEX estimate of Actions is presented by sector, in Table 10-2, and by Focus Area in Table 10-3.

Table 10-2 – Overall cost estimate by sector for GCAP Actions

Sector	Total CAPEX EUR (€)	Total CAPEX EGP
Climate Resilience & Land Use	€ 81.25 million	EGP 4,316.81 million
Transport	€ 170,50 million	EGP 9,058.67 million
Energy	€ 65.23 million	EGP 3,465.67 million
Water and Wastewater	€ 136.00 million	EGP 7225.68 million
Solid Waste	€ 53.40 million	EGP 2,837.14
Total	**€ 506.38 million**	**EGP 26,903.97million**

Source: AtkinsRéalis

Table 10-3 – Overall cost estimate by Focus Area for GCAP Actions

Focus area	Total CAPEX EUR (€)	Total CAPEX EGP
Focus Area I – Alexandria City	€ 105.50 million	EGP 5,605.22 million
Focus Area II – Lake Mariut/Al Ameriyah Growth Area	€ 273.63 million	EGP 14,537.96 million
Governorate Wide Actions	€ 127.25	EGP 6,760.79
Total	**€ 506.38 million**	**EGP 26,903.97million**

Source: AtkinsRéalis

The proformas for GCAP Actions, presented in Annex A, contain notes that indicate how CAPEX and OPEX, where provided, were derived and how the costs were split up into individual activities and components.

It is expected that the implementation of the Actions would provide the platform for further future infrastructure investments in the Governorate with the realisation of long-term projects.

10.4. Implementation Programme

The GCAP implementation programme, in

Figure 10-1, begins with the implementation of short-term Actions, which are designed to address immediate challenges and deliver quick, visible improvements in the City. These projects are not only important but also serve as a foundation for longer term initiatives.

Supporting studies and policies are integrated into the implementation of the Actions, providing necessary guidance, data and information to ensure each Action is viable, compliant, and aligned with the Governorate's strategic objectives.

Following the completion of the short-term Actions, the focus will shift to medium- and longer-term projects. These are designed to build upon the short-term Actions to ensure a sustained approach to achieving the City's long-term vision. Although such projects are stated to start in the longer-term, preparation of feasibility studies and other plans, policies and documents to support the implementation of these projects needs to be undertaken at an earlier stage.

The GCAP implementation programme provides a clear pathway guiding Alexandria City through each phase of the implementation of the plan.

Figure 10-1– Alexandria GCAP Implementation Programme

GCAP Sector	Action Code	Action	Timeframe (2024-2034)
			2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035
Climate Resilience and Land Use	CR1	Coastal Protection	
	CR2	Sustainable Drainage	
	CR3	EWS and Local Preparedness Plan	
	CR4	Cool Street Design	
	LU1	Mina El Basal/Mahmoudia Canal Development	
Transport	TR1	Sustainable Urban Mobility Plan & priority transport investments	
	TR2	Decarbonisation of public transport fleet	
	TR3	Expansion of EV Charging Infrastructure	
	TR4	Integrated Public Transport Network Ticketing (Electronic Fare Payment System)	
	TR5	Public Transportation Connection between Al Ameriyah and Alexandria City	
	TR6	Implementation of the BRT corridors	
	TR7	Replacement Services Needs Identification and Implementation	
	TR8	Metro 2 & Future Tram Upgrades	
	TR9	Developing a Green Corridor Under the Abu Qir Metro Viaduct	
Energy	E1	Sludge to Energy	
	E2	Solar Plant	
	E3	Sustainable Energy Residential Compound Package	
	E4	Automated solar powered street lighting for public places and roads	
Water and Wastewater	WW1	Water Distribution Network upgrading	
	WW2	Small Scale Desalination Plants	
	WW3	Expansion of the Sewerage Network	
	WW4	Upgrade of Wastewater Treatment Plants	
	WW5	Industrial Water & Wastewater Management	
	WW6	Treated Sewage Effluent Use in Industry	
Solid Waste	SW1	Solid Waste Study	
	SW2	Decentralised Transfer Stations	
	SW3	Upgrade of Waste Treatment Facilities	
	SW4	Upgrade of Sanitary Landfill and Waste to Energy	

Source: AtkinsRéalis

10.5. Monitoring, Evaluation, and Reporting

A monitoring and evaluation process is recommended to ensure the success of the GCAP programme. Monitoring allows the application of a learning-by-doing approach, and correcting implementation issues.

10.5.1. Scope and Purpose of GCAP Monitoring and Evaluation

Monitoring and evaluation (M&E) are two distinct but complementary processes, with evaluation providing context to monitoring. Table 10-4 summarises the distinction between the two activities as used in this section and as applied in relation to the GCAP.

Table 10-4 – The distinction between monitoring and evaluation

Monitoring
• A continuous process involving the systematic collection of data in relation to specific indicators; • Links Actions with strategic goals; • Provides an indication of the extent of progress and achievement of strategic goals; and • Describes **where** an action is in relation to outcomes and mid term targets.
Evaluation
• The systematic and objective assessment of an ongoing or completed action's design, implementation and results; • Examines an action's implementation process; • Informs decision-making process by determining the relevance and fulfilment of objectives and the efficiency, effectiveness, impact and sustainability of related Actions and their impact; and • Describe **why** outcomes and mid-term targets are or are not being achieved.

10.5.2. M&E Process, Reporting and Frequency

Monitoring is an ongoing process to ensure the GCAP Actions are being pursued in the right direction and in line with the agreed scope, identify emerging issues and address these early. There are two main components that support this process:

Progress Monitoring Plan (PMP) summarising the implementation status of Actions included in the GCAP on an annual basis. The aim is to have an updated understanding of the status of action implementation over time including budget spent alignment with deadlines and achievements of key milestones.

Impact Monitoring Plan (IMP) summarising the status and likelihood of achieving the GCAP vision, strategic goals and mid-term targets. Similarly, to the PMP, the IMP is populated at the end of the GCAP development process and will is updated after three years and five years to report on the impact of the GCAP.

In order to monitor and evaluate the implementation and impact of the GCAP Actions and the GCAP as a whole, data will need to be collected regarding:

- The implementation status of each GCAP action: this should be recorded as 'No action', 'In preparation', 'Implementation underway', or 'Completed', with an explanatory note provided;
- Any changes to the implementation programme for the GCAP and each sector; details regarding the budget, scope and implementation programme of each action should be collected; and
- Indicators that will be used to determine the impact of the GCAP Actions; it is anticipated that these will largely comprise indicators used in the Integrated Baseline Report and featuring the overall targets, that can be monitored to determine the impact of GCAP Actions[18].

This data, once verified, are analysed to determine factors including:

- The likelihood of the GCAP vision, strategic goals and mid-term targets being achieved;
- Lessons learnt (notably what has gone well and where there is room for improvement);
- The need to take corrective action, for example, the revision of an element of the GCAP implementation programme;
- Cost-effectiveness of investment;
- The effectiveness of the monitoring process; and
- whether there should be a refresh of the GCAP.

The responsibility for the M&E process should ideally stay with the identified GCAP co-ordinator drawing the support of technical experts from the City Authority and relevant national stakeholders.

These reports are circulated internally to inform internal decision-making and communicate them with other stakeholders as appropriate.

[18] Although it is not necessary to collect data to update all indicators in the IDB, doing do would constitute good practice and facilitate a holistic understanding of the PSR indicators in Alexandria. This can be a valuable tool for informing future decision-making and enable the periodic revision of GCAP challenges, strategic goals, mid term targets and action and its ultimate refresh.

10.6. Climate-smart Considerations

As the City Authority proceeds with the implementation of the GCAP, it is recommended that the GCAP team and technical experts continue to consider and prioritise low-carbon and resilient alternatives of the proposed interventions. While the Actions have been developed with climate-smart considerations embedded, more long-term projects have been considered in less detail. These will also require further studies later on. Thus, it is suggested as the GCAP implementation moves into mid/longer term projects it is ensured that climate change-related risks and opportunities are thoroughly considered including different options for delivery.

Key questions designed to help improve project design are provided below with the aim of leading to stronger projects more closely aligned with climate action priorities[19]:

- Which climate risks could impact the performance of the project?;
- How do the specific project activities address local climate vulnerability?;
- Is there a possibility that the project increases vulnerability elsewhere (for example increasing flood risk downstream)?;
- Are there opportunities to reduce water use?;
- Could the project be eligible for sources of green or climate finance?;
- Will the project increase or reduce carbon emissions? (e.g., green/low carbon development?);
- Are there plans to reduce the capital/embedded carbon emissions of the project?;
- Are there plans to reduce the operational carbon emissions of the project?;
- Is there an opportunity for onsite renewable energy generation?;
- Does the project use the best available standards for energy efficiency?;
- Will the project increase air pollution and/or lead to environmental degradation?;
- Does the project support minimisation of waste and efficient use of resources including land and water?;
- Consider Carbon Hierarchy - Can You Build Nothing/Build Less?;
- Are there opportunities in this project to Maintain, Reuse, Repurpose?;
- Does the project have the potential to catalyse further investment in or around the area of intervention?;
- Will the project have a positive/neutral or negative impact on public health and wellbeing?; and
- Does the project directly benefit marginalised groups?

10.7. Next Steps

The Alexandria GCAP is a document plan that is used as a basis to communicate the Governorate's Green City vision and indicate a roadmap for realising ambitions. It presents long term aspirations and priority Actions for the City in the medium and short term.

10.7.1. GCAP Implementation

A concerted effort will be made to help ensure the GCAP implementation period begins in early 2025 as planned. The Governorate in collaboration with national stakeholders will focus on the priority GCAP Actions to implement. This will require further analysis of each proposal, including with regard to the funding needs, and their potential to generate revenue. Feasibility and modelling studies, which are objective assessments of the practicality of proposed interventions and Actions, will need to be conducted as part of this process.

10.7.2. GCAP Monitoring

The GCAP process is iterative, the identified Green City challenges, strategic objectives, midterm targets and Actions will need to be periodically reviewed to identify changes needed d. The effectiveness of the process will depend on the continued political support and clear and consistent ownership by a committed individual within the Governorate, supported by a monitoring process.

A series of next steps, in the form of activities and suggested timelines, is outlined in Figure 10-2.

[19] Based on Atkins / UN Habitat work on the Addis Ababa Climate Prioritisation Framework under the City Climate Finance Gap Fund.

Figure 10-2 – Programme of next steps for the Alexandria GCAP

	Activity	Year					
		2025	2026	2027	2028	2029	2030
GCAP Implementation	Approve the GCAP						
	Confirm GCAP Co-ordinator for implementation phase						
	Engage ministries and other decision-makers						
	Include the GCAP Actions in the annual budget and mid/long term development plans						
	Review and mitigate GCAP implementation risk						
	Commission feasibility studies for GCAP Actions						
	Pursue sources of funding						
	Select key GCAP measures and prepare a detailed implementation plan						
	Establish and formalise implementation partnerships						
	Implement GCAP Actions						
GCAP Monitoring	Agree and refine the monitoring process						
	Monitoring GCAP implementation						
	Monitor the contribution of GCAP towards goals and midterm targets						
	Report GCAP implementation progress and plan and implement any necessary corrective measures						
	Report the contribution of GCAP Actions towards targets and plan and implement any necessary corrective measures						
	Identify and report on changes in environmental indicators						
	Prepare for the next GCAP cycle						

Technical Appendices

Appendix A. Detailed Action Deep Dive Proformas

This appendix provides more information on the proposed projects that are deemed critical and mature for delivery in the short term.

A.1. Climate Resilience and Land Use

A.1.1. CR1 – Coastal Protection

Project Aim	Status	Impact / GHG Reduction	Possible Location
The investments are designed to reduce the risk of flooding and coastal erosion and protect against sea-level rise.	Ad hoc coastal improvement projects have been implemented, including notable efforts to protect the citadel. Ongoing development of ICZM for the Northern coast region provides an important framework to build from.	Increased protection of the coastal area of the City and key infrastructure. Enhanced social and environmental value of beaches and marine environment ecosystems, in addition to paving the ground for implementing the National ICZM strategy.	Initial focus on the area of the Corniche

Project Description

This project addresses the risks of sea-level rise and coastal erosion through a series of coastal protection investments and will be designed as a mix of traditional hard engineering, and nature-based approaches. The project will link closely with the *Enhancing Climate Change Adaptation in the North Coast and Nile Delta Regions of Egypt* project, and associated ICZM. Investments will include:

Beach Nourishment to address significant ongoing beach loss and associated loss of protection. Initial investments will focus on beaches lost due to Corniche expansion.

Rehabilitation of sea walls and revetments – current infrastructure is in poor repair and less effective than planned. Investments will rehabilitate and enhance existing defences, in particular linked to the expansion of the Corniche Road. Living sea wall technology will be piloted.

Submerged reefs to reduce the impact of waves and storm surges while supporting biodiversity.

Environmental, long-term impact, effectiveness and socio-economic assessment will be carefully investigated for each approach. Lessons learned from previous national projects and studies will be taken into account when choosing the tools and methodology to be applied. For example, evidence shows that beach nourishment can be applied without major damage to coastal ecosystems (Vacchi et al. 2020). It can enhance the natural landscape of the coast, promote a leasing environment and provide a large space for recreational and tourism activities. Although beach nourishment helps dissipate wane energy, it does not prevent coastal erosion; the beach naturally erodes, requiring regular re-nourishment.

Key Considerations
The risks from climate change and coastal erosion are not currently considered in development decisions, and existing development practice in the City can actively undermine its resilience, for example through the destruction of beaches through the expansion of the Corniche road. The development of the regional Integrated Coastal Zone Management plan provides an important opportunity to address this lack of coordination for coastal issues, but there is a need for this to be clearly adopted and implemented at the City level.

Implementing Agency	Stakeholders
MoWRI	Alexandria Governorate

CAPEX	OPEX	Potential Funding Sources	Timeframe for Implementation
€40 million EGP 2,125 million	Estimated at 1-2% of investment costs: €400,000 for ongoing replenishment.	Multilateral Development Banks (MDBs) Government	Short-term (1-3 years)

Prerequisite Steps for Implementation
A detailed sediment transport model is needed in order to assess the root causes of coastal erosion and the potential impact that different interventions, and combinations of investments will have. This is essential in order to ensure the long-term sustainability of the shoreline. The CAPEX and OPEX of the action include undertaking the necessary assessments and developing a common data environment platform.

Social Considerations (Gender and Inclusion)	Smart Considerations
The restoration of the beachfront and Corniche should be carried out in a way that retains and enhances access to the beach for all. If carried out in a sensitive way, there are many potential employment opportunities that could be associated with the project. This project will create significant employment opportunities across various stages, including planning, construction, and long-term maintenance. It will need to prioritise inclusive hiring practices to engage underserved segments of the population, such as local youth, women, and marginalised communities, ensuring they benefit directly from the job creation. Additionally, the project should offer training programs and apprenticeships to equip individuals with skills for sustainable careers, fostering economic resilience and empowering communities while addressing climate challenges.	There are a number of smart possibilities associated with this project. These include: • Deployment of **sensors** for real-time monitoring of condition of coastal zone. • Development of **sediment transport model** to understand the erosion and sedimentation patterns along the coastline and opportunities for intervention such as groynes and beach supplementation where needed to build resilience. • Develop a **common data environment** to provide a platform for data storage and exchange, this should be integrated with other departments and data stores, for example, the APTA despite their limited data storage capabilities.

Related Case Study:

Coastal Protection: Parco del Mare, Rimini

The Parco del Mare project in Rimini, Italy is an urban redevelopment project designed to increase the resilience of the city to sea-level rise and coastal erosion while at the same time creating a multi-functional, attractive seafront. Combining green and grey approaches, the existing road and car parks were converted into a concrete barrier covered by vegetated sandy dunes with walking paths. The barrier is 2.8m tall and provides coastal protection during storm surges and high sea level events. The cost of the project was €5.5m/km.

