Clima-Med
Acting for Climate in South Mediterranean

Funded by the European Union

EGYPT

The city of Al Zayniyyah Luxor

Sustainable Energy Access & Climate Action Plan

SEACAP

This document was produced as part of the activities of the European Union's project for ENP South Countries EUROPEAID / 139067 / DH / SER / MULTI. The SEACAP was prepared with the direct support of Clima-Med experts.

Table of Contents

3 Risk & Vulnerability Assessment

4 Capacity Building & Local Governance

5 Mitigation Actions

List of Tables

List of Figures

Glossary

AFOLU	Agriculture, Forestry, and Other Land Use
BEI	Baseline Emissions Inventory
CAF	Capital Approach Framework
CAP	Citizens Awareness Plan
CAS	Climate Action Strategy
CAU	Climate Action Unit
CoM	Covenant of Mayors
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
MSW	Municipal Solid Waste
NCCC	National Council for Climate Change
NDC	Nationally Determined Contribution
NEFE	National Emissions Factors for Electricity Consumption
RCP	Representative Concentration Pathways
SEACAP	Sustainable Energy Access and Climate Action Plan
SWDC	Solid Waste Disposal Sites
SWM	Solid Waste Management
UNFCCC	United Nations Framework Convention on Climate Change
VTMS	Vehicle Tracking & Monitoring System

Executive Summary

Al Zayniyyah is known as the last village that speaks the language of the ancient Egyptians and is also famous for its sugar cane and banana plantations.

The town's 65,000 inhabitants cover 100 km2, and over 40% work in agriculture (and most other jobs depend on agricultural production or are government/public sector jobs).

The desert climate has day temperatures ranging from warm to hot with periodically cold nights. The average annual temperature is 28°C with a very low level of precipitation and dry weather 350 days a year.

The city plans to expand and create infrastructure by supporting sustainable projects, and participating in large-scale urban regeneration, and expansion is the city's primary focus.

This document comprises the city's Sustainable Energy Access and Climate Action Plan (SEACAP). It is a strategic planning document as well as a practical municipal operational tool. It defines the city's climate action framework with quantifiable objectives to be reached by 2030 based on a Baseline Emissions Inventory (BEI) and an assessment of climate adaptation, mitigation, and sustainable energy needs.

The SEACAP was developed under the framework of the European Union's Clima-Med project (Acting for Climate in South Mediterranean Cities). It complements and is in line with national climate strategies and goals as well as with local development plans. The SEACAP was prepared with the full participation of the city's leadership, its technical team, and in collaboration with the Governorate of Luxor and the Clima-Med National Focal Point.

By preparing the SEACAP, the city took an advanced step in proving its willingness and dedication to face climate change, reduce its greenhouse gas (GHG) emissions, and build a model sustainable city with a clear vision, objectives, targets and actions.

This SEACAP includes seven sections:

- Chapter 1: City Description & Vision
- Chapter 2: Baseline Emissions Inventory
- Chapter 3: Risk & Vulnerability Assessment
- Chapter 4: Capacity Building & Local Governance
- Chapter 5: Mitigation Actions
- Chapter 6: Adaptation Actions
- Chapter 7: Communication

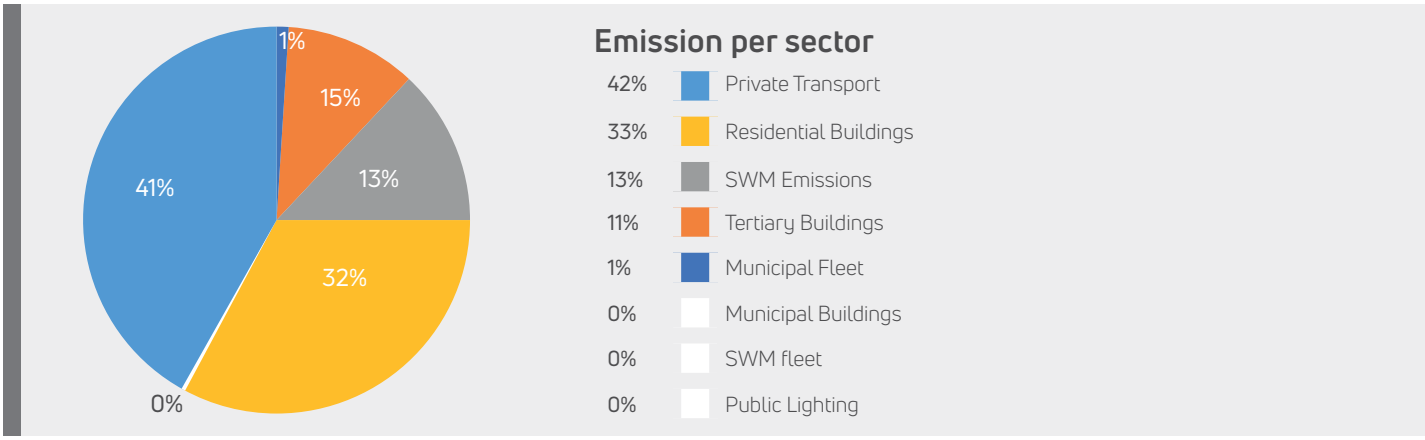
Chapter 1 introduces the city's main goals of reducing air pollution, implementing mitigation actions and measures to reduce CO2 emissions and cope with the impacts of climate change affecting the area. The city wishes to use climate change action to create jobs, restore farms, sustain tourism, invest in renewables, and introduce eco-friendly water systems to head off looming health, employment, and other crises exacerbated by climate change.

Chapter 2 covers the Baseline Emission Inventory (BEI), quantifying current CO2 emissions and prioritising mitigation measures. The BEI is used in Chapter 5 to measure the plan's potential impact.

Based on the BEI assessment, adequate mitigation actions (aiming to cut emissions) were selected. Next to this, adaptation actions (aiming at adapting to the irreversible effects of climate change) were identified. Both were further developed into SEACAP projects (chapters 5 and 6).

Chapter 3 assesses the city's risk and vulnerability to the most impacted sectors from the climate hazards taking place in the region.

Figure 1: Overview of emissions' breakdown by sector



Chapter 4 focuses on capacity building and local governance, especially for actions related to sustainable energy, climate change adaptation, and city greening.
Chapters 5 and 6 detail mitigation actions by sector -- particularly the impact of establishing a green building code – and quantifies adaptation actions. The table below summarises the proposed measures and their emissions impacts, costs, and benefits by 2030.

Chapter 7 provides an overall plan first to convey the objective and use of the SEACAP, the information covered in chapters 1-6, and to motivate the city and its people to support and, whenever relevant, to take part in the implementation of the SEACAP's actions.

The table below also includes the action results related to the abatement of GHG emissions, estimated cost for implementation, annual monetary savings (for saved fuels and energy), and climate cost efficiency by 2030.

The actions will mitigate approximately 14.36% of emissions and generate an annual savings of EUR 2.54 million shared between the local authorities, citizens, and investors, the abatement of emissions could be increased through city greening and planting trees.

The table outlines the SEACAP's abatement of GHG emission by 31,762.2 tCO2-eq annually, with a one-time investment of EUR 7.46 million.

If the plan SEACAP could not be implemented, the city will continue producing CO2 emissions that could reach 221,251.5 tCO2-eq by 2030.

Table 1: SEACAP's Action Results related to Abatement of GHG emissions

Sector	Action	Mitigation, MWh/a	Mitigation, tCO2-eq/a	Cost, EUR	Annual Savings, EUR	BAU Emissions, tCO2-eq (2030)	Climate Cost Efficiency (2030)
Municipal	5.1.1 Existing Municipal Buildings: Consumption Saving Measures	161.0	89.4	N/A	6,301	1,664.3	N/A
	5.1.2 New Municipal Buildings: Implementing & Promoting a Green Building Code	26.4	14.7	N/A	881		N/A
Residential	5.1.3 Existing Residential Buildings: Awareness-raising Activities	14,161.0	7,777.0	340,000	546,878	70,870.9	10.9
	5.1.4 New Residential Buildings: Implementing & Promoting a Green Building Code	5,891.1	2,610.9	260,000	193,124		24.9
Tertiary	5.1.5 Existing Tertiary Buildings: Awareness-raising Activities	9,415.9	5,193.1	350,000	364,853	23,836.1	16.8
	5.1.6 New Tertiary Buildings: Implementing & Promoting a Green Building Code	1,632.5	878.2	240,000	62,031		68.3
Public Street Lighting	5.2 Municipal Public Lighting	315.2	176.2	N/A	12,344	473.9	N/A
Transportation	5.3.1 Road Asset Planning & Management with Sustainable Mobility Measures	24,258.0	6,311.0	1,750,000	1,092,833	90,152.7	69.3
	5.3.2 Municipal Transportation Solid Waste Sector	231.0	62.0	1,300,000	8,579	206.4	5,241.9
Solid Waste Management	5.4 Solid Waste Management		5,107.1	0		34,047.1	0.0
Renewable Energy Production	5.5 Local Energy Production	6,337.2	3,542.6	3,220,000	248,162	0.0	227.2
Total contribution to emissions reduction 31,762.2/221,251.5= 14.36%		**62,429.3**	**31,762.2**	**7,460,000**	**2,536,137**	**221,251.5**	

1 Municipality Description & Vision

Chapter 1: Municipality Description & Vision

1.1 Municipal & NDC Targets

Al Zayniyyah city and Markaz are committed to reducing GHG emissions by 2030 against the baseline emissions in 2019, in the sectors contributing the most. The revised NDC commitments submitted at the national level in July 2022 will be an inspiration for the city and Markaz in the future update of the plan.