Beach replenishment: Bizerte, Tunisia

Bizerte is the 6th biggest city in Tunisia and the northernmost city in North Africa. The city corniche is flanked by 6km of beach, which has been suffering from significant erosion, driven by sea level rise and major storms, to the point that in some areas it has almost disappeared. The erosion of the beach not only removes a significant coastal asset, but also reduces the protection provided to the City itself. The Agence de Protection et d'Aménagement du Littoral (APAL) is carrying out a beach replenishment, stabilisation and rehabilitation project to protect and restore the economic, environmental and social value of the beaches, while increasing resilience to future sea-level rise. The cost of the project is ~€7.1million and is estimated to avoid ~€32million in damages.

A.1.2. CR2 – Sustainable drainage

Project Aim	Status	Impact / GHG Reduction	Possible Location
This action is designed to improve the drainage network in the City through a series of investments in green and grey infrastructure. The aim is to reduce the impact of flooding during extreme rainfall events.	The Governorate has already identified some 155 flooding locations and potential interventions and has implemented 6 out of the 9 priority projects. The implementation of stand-alone stormwater management projects reduced the flooding hotspots to 141 areas, but there is a need to scale up this intervention and provide a more holistic approach.	Improved stormwater management, but additional open/ green spaces also generate further benefits in terms of recreation, cooling, and biodiversity.	Historic urban core of Alexandria, with a focus on the area between the Corniche and Mahmoudia Canal. Areas of the Mahmoudia Canal in proximity to Minal El Basal

Project Description

With a very limited drainage network, and increasing flood risk from climate change, the City will not be able to manage flooding effectively. This programme of investment combines green and grey stormwater management approaches and includes:

- **Programme of SuDs schemes across the City –** initial investments targeted at flooding hotspots identified by AWCO and transport investments in the historic core of the City. Increasing permeability will reduce run-off during flash flood events.
- **Pilot restoration of Mahmoudia Canal** to increase flood capacity. It is clear that the degradation and concreting of the Mahmoudiah Canal has had significant negative social and ecological impacts, including a reduction in flood and drainage capacity. It is expected that initial work would be focussed on the area around Mina al Basr, but there are a wide range of possible scales of intervention. The restoration of the canal will improve flood storage, increase biodiversity, and improve connectivity in the City, as well as enhancing land values.
- **Expansion of city drainage network** which is currently inadequate and in need of significant upgrading to meet the City's needs.
- **Creating retention basins or small reservoirs to increase storage capacity.** Public spaces can be designed in order to provide flood storage capacity during heavy rainfall events and extreme storms that are likely to lead to flooding in Alexandria. Storage can be above or below ground, and the captured water can be reused for irrigation of open space.

Key Considerations

Initial work is needed to determine the right combination of investments. Sustainable drainage features should not require large amounts of water for maintenance. The Canal Restoration project should be linked to wider regeneration in order to provide greatest social benefits.

Implementing Agency	Stakeholders
AWCO	Alexandria Governorate ADSCO MoLD

CAPEX	OPEX	Potential Funding Sources	Timeframe for Implementation
SuDS investments (including basins): €15million Canal Restoration: €10million (2km) Drainage Network: €10million Total CAPEX € 35 million (EGP 1,860 million)	Estimated at 1-2% of investment costs: € 350,000 to € 750,000 (EGP 18.6 million – 40 million)	Multilateral Development Banks (MDBs) Government	Short-term (1-3 year)

Prerequisite Steps for Implementation

There is a need for a supporting study, including an environmental impact assessment, to be carried out to identify the most appropriate combination of investments. This would include a detailed assessment of the current flood risk and how this will change under climate change, identification of further areas with potential for sustainable drainage interventions, beyond those already identified by AWCOO, and a feasibility study for improvements to the drainage network. The study will also need to gather and consider lessons learned from the first stage of implementation of the initial projects.

Social Considerations (Gender and Inclusion)

This project provides the opportunity to significantly improve conditions for poor and marginalised groups in the City by reducing flood risk in low-income neighbourhoods. The socio-economic status of neighbourhoods should form a criterion for the selection of priority interventions.

Smart Considerations

There are a number of smart possibilities associated with this project, including:

- Deployment of **sensors** for real-time monitoring of condition of drainage network, including to monitor drain capacity, sedimentation and blockages, water flow and outfalls for discharge.
- Production of **dynamic hydro model of drainage network** to develop a digital twin fed by information from the deployed sensors and weather reporting to help identify areas across the network which need intervention. Such modelling will also help to determine where further investment is necessary to alleviate pressure on the drainage network.

Related Case Studies:

Green and Grey investments to reduce flash flooding in Amman.

Increases in urbanisation, inadequate drainage systems, and more rainfall extremes as a result of climate change have meant that flash flooding is a significant issue in Amman, which has experienced significant damage to infrastructure, as well as loss of life. The Municipality of Greater Amman has prioritised a project to develop a conveyance or storage system which will divert floodwaters from flooding critical areas at risk in the city's core. The project emerged as a recommendation from both a UN Habitat flood risk assessment for the city, and the Amman's Green City Action Plan.

Actions include piloting Sustainable Urban Drainage systems such as bioswales and rainwater gardens, as well as underground flood storage created under the Al Zohour Green Triangle. The Al Zohour Green Triangle swales and retention basin have a capacity of 2850m^3 and are designed to demonstrate proof of concept for Sustainable Urban Drainage in the city.

Implementation of several rainwater retention basins - Marseille

Increasing permeability and flood benefits of existing green/open spaces and using stored water for irrigation. These are expected to be underground retention basins, below existing open space. Water can then also be used for maintenance of green and open space. For example, the city of Marseilles, France has constructed 5 major stormwater retention basins in order to reduce the risk of flooding and improve the quality of coastal waters. The retention basins stop the direct discharge of sewer stormwater overflow into the sea. This has been part of an integrated approach to upgrade the sanitation and drainage system, with improvements in health and environmental outcomes targeted.

Multi-functional flood storage - Barcelona

Joan Reventós Park is a public park of about two hectares in Barcelona. In the catchment of a stream prone to flash flooding, it has been designed to increase water absorption for flood storage during heavy rain. The scheme combines Sustainable Urban Drainage, recreation and flood storage, with water filtered and then reused for irrigation of the green space during summer.

Restoration of stretches of canal system. - Both Seoul, and Utrecht provide good examples of how the restoration of urban canal and river systems can increase flood resilience while at the same time providing multiple environmental and social benefits, and regeneration potential

Cheonggyecheon Stream, Seoul, S. Korea - The Cheonggyecheon Stream restoration in Seoul, S. Korea was completed in 2005 and involved the removal of an elevated freeway and the uncovering and restoration of the historic Cheonggyecheon Stream. The restored stream has had major social, economic and environmental benefits, catalysing investment in the area and with the following key outcomes:

- Increased the price of land by 30-50% for properties within 50 meters of the restoration project. This is double the rate of property increases in other areas of Seoul;
- Catalyst for an estimated 22 trillion won (USD $1.98 billion) worth of capital investment in Cheonggyecheon-area redevelopment;
- Provides flood protection for up to a 200-year flood event and can sustain a flow rate of 118mm/hr; and
- Increased overall biodiversity by 639% between the pre-restoration work in 2003 and the end of 2008.

Cathaerijnsingel Canal, Utrecht, Netherlands

In 1969 the canal was concreted over to make room for a major motorway but has been restored and enhanced to provide major flood protection, environmental and socio-economic benefits, with works finished in 2020. A linear park has been created along part of the length of the canal, and it has significantly improved the city's cycling and walking network as part of a major reorganisation of traffic flow in the city. The restoration has formed a key part of the regeneration of central Utrecht.

A.2. Transport

A.2.1. TR1 – Sustainable Urban Mobility Plan and Priority Transport Investments

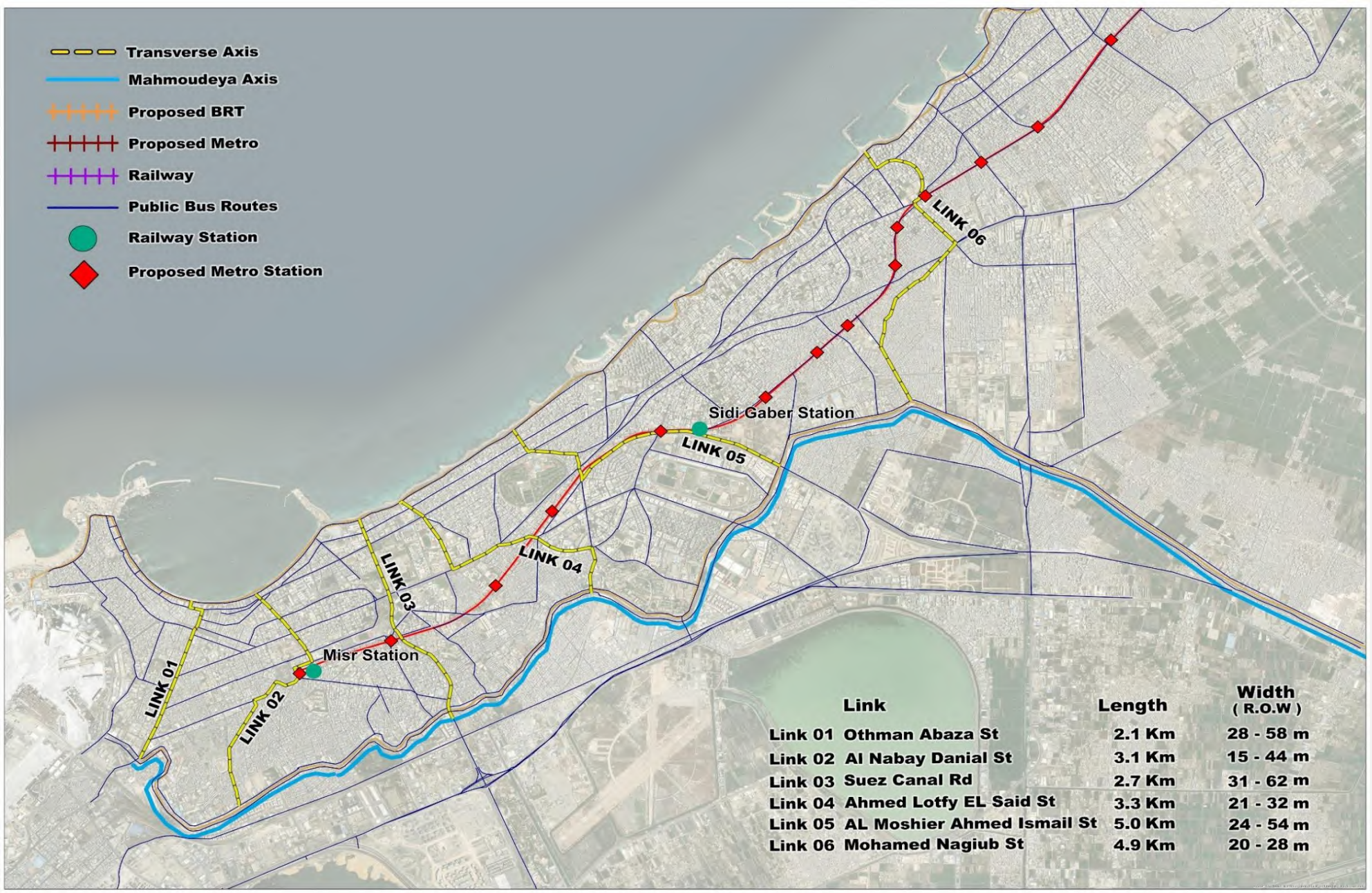
Project Aim	Status	Impact / GHG Reduction	Possible Location
The aim of developing a Sustainable Urban Mobility Plan (SUMP) is to set a strategic plan for transforming Alexandria's current urban transport system following the concept of sustainable urban mobility planning. The SUMP will aim to: • Improve the efficiency and cost-effectiveness of the transport network. • Reduce the impact of transport on the environment. • Ensure accessible transport options for all citizens. • Ensure personal safety and security within the transport system and improve the overall quality of life for the citizens. This will be a holistic plan including policies, traffic model development, software procurement, and measures to address multimodal transport across the entire urban agglomeration, including public and private operators, passenger and freight, zoning and parking, and door-to-door mobility. Three critical investments will be the core of the SUMP: • **1st investment:** Replanning the transverse roads (six links) linking the Corniche Road and Mahmoudiya • **2nd investment:** Expanding the Traffic Management System established by the Alexandria Traffic Department. • **3rd investment**: Sidewalks and pedestrian paths are an integral part of SUMP as people move to, from, and between transport stops, stations, and hubs.	• APTA currently runs bus routes on the Corniche Road and, lately, on the Mahmoudiya axis. APTA has no routes along the transverse roads (six links) linking the Corniche Road and Mahmoudiya axis. • In ongoing discussions with MoT, six transverse roads were re-proposed to link Corniche Road with the Mahmoudiya axis. • A traffic management system has already been introduced in the City on arterial roads only, and it needs to be expanded for major collector roads. • No cycling route projects have been built in the City to date.	• Improved air quality. – Concentration of all air quality indicators will be reduced (PM2.5, PM10, SO2, NOx) • Improved soil quality – reduced concentration of mercury, cadmium, mineral oil, and zinc in soil • Reduced annual CO2 emissions per capita and per unit of GDP.	The SUMP is Governorate-wide. **1st investment:** Area-wide between the Corniche Road and Mahmoudiya axis **2nd investment:** Expanding the Traffic Management System on arterials and major collector roads. **3rd investment:** Implement cycling routes, cycling, and pedestrian infrastructure investments at the Corniche Road and Mahmoudiya axis and at the transverse roads between them.

Project Description

Currently, the City lacks a detailed plan to leverage major transport projects and ensure last-mile connectivity, support effective modal shifts, and reduce the overlap of services that several operators provide. Sustainable Urban Mobility Plan (SUMP) study is proposed to ensure efficient traffic circulation and the development of well-managed and effective mass transit networks. Alexandria has experienced a rapid expansion in the use of private motor vehicles, which negatively affects the City in terms of people's mobility and wellbeing (i.e., air pollution). This is partly because APTA's public transport system is constrained and does not serve all parts of the City. The longitudinal pattern of the road network of Alexandria is a strong aspect in terms of public transport coverage, while the transverse roads do not have the same level of coverage.

The SUMP will help define the following three critical investments in more detail:

- **1st investment:** Replanning the transverse roads (six links) linking the Corniche Road and Mahmoudiya axis through land readjustments, road improvement, and public transport implementation to re-accommodate and prioritise space for sustainable transport modes such as walking, cycling, and public transport. The primary rationale of this investment is traffic/demand management & road capacity expansion. Improving road corridor layouts will reduce reliance on private car usage along key corridors in the City. It will also promote connectivity between key transport nodes (bus stations, metro stations) and enhance road safety while reducing congestion, improving the movement of public transport, and promoting non-motorised transport. Selected corridors will link Corniche Road with the Mahmoudiya axis with mass transit modes (buses/minibuses/microbuses). There is further potential to enhance more comprehensive traffic management by dedicating other parallel roads for other uses (cycling, green/open spaces) or a one-way system.
- **2nd investment:** Expanding the Traffic Management System established by the Alexandria Traffic Department. This will include implementing smart and adaptive traffic lights prioritising public transport at key junctions and cross roads, cameras, and sensors to manage traffic flow, especially during peak hours on arterials and major collector roads. The system will also enforce traffic rules and identify road regulation violators. Installing an ITS will help regulate traffic flow and thus reducing GHG emissions. Moreover, ITS will enhance data collection and inform future evidence-based transport planning and decision-making. It will also support the right of way for public transport and bicycles and support optimised street parking.
- **3rd investment**: Sidewalks and pedestrian paths are an integral part of SUMP as people move to, from, and between transport stops, stations, and hubs. The SUMP will include alternative ways of moving around the City, especially walking and cycling. A well-integrated and maintained network of sidewalks and pedestrian paths is required to enable such movement and make it inviting, comfortable and safe. The investment will also implement cycling routes, including wheelchair accessibility on pavements. By integrating pedestrian and cycling corridors into the new land use plan, Alexandria can create a more coherent and efficient non-motorised transport network and an efficient, environmentally friendly, user friendly, comfortable, and well-connected public transport to make it the transport mode of choice. New areas for cycle parking need to be located adjacent to the main cycle route network and strategically located throughout the City – preferably close to areas with significant concentrations of tourists, commuters, and students. Bicycle parking will be determined through local standards or regulations. There is significant variety in the number of spaces that can be provided in different areas of the cities linked to levels of density.