1.2 Overview of City

1.2.1 Geographical Location

The city of Al Zayniyyah is the capital of the Al Zayniyyah district in the Luxor Governorate. It is known for being the last village to speak Tayniah, the language of ancient Egypt. The city is famous for its sugar cane and banana plantations as well.

It is located east of the Nile River, north of Karnak district, and south of Qous centre in Qena Governorate. It is bordered in the south by the desert and Taibah city. Al Zayniyyah district covers 100 km2. It consists of the local units (villages) of Al Zayniyyah, Bahary, Al Saaydah, Al Ashshi, Al Madamoud Qibli, and Al Madamoud Bahary.

1.2.2 Population & Employment

Most of the population of 65,000 – 61.5% male, 38.5% female – work in agriculture or government and public sector jobs such as education, health, or in agencies like electricity and railways. The rest farm or work in trading livestock and crops.

1.2.3 Economic Sectors

Rural Al Zayniyyah's main economic activity is farming sugar cane, bananas, wheat, and traditional crops and employs over 40% of the population. About 650 acres of bananas generate income for farmers and are cultivated in the south, where the hot weather is optimal. Moreover, about 7,340 acres of sugar cane, barley, and palms are cultivated. During winter, about 6,853 acres of wheat are cultivated. In summer, 3,763 acres of corn are cultivated. This sector faces many challenging problems due to the effects of climate change.

Additionally, a large number of farmers are raising livestock, including 57,352 goats, 85,429 sheep, 325 camels, 153 horses and 21,678 cows. Most of the rural people in the villages raise all kinds of birds, including ducks, geese, pigeons, and poultry.

Second is the commercial sector which includes supermarkets, livestock trade, fruits, spices, and vegetables – most of which depend on agricultural production. Stimulating the agricultural production will automatically support this sector.

Noticeably, the industrial sector is weak. There are no factories in the centre except for some red brick factories. People bake mud bricks and convert them into red bricks. The diesel used pollutes the environment by generating thick black smoke, carbon dioxide, carbon monoxide, and other gases.

The only tourist site is the Al Madamoud Pharaonic Temple (also called the Temple of Montu). The remnants date to the Ptolemaic era and were dedicated to the Egyptian god of war during the Middle Kingdom era in the reign of King Senusret III. Later, during the eighteenth dynasty, a new temple was built in the style of official temples consisting of an edifice and an open courtyard with the covered courtyard leading to the holy of holies, and in the Ptolemaic era, stones and gates dating back to the Middle Kingdom era were added.

1.2.4 Infrastructure & Key Services

The electricity network covers 98% of the city, villages and hamlets of Al Zayniyyah. Diesel is used in the machines powering the water engines irrigating reclaimed agricultural lands in the Western Desert. The development of renewable energy would significantly limit GHG emissions and offer more sustainable options.

The water network supplies more than 98% of the villages and hamlets with drinking water. There is one surface station. Additionally, regarding irrigation, the central area includes agricultural lands representing 90% of the total crops and is irrigated from the Nile River. The newly reclaimed desert lands in the east are irrigated through underground wells (approximately 40 to 130 meters deep, depending on their distance from the Nile). Village crops are supplied from the Kallabiyyah Canal, the Luxor Canal, and the Al Bani Canal.

The road network consists first of the 25 km desert road located to the east of the city and second of the agricultural road east of the Nile River with the same length. The latter connects the city of Qus in the north and the city of Luxor in the south. There are more than 100 km of internal roads between villages and hamlets inside the city.

A significant issue in Al Zayniyyah is the management of solid waste. About 45 tons of solid waste (household garbage) are generated daily and collected by the cleaning department in the centre using loaders, dump trucks, and compactors. The waste is collected from the garbage containers in the streets and then sent to the sanitary landfill in the nearby desert, where the garbage is sorted, and some is buried.

Regarding wastewater and rainwater infrastructure, there is a 64 km network used to drain excess irrigation water from Luxor and Al Zayniyyah until reaching the

Nile River. There are also drains for rain and torrential water called Number 1 for downstream torrents. They are located close to the mountains to the east, where water is collected into the Nile River.

1.3 Strategy

1.3.1 Vision for the Future

The vision stems from the city's history and intends to capitalise on the city's identity as a historic village with sustainable tourism.

The city's main goal is to reduce air pollution while implementing mitigation actions and measures to reduce CO2 emissions and cope with the impacts of climate change affecting the area.

In close concert with the Governorate of Luxor, the city's strategic decisions aim to use future development of the region to create local jobs for residents through reactivating the agricultural sector as it was in the past, developing sustainable tourism, investing in producing renewable energy and energy efficiency equipment and materials, improved water harvesting systems (namely torrential rain), city greening, introducing a sustainable strategy for livestock development, plus a sustainable solid waste management strategy.

1.3.2 Complementarity & Coordination with Local & National Plans & Authorities

The SEACAP has been developed in line with the Egyptian National Climate Change Policy. The policy is designed to adapt the country to climate change impacts on water, coastal areas, agriculture/food security, health, tourism, biodiversity, and socioeconomic development/poverty.

Also, in line with the National Strategy and Action Plan for Sustainable Consumption and Production, the SEACAP is mainstreaming sustainable consumption and production into agriculture/food production, transport, and waste management.

Additionally, the SEACAP will play an extremely important role in implementing the country's Nationally Determined Contribution (NDC) submitted to the UNFCCC and used to reduce GHG emissions by 2030 unconditionally.

1.3.3 Adapting Administrative Structures & Involving Local Stakeholders

The plan will be mainstreamed through the current existing structures already set to implement similar initiatives. Al Zayniyyah city and Markaz have an active technical services department and an environmental committee, closely linked to the Governorate system, and the necessary related channels to communicate with the local community and various significant local stakeholders.

To assure long-term sustainability, the relevant municipal staff, including members of the municipal council as well as volunteers from the local community, linked to the Governorate system will engage in plan updates and implementation beyond the current council mandate.

The city has appointed a local coordinator, responsible for overseeing the varied work between the different municipal departments, the president of the city, and city council and the Governorate's services, as well as with the local stakeholders engaged in the process. SEACAP implementation usually requires a series of cross-sectoral targets; thus, coordination between them and improvement of multi-level governance is of high importance. This role is especially challenging as authorities in different departments must cope with differing roles and responsibilities.

1.3.4 Overall Budget for Implementing & Financing Sources

The municipal funds largely originate from the budget received by the national government as well as municipal taxes and fees (solid and water waste collection, irrigation services, etc.) and fees for services offered to citizens (e.g., solid waste removal). The municipal budget allows small-scale investments but is still heavily dependent on attracting financing from central authorities to implement planned activities.

1.3.5 Implementation & Monitoring Process

The monitoring process of the SEACAPs implementation should be set to track indicators allocated across all municipal activities to assess progress and take corrective actions as needed.

1.3.6 Awareness-raising

Implementing the SEACAP's Citizens Awareness Plan requires the participation of all municipal departments working in harmony to avoid conflicts. This requires the special SEACAP Unit to work independently on the framework development and coordinate with each to monitor and evaluate the results.

2 Baseline Emission Inventory (BEI)

Chapter 2: Baseline Emission Inventory (BEI)

2.1 BEI Methodology

The Baseline Emission Inventory (BEI) quantifies the amount of CO2, or CO2-equivalent emissions produced mainly due to energy consumption in the territory of the local authority during the selected baseline year. The BEI identifies the principal anthropogenic sources of CO2 emissions and allows prioritising the mitigation measures accordingly.

The emission inventory includes direct CO2 emissions due to fuel combustion, indirect emissions related to consumption of grid-supplied energy (electricity, heat/cold), and relevant non-energy-related emissions occurring in the territory of the local authority.

As the city has been using Intergovernmental Panel on Climate Change (IPCC) emissions factors for CO2-equivalents based on the IPCC 2006 Guidelines (IPCC 2006), the emissions of CH4 and N_2O from the energy generating activities are already included in this methodological approach. For non-energy-related activities like wastewater treatment, solid waste management, and others, the CH4 and N2O, where applicable, will be calculated separately and transformed into CO2-eq. These emissions will be included in the BEI since the city is planning to include mitigation measures in these sectors.

CO2 emissions from the sustainable use of biomass/biofuels and emissions of certified green electricity are considered zero in the calculation.

The method adopted in the BEI calculation utilises the standard emission approach in line with the IPCC principles and complies with the UNFCCC reporting system.

Data collection is a key part of the inventory. The local authority has taken the following steps for gathering accurate data:

- Selecting a baseline year for which the most complete and reliable data exist
- Collecting data for the sectors to be included in the SEACAP's inventory for the baseline year
- Analysing, evaluating, and assessing data for accuracy, transparency, consistency, and completeness
- Compiling selected data

Emissions' calculation is conducted by multiplying the activity data collected by the emission factor per energy carrier (electricity, fuel, and heat/cold), based on the formula:

GHG Emissions = Activity Data x Emission Factor

2.1.1 Baseline Year

A primary component of the inventory process is choosing the baseline year. Determining the baseline year depends on the availability of accurate historical data. The baseline year is the year against which progress in emission reductions by 2030 will be compared. The city has selected 2019 as its baseline year.

2.1.2 BEI Sectors

The local authority will report CO2 emissions for the following sectors:

- Municipal buildings, equipment, and facilities, including public lighting, tertiary buildings and residential buildings.
- Transportation, including the municipal fleet, private transport, and public transport.
- Local energy production from renewable energy sources and other local power generation.
- Other non-energy-related activities such as solid waste management and wastewater.

2.1.3 Emissions Factors & Conversion Rates

The emissions factors expressed as tCO2-eq/MWh are coefficients quantifying the emissions per category of activity data. The emissions factors used by the local authority are the last updated emissions factors provided by JRC and attributed to electricity consumption. The JRC-CoM-NEFE dataset includes the 1990-2015 time series of the National Emissions Factors for Electricity Consumption (NEFE). Considering the lack of availability of more recent data and following consultation with the JRC, the emissions factor for 2015 (IPCC approach) is used for calculations in this report. **The emissions factor is 0.559 tCO2-eq per MWh.**

Besides electricity, the fuel emissions factors used by the local authority, expressed in tCO2-eq/MWh and presented in the table below, are the default factors of the IPCC (2006).

Table 2 : CO2 Emissions Factor tCO-2eq/MWh

Fuel	CO2 Emissions Factor tCO2-eq/MWh
Diesel	0.268
Gasoline	0.250
Kerosene	0.259
LPG	0.227

The conversion factors between litres or kg and kWh expressed in kWh/L for fuel combustion used by the local authority are factors provided by the IPCC (2006) in the table below:

Table 3 : Conversion Factor for Energy Fuel Resources to kWh

Fuel	Conversion Factor	Unit
Gasoline	9.2	kWh/L
Diesel	10	kWh/L
Kerosene	9.7	kWh/L
LPG	13.7	kWh/kg

2.2 Energy Consumption in Buildings

2.2.1 Municipal Buildings, Equipment & Facilities

The city has buildings under its direct control and management – notably the main municipal buildings, gardens, and storage buildings. Overall, the city consumes 2,236 MWh per year for lighting, space cooling, and other electromechanical devices in the municipal buildings and facilities. The supplied electricity comes from the national electricity grid. Based on these assumptions, the table below presents the annual electrical consumption and emissions of municipal buildings, equipment, and facilities:

Table 4 :Municipal Buildings, Equipment, & Facilities Annual Electrical Consumption and CO2 Emissions

Site Category	Annual Consumption, MWh	Annual Emissions, tCO2-eq
Municipal Buildings & Facilities	533	297.94
Waste Management	1,703	951.97
Total	2,236	1,249.92

The table below presents the fuel consumption and the CO2 emissions for the municipal buildings, equipment, and facilities:

Table 5 : Municipal Buildings' Annual Fuel Consumption & CO2 Emissions

Fuel Type	Fuel consumptions in Litres	LPG (KG)	Fuel Consumptions in MWh	Annual Emissions in tCO2-eq
Fuel (Diesel)	546	0	5.46	1.46

2.2.2 Residential Buildings

The city believes there are approximately 12,745 households in its area. Utility company data reflects annual electricity consumption of 78,294 MWh. A typical household averages 5.1 members resulting in an annual electricity consumption per capita of 1,204 kWh. Based on these assumptions, the table below presents the annual electricity consumption and emissions of residential buildings:

Table 6 : Residential Buildings' Annual Electricity Consumption & CO2 Emissions

Energy Source	Annual Consumption, MWh	Annual Emissions, tCO2-eq
Electricity	78,294	43,766.34

Emission factor for electricity consumption is 0.559 tCO2-eq/MWh (CoM-JRC)

The households consume LPG for cooking. The data provided by the city shows that each household consumes about 20 kg of LPG per month. Based on these assumptions, the table below presents the annual fuel consumption and relevant CO2 emissions:

Table 7: Residential Annual Fuel Consumption & CO2 Emissions for Cooking

Fuel Type	Fuel consumptions in Kg	Fuel Consumptions n MWh	Annual Emissions in tCO2-eq
LPG	3,061,216	41,938.60	9,520

2.2.3 Tertiary Buildings, Equipment & Facilities

The tertiary sector includes commercial buildings, private offices, banks, commercial and retail activities, private and government schools, and other activities offering services beyond the municipality's control. Based on the annual electricity consumption figures obtained from the utility company, the table below shows the annual energy consumption and emissions from tertiary buildings:

Table 8: Tertiary Buildings' Annual Energy Consumption & CO2 Emissions

Energy Source	Annual consumptions in MWh	Annual Emissions in tCO2-eq
Electricity	31,200	17,440.80

Emission factor for electricity consumption is 0.559 tCO2-eq/MWh (CoM-JRC)

The annual fuel consumption for cooking and the relative CO2 emissions in tertiary buildings are shown in the table below:

Table 9 : Tertiary Buildings' Annual Fuel Consumption & CO2 Emissions for Cooking

Fuel Type	Fuel Consumption, kg	Fuel Consumption, MWh	Annual Emissions, tCO2-eq
LPG	154,700	2,119.3	481.1

2.2.4 Buildings & facilities' Synopsis

Buildings consume a lot of electricity for lighting, heating, cooling, and other electrical device operations. The table below summarises the annual energy consumption and the CO2 emissions from buildings:

Table 10: Buildings & Facilities Annual Energy Consumption & Emissions

FINAL ENERGY CONSUMPTION [MWh]						
Sector	Electricity	Diesel	Fossil Fuels Gasoline	LPG	Total (MWh)	Emission tCO2-eq
BUILDINGS, EQUIPMENT/FACILITIES						
Municipal Buildings	2,236.0	5.5	-	-	2,241.5	1,251.4
Residential Buildings	78,294.0	-	-	41,938.6	120,232.7	53,286.4
Tertiary Buildings	31,200.0	-	-	2,119.3	33,319.4	17,921.9
Subtotal	**111,730.0**	**5.5**	**0.0**	**44,057.9**	**155,793.5**	**72,459.7**

2.3 Municipal Public Lighting

The city's street lighting is partly provided by LED efficient lights but is still heavily reliant on inefficient lamps (HPS, MH), causing high emissions of CO2. The annual electricity consumption and CO2 emissions for the baseline year are shown in the table below:

Table 11: Public Lighting Annual Electricity Consumption & CO2 Emissions

Annual Consumption, MWh	Annual Emissions, tCO2-eq
637.39	356.30

Emission factor for electricity consumption is 0.559 tCO2-eq/MWh (CoM-JRC)

2.4 Transport

The transport sector in the city includes only road transport with subcategories such as the municipal fleet as well as private and commercial transport though there are no public transport services in the city. According to the city, the municipal fleet comprises many vehicles and includes passenger vehicles, light trucks, medium to large trucks, construction machinery, and other vehicles. The fuels used for the municipal fleet are gasoline and diesel.