Link		Length	Width (R.O.W)
Link 01	Othman Abaza St	2.1 Km	28 - 58 m
Link 02	Al Nabay Danial St	3.1 Km	15 - 44 m
Link 03	Suez Canal Rd	2.7 Km	31 - 62 m
Link 04	Ahmed Lotfy EL Said St	3.3 Km	21 - 32 m
Link 05	AL Moshier Ahmed Ismail St	5.0 Km	24 - 54 m
Link 06	Mohamed Nagiub St	4.9 Km	20 - 28 m

Key Considerations

- **1st investment:** The six-road links shown in the map above were selected to align with the following criteria:
  - Create direct linkage between the Mahmoudiya axis and the Corniche Road (All roads are major collectors).
  - The right-of-way of all roads is wide, ranging from a minimum of 15m near the Mahmoudiya axis to a maximum of 62m near the Corniche Road. This will enable the implementation of public transport routes and facilities, sidewalk widening, construction of cycling routes, and rehabilitation of existing green/open spaces along the roads.
  - The suggested roads intersect with the proposed metro line, exiting tram and bus lines, and Cairo Alexandria railway.
  - The proximity to metro stations, including Misr Station, and Sidi Gaber railroad station whenever possible (Link 2, 3, 5, and 6) to enable multi-modal public transport integration.
  - The connection of link 3 with Cairo Alexandria Regional Road as the main entrance to the City.
- **2nd investment:** The Alexandria Traffic Department and Alexandria Governorate should approve the type of ITS and installed location of IT devices that aim to resolve chronic traffic and transportation issues and fill traffic security at important roads and locations.
- **3rd investment:** The Alexandria Traffic Department and Alexandria Governorate should approve the locations of the cycling routes (on the sidewalks, on the side of the road in separate lanes). The installation of new cycle parking infrastructure needs to support an improved Governorate-wide network of cycle routes. In line with international good practice, cycle facilities should be planned, designed, and installed based on visibility, accessibility, safety and security, maintenance and monitoring, availability and capacity, connectivity, and attractiveness.

Implementing Agency	Stakeholders
1st Investment Governorate: Approvals, land allocation and provision; APTA/Private operators: Route Implementation MoT (Authority for Roads and Bridges): Enabler **2nd Investment** Governorate: Approvals MoT: Enabler MoI: Key stakeholder **3rd Investment** Governorate: Approvals, land allocation and provision MoT (authority for roads and bridges): Enabler	Alexandria Governorate APTA MoERE Electric bus manufacturers/suppliers Bus operators Specialised Information Technology (IT) companies, ITS experts, Alexandria Traffic Land Transport Regulatory Authority (LTRA) MoT NGOs Private operators

CAPEX	OPEX	Potential Funding Sources	Timeframe for Implementation
Development of the SUMP: € 500,000 **1st investment:** Requires detailed studies **2nd investment:** € 3,000,000 – € 6,000,000 **3rd investment:** Requires detailed studies SUMP: EGP 26.5 – 106.3 million, 1st Investment – Requires detailed studies 2nd Investment: EGP 160 - 318 million 3rd Investment – Requires detailed studies	**1st investment:** N/A **2nd investment:** N/A **3rd investment:** N/A	Multilateral Development Banks (MDBs) Government Private finance (fleet companies, etc.)/ PPPs	Short term (1-3 years) Implementation to continue into the medium and long term.

Prerequisite Steps for Implementation

1st investment:

1. Establish the project team and focal point within Alexandria Governorate, APTA, and Transport-related Enterprises.
2. Conduct a feasibility study to prioritise a list of potential pilot transport projects to deliver sustainable urban mobility identified in the SUMP
3. Develop preliminary designs for specific locations and test with users (engagement with local businesses/users) – include “quick wins” and “flagship” options
4. Develop study scope, issue Request for Quotation and submission of proposals by interested parties
5. Review of proposal and issue of contract
6. Develop SUMP alongside the four-step multi-modal traffic model, review the spatial plan, including micro-mobility infrastructure, integration with the public realm and public transport interchanges, and a car parking management plan.
7. Publication of the SUMP and capacity building of stakeholders for adoption of the plan.

2nd investment:

1. Alexandra Traffic Department conducts a feasibility study to identify the past ITS data already collected in the City by the traffic management center.
2. Alexandria Traffic Department and relevant experts to prioritise the aspects of ITS that are most critical to Alexandria (e.g., traffic congestion, pedestrian movement, safety, parking, real-time public transport movement, etc.) and ensure that these are communicated to national authorities to ensure proper integration into existing systems.
3. Alexandria Traffic Department will develop a mechanism, legislation, and policies to increase incentives for different users and relevant agencies to use, generate, and manage ITS data.
4. Alexandria Traffic Department will expand and modernise the existing unit to host and manage the ITS.
5. Transportation and specialised information technology experts to identify the proper technology-related matters, including the framework architecture and the digital hardware and software elements for the mobility platform, with proper integration of geospatial analysis technologies.
6. Procure the development of the ITS system.
7. Launch the system and monitor its development and performance.
8. Depending on the evaluation, scale up action accordingly.

3rd investment:

1. Alexandria Governorate, in cooperation with the Alexandria Traffic Department, conducts a feasibility study to identify routes and solutions for arranging bicycle lanes and facilities (such as cycle parking) across the City and subsequent investment for cycling and pedestrian infrastructure in the land use plan.
2. Involve citizens in selecting the routes to connect the public spaces and parks.
3. Ensure a good connection of the network to public transport.
4. Install a pilot bike-sharing scheme at key points of the network.

5. Allocate budget and resources to implement new infrastructure envisioned in the land use plan.
6. Review of proposal and issue of contract
7. Launch and monitor its development and performance depending on the evaluation scale-up action accordingly

Social Considerations (Gender and Inclusion)	Smart Considerations
The improved sustainable mobility project aims to enhance air quality, providing significant health benefits for vulnerable residents suffering from respiratory diseases. By improving safety, security, and access to essential services, the project will promote social equity and a more inclusive urban environment. It will enhance the public realm, creating spaces that are accessible and welcoming to all. A key focus will be on promoting public and non-motorised transport options that better meet the needs of women, children, the elderly, and individuals with disabilities. Ultimately, this project seeks to create a more equitable, sustainable, and healthier city for all its residents.	Integrating smart and digital technology is crucial in transport planning and management, smart possibilities associated with this action include: • Developing **real-time information systems** using GPS tracking of vehicles and other traffic, and capacity sensors, to inform passenger or any changes to timetables and keep track of the network and its operation. • **Passenger information systems** integrated at stations and stops to inform passengers of upcoming departures and any timetable changes. • Integrating **automated Fare Collection** across the network to streamline payment and improve customer accessibility. • Establishing an **integrated bike-sharing system** and development of digital infrastructure in this sector offers strong private sector potential. This should include introducing **cycling apps for navigation** around historic sites. Consider integrating **ticketing for shared bicycles with overall public transport ticketing**. • Expand the **Traffic Management System** (as discussed as part of the 2nd investment) to aid with monitoring traffic congestion, pedestrian movement, safety, parking, real-time public transport movement, etc.

Related Case Study:

1. Bogota's comprehensive Urban Mobility Plan and cycling network, Colombia[20]

Since 1998, Bogota has been developing the City's cycling network and renovating sidewalks, streets, and public spaces to increase quality. As of 2022, the cycling network amounted to more than 590 km of permanent cycling paths – including 162 km of dedicated cycle paths along roadways, 299 km integrated into the sidewalk, 124 km of shared cycleways on roadways (shared road spaces between cyclists, buses, and cars), and 5 km cycle bridges and tunnels.

The efforts of the city to expand the network meant that, in 2019, 6.6% of people chose cycling as their main mode of transport. In general, active modes of transport accounted for around one-quarter of all trips made, public transport (buses) accounted for half, whilst private vehicles, motorcycles, and taxis accounted for the other quarter (see Figure 6-6). Bike ridership increased by 40% in the four years leading up to 2020 and has since been estimated to have increased to approximately 8% of the total modal share – this translates to around 900,000 daily trips undertaken by bike.

This modal shift has also been facilitated by changes to national traffic codes, the implementation of private vehicle speed management, the creation of traffic calm zones around schools, and swift action by elected officials to improve road safety (particularly for cyclists). Cycle lanes often run parallel to the Bus Rapid Transit system and help to connect cyclists with public transport services. Moreover, in 2022, the city launched its first bike-sharing scheme with over 3,000 bikes and 300 docking stations. Discounted fares for bicycle hire are offered to disadvantaged groups. Women account for 24% of ridership.

[20] Mobilize, From Transmilenio to cycle networks – lessons learned from Bogota's Comprehensive Urban Mobility Planning, (2022), Available at: https://transformative-mobility.org/wp-content/uploads/2023/06/From-Transmilenio-to-Cycle-Networks-Lessons-Learned-from-Bogotas-Comprehensive-Urban-Mobility-Planning-MAY4.pdf

2. Intelligent Transport System in Florence, Italy[21]

Florence is the main city in the Province of Florence and the capital of the Region of Tuscany. Its population is approximately 400,000 people, and several small towns in its hinterland are connected to Florence by local public transport services. Florence is a historic city that attracts many tourists throughout the year. The city center has relatively narrow streets that permit but also constrain public transport services. The arterial roads from the city center are also quite narrow, with relatively low running speeds and a high risk of delays. Until 2008, public transport in Florence was entirely by bus. In 2010, a tramway line (Line 1) was opened. No further lines are currently under construction. While the tramway has absorbed some of the bus business, the bus is still Florence's primary passenger transport mode and will remain so for the foreseeable future. Public transport to/from Florence is provided by long-distance and regional buses and mainly by regional trains. The regional trains connect many of the hinterland towns, providing an extensive commuter rail network, although it does not fully meet the overall commuter demand. ATAF, the Municipally Owned bus operator in Florence, implemented an ITS system on its fleets in the Florence area by operating electric buses with smart amenities such as real-time information, Automated Fare Collection, and passenger information systems, thus having significant reduction in GHG emissions.

3. The City of Copenhagen's Bicycle Strategy, Denmark[22]

Copenhagen has set itself the goal of becoming 'the world's best bicycle city by 2025'. Achieving this goal is also viewed as integral to the city's health plan, to the environmental goal of making the city CO2 neutral by 2025, and to enhancing the city's liveability. Copenhagen's plan for achieving a greater modal share for bicycles includes increasing the capacity of the cycle tracks to the city centre, to accommodate an additional 60,000 cyclists by 2025. From 2010 to 2014, the City of Copenhagen allocated € 80 million to implement its bicycle strategies and infrastructure. The major spending came in 2012, with €25 million, and in 2014, with €30 million.

Planning and Infrastructure:

There have been two main dimensions of implementation for Copenhagen's Bicycle Strategy: planning and infrastructure. Planning is now an integrated feature of Copenhagen's urban development and urban governance. Between 2002 and today, the city has developed four separate cycle-based policies, plans, and strategies. The Copenhagen Bicycle Strategy (2011-2025) is one of these. The key goal of this strategy is to increase the number of daily bicycle trips in Copenhagen to 240,000 by 2025, from a baseline of 110,000 in 1970 and 150,000 in 2015. Others include the Priority Plan, which addresses implementation, and the Transport and Environment Plan, which deals with questions of funding for bicycle infrastructure.

In terms of infrastructure implementation, this includes the construction of a network of dedicated bike paths that are segregated from both pedestrians and vehicle traffic; dedicated bicycle traffic lights that allow for cyclists to leave intersections before cars; and separately coloured bike paths where cars and bikes share road space.

Currently, cycling forms a minor proportion of Alexandria's total transportation modal share, partly due to a lack of dedicated cycling infrastructure. This case study demonstrates a best practice example of the planning, strategy, policy, and investment needed to develop cycling infrastructure that helps promote a greater modal share of bicycles.

[21] https://www.ssatp.org/sites/ssatp/files/publications/Toolkits/ITS%20Toolkit%20content/case-studies/florence-italy.html
[22] Urban Sustainability Exchange, The City of Copenhagen's Bicycle Strategy Case Study, https://use.metropolis.org/casestudies/cycling-in-copenhagen

A.2.2. TR2 – Decarbonisation of Public Transport Fleet

Project Aim	Status	Impact / GHG Reduction	Possible Location
The aim of this action is to support the APTA's request and to replace the APTA's fleet from fossil fuels to electric vehicles. This project aims to reduce emissions from public transport in Alexandria. Ultimately, it will expand the electric vehicle infrastructure and promote BRT.	APTA operates over 600 buses, mostly diesel. In 2019, APTA introduced 15 air-conditioned electric buses operated with two 150-kilowatt electric motors each, equipped with six internal cameras and tracking features, with a charger capacity of 80 kilowatts, lasting approximately 4.5 hours and a maximum speed of 80 km/h, offering a cost-effective and eco-friendly mode of transport. APTA already has four depots (Moharam Bek depot, Middle district depot, East district depot, and West district depot). Each depot contains 10 EV charging stations and has extra space for expansion for five more EV stations. Each EV station has dual ports, and power varies from 60 to 80 or 100 to 120 KW. APTA emphasises that their crew is now fully trained to maintain the bus batteries and do all routine bus checkups and repairs.	All air quality indicators: less concentration of PM2.5, PM10, SO2, NOx Less concentration of mercury, cadmium, mineral oil, and zinc in soil. Reduced annual CO2 emissions per capita and per unit of GDP	It is to be operated on major routes in the City and at the Mahmoudia Axis. The charging station of busses will be implemented in APTA existing four depots.

Project Description

Alexandria's public transport system has been deteriorating over the last few years. The bus fleet is aging. In addition, insufficient policy and financial incentives for electric buses are limiting their adoption. The increase in energy-efficient public transport will have a multitude of environmental and social co-benefits. On the environmental side, there will be less air pollution from modern diesel engines, less CO2 emissions, and reduced traffic if public transport becomes the preferred travel mode. Socially, the benefits will be increased access to public transport due to a larger fleet of buses and possibly greater connectivity due to expanding the bus network. Higher frequency and capacity will improve the level of service and travel options for passengers, encouraging a modal shift away from private cars.

This investment will support and replace the APTA fleet by purchasing and operating 100 electric buses in the short term that are equipped with modern amenities, facilities, and systems. Thus, the project will promote e-mobility as an alternative, enhance user experience and ridership of the bus fleet, increase energy efficiency, and reduce emissions from public transport. In the medium term, the investment will be extended to purchase and operate 300 more electric buses to replace about 2/3 of APTA Fleet. This includes charging either 'in-route' or 'off-duty" and will consider the space requirements, charging rates, and grid capacity. **TR4** considers implementing the integrated public transport network ticketing system on the 100 electric buses. Some of the purchased 100 buses will be used for the early stages of implementation in **TR5** & **TR6**. It is planned that the BRT infrastructure and buses will be implemented on Corniche Road and Mahmoudia Canal corridor in the long term. Real Time Information and journey planning for all of Alexandria's public transport network should be embedded in popular navigation apps to improve passengers ability to plan their journeys.