Regarding private cars, their fuel consumption is calculated by the city based on the total number of cars in the region, the average distance travelled, and the average consumption per kilometre for each type of vehicle. The same approach is used for commercial vehicles. Based on the numbers provided by the city, the table below presents the estimated data for annual diesel and gasoline consumption:

Table 12: Municipal, Private, & Public Transport Fuel Consumption & CO2 Emissions

Fuel Type	Municipal Fleet, litres	Private Transport, litres	Public Transport, litres	Fuel Consumption, litres	Fuel Consumptions in MWh	Annual Emissions in tCO2-eq
Diesel	119,136.0	14,573,650.0	0.0	14,692,786.0	146,927.9	39,376.7
Gasoline	8,162.0	12,342,850.0	0.0	12,351,012.0	113,629.3	28,407.3
TOTAL				**27,043,798.0**	**260,557.2**	**67,784.0**

Emissions factor for diesel is 0.268 tCO2-eq/MWh; emissions factor for gasoline is 0.25 tCO2-eq/MWh
Conversion factor for diesel is 0.010 MWh/L; conversion factor for gasoline is 0.0092 MWh/L

Transport for solid waste management (SWM)

The municipality collects and transfers solid waste using different types of garbage vehicles which consume significant diesel. The solid waste produced is about 33,514 tons annually, 91.81 tons daily, and is steadily increasing due to the growing population. The table below shows the annual fuel consumption for garbage vehicles:

Table 13: Transport Emissions from Solid Waste Management

Annual Solid Waste Garbage Vehicles Fuel Consumption & CO2 Emissions			
City	Diesel/a	Consumption, MWh	tCO2-eq
Al Zayniyyah	57,915	579.15	**155.21**

Table 14: Total Transport Emissions

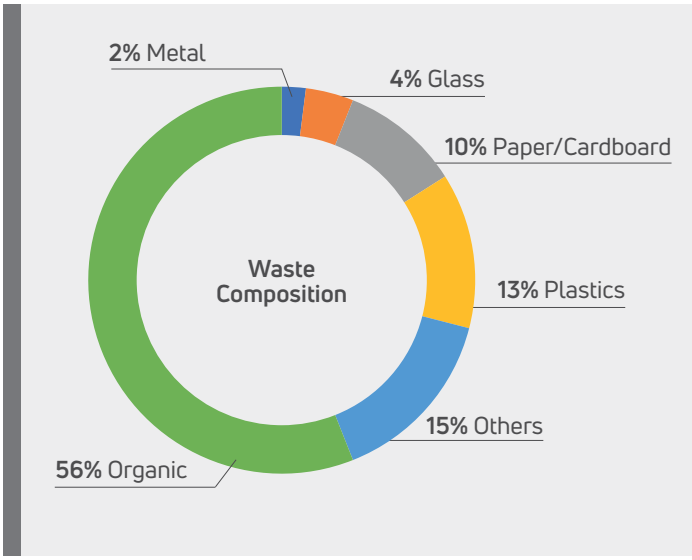
Sector	Fuel Consumptions (MWh)	Emissions, tCO2-eq
Municipal Fleet	1,266.5	338.1
SWM Fleet	579.2	155.2
Private Cars & Trucks	259,290.7	67,445.9
Total	**261,136.3**	**67,939.2**

2.5 Solid Waste Landfill Emissions

Egypt is the most populated country in the Middle East, with around 102 million inhabitants generating around 26 million tonnes of municipal solid waste annually.(1) Around 60% of solid waste is collected in Egypt, and less than 20% is being collected or recycled – the rest of the waste is disposed of in rivers, canals, open areas, and streets. This creates significant environmental risks affecting water, soil and causing air pollution. As with all environmental problems, the increase in solid waste production goes hand in hand with a growing population, and rising consumption has become a focus of great concern.

Of the 91.81 tons of solid waste produced daily – 56% is organic waste, 10% paper and cardboard, 13% plastics, 4% glass, 2% metal, and 15% other materials:

Figure 2: Solid Waste Composition



Converting organic waste to compost is one solution for 56% of the city's waste. Composting is the process of controlling biological maturity under aerobic conditions where the organic matter is decomposed into materials with shorter molecular chains that are more stable, hygienic, and beneficial for agriculture and recycling of organic soil matter.

At the solid waste disposal sites (SWDS), the degradable organic carbon in waste is decomposed by bacteria under anaerobic conditions into methane (CH4) and other compounds. The CH4 emissions from SWDS are important contributors to global anthropogenic CH4 emissions.

This report uses the IPCC default method of a simple mass balance calculation, which estimates the amount of CH4 emitted from the SWDS, assuming that all CH4 is released the same year the waste is disposed of. The equation below calculates the landfill emissions and can also estimate emission reductions. This This report uses the IPCC default method of a simple mass balance calculation, which estimates the amount of CH4 emitted from the SWDS, assuming that all CH4 is released the same year in which the waste is disposed of. The equation below calculates the landfill emissions and can also estimate emission reductions. This method is simple, and emission calculations require only input of a limited set of parameters for which the IPCC Guidelines provide default values, where country-specific quantities and data are not available:

Methane emissions (Gg/yr) = (MSWT x MSWF x MCF x DOC x DOCF x F x 16/12-R) • (1-OX)

Where:

MSW_T: total MSW generated (Gg/yr)

MSW_F fraction of MSW disposed to solid waste disposal sites (assumption 80%)

MCF: methane correction factor (fraction), 0.6 as general default value.

DOC: degradable organic carbon (fraction) (kg C/ kg SW)

DOC = (0.4 x A) + (0.17 x B) + (0.15 x C) + (0.3 x D)

Where:

A = Fraction of MSW that is paper and textiles

B = Fraction of MSW that is garden waste, park waste or other non-food organic putrescibles

C = Fraction of MSW that is food waste

D = Fraction of MSW that is wood or straw

DOC= (0.4 x 0.1 + (0.17 x 0) + (0.15 x 0.56) + (0.3 x 0)

(1) Safwat Hemidat 1*, Ouafa Achouri 2, Loubna El Fels 3, Sherien Elagroudy 4, Mohamed Hafidi 3, Benabbas Chaouki 5, Mostafa Ahmed 4, Isla Hodgkinson 6 and Jinyang Guo 7. Solid Waste Management in the Context of a Circular Economy in the MENA Region. (Sustainability 2022) 2-6.

DOC= 0.142

DOCF: fraction DOC dissimilated; The IPCC default value is 0.77

F: fraction of CH4 in landfill gas (IPCC default is 0.5)

16/12: conversion of C to CH4

R: recovered CH4 (Gg/yr) The default value for methane recovery is zero

OX: oxidation factor (fraction); IPCC default is 0

The results:

Methane emissions (Gg/yr) = (33.514 Gg x 0.8 x 0.6 x 0.124 x 0.77 x 0.5 x 16/12-0) x (1-0))

Methane emissions (Gg/yr) = 1.02397335 Gg/yr

Methane Emissions, Gg/yr	Methane Emissions,	2030 BAU,
1.02397335	1.02397335*1,000*25= 25,599.33	25,599.33*1.33 = 34,047.11

2.6 Final Emissions from Fossil Fuels & Non-related Energy Activities

The total energy consumption in the territory of the local authority is the sum of electricity consumption and fuel consumption:

Table 15: Emissions from Fossil Fuel & Non-Energy Activities (2019)

Sector	MWh	tCO2-eq
Buildings, Equipment, & Facilities	**155,793.5**	**72,459.7**
City	2,241.5	1,251.4
Residential	120,232.7	53,286.4
Tertiary	33,319.4	17,921.9
Transport	**261,136.3**	**67,939.2**
City Fleet	1,266.5	338.1
Private Cars/Trucks	259,290.7	67,445.9
SWM Fleet	579.2	155.2
Public Lighting	**637.4**	**356.3**
SWM Landfill	**0.0**	**25,599.3**
Total	**417,567.2**	**166,354.5**

An overview of emissions breakdown by sector is provided in the figures below:

Figure 3: Sectoral contribution in the city's emissions

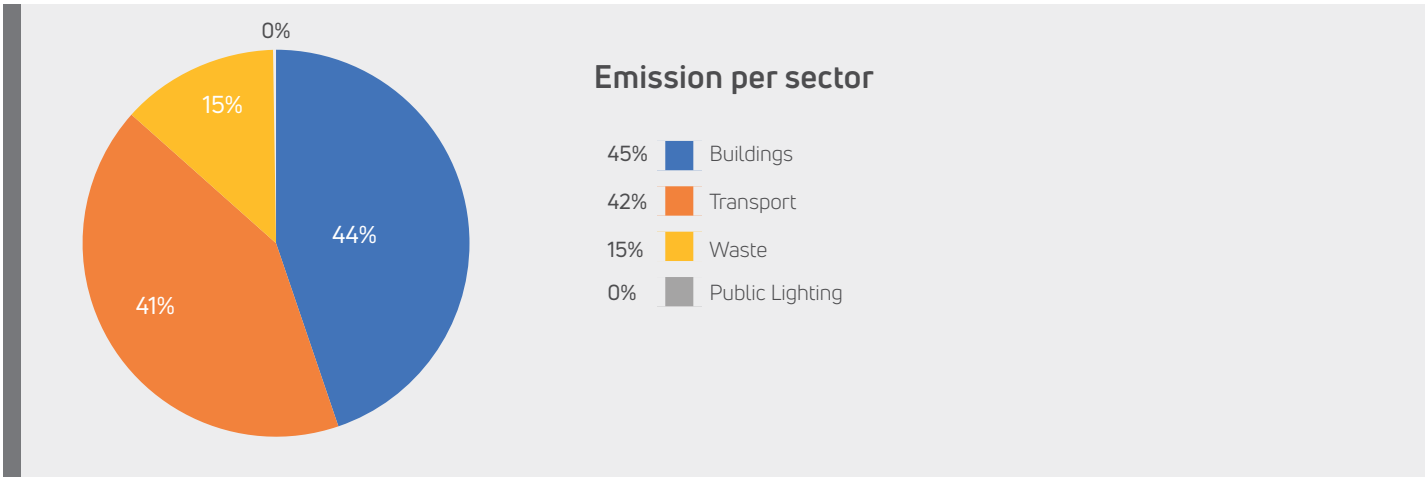


Figure 4: Breakdown of emissions by building category

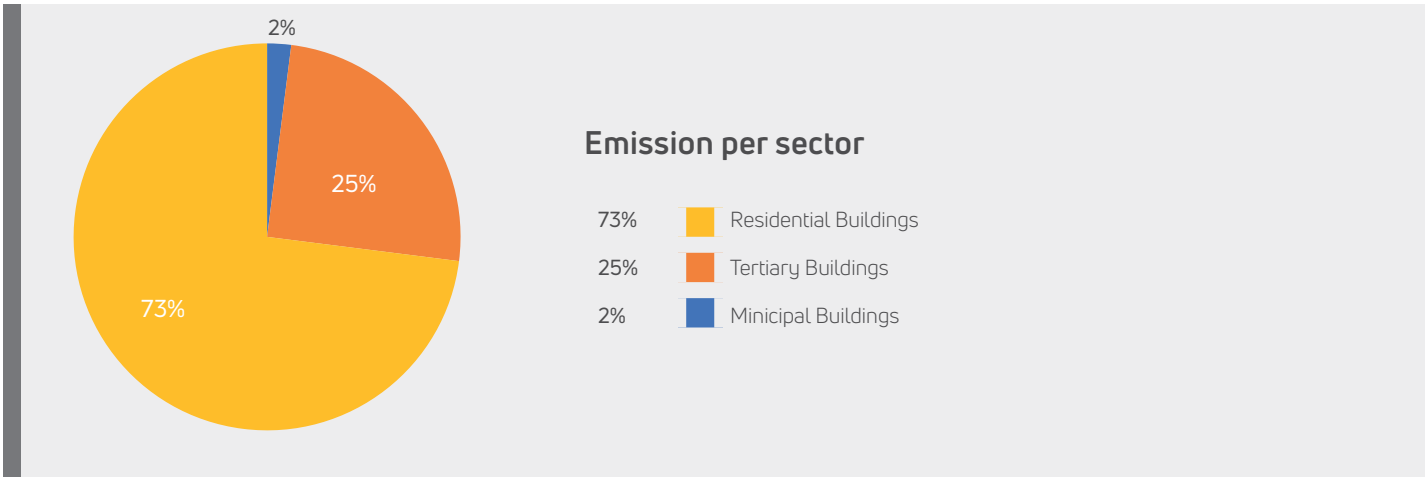
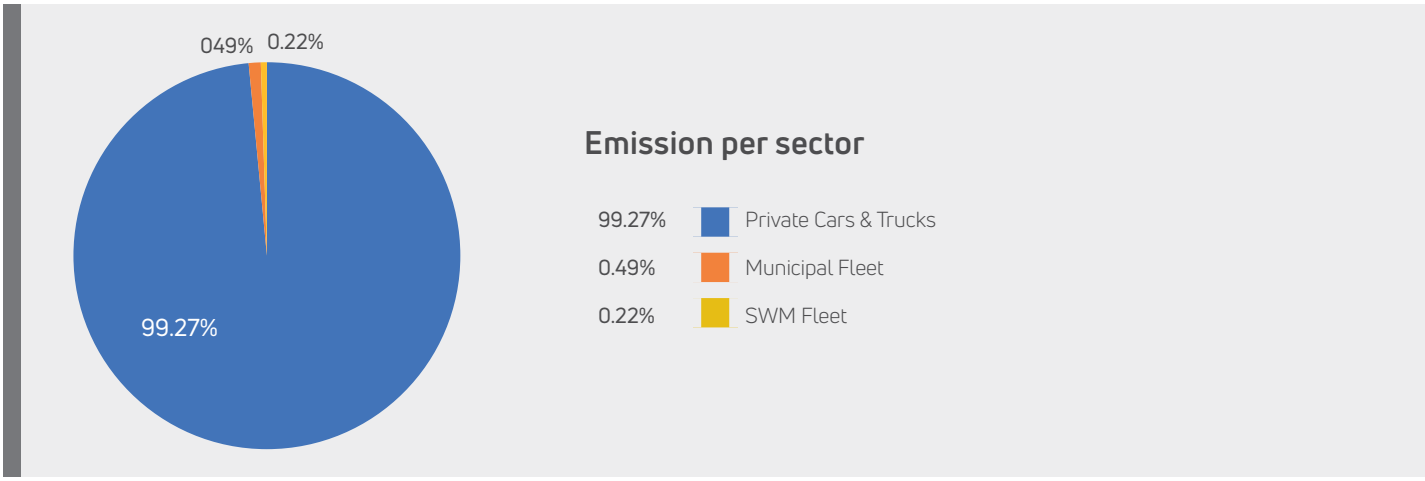


Figure 5: Breakdown of emissions in the transport sector



2.7 BAU Scenario & 2030 Targets

The table below illustrates the city's projected emissions by 2030:

Table 16: Emissions CO2-eq as BAU Scenario & 2030 Target

Municipality final energy and non-energy activities			BAU 2030
Sector	**MWh**	**tCO2-eq**	**tCO2-eq**
Buildings, equipment/facilities	155,793.5	72,459.7	96,371.4
Municipality	2,241.5	1,251.4	1,664.3
Residential	120,232.7	53,286.4	70,870.9
Tertiary	33,319.4	17,921.9	23,836.1
Transport sector	261,136.3	67,939.2	90,359.1
City Fleet	1,266.5	338.1	449.6
Private cars and trucks	259,290.7	67,445.9	89,703.1
SWM Fleet	579,2	155.2	206.4
Public Lighting	637.4	356.3	473.9
SWM Land fill emissions	0	25,599.3	34,047.1
TOTAL	**417,567.2**	**166,354.5**	**221,251.5**

Annual Consumption x BAU Coefficient (1.33 JRC 2019)

3 Risk & Vulnerability Assessment

Chapter 3: Risk and Vulnerability Assessment

3.1 Introduction on climate change impact

The Mediterranean region is rich in a large variety of complex climatic phenomena caused by its morphology and its geographical location. The location of the Mediterranean Sea in a transitional band between subtropical and midlatitude regimes produces large climate variability at multiple timescales and a strong seasonal variability of precipitation in many areas (Lionello 2012). The Mediterranean has been identified as one of the most prominent "Hot-Spots" in future climate change projections (Giorgi 2006). The water cycle and its extremes are one of the major concerns as many countries are over exploiting the water resources – a problem expected to deteriorate in the future. Episodes of extreme precipitation are also taking place, and disastrous floods are a major threat to the region, especially the coastal areas. Additionally, phenomena taking place, especially in the Southern Mediterranean countries (such as the cultivation of marginal land, overgrazing, and firewood harvesting), put more pressure on the environment (Lionello 2012).