Key Considerations

The project will include a pilot study of electric buses and charging station infrastructure to support the fleet renewal programme. A feeder study will assess the number and distribution of new buses required in the City to serve as feeders between existing stops and target neighborhoods.

Implementing Agency	Stakeholders
APTA	Alexandria Governorate MoERE Electric bus manufacturers/suppliers Bus operators LTRA MoT NGOs Private operators

CAPEX	OPEX	Potential Funding Sources	Timeframe for Implementation
Short Term: € 400,000 x 100 Buses = € 40,000,000 (EGP 2,577 million) Medium Term: € 4000,000 x 300 Buses = € 120,000,000 Electric vehicle charging infrastructure – buses (mix of fast charging and slower charging): € 25,000 each x 20 stations = € 500,000 (EGP 26.5 million)	Estimated at 1-2% of investment costs: Short Term: € 250,000 to € 500,000 (EGP 13 - 26.5 million) Long Term: € 750,000 to € 1,500,000 (EGP 40 – 80 million) (The use of electric vehicles will lower the APTA fleet's OPEX over time, and generally have fewer associated maintenance costs.)	Multilateral Development Banks (MDBs) Government	Short term (1-3 years)

Prerequisite Steps for Implementation

1. Assess the outputs of the feeder study and establish annual targets for fleet replacement.
2. Assess the outcomes of the existing pilot project for electric buses and associated charging infrastructure.
3. Conduct a feasibility study, including a financial and economic assessment for:
    - The routes identified in the feeder study to determine which routes are most suitable for operation by electric buses (in terms of route length, slopes/grades, expected passenger demand, bus stop locations, bus frequency, connectivity with the new proposed BRT system, etc.).
    - New sites for charging infrastructure for buses and service vehicles, considering the space requirements, charging rates, and grid capacity. This could include dedicated charging sites for many buses or in-route charging.
4. Alexandria Governorate, APTA, and the Land Transport Regulatory Authority should be included in the process.
5. Engage with donors and International Financial Institutions to identify finance options and initiate financing.
6. Identify costs, procurement procedures, operational needs, implementation logistics, and the operations business modality.
7. Determine the priority implementation of routes, the buses required for each route, and the timeframe for service vehicle-renewal/replacement.
8. Prepare the procurement documents and release the invitation for tender
9. Prepare a tender strategy, process, and evaluation.
10. Purchase new vehicles and fleet replacements, integrate them into transport planning, and put them into operation.
11. Construction of infrastructure, including depots and the charging infrastructure required to run the fleet, etc.

Social Considerations (Gender and Inclusion)	Smart Considerations
Improved air quality, benefitting vulnerable residents suffering from respiratory diseases. Improve safety and/or security, access to basic services, social equity. Enhance the public realm. This project has the potential to create significant employment opportunities across various stages, including the production, deployment, and maintenance of a decarbonised public transport fleet. It should prioritise inclusive hiring practices to engage underserved segments of the population, such as local youth, women, and marginalised communities, ensuring they benefit directly from the transition to greener transport.	The electrification of vehicles gives a potential platform for the 'smartification' of transport systems in the City. This includes: • **Real Time Information and online journey planners** by introducing new routes/timetables. • Improvements **smart technology in vehicles**, such as comfortable seats, air conditioning/heating cooling system, Wi-Fi equipment, traffic management system, passenger audio-video information system, passenger counting system, camera video surveillance system, and USB sockets for charging various devices. • Implementing **automatic fair collectio**n and equipping all bus stops with **screens displaying information** on schedules and routes. • **Charging infrastructure and data monitoring**, including, electricity consumption, charge times, battery storage depletion, to optimise the need for charging against timetables and routes.

Related Case Study:

Clean Vehicles in Rotterdam[23]

In 2012, Rotterdam embarked on a 12-month project to test the overall feasibility of electric vehicles, during which it monitored 75 electric vehicles and 129 charging points. This project assessed the performance of fully electric and plugin hybrid vehicles, but it also focused on the efficiency of the whole chain of electric vehicle technological components, from distribution transformers to charging points. The tank-to-wheel results showed that the electric vehicles reduced direct CO2 emissions by 67% and particulate emissions by up to 20%. In addition, Rotterdam and its different public and private partners also tested the feasibility of electric garbage trucks, buses, delivery vans, and an electric carsharing program.

- **The expansion of its electric charging infrastructure:** Rotterdam Municipality provides electrical charging infrastructure according to consumer demand. If an electric vehicle owner cannot have a charging station on their property, the city will install a public charging station within 250 meters of their home or business. Rotterdam Municipality also provides charging infrastructure in its public car parking facilities
- **Revision of its municipal fleet, favouring electric vehicles:** In 2014, the municipal fleet had 25% electric vehicles. The new challenge is to increase the whole municipal fleet to 50% clean vehicles by 2018
- **Funding innovative projects to attract business/private sector interest in electromobility and new charging technology:** Rotterdam's current pilot projects include projects on smart charging, inductive charging, battery improvement, infrastructure improvement to increase the business case for charging facilities, and pilot projects on the feasibility of electrical buses and garbage trucks.
- **Creating Green Deals with urban logistics companies to encourage zero-emission deliveries:** The city aims to have zero-emission goods delivery in the city by 2020, working with big frontrunner freight companies such as TNT and DHL.

[23] Compiled from Paris Process on Mobility and Climate (PPMC) Article: http://www.ppmc-transport.org/rotterdamscommitment-to-electric-mobility/
Success Stories: Rotterdam City: https://evbox.com/en/success-stories/rotterdam-city
Clean Vehicle Procurement in Rotterdam Presentation by Rotterdam Climate Initiative:
https://civitas.eu/sites/default/files/3b_national_framework_nl_messemaker.pdf

A.2.3. TR4 – Integrated Public Transport Network Ticketing (Electronic Fare Payment System)

Project Aim	Status	Impact / GHG Reduction	Possible Location
The aim of the action is to make public transport ticketing more convenient by implementing an integrated Public Transport ticketing system and thereby encourage the use of public transport.	APTA completed an initial phase. The next step would be to widen the provision to all public sector transportation modes including installing devices on all buses, setting up real-time-schedules and mobile applications.	• All air quality indicators: less concentration of PM2.5, PM10, SO2, NOx in air • Less concentration of mercury, cadmium, mineral oil, and zinc in soil • Reduced annual CO2 emissions per capita and per unit of GDP	APTA ICT system

Project Description

This investment involves developing and implementing an integrated ticketing system, real-time tracking, and a unified timetable covering all transit services, including Metro, Tram, and Buses, to be implemented by MoT. APTA introduced the electronic ticketing system on some buses by adding electronic devices for ticket processing. APTA needs to complete the next phase of the Electronic Fare Payment System, including the devices installed on buses, real-time timetables, and mobile applications, to provide passengers with improved access to flexible and easy multimodal travel, promoting e-mobility as an alternative and enhance user experience and ridership. This will involve developing a system that will be compatible with all modes of transportation and phase the implementation accordingly.

Integrated public transport network ticketing allows passengers to transfer between different transport modes or buses operated by different service providers with a single ticket, valid for a complete journey. Such a system promotes a seamless journey for the users and can increase the attractiveness of public transport by simplifying switching between transport modes and improving service efficiency.

The integrated ticketing system provides passengers with real-time information about the nature and state of a public transport service, using real-time information derived from automatic vehicle location systems. These systems change continuously because of actual events and are typically used during a journey.

The integrated ticketing system includes robust IT-based systems supporting the operation of the network model as well as the ticketing, ticketing hardware, new expert personnel for the APTA, new personnel for the ticketing system operator

Key Considerations

- Several alternatives can be considered in implementing this system:
  - A flat fare across the City. It is suitable for a small City. Otherwise, an average fare would be costly for short travel and cost-effective for long-distance travel.
  - Define multiple zones around the City centre and vary ticket prices by zone (suits Alexandria Case).
  - Distance-based travel through electronic tickets, which can be used across all services (suits Alexandria Case).
- Integrated ticketing systems are very (integrated cashless ticketing) such as smart cards, magnetic stripe cards, bank cards, and phone-based payment systems (e.g. Apple Pay, Android Pay).
- A good communication backbone is needed to implement such a system. Also, the transaction will have to adhere to the national electronic money regulation. The integrated ticketing system would primarily cover bus services but should be developed with consideration of other modes, including trams.
- Multimodal stations will be built to accommodate multiple types of transport (terminal and exchange stations). Implementing an integrated ticketing system will require buy-in from the operators.

- A revenue share agreement must be established for the operators, APTA, and the Alexandria Governorate to implement successfully.

Implementing Agency	Stakeholders
Private sector operators International finance institutions	Alexandria Governorate; APTA; MoERE; Electric bus manufacturers/suppliers; Bus operators; LTRA; MoT;NGOs; Private operators

CAPEX	OPEX	Potential Funding Sources	Timeframe for Implementation
Requires further detailed study Requires further detailed study	N/A	Multilateral Development Banks (MDBs) Government Private finance (charging companies, etc)	Short-term (1-3 years) and Medium-term (3-5 years)

Prerequisite Steps for Implementation

- Conduct a feasibility study on the appropriate implementation of an integrated ticketing system that suits APTA.
- Evaluate APTA current experience in implementing the smart ticketing system
- Develop guidelines for an integrated ticketing system, detailed specifications of the electronic Platform of Integrated Mobility Services including (common application) and the suitable new bus operator model
- Prepare tender documents and estimate the contract value.
- Evaluate the tender and establish the new bus operator model to be implemented
- Rollout of the batch of electric buses
- Conduct tender for integrated public ticketing system
- Rollout of integrated public ticketing system

Social Considerations (Gender and Inclusion)

The integrated public transport system will improve safety and security by reducing cash transactions, minimising theft, and streamlining passenger flow, ensuring better access to basic services and promoting social equity. It will enhance the public realm by making transport more accessible and inclusive for all. The system will simplify access to multimodal transport options, fostering social inclusion and encouraging green behaviours by embedding sustainability messaging in ticketing platforms. Inclusiveness will be further supported through differentiated fares for underserved groups (e.g., elderly, persons with disabilities, youth) and ensuring balanced gender representation in decision-making processes. All planning, implementation, and decision-making processes should be well communicated with the residents.

Smart Considerations

Modernisation and improvement of the public transport system have great potential for smart solutions; one of them is the smart ticketing system that provides passengers with the following:

- All transport-related information, such as, **Real Time Information and online journey planners** by introducing new routes/timetables, schedules, identification of transport stops, and service interruptions, and offer them the possibility of paying for a ticket in real-time.
- Improvements, such as, comfortable seats, air conditioning/heating cooling system, Wi-Fi equipment, traffic management system, passenger audio-video information system, passenger counting system, camera video surveillance system, and USB sockets for charging various devices.
- **Automatic fair collection** and equipping all bus stops with **screens displaying information** on schedules and routes.
- **Data collection and sharing** for the City Intelligent planner application use.
- Integration of all means of transport into the **transport management system**.

Related Case Study:

Integrated Public Transport Network Ticketing in Dublin[24]

This case study deals with the Fare Collection systems implemented at Dublin Bus, the public bus operator in the metropolitan area of Dublin.
It does not cover the Fare Collection systems implemented at the rail or tram operators or any fare collection systems at the small number of other operators of urban bus services, except where this is directly relevant to the Fare Collection implemented at Dublin Bus and for multimodal fare products.
Dublin has a population of 1.2 million people, and the broader metropolitan area population is about 1.6 million.
Public transport in Dublin consists of the following:

- Urban bus services.
- Tram/light rail ("Luas," 2 lines, implemented in 2005).
- Urban commuter rail (DART, 1 line, renovated in 1984).
- Suburban commuter rail (multiple services sharing the mainline tracks).
- Outer suburban/hinterland bus services.
- Urban buses are the main means of public transport, providing Governorate-wide coverage and carrying more passengers than the other public transport modes combined.

The public transport mode share is low, although this varies greatly across metropolitan areas. Public transport has a relatively high modal share for trips entering the central area during the peak hours (>50% on some corridors). This quickly tapers off within a distance from the center. Private cars are the dominant mode of transportation outside the center, and they are used for suburban and peripheral travel. Cycling and walking have low mode shares despite being favoured in policy terms. Taxis are deregulated, plentiful, relatively expensive, and have a low travel market share.
Plans for Metro and additional LRT/tram are well advanced, although the economic crisis in Ireland has made their implementation uncertain and BRT may be considered an alternative. These policy issues and investment decisions are likely to be determined in 2011-12 and will have a major impact on the modal balance in Dublin.
The primary means of travel demand management is parking control, with the strongest parking control in the central areas and in suburban hubs. This is primarily based on dissuasive pricing mechanisms and, to a lesser extent, on quantity control.

[24] https://www.ssatp.org/sites/ssatp/files/publications/Toolkits/Fares%20Toolkit%20content/case-studies/dublin-ireland.html

A.3. Water and Wastewater

A.3.1. WW1 – Water Distribution Network Upgrading

Project Aim	Status	Impact / GHG reduction	Possible Location
Increasing the efficiency of drinking water networks and improving the level of service by reducing Non-revenue water (NRW) and replacing old asbestos pipes. NRW is an important topic for drinking water companies, as it influences the financial sustainability, serviceability, and the management of precious water resources. Implementation of NRW strategy will enhance and support the sustainable water management plan as follows: • The reduction of physical loss helps increase the supply without investing in new water supply infrastructure or without limiting water usage; • Reduction of leakage helps reduces the amount of water to be supplied. This reduces the operation cost, such as electricity and chemicals used for treatment and disinfection; and • By reducing illegal connection and metering errors, it becomes possible to increase the amount of billable water, and thus increase revenue. The proposed project for reducing NRW & water losses in water pipes, replacing old customer meters, and developing a system for monitoring and controlling drinking water networks is planned to reduce losses from over 24% to at least 21%.	AWCO has implemented 2 projects related to District Meter Zoning which should be expanded upon.	The GHG reduction in the context of NRW focuses on minimising the energy consumption associated with treating and distributing water that ultimately does not reach the consumer. GHG reductions can be achieved in the following ways: • Energy Efficiency: By reducing NRW, the amount of energy required for water treatment and distribution decreases, therefore leading to lower GHG emissions as a factor of energy production; • Resource Optimisation: Minimising NRW means optimising the use of water resources and the associated energy inputs, thereby reducing the overall environmental footprint, including GHG emissions; and • Climate Resilience: Efficient water management, including reducing NRW, enhances climate resilience by ensuring that water resources are used more effectively and sustainably. This resilience helps mitigate the impacts of climate change on water availability and quality, indirectly contributing to broader climate change mitigation efforts.	Reducing NRW in 10 DMZ areas within Alexandria. Governorate wide (Including; Ibrahemia - Moharam beik - Merghm - Qabari - Nozha - Agami - Borg Alarab - North coast - Zohor -Petrochemicals).

Project Description

Identification of issues and Prioritisation:
The key to developing a strategy for management of NRW is to gain a better understanding of the reasons for NRW, and the factors which lead toits occurrence. Component of NRW include illegal connections/high unauthorised water use, absence of water meters, and poor-quality infrastructure with high leakage levels (old pipeline).
Priority activities include:
Identification of illegal connections and reduction of illegal connections, check of physical losses, awareness program, and structuring of billing system.
For the purpose of accurately calculation of losses and NRW a Water Audit is proposed to be conducted. The scope of work will involve assessment of existing water supply system, conducting water audit proposal for coverage of gap and detail project report for SCADA system.
SCADA System: A SCADA (supervisory control and data acquisition) system is an architecture used in industrial settings to manage, monitor, and control processes, machines, and plants. The SCADA system in first phase should be installed for monitoring and water at water source, treatment plants, water distribution rising mains, ground service tanks and feeder mains. The system will provide live monitoring of water consumption, flow rate pressure etc. This will help identify the location of water loss and area of high demand.

Regular monitoring for Illegal Connections and Citizen Involvement: Illegal connections involve the physical installation of a connection to water distribution pipelines without the knowledge and approval of the municipality. Surveys should be undertaken to identify these, apply appropriate repercussions to those who connect to the network illegally and subsequently install legal connections to ensure they are properly metered and charged for the water that is used.
Smart Metering: Currently the majority of building and household water meters across the City use old mechanical technology, many of these are disabled while others take incorrect readings. Therefore, these would be replaced by smart prepaid meters and implemented to provide 100% coverage. This will help to monitor water use, increase collection of water fees and therefore revenue for the water company.
Upgrading the water distribution network, to minimise leakage including the replacement of old asbestos pipes to mitigate health risks and improve the durability of the system. The investment includes:

- Implementation of advanced leak detection technologies to identify and repair leaks in the water supply network, thereby reducing NRW and improve the efficiency of the network. The scope including reducing NRW in 10 DMZ areas within Alexandria Governorate (Ibrahemia - Moharam beik - Merghm - Qabari - Nozha - Agami - Borg Alarab - North coast - Zohor - Petrochemicals). Reducing NRW & water losses, reducing leaks in water lines, replacing old customer meters, and developing a system for monitoring and controlling drinking water networks. It is planned to reduce losses from 24% to 21%;
- Upgrade of the water supply network in areas suffering from low pressure and low water velocities by installing larger diameter pipes and pressure-boosting stations. This would improve water pressure and flow rates and reduce the risk of pipe breakage due to increased pressure. This involves first assessing then potentially replacement elements of the existing asbestos pipe network to UPVC with lengths of up to 175 km and diameters of 100-300 mm within Alexandria Governorate;
- Upgrading and replacement of old pump stations to meet the urban demands (137 pumps for (3) WTP (Manshia 1 - Alseyouf - Sharqi) and (12) pressure boosting stations);
- Completion of 2 additional District Meter Zones;
- Smart customer meters: roll out of smart meters to enable improved billing and understanding of customer water use.
- Implementing the SCADA system within (14) pressure boosting stations pumping stations; and
- Development of drainage network (linked to Action CR2 Sustainable Drainage)

Key Considerations

Sustainable water management involves several key elements:

- it requires the use of technological innovation to adapt to changing water patterns and manage water resources effectively.
- it involves maintaining a balance between water demand and supply.
- sustainable water management focuses on the avoidance of over-extraction of freshwater supplies, improvement of water quality, and the identification of alternative water resources.

Additionally, it requires the implementation of water conservation strategies such as limiting consumption, reuse and recycling, pollution prevention, and smart monitoring of distribution networks.
Furthermore, sustainable water management emphasises the need for integrated water resource management and policy changes to protect and allocate water resources. Finally, it recognises the importance of considering local conditions, social systems, cultures, and historic path dependencies in water management practices.

This action complements the proposed sustainable drainage project and implementation of the two projects will require careful planning and coordination.

Implementing Agency	Stakeholders
Ministry of housing, utilities and urban communities	Alexandria Governorate AWCO

CAPEX	OPEX	Potential funding sources	Timeframe for Implementation
€ 26,000,000 EGP 1,381 million	10-15 % Of CAPEX	Multilateral Development Banks (MDBs) Government Private finance (charging companies, etc)	Short term (1-3 years)

Prerequisite steps for Implementation

- Establish the project team and focal point within Alexandria Governorate and AWCO;
- Conduct a feasibility study to identify the full needs and prioritise a list of potential projects;
- Develop designs and study scope, issue Request for Quotation and submission of proposals by interested parties;
- Review of proposal and issue of contract; and
- Launch and monitor project development and performance.

Social considerations (Gender and Inclusion)	Smart considerations
The action would lead to improved water quality and access to potable water via safe connections, benefitting vulnerable residents, for example, people with disabilities and those suffering from long term illnesses.	The action presents several opportunities to integrate smart components, including: • **Acoustic sensors** have proven to be invaluable tools in the fight against water leaks, for example. These devices detect leaks by listening for the distinct sound patterns created when water escapes through pipes or infrastructure. These sensors can be strategically placed throughout a water distribution system and when anomalies are detected, they pinpoint the location of potential leaks. The real-time monitoring capability of acoustic sensors allows for prompt response and intervention, minimising water loss. • **Pressure and flow sensors** can further help with optimising the piped water networks across the City. Such sensors can help to provide insight into water consumption patterns, optimise water resource allocation and enable more precise billing based on actual usage of water. • **Smart meters** have become integral components of modern water management systems. These devices provide real-time data on water usage, allowing consumers to monitor their consumption patterns. In the event of abnormal usage, which may indicate a leak within a property, smart meters can alert homeowners or businesses, prompting swift action to address the issue. By empowering consumers with information, smart metering contributes to a culture of water conservation. • Potential for **Artificial Intelligence (AI)**, currently making significant strides in enhancing water leak detection through advanced analytics. Machine learning algorithms can analyse vast amounts of data, including flow rates, pressure variations and historical usage patterns. By establishing baselines and identifying deviations, AI systems can predict potential leaks before they escalate. This proactive approach enables water utilities and municipalities to take preventive measures, reducing the impact of leaks on water infrastructure.

A.3.2. WW2 – Small Scale Desalination Plants

Project Aim	Status	Impact / GHG reduction	Possible Location
To implement small-scale desalination plants with the aim of helping to diversify water sources and reducing dependency and pressure on traditional freshwater supplies.	The project has been prioritised by the Governorate and AWCO.	Implementing energy recovery devices, such as pressure exchangers in reverse osmosis systems, can capture and reuse energy from the desalination process, low-energy membranes for reverse osmosis and utilising smart sensors and automation technologies to optimise the desalination process reducing overall energy consumption. Incorporating renewable energy production would further GHG reductions and is considered further below. However, the implementation of this depends on the availability of land at the allocated sites.	Land has been identified and allocated although the specific locations will need to be identified as part of the feasibility stage of the action development.

Project Description

As identified by the National Level Programme, Alexandria requires an additional two desalination plants with a capacity of 50,000 m3/day each in order to increase the availability of water and fulfil growing demands across the City. Therefore, this action considers the investment for the development of these two plants. Other options could include one desalination plant with 100km3/d capacity or a phased construction of 50km3/d extending to 100km3/d in the future.
For full GhG emissions offset, a solar PV system of at least 30 MWp size is required (based on assumed SWRO energy use of 3 kWh/m3). This could be achieved based on the new regulations of Egypt ERA Circular 2 of 2024[25] regulating private to private renewable energy agreements. Alternatively, a smaller rooftop system of 100 kWp can be assumed which would cover no more than 0.3% of the plant's annual electricity use.

Priority activities as part of Action:

- **Plant siting study**: confirmation of suitable locations for intake and brine discharge and the plant(s), taking account of marine conditions and environment (see below), ground conditions, visual impact and availability of power and other logistics.
- **Financial sustainability plan and policies**: desalination is generally more costly than other sources of water and a plan will be required to ensure it is as cost-effective as possible but also to ensure that water use tariffs (and potentially other income) are sufficient to make the plant financially viable.
- **Phasing**: consideration will need to be given to phasing of the plant(s) and whether core elements (such as the marine works) should be designed for future expansion. Consideration should also be given to siting all of the desalination in one location with phased development of 50,000m3/d and an additional 50,000m3/d to be added at a later stage.
- **Power supply**: identification of suitable power sources and procurement strategy e.g., if renewables are to be used whether they will be drawn via the grid or a dedicated supply.
- **Role of the private sector and enabling environment:** a decision will need to be made about the approach to procurement and the operating model and how to ensure it is a success. Desalination plants are often procured using design, build, finance, operate (DBFO) or build-own-operate-transfer models. These can bring operational expertise and efficiency. However, they also require consideration of appropriate safeguards and enabling factors (guarantees etc).
- **Marine works study:** the design (length, location, anti-entrainment etc) of the intake and brine discharge will be a key component of the project development. Surveys and modelling will be required to refine these.

[25] https://egyptera.org/en/Download/journal/2024/2_2024.pdf

Implementing Agency	Stakeholders
Ministry of housing, utilities and urban communities	AWCO

CAPEX	OPEX	Potential funding sources	Timeframe for Implementation
€ 50 million - desalination plants (EGP 2,656.5 million) The CAPEX for a solar PV of at least 30MWp is estimated to be in the range of € 16.5 million (500 €/kWp). (EGP 877 million) The CAPEX for a smaller system of 100 kWp is estimated to be in the range of € 75,000 (750 €/kWp).	€ 5.5 to 7.3 million €/year (0.3 to 0.4 €/m3)– desalination plants € 300,000 to 450,000 €/year (15 €/kWp/Year) for a 30 MWp solar PV plant 1000 €/year (10 €/kWp/Year) for small rooftop system.	Multilateral Development Banks (MDBs) Government Private finance/PPPs	Short term (1-3 years) (Note: potential for this project to be implemented in the short-term depending on maturity – to be confirmed) Medium-term (3-5 year) (possible implementation)

Social considerations (Gender and Inclusion)	Smart considerations
Inclusive hiring practices can prioritise women, persons with disabilities, and marginalized communities, supported by tailored training programs. Facilities should be physically accessible, with policies fostering gender equity and anti-discrimination. Engaging diverse stakeholders in the planning process ensures the needs of underserved groups are addressed. These measures promote equitable employment and long-term socio-economic benefits. Moreover, once in operation the plants will increase the amount of potable water entering the network and therefore improve access to water to residents of Alexandria considerations should be made for prioritising access to clean water for underserved communities	Smart considerations in the context of desalination plants involve: • Integrating advanced technologies and data-driven approaches to optimise efficiency, reduce costs, improve sustainability, and enhance operational flexibility. • Deploying Internet of Things (IoT) devices and sensors to monitor key parameters such as water quality, flow rates, pressure, and energy consumption in real-time and Utilising data analytics and machine learning algorithms to analyse operational data and optimise desalination processes for efficiency and performance are the key smart considerations for desalination plants. Data collection and monitoring will be key to facilitate sustainable management and optimise the operation of the plant. The data will be collected can only be shared witing the AWCO due to current regulatory restrictions.

A.4. Energy

A.4.1. E1 – Sludge to Energy

Project Aim	Status	Impact / GHG reduction	Possible Location
Rapid urbanisation has substantially increased the quantity of liquid waste in municipalities and has simultaneously engendered massive investments in wastewater conveyance and treatment. This increase in the number of WWTPs has generated a sharp rise in the volume of sludge, the byproduct of the treatment process. While the pollution is a serious local environmental problem, sludge treatment is also a valuable global opportunity to capture and reuse the considerable potential energy and reduce greenhouse gases otherwise emitted during the treatment process. Alexandria needs effective and sustainable solutions for sludge disposal.	ADSCO has identified land for the development of the facility	The facility would help to significantly reduce greenhouse gas emissions compared to incineration and landfill; The biochar produced during the treatment process will be used as a soil enhancement in planting in total; the mature trees that grow from these saplings will eventually accumulatively sequester an additional millions metric tonnes of CO_2e.	Al Ameriyah WWTP

Project Description

The Al Ameriyah WWTP was recently upgraded and there are currently plans to develop a Sludge to Energy Facility. This action is an investment to develop the facility, which will additionally improve the environmental conditions of the area around site 9N which was previously used for sludge dewatering purposes.
Sludge digestion refers to Anaerobic Digestion (AD) of municipal sewage sludge. The process consists of a primary mesophilic anaerobic digestion stage, followed by an unheated secondary digestion stage. Biogas produced through correct operation of the AD plant may be utilised for process heat requirements through boilers or through combined heat and power (CHP) plant.

Technical Description

The project aims to build a sludge treatment unit at the East Alexandria WWTP. This type of unit would be the first in Egypt outside Cairo and could act as a catalyst by encouraging the Government to create similar units nationwide. The project contracting authority is the Construction Authority for Potable Water and Wastewater (CAPW), the public implementing agency under the supervision of the Ministry of Housing, Utilities and Urban Communities.

Context:

Alexandria is the 2nd largest city in Egypt, with a total population of some 5 million inhabitants. The City has several WWTP. The largest is the East Alexandria WWTP, which has a treatment capacity of 800,000 m^3 a day. The sludge produced by the East Alexandria WWTP is currently subject to a dewatering process, but with no treatment. The sludge is transported by truck 45 km away to a landfill called “9N”, which is located in Nagaa Abou Bessissa in southwest Alexandria. This landfill, which was commissioned in 1997, gives rise to numerous complaints by the surrounding population because of the nuisances it causes (odours, insects, snakes). The “9N” landfill will soon reach saturation point.
With no alternative solution, the sludge produced by the East Alexandria WWTP will need to be transported to a site even further away, located at 70-80 km from the plant.

Description:

The project aims to build a unit to treat sludge through anaerobic digestion (also known as methanisation) at the East Alexandria WWTP. This unit will be built on existing empty land covering an area of 12 feddans (approximately 50,400 m^2), which is located inside the plant, and will include a new sludge thickening reservoir, digesters, gasometers, as well as a CHP unit. The aim of the project is to reuse the sludge produced by the plant in order to generate electricity and incomes. The project’s objectives are:

- from an environmental perspective, to reduce the impact of wastewater treatment, including reducing emissions;
- from an economic and financial perspective;

- from a social perspective, minimise nuisances for people living close to the plant and current landfill.

Impacts:

- 30% to 35% reduction in the quantity of sludge produced.
- Electricity generation (between 110,000 and 160,000 kWh a day) thanks to the biogas produced by the sludge treatment, allowing the plant to reach a 60-70% level of self-sufficiency in electricity.

Key Considerations

Implementation of this project will require:

- **Sludge quality and quantity assessment**: the quality and quantity of current sludge will need to be assessed and confirmed as well as potential future sludge generation. This is the feedstock for the process, so it is a vital input to the project development and feasibility
- **Bioresource strategy**: the project should sit within a comprehensive and coherent bioresource strategy, encompassing generation, transport, valorisation and disposal to ensure that it fits within a long-term plan and will bring sustainable benefits. This should take account of municipal waste streams.
- **Technology assessment**: using the sludge quality and quantity data, an assessment of the technology options should be carried out to refine the project definition.
- **Market assessment**: this is a vital component of project development, to confirm routes to market (and potential revenues) for the products such as biochar and energy production.
- **Site assessment**: it will be important to consider and confirm the optimal location for the facility taking account of site constraints, transportation costs and end uses.
- **Financial assessment:** a study should be undertaken to assess and maximise the financial returns of the project, examining ways to generate revenues or savings and ensure that the project is financially viable.
- **Procurement approach**: there are a number of ways to procure the solution. It will be useful to engage with potential suppliers and consider options ranging from simple design & build to DBFO for example, noting that many suppliers have their own proprietary solutions affecting which can affect whether performance specifications are an appropriate way to procure.

Implementing Agency	Stakeholders
MoHUUC	MoERE, ADSCO

CAPEX	OPEX	Potential funding sources	Timeframe for Implementation
€ 30,000,000 EGP 1,594 million	8-10 % Of CAPEX	Multilateral Development Banks (MDBs) Government Private finance/PPPs	Short term (1-3 years)

Prerequisite steps for Implementation

1. Conduct a detailed sludge assessment
2. Conduct a feasibility and ESIA studies
3. Providing space inside WWTP and design studies
4. Tender documents

Social considerations (Gender and Inclusion)	Smart considerations
During implementation, the project should incorporate best practices for environmental management, ensuring air and water quality are protected. It will also create local job opportunities, prioritising the inclusion of marginalised groups through accessible training and employment initiatives. In its operation, the facility should utilise state-of-the-art filtration and energy recovery technologies to minimise environmental impact, while actively involving the community in monitoring and engagement to ensure transparency and inclusivity.	The main smart component of the following action involved the use of **smart sensors** within the sludge to energy facility to: • **Ensuring safety** as a top priority both for employees and customers to improve health outcomes. • **Prevent pollution and minimise their impact on the environment**. • **Increased efficiency** by collecting data on energy production/consumption and utilisation rates associated with the use of sludge, energy production can be optimised. • **Predictive maintenance** to increase efficiency, reduce waste, extend equipment life spans, etc. helping the facility to maximise the value of their equipment and prevent key systems from going offline due to breakdowns.