The Mediterranean region has experienced drastic changes in its climate over the years and has shown large climate shifts in the past (Luterbacher, et al. 2006). Twenty thousand years ago, cold steppes (with sparse forests) extended from the south of Spain to the Caucasus. In the northern part of the Mediterranean basin, the temperature of the coldest month was 15°C lower than it is today (Peyron, et al. 1998). Less water was available for vegetation. Over the last 2,000 years, the climate over the Mediterranean has experienced a sequence of humid/dry and warm/cold periods impacting environmental conditions.

In the figure below, the seasonal mean temperature for the period 1961-1990 is depicted in panels A-D, while the total precipitation maps for the same period are depicted in panels E-H

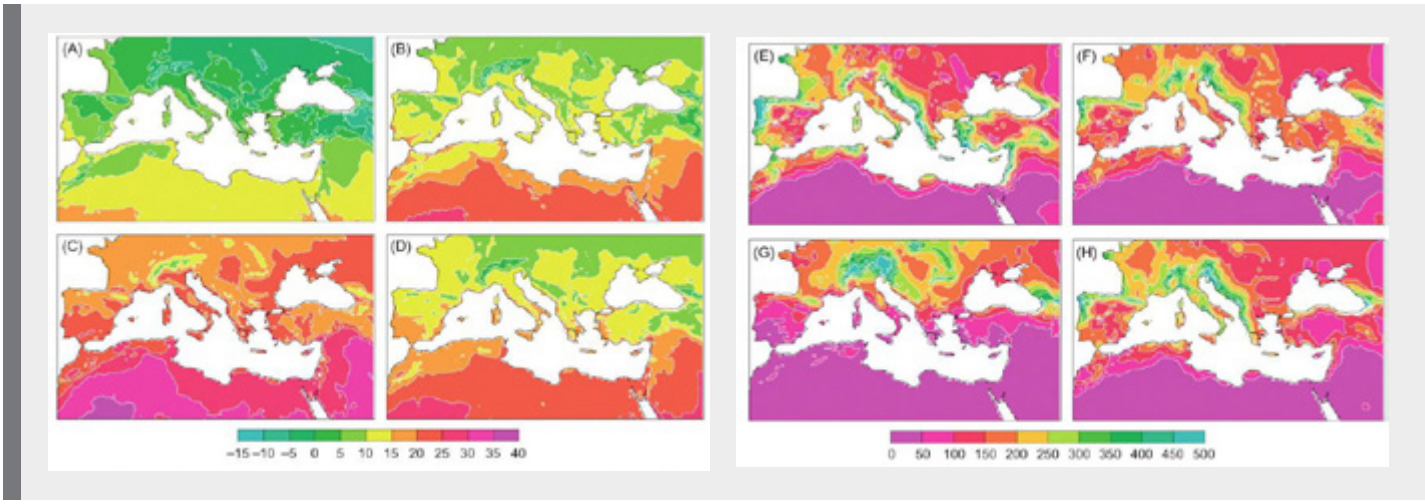
According to a 2008 EIB report for the Mediterranean region, climate experts anticipate during this century:

- An increase in air temperature in the range of 2.2°C to 5.1°C for the countries of Southern Europe and the Mediterranean region over the period 2080-2099 (compared with 1980-1999);
- A significant decrease in rainfall, ranging between -4 and -27% for the countries of Southern Europe and the Mediterranean region (while the countries of Northern Europe will report a rise between 0 and 16%);
- An increase in drought periods manifested by a high frequency of days during which the temperature would exceed 30°C. Extreme events (such as heat waves, droughts, or floods) are likely to be more frequent and violent; and
- An increase in the sea level which, according to some specific studies, could be around 35 cm by the end of the century.

Giannakopoulos et al. (2005) underlines that in line with the results of the projection scenarios, the most significant temperature increases this century are expected in Eastern Egypt and especially the Nile Delta, Lebanon, Israel, Palestine, and the Maghreb. It is therefore evident that the more vulnerable Mediterranean areas will be those of North Africa adjacent to desert areas, the major deltas (such as the Nile Delta), the coastal areas (northern rim and southern rim of the Mediterranean basin), as well as the high-demographic growth and socially vulnerable areas (southern and eastern rim, densely populated cities and suburbs).

In the Mediterranean region, 50% of the urban population lives at an altitude of less than 10 meters above sea level – areas vulnerable to sea level rise. Additionally, tourist destinations in these areas are vulnerable not only due to the sea level rise, but also due to the temperature increase encountered (Plan Bleu 2009).

Figure 6: Seasonal mean temperature and total precipitation



The impacts of climate change on the Mediterranean environment will relate particularly to (EIB, 2008):

- Water, via a change of its cycle due to a rise in evaporation and a decrease in rainfall. This water problem will be of crucial importance regarding sustainable development in the region;
- Soil, via the acceleration of already existing desertification phenomena;
- Land and marine biological diversity (animal and plant), via a displacement northward and in the altitude of certain species, extinction of less mobile or more climate-sensitive species, and the emergence of new species; and
- Forests, via a rise in fire hazards and parasite risks.

These impacts will exacerbate already existing pressures on the natural environment connected with anthropogenic activities, such as agriculture and fishery (reduction of yields), tourism attractiveness (heat waves, water scarcity), coastal areas and infrastructures (significant exposure to the action of waves, coastal storms and other extreme weather events, sea level rise), human health (heat waves), and the energy sector (water needs for power plants, hydropower, and increased consumption).

This all indicates that southern and eastern Mediterranean countries appear to be more vulnerable to climate change than the northern Mediterranean countries.

Indeed, they are, on the one hand, more exposed to accelerated desertification, soil aridity and water scarcity and, on the other hand, presenting economic structures that are more strongly dependent on natural resources as well as relying on technical and financial capacities too limited to implement large-scale adaptation options (EIB 2008).

The Mediterranean, especially the Maghreb and Mashreq countries, is and will be more affected by climate change than most other regions of the world during the 21st century. The impacts from the rise in temperatures, the decrease in rainfall, the multiplication of the number and intensity of extreme events and the possible rise in sea level overlap and amplify the already existing pressures of anthropogenic origin on the natural environment.

Through the crucial issue of scarcity of water resources, their impacts are fraught with consequences in the 21st century for human activities, in particular agriculture, fishery, tourism, infrastructure, urbanised coastal areas, and hydropower production. To minimise as much as possible the economic losses and damages, several adaptation options must be thought out and implemented.

Energy lies at the heart of the climate change issue. On the one hand, it is the main GHG emitting sector, and CO2 emissions in the future are likely to increase much more rapidly than the global average. On the other hand, hydropower production—relatively significant in certain countries (13% of power production in the Maghreb and Mashreq countries)—is affected by the climate as well as by the plant cooling constraints. Lastly, the energy demand (in particular, electricity), which is growing at a very high pace in the region, is likely to be further accelerated by the additional demand necessary to lessen the impacts of climate change (water desalination, air-conditioning of buildings, etc.).

3.2 Climate Data & Climate Projections

Al Zayniyyah is located east of the Nile River in the Luxor Governorate. It was called Al Tyniah previously due to the presence of silt and mud produced from the Nile River and soil fertility in it. Al Zayniyyah is an agricultural city famous for its sugar cane and banana plantations.

Al Zayniyyah has a desert climate. During the day, the temperature is warm to hot and can be cold at night sometimes. Its average annual temperature is 28°C with very little precipitation and is dry for 350 days a year.