Related Case Study: Sludge to resource project, Gabal el Asfar WWTP, Cairo

A sludge to resource project has been in place in Gabal el Asfar WWTP in Cairo since 2018. The electricity generated is understood to cover approximately 85% of the power requirements in the 500,000 m^3/day WWTP, with the digestate being dewatered and dried before use.

A.4.2. E2 – Solar Plant

Project Aim	Status	Impact / GHG reduction	Possible Location
The primary objectives of a solar PV plant is to convert sunlight into electricity efficiently and sustainably. Here are some specific objectives of a solar plant: **Electricity Generation:** The main purpose of a solar PV plant is to generate electricity by converting sunlight into a direct current (DC) electrical energy. Other equipment converts the electricity to alternating current (AC) so it can be used in electrical equipment or connected into an electrical network. **Renewable Energy Production:** Solar PV plants aim to harness the abundant and renewable energy resource of sunlight to produce clean electricity without depleting finite resources like fossil fuels. **Environmental Benefits:** Solar PV plants help in reducing greenhouse gas emissions and mitigating climate change by producing electricity without the release of harmful pollutants. **Energy Independence:** By generating electricity on-site, solar PV plants can help reduce dependence on traditional energy sources and stabilise energy costs. **Cost Savings:** Solar PV plants aim to provide cost savings over the long term by reducing electricity bills and offering a reliable source of energy. **Grid Independence:** Solar PV plants can provide power in remote areas or during grid outages, increasing energy resilience and independence. **Sustainable Development:** Solar PV plants contribute to sustainable development by promoting the use of clean energy sources and reducing the environmental impact of electricity generation.	ADSCO already implemented small solar farm.	Solar energy technologies represent one of the least carbon-intensive means of electricity generation. Solar power produces no emissions during generation itself, and life-cycle assessments clearly demonstrate that it has a smaller carbon footprint from "cradle-to-grave" than fossil fuels.	9N Site Implementing solar energy systems to rationalise energy for (4) WTP (Manshia 2 - Alseyouf - Maamoura - Nozha) and (1) (Abo quir) pressure booster station.

Project Description

This action is an investment to upscale the existing small solar farm developed on site 9N - previously used for sludge treatment. In addition, implementing solar energy systems to rationalise energy for four water treatment plants (Manshia 2 - Alseyouf - Maamoura - Nozha) and one pressure booster (Abo Quir station). The mentioned project aims to improve local environmental quality while producing about 1.5 million kilowatt-hours of renewable energy annually leading to a reduction of around 670 thousand tonnes of CO_2e annually.

The project site area is 75 ha which is equivalent to 750,000 m2. If only 80% of this area can be used to construct a new solar PV plant, then based on an assumed ground coverage ratio of 0.45 (to account for inter rows spacing required to avoid self-shading), approx. 96,500 modules (assuming Jinko 650 W NEO modules are used) can be installed which is equivalent to a 60 MWp solar PV system.

Key Considerations

Key considerations for a photovoltaic (PV) project, which involves the installation and operation of solar panels to generate electricity from sunlight, include:

1. **Site Selection:** Choosing the right location is crucial for maximising solar energy generation. Factors to consider include solar irradiance levels, shading from nearby structures or vegetation, land availability, proximity to grid connection points, and local regulatory requirements.
2. **Technology and System Design:** Selecting appropriate PV technologies (e.g., monocrystalline vs. polycrystalline panels, thin-film technologies) and designing the system layout to optimise energy production. Considerations include panel orientation, tilt angle, tracking systems (if applicable), and balance of system components (inverters, mounting structures, and wiring).

3. **Financial Feasibility:** Conducting a thorough financial analysis to assess the project's economic viability. This includes estimating initial investment costs, expected electricity generation, operational and maintenance expenses, financing options (e.g., loans, grants, tax incentives), and potential revenue streams (e.g., electricity sales, feed-in tariffs, renewable energy certificates).
4. **Regulatory and Permitting Requirements:** Understanding and complying with local, state/provincial, and national regulations related to PV installations. This includes zoning laws, building codes, environmental permits, grid connection requirements, and interconnection agreements with utilities.
5. **Resource Assessment:** Conducting a comprehensive solar resource assessment to accurately predict energy production potential. Factors include historical weather data, solar irradiance levels, temperature coefficients, and degradation rates of PV modules over time.
6. **Grid Connection and Integration:** Ensuring compatibility with the local electrical grid and complying with grid connection requirements. This involves assessing grid capacity, voltage levels, grid stability considerations, and potential impacts on grid infrastructure.
7. **Environmental and Social Impact:** Assessing potential environmental impacts (e.g., land use, wildlife habitat, visual aesthetics) and implementing measures to mitigate adverse effects. Engaging with local communities and stakeholders to address concerns and promote acceptance of the project.
8. **Operational and Maintenance Plan:** Developing a plan for ongoing operation and maintenance to ensure optimal performance and longevity of the PV system. This includes monitoring energy production, cleaning panels, inspecting equipment, and scheduling repairs or replacements as needed.
9. **Insurance and Risk Management:** Securing appropriate insurance coverage to protect against risks such as equipment failure, damage from extreme weather events, and potential liability issues. Developing risk management strategies to minimise operational disruptions and financial losses.
10. **Long term Sustainability:** Considering the long-term sustainability of the PV project by incorporating considerations such as panel recycling options, lifecycle assessments of environmental impacts, and potential for future technology upgrades or expansions.

Implementing Agency	Stakeholders
MoHUUC	MoERE

CAPEX	OPEX	Potential funding sources	Timeframe for Implementation
€ 30,000,000 EGP 1,594 million	€ 600,000 -900,000 per year EGP 27 – 52 million	Multilateral Development Banks (MDBs) Government Private finance/PPPs	Short term (1-3 years)

Prerequisite steps for Implementation

Implementing a photovoltaic (PV) project involves several prerequisite steps to ensure successful planning, development, and execution such as:

1. **Feasibility Study:** Conduct a feasibility study to assess the technical, economic, and regulatory viability of the PV project. This study should include a site assessment, solar resource evaluation, preliminary system design, financial analysis, and identification of potential risks and challenges.
2. **Site Selection and Assessment:** Identify and evaluate potential sites for PV installation based on criteria such as solar irradiance levels, shading analysis, land availability, proximity to grid connection points, and regulatory considerations. Conduct a site visit to assess ground conditions, accessibility, and any environmental or permitting constraints.
3. **Financial Analysis and Funding:** Perform a detailed financial analysis to evaluate the project's financial feasibility and potential returns on investment. This analysis should consider upfront capital costs, operational expenses, expected revenue from electricity sales or incentives (e.g., feed-in tariffs, renewable energy certificates), financing options (e.g., loans, grants, tax incentives), and payback period.
4. **Regulatory and Permitting Requirements:** Understand and comply with all regulatory requirements and obtain necessary permits for PV installation and operation. This may include zoning approvals, building permits, environmental assessments, grid connection agreements, and interconnection agreements with utility companies.
5. **System Design and Engineering:** Develop a comprehensive system design based on the site assessment, solar resource data, and project goals. This includes selecting PV technologies (e.g., types of solar panels, inverters), determining system capacity and configuration, designing electrical layouts, and considering factors such as panel orientation and mounting structures.

6. **Grid Connection Planning:** Coordinate with local utility companies to assess grid connection feasibility and requirements. This involves evaluating grid capacity, voltage levels, interconnection standards, and any necessary upgrades or modifications to ensure reliable and compliant grid integration.
7. **Procurement and Vendor Selection:** Procure PV equipment and select vendors or contractors based on competitive bidding processes, quality assurance, track record, and cost-effectiveness. Develop procurement contracts that outline responsibilities, delivery schedules, warranties, and performance guarantees.
8. **Environmental and Social Impact Assessment:** Conduct an environmental and social impact assessment to identify potential impacts of the PV project on the environment, local communities, and stakeholders. Implement measures to mitigate adverse effects and engage with stakeholders to address concerns and promote acceptance.
9. **Risk Management:** Identify and assess potential risks and develop risk management strategies to minimise their impact on project implementation. Risks may include technical risks (e.g., equipment failure), financial risks (e.g., fluctuating energy prices), regulatory risks, and external risks (e.g., weather-related disruptions).
10. **Project Management and Implementation Plan:** Develop a detailed project management plan that outlines timelines, milestones, responsibilities, and resource allocation. Coordinate activities among stakeholders, monitor progress, manage budget and schedules, and implement quality control measures throughout the project lifecycle.
11. **Operations and Maintenance Planning:** Develop an operations and maintenance plan to ensure ongoing performance and reliability of the PV system. This includes scheduling regular inspections, monitoring energy production, cleaning panels, conducting preventive maintenance, and responding to any issues or emergencies promptly.

Social considerations (Gender and Inclusion)	Smart considerations
The solar plant project will prioritise workforce diversity by promoting gender equality in the development, construction, and operation of photovoltaic (PV) systems, encouraging equal opportunities for women in technical and managerial roles traditionally dominated by men. It will offer accessible training and capacity-building programs for both men and women, ensuring equitable access to education and skill development in PV technology. The project will support women entrepreneurs and small businesses by providing opportunities within the PV value chain, including procurement, subcontracting, and service provision. Community engagement will be a key focus, ensuring both women and men are equally consulted and involved in decision-making processes regarding project planning, implementation, and the distribution of benefits.	There are several opportunities for smart technology implementation focusing on operation and maintenances as well as monitoring technology: • **Data collection and monitoring** through the implementation of **smart sensors**, including energy production/consumption, temperature and general weather conditions, to help optimise maintenance of solar plant and optimise electricity production. • Beyond this there are opportunities to explore **emerging technologies**, such as, **bifacial panels, trackers for optimising panel orientation**, and **energy storage solutions** to enhance energy yield and grid integration. • Moreover, when implementing the action, **sustainable practices** should be explored, such as using **recycled materials, reducing water consumption during panel cleaning, and promoting biodiversity-friendly landscaping** around PV installations.

A.4.3. E4 - Automated Solar Powered Street Lighting for Public Places and Roads

Project Aim	Type of Intervention / Status	Impact / GHG reduction	Possible Location
The primary goal of this project is to reduce grid energy consumption and contribute to the governorate's sustainability targets by reducing emissions. By leveraging solar photovoltaic (PV) energy and automated control systems for streets lighting.	Intervention: This project represents energy-efficiency investment. It involves the developing solutions of renewable energy sources and smart technologies to enhance the governorate's infrastructure and reduce its carbon footprint in the Governorate. Status: The new corridors being implemented in east and west of Alexandria where electricity network infrastructure doesn't exits require installation of PV powered lighting systems.	Given the assumptions of up to 60-200 W per pole and about 4000 (2*2000) units to cover the two way- 5/6 lanes (3 lanes main, 2 lanes service for each direction) 60 km corridor in east and west of Alexandria with an operation time of 12 hours, the project is expected to achieve a GHG reduction of 1,460 t CO2e / year.26 Emissions: 4000 * 200* 12 /1000*365= 3,500 MWh/Year 3,500 * 0.4167/1000 = 1,460 ton- CO2/Year	Along the new corridors of east and west Alexandria which connect the desert road with both Borg Al Arab and East Alexandria. In addition, the project is applicable to main roads and public spaces across the Governorate. It can also be implemented within residential compounds, depending on the availability of sufficient space for the installation of solar-powered lighting units. The project also holds potential for replication in other cities and governorates.

Project Description

The proposed project aims to use renewable energy source to power the road lighting of the new west and east corridor to cover a distance of 60 km in total in which electricity network infrastructure doesn't exist. Each unit, equipped with a 60-200 W solar panel, will be a solution for road lighting eliminating the need for extensive and costly infrastructure such as transformers and cables.

Technical Description:

The project involves the installation of solar PV streetlamps equipped with a 12-hour storage battery (0.85-2.8 kWh27). The design of the system needs to be efficient and secure to prevent theft and vandalism. The solar system can be centralised to reduce maintenance costs and complexity, but in this case, individual battery powered units are proposed for the corridors being newly installed and on boarders of the Governorate.

The project also includes the installation of sensor and control units on an estimated 3000 poles in the proposed corridors. These units will enable the automated control of the lighting system, ensuring optimal use of energy and extending the lifespan of the equipment.

Key Considerations:

The successful implementation of the project requires careful planning and consideration of several factors:

Maintenance: A proper maintenance scheme is crucial to ensure the longevity and efficiency of the solar-powered lighting units.

Lumens Requirement: The lighting units should meet at least 75% of the lumens required for adequate illumination.

Reliability: The operation of the lighting units should be highly reliable, with more than 90% of the poles operating effectively.

Local Market Participation: At least 25% of the capital expenditure, including implementation, should be sourced from local markets to support local businesses and economy.

Monitoring and Strategy Implementation: Careful monitoring and implementation of effective operational strategies are essential for the success of the project.

[26] Based on May 2023 grid emissions factor reported by Egypt ERA https://egyptera.org/ar/download/Report/Elec_ob_May2023.pdf

[27] Assuming a charge-discharge cycle efficiency of 85%

Implementing Agency	Stakeholders
The Governorate or The General Authority for Roads and Bridges will be responsible for the implementation of the project.	The stakeholders involved in this project include the Electricity Distribution Company, suppliers/installers, and Operations and Maintenance (O&M) service providers.

CAPEX	OPEX	Potential funding sources	Timeframe for Implementation
The capital expenditure (CAPEX) for street lighting is estimated to be 2000 EUR per KW including battery lighting sensors and installation. Total 1.6 million Euros (600 kW)	The operational expenditure (OPEX) for street lighting is estimated to be 10% of the CAPEX	Multilateral Development Banks (MDBs) Government Private finance/PPPs	The project is expected to take approximately 14-24 months for full implementation. This includes planning, design, pilot testing, full-scale installation of 3000 lighting units equipped with batteries and control sensors, and post-implementation maintenance training.

Notes on cost estimate

OPEX for maintenance and battery replacement is assumed to be approximately 10% of total CAPEX, per year.

Prerequisite steps for Implementation

Before the project can be implemented, several prerequisite steps need to be taken:

- **Mapping and Prioritisation**: Identify and prioritise locations with sufficient space for the installation of the solar-powered lighting units.
- **Market Assessment**: Conduct a market assessment to understand the availability and suitability of the technology for this initiative.
- **Regulatory Approval**: Obtain necessary approvals and permits from relevant authorities.

Social considerations (Gender and Inclusion)	Climate adaptation mainstreaming	Smart considerations
The implementation of this project will not only contribute to energy efficiency and sustainability but also significantly enhance public safety, particularly for women. Adequate street/ road lighting is an important factor in improving safety and security, reducing the risk of accidents and crime, and promoting a sense of well-being among residents. Although Alexandria's Street lighting is generally good, this is not the case on the roads. New corridors and roads are not particularly well lit, this increases the risk of violence/crime and perception of fear in these areas, particularly affecting youths. The project will ensure that the benefits of improved lighting and spatial inclusion are equitably distributed across all sectors of the community. Furthermore, the project will aim to promote gender equality by ensuring women's participation in all stages of the project, from planning and implementation to monitoring and evaluation.	The solar PV systems and other technologies used in the project could be designed to withstand the impacts of climate change, such as heatwaves and extreme storms. This could involve using low temperature coefficient PV cells and module components, and mounting structures that can withstand higher winds.	The project will leverage smart technologies to enhance the efficiency and effectiveness of the solar-powered lighting systems. This includes the integration of fault detection and reporting systems to facilitate maintenance and ensure the longevity of the lighting units. Remote monitoring of the operational status of each pole will be enabled through wireless systems such as Zigbee, including mobile applications to help Operations & Maintenance personnel trace faulty poles. Furthermore, the poles could be integrated with other sensing capabilities to monitor traffic, air quality, providing valuable data that can be used to improve planning and management.

A.5. Solid Waste

A.5.1. SW1 – Solid Waste Study

Project Aim	Status	Impact / GHG reduction	Possible Location
To better understand and address not only current challenges and opportunities within the waste sector but also future, including related to new urban growth areas across the Governorate. The study will enable future interventions, ensuring that they are both technically feasible and economically viable, environmentally beneficial, and socially inclusive.	No development noted.	Solid waste management plays a significant role in greenhouse gas (GHG) reduction, improved air, water and soil quality through various practices aimed at minimising waste generation, promoting recycling and composting, and reducing methane emissions from landfills.	N/A

Project Description

Development of a study that will help understand and address not only current challenges and opportunities within the waste sector but also future, including related to new urban growth areas across the Governorate. Key components would include:

- **Waste market study** to determine current and future types and quantities of waste, so that facilities are designed tailored and distributed across the Governorate accordingly. By determining the types and quantities of waste, the Governorate can design facilities tailored to handle specific waste streams. This study also evaluates the economic viability of potential projects, guiding the selection of appropriate technology solutions based on the waste profile. Furthermore, it identifies environmental benefits, such as potential reductions in greenhouse gas emissions. From a regulatory perspective, this study is crucial for aligning interventions with the existing framework or pinpointing policy gaps that need addressing;
- **Strategy to Introduce Waste Hierarchy and Promote 'Zero Waste'**: emphasises the principles of waste hierarchy, prioritising waste prevention and reduction. By promoting 'zero waste' initiatives across commercial, industrial, and residential sectors, the Governorate can integrate systematic solid waste management planning. This strategy also aims to engage stakeholders, from businesses to residents, fostering a Governorate-wide commitment to sustainable waste practices and driving the transition towards a circular economy;
- **Waste Management Regulations and Recycling Initiatives**: To ensure compliance and promote recycling, the Governorate should enforce stringent waste management regulations. Large waste producers should be mandated to maintain comprehensive documentation and waste management plans. In industrial areas, a non-disposal policy should be enforced, coupled with the promotion of investments in recycling and waste reduction initiatives. This component also focuses on targeting the organic component of waste management within industrial zones;
- **Waste Sorting, Pre-treatment, and On-site Management**: Promoting waste sorting and pre-treatment practices is essential for efficient waste management. The Governorate should encourage on-site composting, especially in compounds, malls, and villas, focusing on the organic fraction of municipal waste. Additionally, there's a need to champion the use of reusable bags in retail sectors and advocate for reduced packaging material and the adoption of refillable green products in commercial areas; and
- **Integration of Informal Waste Pickers**: The invaluable role of waste pickers in the waste management processes, cannot be overlooked. Recognising and integrating their role ensures that waste management is inclusive and socially responsible. By leveraging the expertise of their community, the Governorate can enhance the efficiency of waste collection and recycling processes.

Implementing Agency	Stakeholders
Governorate	Private sector and informal waste pickers

CAPEX	OPEX	Potential funding sources	Timeframe for Implementation
€ 400,000 EGP 21.25 million	N/A	Multilateral Development Banks (MDBs) Existing solid waste management budget	Short term (1-3 years)

Social considerations (Gender and Inclusion)	Smart considerations
Workforce Diversity: Promote equal opportunities for women and marginalised groups in solid waste management jobs, including collection, sorting, recycling, and management roles. **Entrepreneurship and Livelihoods:** Support women and marginalised groups in establishing waste management enterprises, such as recycling cooperatives or composting initiatives, to create sustainable livelihood opportunities. **Accessibility:** Ensure waste collection services are accessible to all community members, including those with disabilities, elderly individuals, and residents in informal settlements or remote areas.	The action presents the exploration of the following smart technologies and considerations as part of the study: • **Route Optimisation** using GPS and real-time data analytics to optimise waste collection routes, reducing fuel consumption, emissions, and operational costs. This should be a priority when undertaking the study. • **Deploying smart bins** equipped with sensors to monitor waste levels and schedule pickups based on fill levels, optimising collection routes and reducing overflow. • **Automated Sorting** implementing robotic and AI-powered sorting technologies at Material Recovery Facilities (MRFs) to enhance sorting accuracy and increase recovery rates of recyclable materials. • **RFID** (Radio Frequency Identification) **Tracking** tags to track and trace recyclable materials throughout the sorting and recycling process, improving transparency and efficiency.

Appendix B. High level description of Actions to Inform Next Steps

B.1. Climate Resilience and Land Use

B.1.1. CR3 – EWS and Local Preparedness Plan

Description

This action relates to a study to update the existing local preparedness plan to include focus on climate risks and scope out the need for an Early Warning System. To ensure that the city is better prepared for extreme events and climate-related hazards, with a particular focus on reducing impacts on vulnerable groups, the existing the local preparedness plan will be updated with a focus on various hazards and civil emergencies (not considering fully climate risks) and established channels of communication and staff for emergencies.

Social considerations (Gender and Inclusion)

Ensure inclusive communication channels, such as accessible formats for persons with disabilities, and target outreach to women, elderly, and other vulnerable groups to ensure they are aware of and can act on warnings.

Next steps

- Review of existing local plan to understand hazards that are currently covered and key gaps (noting that climate hazards are not explicitly considered at present).
- Specific assessment of how the preparedness plan accommodates marginalised groups, and how this can be strengthened.
- Engagement with the Egyptian Meteorological Department to understand any ongoing plans for early-warning systems along the North coast and Delta, and what information could be available to the city of Alexandria. Based on understanding of this, define needs to support Actions in the local preparedness plan, outline the specific requirements of an EWS.
- Refresh the local preparedness plan to better incorporate climate risks.

Timeframe

Review of existing plan can start immediately, and the refresh of the plan and EWS scoping should be completed within 1 year. Development of an operational EWS would be a follow-on project and would be on a 1-3 year timeframe.

Implementation agency

Governorate, and Egypt Meteorological Department, Alexandria University

B.1.2. CR4 – Cool Street Design

Description

This action comprises retrofitting existing streets to enhance their greening and promote resilience against environmental, social and infrastructure challenges. This involves updating and modifying the street infrastructure to enhance cooling and permeability. Streets are quite often narrow and poorly designed with street vendors and parking blocking parts of the road. They are often congested and not safe for non-motorized transport (walking and cycling). Such roads contribute to the UHI e.g., through:

- a lack of vegetation, greenery and trees which would support shading and cooling,
- impervious surfaces (asphalt and concrete) that absorb and retain heat,
- traffic congestion, additional heat through vehicle engines and higher levels of air pollution, which have a compounding effect on heat, and
- narrow buildings can trap heat and limit natural ventilation through wind.

The action will help to transform selected street space in the city's heat hotspot areas to aid in reflecting heat from the sun back into the atmosphere limiting the absorption of heat by asphalt/concrete/dirt roads while also helping to develop a pedestrian environment that is passively cooled by increased greenery, access to water and shading. This includes streetscape enhancements integrated within transport sector investments in the urban core; however, this action comprises

investments focused on Al Ameriya and similar inland developments where heat stress will be more pronounced.

Social considerations (Gender and Inclusion)

Design streets that are accessible to all, including those with mobility challenges, while involving community input to ensure diverse needs, particularly for women, children, and elderly users, are reflected in the greening and infrastructure.

Timeframe

This action can start immediately and continue throughout the implementation period of the GCAP and beyond establishing it as required practice for redeveloping existing vulnerable areas and incorporating it in new developments.

Implementation agency

Governorate

B.1.3. LU1 – Mina El Basal/Mahmoudia Canal Development

Description

Minat El-Bassal was built around 1810, located near the end of the Mahmoudia Canal fronting the Western Harbor and next to the city centre. At the time, the district was a logistics hub which controlled the cotton industry of Egypt. Currently, Minat El-Bassal is one of the poorest districts in Alexandria, with high levels of unemployment, physical isolation, and poor infrastructure. The large historic warehouses, although in good structural condition, are abandoned and neglected. This action relates to the development of a study for the regeneration of Minal El Basal which would generate significant benefits for Alexandria. The project would create a mixed-use development in the heart of the city reducing the demand for out-of-town development, connecting with existing transport infrastructure, and expanding the tourist trail. Implementation of such a project could considerably enhance the attractiveness of the city and increase investment flows and job creation. Large urban regeneration projects around the globe have been very successful in integrating their industrial heritage as part of sustainable urban development strategies resulting in vibrant, resilient, and culturally rich environments. These cities are preserving their unique architectural and historical industrial identity, fostering a sense of place while stimulating economic growth, attracting tourism, and providing spaces for innovative businesses and community activities.

Social considerations (Gender and Inclusion)

Create affordable, mixed-use spaces with community consultation, ensuring housing and public areas are accessible to underserved groups, and prioritising safety and inclusivity in public space design for all genders and abilities.

Next steps

Preparation of a regeneration strategy and action plan which includes:

- Demand assessment for real estate and analysis of socio-economic conditions to understand possible uses
- Essential due diligence, such as land ownership considerations and priorities
- Multidisciplinary assessment to support the development of options and their evaluation for the site's regeneration, including environmental conditions, transport and infrastructure provision
- Development of vision for the area based on stakeholder engagement including community involvement, including development parameters and expected economic, environmental and social outcomes.
- Development of brief, including concept masterplan with financial and economic assessments to engage developers, investors and government entities for implementation.
- Funding strategy seeking to use both public and private resources. Significant funding can come from private developers and investors who are interested in commercial and residential development in the area, while the public sector can provide enabling infrastructure, incentives to attract developers and potentially take on a role for development through the provision of affordable housing following green principles.

Key considerations and development principles include:

- Prioritisation of inclusive development. The plan should address potential gentrification risks by preserving and creating affordable housing and ensure a diverse mix of housing and commercial options that cater to varying income levels.
- Ensuring sustainable certification (LEED/BREEAM) requirements for the redevelopment including renovating and repurposing of existing buildings with a core objective to reduce embodied carbon as far as possible.
- Converting underutilised land into public spaces serving the purpose of community spaces and passive cooling.
- Provision of a mix of residential offerings with additional uses including office, workspace, retail, leisure, and community facilities;

- New development should build on the opportunities presented in the area in terms of its existing industrial heritage, currently vacant land, proximity to the city centre and public transport nodes and canal-side settings;
- New buildings should offer a well-considered, contemporary, and distinctive design which is contextually responsive to the Minet El-Bassal's heritage in terms of the materiality and the scale and heights of the massing proposed. The public realm design should also celebrate the historic features of the neighbourhood as part of the place-making strategy;
- New development should also promote connectivity to the Mahmoudia Canal. These routes should be treated as key linkages with canal crossing points located in appropriate locations reflecting the principal pedestrian routes. As part of the placemaking strategy, a stepping-down approach to the development towards the Mahmoudia Canal could be considered to facilitate an open canal-side atmosphere;
- The new development should be a neighbourhood that is spatially integrated with the city centre, with enhanced north-south pedestrian and cyclist connections towards the city centre. Well, consider, high-quality and consistent public realm should be proposed along these connectors to provide attractive and easy-to-navigate routes;
- New buildings should be designed to support active streets, particularly along key public spaces and pedestrian routes. This may be in the form of ground floor active commercial uses when appropriate;
- A car parking strategy should be prepared with any new development proposal allowing the potential demand generated to be met. Off-site solutions should be considered subject to site constraints (i.e., heritage buildings); and
- The proposal should design the edge towards Al Bitash Street responding to the environmental conditions of this heavily trafficked road and considering the port to the west

Timeframe

Regeneration projects take considerable time for implementation. The study is expected to start in the short term and take a year to complete with development taking place over the next 5-10 years.

Implementation agency

it is understood that ownership of the site is currently with the Government of Egypt and specifically the Sovereign Fund who will also take forward the implementation of the project.

B.2. Transport

B.2.1. TR3 – Expansion of EV Charging Infrastructure

Description

The project aims to expand provision of EV charging infrastructure for private cars across the City. Existing private car EV charging stations are insufficient and need to be expanded. Alexandria has only four EV charging stations for private E-cars (two within the City and two on the outskirts, including Borg-Al-Arab). This action considers the potential for the private sector to invest in and provide EV charging points across the City and how the Governorate can facilitate this investment.

It should be noted that currently, Infinity EV is the main entity installing EV charging stations. They install them for free, with only a small portion of the tariff going to Infinity and the landowner.

Alexandria Governorate will confirm the proposed locations for implementing EVs for private car use based on land ownership and spaces available in the city.

Social considerations (Gender and Inclusion)

Ensure charging points are strategically placed in underserved areas, designed to be safe and accessible for women, persons with disabilities, and elderly people, with clear, easy-to-use payment systems.

Next steps

While this action is mainly for the private sector to initiate and implement, the Governorate has a key role to play including:

- propose locations for implementing EVs for private car use based on land ownership and spaces available in the City;
- Set out parking policies that can incentivise EV ownership through restricting use of spaces by non-EV vehicles;
- Provide incentives for the conversion of private sector minibuses to EV fleets through dedicating routes and bus stops.

Timeframe

A study to provide guidelines and regulations in the short term to enable implementation in the medium term.

Implementation agency

Private sector & Governorate

B.2.2. TR5 – Public Transportation Connection Between Al Ameriyah and Alexandria City

Description

This action is to invest in dedicated transport services (buses) between Alexandria City and the Al Ameriyah growth area. Currently, the two areas have limited mass transport options and people rely on private cars to commute between them.

Social considerations (Gender and Inclusion)

Design bus routes and stops with consideration for vulnerable groups, ensuring accessibility, safety, and gender-sensitive features such as well-lit stops and security measures to reduce harassment.

Next steps

This investment will form part of the Sustainable Urban Mobility Plan, which will consider beyond the connection between the two areas, high level requirements for park-and ride facilities, and last mile connectivity.
A dedicated study will then need to be conducted to:

- Assess the proposed principal bus corridors and define their routes and capacity required. This process must include public consultation regarding the final principal bus corridors.
- Identify park and ride facilities, multimodal hubs
- Optimise bus stations and introduce new ones as needed
- Consider the potential for EV buses and required charging infrastructure along the route and;
- Integrated ticketing.

Timeframe

A study in the short term to enable implementation in the medium term.

Implementation agency

APTA

B.2.3. TR6 – Implementation of the BRT Corridors

Description

The BRT is planned to run on two main corridors: the first along the Corniche Road and the second along the Mahmoudia axis. This investment will support the development of dedicated bus lanes, bus stops, and other infrastructure supporting the transport system. The introduction of a BRT system will contribute to environmental sustainability and offer a cost-effective solution for mass transit. This action will not only modernise the City's public transport system but also pave the way for a greener and more sustainable future.

An intelligent transport system (ITS) will be implemented, including real-time bus tracking, traffic management, and fare collection through smart cards or mobile apps. Implementing the system will require capacity-building programs to train the drivers, operators, and staff and to raise awareness about the benefits of the BRT system among the public.

Social considerations (Gender and Inclusion)

Incorporate feedback from diverse communities, ensuring BRT stations are accessible to all, with safety features and seating arrangements that consider the needs of women, children, and persons with disabilities.

Next steps

Before project implementation, a detailed study is required to address several key aspects, including

- dedicated lanes, bus stations and infrastructure requirements,
- grid capacity (grid impact study) in case of e-buses,
- vehicle procurement strategy,
- last-mile connectivity and multimodal hubs,
- integrated ticketing.