3.3 Climate Change Vulnerability Analysis & Risk Assessment

The main climate hazards the city faces are extreme heat and extreme cold. As mentioned above, the city is already dealing with these issues, which are expected to be aggravated with the effects of climate change. These climate hazards affect a number of sectors, such as public health, infrastructure (transport, building, water), as well as the local economy, especially as concerns agriculture. The vulnerability analysis conducted is presented in the table below:

Table 17: Vulnerability Analysis

Receptors		Extreme Weather Event	Potential Impacts	Who/What Impacted
Population	Public Health	Extreme heat	Deaths due to cardiovascular diseases	Everyone, but especially elderly people, babies, children, workers in outdoor environments, and sensitive groups of people
			Spread of vector-borne and infectious diseases	
			Altered allergic pattern	
			Heat stress	
		Extreme cold	Increased heart rate and blood pressure	Everyone, especially elderly, babies, children, and workers in outdoor environments as well as sensitive groups
			Decreased lung function	
			Spread of infectious diseases	
Infrastructure	Transport	Extreme heat	Road network damages	Roads, people mobility
			Changed behaviour patterns	
			Air quality problems	
			Higher maintenance costs	
	Energy	Extreme heat	Altered electricity peaks/demands	Electricity providers and consumers
			Cooling problems	
			Reduced efficiency yield from distribution grid	
			Higher maintenance costs	
	Water	Extreme heat	Higher water demand	Public health, water infrastructures
			Water quality issues	
			Higher maintenance costs	
			Water scarcity	
	Social	Extreme heat	Higher electricity demand to cover cooling needs	Hospitals, schools, public places, municipal facilities/ infrastructure, athletic facilities
			Changes in behaviour patterns (e.g., living outdoors)	
			Burdening healthcare facilities due to increased patients in hospitals	
Built Environment	Building Stock & Material	Extreme heat	Concrete damages	All building infrastructure
			Increased cooling demands	
			Higher maintenance costs	
			Urban heat island effect	
			Damage to structure and contents of building	

Table 17: Vulnerability Analysis

Receptors		Extreme Weather Event	Potential Impacts	Who/What Impacted
Economy	Tourist	Extreme heat	Increased demand for cooling	Tourists, tourist infrastructure, tourist-related economy
			Lower tourist flows during impacted seasons	
			Higher water demand	
	Agriculture	Extreme heat	Changed growth cycle	Farmers, food industry, consumers
			Damaged/lost harvest	
			Livestock loss & health impacts	
			Lower crop yields	
		Cold	Changed growth cycle	Farmers, food industry, consumers
			Damaged/lost harvest	
			Lower crop yields	
			Increased possibility of landslides	
			Lost crops	
Biodiversity	Green Zones & Forests	Extreme heat	Fires and destruction of the ecosystem, flora, and fauna	Ecosystem, fish industry, consumers
		Extreme cold	Changed growth cycle	Ecosystem
			Damaged/lost harvest	
			Lower crop yields	
		Storms	Damaged/lost harvest	Farmers, food industry, consumers
			Lower plant productivity	
		Fires from burning agricultural waste	Soil erosion and degradation	Ecosystem

In the table below, the municipality's risk assessment outlines the impact of each climate hazard on the sectors identified above:

Table 18: Risk Assessment

Receptors		Weather Sensitivity	Future Risk	Impact
Population	Public Health	Extreme heat	Increased number of deaths	High
			Reinforcement of heat stress	
			Increased infectious diseases	
			Altered allergic patterns	
		Cold	Increased infectious diseases	Low
			Increased number of deaths	
			Increased cardiovascular diseases	
Infrastructure	Transport	Extreme heat	Damaged road networks	High
			Modification of transport frequency and means	
			Air quality problems	
			Higher maintenance costs	
	Energy	Extreme heat	Blackouts and inability to cover demand load	High
			Higher maintenance costs	
		Cold	Breakdown of electricity	Low
	Water	Extreme heat	Water scarcity	High
			Water quality issues	
	Social	Extreme heat	Increased needs for air-conditioned public spaces	Medium
Built Environment	Building Stock & Material	Extreme heat	Concrete damage	Low
			Increased cooling demands	
			Higher maintenance costs	
			Urban heat island effect	
Economy	Tourist	Extreme heat	Change of tourism season – lower tourism flows	High
			Reduced tourism-related activities	
	Agriculture	Extreme heat	Changes in growth cycle	High
			Damages/loss of harvest	
			Livestock loss and impacts on health	
			Lower crop yields	
			Increased fire risks	
		Cold	Changes in growth cycle	High
			Damages/loss of harvest	
			Lower crop yields	
			Trees falling due to winds	

Table 18: Risk Assessment

Receptors		Weather Sensitivity	Future Risk	Impact
Biodiversity	Green zones & forests	Extreme heat	Fires and destruction of the ecosystem	High
		Extreme cold	Changed growth cycle	High
			Damaged/lost harvest	
			Lower crop yields	
			Trees falling due to gusty winds	
		Sandstorms	Decreased Kaya and Jatropha trees	High

4 Capacity Building & Local Governance

Chapter 4: Capacity Building and Local Governance

4.1 Developing Capacity for Local Governance

Background

Egypt is highly threatened by the impact of climate change, which crucially affects water, agriculture, and food security. Regarding water resources, there is already a major gap between supply and demand, in addition to recent defiance caused by the construction of the Al Nahda Dam in Ethiopia, which could further restrict the scarce supply of Nile water. This issue is also related to energy consumption and climate effects.

- While active political involvement and official public documents indicate that the Egyptian government highly prioritises climate change issues and is committed to international agreements, we note the need to further specify clear planned actions per sectors, territories, modalities of climate finance, prioritise mainstreaming steps and raising public awareness in the short and long term.
- Despite a stated commitment to grassroots involvement in climate change adaptation processes and actions, the actual focus in national adaptation plans is on large-scale technical and infrastructure options for mitigation and adaptation, with little attention given to the operational, social, and institutional context in which these options operate. Future national-level efforts to develop climate plans (including SEACAPs) need to consider the role of local institutions more centrally if they seek to address those aspects and better serve the needs and interests of the most vulnerable populations.
- Notably, there is still a lack of support for developing the local institutional capacity and the corresponding mechanisms necessary to address climate variation and problems at the local and city levels. Policymakers need to consider climate change governance as a complex, multi-actor process that is deeply embedded in local and urban realities.

Yet, many opportunities for action are arising:

- Following its hosting of the 2021 UfM Ministerial on Environment and Climate Action, Egypt is planning to host the coming COP 27. The TAT will plan to capitalise on this momentum and participate actively in the events that will be held in Sharm El Sheikh in November 2022, even though this date will come after the conclusion date of the Clima-Med current phase (June 22).
- Clima-Med's climate policy integration at governorate levels can help incorporate the aims of climate change mitigation and adaptation into all the stages of policymaking and in multiple sectors. Our bottom-up approach proposes a planning and implementation model and mainstreaming tools to national authorities and sectoral ministries, who are invited to take a top-down action for the replication of SEACAPs to all governorates, and hence help decentralise a wide range of sectoral climate action.
- Clima-Med's approach to preparing regional climate strategies and SEACAPs for two governorates, including Luxor, where Al Zayniyyah Markaz and city are located, is expected to consolidate strategic planning at the national level. Preparing demonstrative regional Climate Action Strategies (CASs) and SEACAPs proposes a tool and mechanism to involve governorates and local authorities to implement the NDC through concrete actions nationwide, allowing consideration of climate change causes, consequences, mitigation, and adaptation in most climate-related sectors.

The city is disproportionately affected by climate change primarily due to its exposure to impacts as well as various constraints in resources. Local governance suffers from lack of technical know-how, financial and human resources, inflexible legislation and ineffective monitoring mechanisms – all of which prevent optimal climate change adaptation.

Developing capacity for local governance is essential not just for delivering development goals but also to support the process of making the local authority more responsive, inclusive, and accountable. Individual and societal vulnerability to climate change is often determined by the availability of resources and influenced by institutional dynamics.

Action

Based on the above, the focus will be on identifying local capacity needs, in complementarity with broader needs at the Governorate's level, as key for enabling multi-level governance to effectively respond to climate change by:

- Conducting a local governance assessment based on evaluation criteria to identify local capacity needs for implementing climate change adaptation in the city.
- Identifying and integrating local capacity needs into recommendations for policy measures to support a municipal local adaptation plan process.

Processing these activities requires the intervention of consultants conducting specific activities, not only to assess the capacity of local governance systems to implement climate change adaptation and to identify capacity needs, but to address capacity needs in recommendations for climate-smart policy formulation, all in line with national policies and complemented by multiple ongoing related capacity building actions in Egypt.

The **recommended and indicative methodology** of this work is essential and done in close coordination with the Governorate and its affiliated sectors representing national authorities:

1. Conduct a Capital Approach Framework (CAF) to assess the capacity of local governance for implementing climate adaptation.

2. Convene participatory, interactive workshops to co-develop appropriate recommendations for policy formulation based on the results of the CAF.

The participatory workshops can be organised in the following manner:

- **Municipal council participatory workshop with the participation of municipal and the Governorate's technicians** at a plenary discussion and deliberation on the management objectives of the council concerning climate change adaptation. The results of the CAF can be presented and validated. This can be done by asking participants to either agree or disagree with key findings.
- Considering that multiple cities from Luxor Governorate are preparing SEACAPs, a joint workshop should be considered.
- **National government participatory, interactive workshop with representatives from various ministries**, non-governmental organisations, and external research institutions to
  - Discuss the management objectives of local governance in the context of climate change adaptation;
  - Validate the findings from the assessment; and
  - Agree on the policy recommendations from the municipal council.