Timeframe

Detailed study to be developed in the short term with implementation in the medium term.

Implementation agency

APTA

B.2.4. TR7 – Replacement Services Needs Identification and Implementation

Description

Alexandria will benefit from considerable investments that are already underway to upgrading the Abu Qir Metro and the Al Raml Tram. LATRA has initiated a study and competition for the private sector to provide replacement services during construction phase. This action will look to plan and provide for similar services under future planned upgrades with a view of incorporating these services on a semi-permanent basis during seasonal peaks in the summer.

Social considerations (Gender and Inclusion)

The replacement tram and metro services should ensure accessibility for all, including people with disabilities and the elderly. Community engagement is vital, especially with women and vulnerable groups, to ensure services meet diverse needs. The project should include affordable fare structures and provide safe, secure travel, particularly for women and children.

Next steps

Implementation will follow a similar process to the one currently undertaken by LATRA conducting the study and securing private sector provider with services managed by APTA. Additionally, it would be beneficial to consider the following for any future studies

- Lessons learned from the provision of replacement services for Abu Qir Metro and the Al Raml Tram and in particular any additional traffic measures required;
- The opportunity to include incentives for services to focus on either CNG or EV buses, and requirements for implementation and charging infrastructure;
- The potential to establish these additional services on a semi-permanent basis to address high demand during seasonal peaks in the summer.

Timeframe

Detailed study to be developed in the short term with implementation in the medium term.

Implementation agency

APTA

B.2.5. TR8 – Metro 2 & Future Tram Upgrades

Description

In the long term, there will be need to further improve and expand the network to support modal shift as the population increases. There is currently an alignment study ongoing with the support of EBRD and EIB focusing on Alexandria Metro line 2. This is aimed to connect the coastal zone (phase 1) and future HSR station at Carrefour commercial zone (phase 2).

Additionally, there is potential to rehabilitate other tram lines and suburban services. This will support increasing restrictions on private vehicles, including potential restrictions and rerouting of freight related to industrial and port areas away from urban areas and rationalising minibuses routes.

Social considerations (Gender and Inclusion)

Include inclusive design practices like accessible platforms, gender-sensitive lighting, and dedicated spaces for people with disabilities, ensuring that transport options meet the diverse needs of the community.

Next steps

Following the completion of the alignment study there will be a requirement to prepare a feasibility study and preliminary design.

Timeframe

A feasibility study to be developed in the medium term for implementation in the long term

Implementation agency

MOT

B.2.6. TR9 – Developing a Green Corridor Under the Abu Qir Metro Viaduct

Description

With the upgrade of the Abu Qir Metro line, there is potential to develop a green corridor under and around the Metro viaduct with spaces and infrastructure for local communities and commercial uses enhancing social cohesion and provide job creation opportunities. An urban project led by the Governorate, and the private sector, which will be very beneficial to the local authorities and residents. The spaces under the viaduct and around metro stations could be used for community and commercial uses to enhance social cohesion and provide opportunities for new jobs. The project would have high visibility and a social, green impact, encouraging donors to support grant contributions for additional FS and design work. Enhance provision of social infrastructure with the opportunity for improving local livelihoods and increased provision of green and open spaces. Aligned with the sustainable drainage and cool street design proposed Actions, the available space can accommodate for potential uses to deliver multiple benefits such as covered spaces for street vendors and ensuring flood mitigation measures.

Social considerations (Gender and Inclusion)

Consult with local communities to ensure the green corridor design reflects the needs of vulnerable groups, incorporating safe, accessible pathways and spaces for recreation and social interaction for all.

Next steps

The project will require a feasibility and concept design study to identify the socio-economic characteristics of the area and potential users and beneficiaries, define potential uses including urban layout, social infrastructure and green landscaping and identify funding sources. The project could act as a social green impact investment opportunity encouraging donors to support contributions for both the design and implementation stages. A critical component of this work will be engagement of the local community to ensure inclusive design as well as gender aspects are taken into account in terms of accessibility and safety.

Timeframe

A feasibility study to be developed in the short term for implementation in the medium term

Implementation agency

Governorate

B.3. Water and Wastewater

B.3.1. WW3 – Expansion of the Sewerage Network

Description

This action is an investment to expand sanitation provision to unserved areas and new planned areas in Al Ameriyah growth area as well as Alexandria urban core area. The aim is to increase the coverage of the sewerage network while improving sanitation services aimed to promote public health and environmental sustainability through various activities related to wastewater management, cleanliness, and hygiene. In doing so, capacity of WWTP will also need to be accounted for.

Social considerations (Gender and Inclusion)

Involve underserved communities in planning to ensure the sewerage network serves their needs, providing equitable access to sanitation and prioritising gender-sensitive engagement, especially for women who manage household hygiene.

Next steps

ASDCO has already identified in detail the areas that require network coverage. The investment will need to focus first on the existing areas that not currently served by the network and gradually expand to cover new planned areas. This will require a detailed study to define implementation steps.
Additionally incorporating smart technologies and considerations into sanitation services can enhance efficiency, monitoring, management, and user experience. Smart sanitation systems leverage advanced technologies, data analytics, and the Internet of Things (IoT) to create more effective and sustainable sanitation solutions.

Timeframe

A detailed feasibility study should commence in the short term so that implementation can take place in the medium term.

Implementation agency

ASDCO and MoHUUC through CAPW

B.3.2. WW4 – Upgrade of Wastewater Treatment Plants

Description

Upgrading wastewater treatment plants play a vital role in protecting public health, safeguarding the environment, and promoting sustainable water management practices. Their aims encompass a wide range of objectives from pollution control and resource recovery to regulatory compliance and community engagement, all aimed at ensuring safe and sustainable water use for current and future generations.
There are currently 6 WWTPs serving Alexandria Governorate. This action is for an investment to vertically expand the capacity of 3 existing WWTPs including:

- Hanovil (50,000 to 100,000 m3/day),
- Seyouf Mowazafeen (from 7,000 to 10,000 m3/day), and
- Al-Nassreya from (3,000 to 8,000 m3/day)

Social considerations (Gender and Inclusion)

Involve local communities, particularly vulnerable populations, in the design and implementation process, ensuring that environmental management efforts do not disproportionately affect low-income or marginalised groups.

Next steps

A detailed feasibility study will need to be undertaken separately for each facility including conducting environmental and design studies, developing an effective contractual framework for off-take agreements, studying the availability and access to land, and developing a capacity-building plan for staff. These steps will ensure that the project is feasible, sustainable, and implementable.
It is important to consider the incorporation of renewable energy sources such as solar photovoltaics or wind farms, which could offset the increase in GHG emissions from this project.
The integration of smart technology into the wastewater treatment plant will significantly enhance its efficiency and effectiveness. This includes:

- Remote monitoring: The Installation of advanced sensors and Supervisory Control and Data Acquisition (SCADA) systems for real-time monitoring and control of the plant's operations. These technologies will enable the detection and control of any wastewater overflow and chemicals in the wastewater, thereby facilitating the prioritisation of maintenance work; and

- Energy Management Systems: Energy management systems will be deployed to optimise energy usage in the wastewater treatment plant. These systems will monitor energy consumption patterns, identify areas of inefficiency, and provide recommendations for energy-saving measures

Timeframe

A detailed feasibility study should commence in the short term so that implementation can take place in the medium term.

Implementation agency

ASDCO and MoHUUC through CAPW

B.3.3. WW5 – Industrial Water & Wastewater Management

Description

This action considers the potential for industrial facilities to invest in on-site wastewater treatment (to meet the national code for wastewater quality) and include integrated treatment units, recycling of water, sensors, water conservation, and reduction of pollution load on sewers to prevent mixing with municipal wastewater, thereby improving the effectiveness of WWTP.
By encouraging industrial facilities to treat wastewater on-site, it will ensure better water quality and reduce the strain on the central sewage system. This initiative promotes sustainable industrial practices, conserves water, and significantly reduces environmental pollution, contributing to a cleaner urban environment which is critical in the ecologically sensitive environment in Alexandria.

Social considerations (Gender and Inclusion)

Involve local communities, particularly vulnerable populations, in the design and implementation process, ensuring that environmental management efforts do not disproportionately affect low-income or marginalised groups.

Next steps

This action requires collaboration with existing industries and undertaking a study to understand potential and capacity to implement the project including financial implications. Once potential has been established then proceed with detailed feasibility study and identification of funding/financing sources. It would also require enforcement of existing regulations to ensure industries are appropriately incentivised to develop on site facilities.

Timeframe

A detailed feasibility study should commence in the short term so that implementation can take place in the medium to long term.

Implementation agency

Industrial Development Authority (IDA)/ Industrial facilities and zones.

B.3.4. WW6 – Treated Sewage Effluent Use in Industry

Description

There is potential for Treated Sewage Effluent to be used in industry with notable benefits including cost-savings and operational efficiencies compared to sourcing freshwater, particularly in areas where water scarcity or high water costs are prevalent, minimising discharge of treated wastewater into water bodies, thereby reducing environmental impact and potential pollution risks. There are existing plans to reuse ww from WWTP's of Hanovil and Al-Amreya in nearby industrial areas.

Social considerations (Gender and Inclusion)

Incorporate community consultations to ensure transparency, addressing potential concerns, and ensure the benefits of treated effluent use are accessible to all, particularly in terms of local employment and economic opportunities.

Next steps

This action is for the development of a study to define the project and end users with a view of replicating elsewhere in the Governorate.

Timeframe

A detailed feasibility study should commence in the short term so that implementation can take place in the medium to long term.

Implementation agency

ASDCO and Industrial Development Authority (IDA)/ Industrial facilities and zones

B.4. Energy

B.4.1. E3 – Sustainable Energy Residential Compound Package

Description

This project aims to support residential compound developers in investing in a carefully selected bundle of renewable energy and energy efficiency technologies, in addition to smart distribution networks. Alexandria has many residential compounds, which provide an opportunity for various sustainable and green applications, such as:

- Installation of solar PV system on roofs;
- Use of solar hot water systems;
- Smart grid application and smart meters (due to residential compounds large area, they typically have their own distribution networks); and
- Energy and cost-efficient district cooling applications, which relies on large chillers which are much more efficient than individual Air Conditioning unit.

The integration of renewable energy sources and energy-efficient technologies in residential compounds can significantly reduce GHG emissions. The project will also contribute to climate adaptation by reducing the Governorate's overall energy use thus its vulnerability to energy shortages caused by climate change.

Social considerations (Gender and Inclusion)

Design energy solutions to reduce the financial burden on low-income households and ensure that vulnerable groups, such as elderly and women-headed households, have equitable access to energy-efficient technologies.

Next steps

Implementation of this project will require development of

- Detailed energy audit and energy modelling exercise of existing compounds;
- Roof assessments to be carried out through satellite images or similar; and
- A feasibility study for district cooling for new developments.

A critical compound will be the creation of appropriate packages that are optimised and tailored to maximise returns for each compound and careful examination of the financial aspects, including the potential for grants, rebates, and loans from utilities, government, and non-profit organisations.

Timeframe

A study and preparation of potential packages of funding will need to start in the short term to ensure implementation can follow quickly in the medium to long term.

Implementation agency

The project will be implemented by compound developers or by Energy Service Companies (ESCO).

B.5. Solid Waste

B.5.1. SW2 – Decentralised Transfer Stations

Description

This investment aims to establish additional transfer stations across different areas of Alexandria to minimise the distance waste collection vehicles need to travel. As a result this would reduce transportation costs and environmental impacts and create a more efficient collection and waste transfer process.
Each transfer station would need the capacity to receive 500 tonnes/day with an estimated area needed of around 6000 to 8000 m2. Due to the existing urban fabric and land scarcity within the urban core, there needs to be careful consideration of where these facilities can be located.

Social considerations (Gender and Inclusion)

Engage local communities, particularly waste collectors, in the planning and design process, ensuring that the stations are accessible, safe, and offer employment opportunities for marginalised groups, including women and youth.

Next steps

A critical step before any investment is taken forward is to complete a comprehensive solid waste management study which will take stock of:

- Existing and future demand solid waste management provision aligning with future growth areas and types of waste generated; and
- Existing facilities to accommodate expansion and potential to combine treatment in new transfer stations.

Additionally, there is potential to include smart considerations such as Real-Time Monitoring deploying IoT sensors to monitor waste levels in containers, equipment performance, and environmental conditions (e.g., temperature, humidity) at transfer stations.

Timeframe

This investment will follow in the medium term once a comprehensive study has been completed in the short term.

Implementation agency

Governorate provides approvals for studies, land allocation, provision, the PPP contracts, monitor compliance with environmental regulations. MoE approval for PPP. Private sector: borrower and implementation

B.5.2. SW3 – Upgrade of Waste Treatment Facilities

Description

This investment will upgrade existing facilities in appropriate locations and combine waste sorting, recycling, composting, and where appropriate energy generation from waste. Implementation will improve waste sorting and recycling rates, reduce the amount of waste going to landfills promote principles of the circular economy, and support renewable energy generation from mixed waste or RDF. Limited actions are taken to separate waste at the source: the proportion of dry recyclables, organic waste and municipal solid waste that is being separated at the source, or from the mixed municipal solid waste stream, is below average. The facility should also have capacity to facilitate the safe and efficient disposal of construction and demolition waste, which is currently being disposed of illegally.

Social considerations (Gender and Inclusion)

Incorporate inclusive hiring practices for local communities, provide training opportunities for women and other underserved groups, and ensure that safety standards protect all workers, particularly vulnerable ones.

Next steps

Similarly to the previous investment, a first step would be to complete a comprehensive solid waste management study. Consideration should be given to incorporate informal waste pickers in the supply chain.

Timeframe

This investment will follow in the medium term once a comprehensive study has been completed in the short term.

Implementation agency

Governorate provides approvals for studies, land allocation, provision, the PPP contracts, monitor compliance with environmental regulations. MoE approval for PPP. Private sector: borrower and implementation.

B.5.3. SW4 – Upgrade of Sanitary Landfill and Waste to Energy

Description

This investment will follow on from the Solid Waste Study to upgrade the sanitary landfill with a potential waste to energy facility. There is one landfill available in the City near El Hammam city entrance receiving more than 3000 ton/day. The current disposal site was recently upgraded to sanitary landfill with bottom liner, leachate collection pipe, weighbridge, tyre washer, gate, fence, and drainage to prevent rainwater from entering the waste disposal area. This action would be an investment to upgrade to EU compliant landfill and accommodate waste for a period of 20-30 years.

There is potential to consider the development for Waste-Energy facility in the future following the completion of the overall Solid Waste Management Study. Generating electricity or heat from the combustion of waste materials, would reduce reliance on fossil fuels and contribute to renewable energy production with potentially selling excess electricity or heat to the grid or nearby industries.

Social considerations (Gender and Inclusion)

Promote the inclusion of informal workers, especially women, in formal waste collection systems, ensuring that safety, health, and economic opportunities are extended equitably, while engaging local communities in planning for waste-to-energy projects.

Next steps

Similarly to the previous investment, a first step would be to complete a comprehensive solid waste management study to understand potential for a Waste to Energy Facility. Separately a dedicated feasibility study will be required for the upgrade of sanitary landfill.

Additional considerations include deploying Internet of Things (IoT) devices and sensors to monitor landfill conditions in real-time, including gas emissions (methane and carbon dioxide), leachate levels, and landfill settlement. This data can help optimise operations and mitigate environmental impacts.

Timeframe

This investment will follow in the medium to long term once a comprehensive study has been completed in the short term.

Implementation agency

Governorate provides approvals for studies, land allocation, provision, the PPP contracts, monitor compliance with environmental regulations. MoE approval for PPP. Private sector: borrower and implementation.

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