Considering that national authorities are represented at the Governorate level, this workshop can include them with the limited additional participation of key authorities, starting with the National Council for Climate Change (NCCC), an inter-ministerial committee and the key-decision body responsible for coordinating climate policy development and implementation across ministries and agencies.

4.2. Green, Sustainable &/or Energy-efficient Public Procurement

Background

Public procurement plays a key role in rationalising public expenditures and strengthening accountability, enhancing transparency, and, consequently, contributing to sustainable development. Public procurement refers to the process by which public authorities, such as local authorities, purchase goods, services, or works from companies. Public procurement and the way procurement processes are shaped, and priorities are set in the procurement decisions offer a significant opportunity for local authorities to improve their overall energy efficiency.

Green public procurement is the process whereby public authorities seek to procure goods, services, and works with a reduced environmental impact throughout their lifecycle when compared to goods, services, and works with the same primary function that would otherwise be procured. This means that public contracting authorities take environmental considerations into account when procuring goods, services, or works.

Sustainable public procurement goes even further as the contracting authorities must consider the three pillars of sustainable development – the effects on the environment, society, and economy when procuring goods, services, or works.

Energy-efficient public procurement allows for improving energy efficiency by setting it as relevant criteria in the tendering and decision-making processes related to goods, services, or works. It applies to the design, construction, and management of buildings, the procurement of energy-consuming equipment, such as HVAC systems, vehicles, and electrical equipment, and also to the direct purchase of energy (e.g., electricity, gas). It includes practices such as lifecycle costing, the setting of minimum energy-efficiency standards, the use of energy-efficient criteria in the tendering process, and measures to promote energy efficiency across organisations.

Energy-efficient procurement offers public authorities and their communities social, economic, and environmental benefits:

- By using less energy, public authorities will reduce unnecessary costs and save money;
- Some energy-efficient goods, such as light bulbs, have a longer lifespan and are of higher quality than their cheaper alternatives. Purchasing them will reduce valuable time and effort involved in frequently replacing equipment;
- Reducing CO2 emissions as a result of energy-efficient procurement will help public authorities decrease their carbon footprint;
- Through leading by example, public authorities help to convince the general public and private businesses of the importance of energy efficiency and support the development of a green economy.

The interest in developing green public procurement concerns its CO2 emission reduction and also its financial impact.

Action

To be undertaken in close coordination with the Governorate and possibly under its leadership: Implementing green procurement at a Governorate level and in a city is not an easy task. It needs a full understanding of green procurement processes with proper implementation and training for municipal staff.

Implementation steps:

- Raise awareness and develop local capacity to enhance green procurement in the Governorate and the city;
- Organise a session on green procurement for municipal staff and institutions concerned with administration development;
- Conduct a SWOT analysis to elaborate the means and tools to ensure proper implementation of green procurement in the city;
- Upgrade the internal procedures and regulations of procurement to include a sustainability clause;
- Adapt local regulations and policies to ensure proper implementation of green procurement;
- Train the local administration departments and related representatives on the new rules; and
- Assign a consultant to develop and implement sustainability rules in public procurement.

4.3. Information Measures & Public Awareness

Background

Public awareness and social engagement play a pivotal role in successful climate action. Measures to induce behaviour change and provide education significantly contribute to the decrease in energy consumption. Social and non-technological approaches must be included in policies that support energy efficiency and energy savings.

Local authorities are to integrate policies aimed at increasing public awareness (such as information and benefit campaigns) towards a behavioural change in energy use in their territories.

Chapter 7 of this SEACAP guides the Governorate and the city in preparing and implementing these kinds of measures which enhance the impact of their information and training campaigns.

Type of measure

Measures targeting different groups and covering several sectors are frequently selected by local authorities in their Sustainable Energy Access and Climate Actions Plans.

The most common tools on which the measures rely include:

- Web-based platforms (the Governorate website), whose popularity is growing.
- Mass info campaigns of varying scope and messaging. There is a need to tailor messages for specific audiences. However, they must target specific areas of society, and the message needs to be repeated to be effective.
- Online tools to calculate CO2 reduction or energy savings estimations.
- Governorate Databases are containing examples of energy efficiency applications such as illustrated examples of energy renovated houses and energy efficiency expert rosters. These kinds of measures targeting users with previous knowledge of the topic may be very effective.
- Energy days promoting dedicated moments, helpdesks, and info points on specific topics to raise public attention on daily themes which may get neglected.
- Training measures may have a great impact on the community as they target more enthusiastic or empathic audiences (students, energy-related workers). However, these measures are not very common because they are more difficult to organise and require specific skills. The three most common training measures are (1) general training for adults, targeting sectors or general ones; (2) education and awareness-raising at schools; and (3) eco-driving, general (adults, students) or professional (drivers, energy-related workers).
- Explore the long-term feasibility of setting online tools to calculate CO2 reduction or energy savings estimations.
- Using adapted communication and awareness-raising messages inspired, be engaged, and have fun when receiving the message. The approach must be carefully selected and kept as simple as possible. City planners should consider:
  - Emphasising energy use and climate change as a real, actual local and personal risk.
  - Facilitating more experiential engagement (personal stories).
  - Leveraging relevant social group norms.
  - Framing policy solutions as what can be gained from immediate action.
  - Appealing to intrinsically valued long-term goals and outcomes.

5 Mitigation Actions

Chapter 5: Mitigation Actions

5.1 Buildings, Equipment, & Facilities

The building sector accounts for a big share of the overall CO2 emissions in a city; thus, it is essential to take specific measures to mitigate these emissions. This section proposes a set of actions applied to the three essential pillars of the building sector – municipal, residential, and tertiary.

5.1.1 Existing Municipal Buildings: Consumption Saving Measures

Background

The city has buildings under its direct control and management consuming 538.46 MWh per year (2019), producing 299.4 tCO2-eq of emissions. The commitment of the municipal council to mitigating emissions through energy-saving projects in municipal buildings and facilities will be a role model at the local level. These measures will enable the municipal staff to acquire the needed expertise in implementing energy efficiency actions and promoting the green economy at a local level.

Below are the city's proposed energy efficiency actions:

Mitigation

MWh/a	t CO2-eq /a		
161	89.4		
Total Consumption Contribution			
30%			
Implementation Cost			
Not identified			
Stakeholder Involvement	LA		H
	External		L
	Other		L
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Energy bill			
Measurement Units			
MWh			
Intervention Area			
Energy efficiency			
Policy Instrument			
Awareness-raising			
Action Origin			
Local authority			
Action Priority			

Description of the actions

Mapping the behaviour of energy consumption in municipal buildings along with energy audits identifies the basic measures to implement, leading to energy savings.

Behavioural change through optimal use of energy and consumption savings measures leads to a material amount of savings.

Energy audits are a useful tool for providing the information needed to analyse current consumption and implement energy efficiency measures through long-term energy management.

Indicators will quantify the cost of implementing the measures. First, the city should assign an energy engineer able to lead the development of measures, identify the implementation steps, and monitor the results.

Measures to be taken by the city are:

- Assign an energy expert to lead the work in municipal buildings as an energy performance advisor. With the expert, the city will set its vision and energy-saving targets.
- Conduct energy audits in municipal buildings and facilities to identify the source of consumption, then list the measures reducing it and quantify the budget required.
- Identify the funding source, apply the measures, and monitor the implementation with an energy expert.

The indicative measures may vary between measures reducing consumption and those improving energy efficiency and can be divided into short-term actions and long-term actions:

Short-term actions:

Implementing consumption-saving measures, such as turning off the lights after leaving; using natural lighting whenever possible; using office equipment (PCs, printers, etc.) efficiently; adjusting air cooling units according to the thermal calendar; and maintaining equipment and appliances.

Long-term actions:

Using high-efficiency equipment through green procurement; replacing old office appliances with new highly efficient ones; using motion sensors in public places such as halls, bathrooms, and stairs; Retrofitting existing lighting with more efficient types such as LED lighting (this could be applied upon the end of existing lamp life) and improving roof and wall insulation.

Financial analysis

In the table below, the calculations for energy savings are presented based on assumptions which can be verified and revised at the time of implementation. Concerning the share of electricity consumption per the

share of electricity consumption per the original source of consumption, the calculation assumes lighting is 25% of municipal consumption; heating, ventilation, and air-conditioning (HVAC) 40%; and equipment and appliances 35%.

	Assumed Consumption	Action Period	Proposed Actions	Energy Savings Assumption	Annual Energy Savings
Electricity Consumption 533 MWh	25% artificial lighting	Short-term	- Turn off the lights after leaving - Use natural lighting	5%	25% * 5% * 533 = 6.6 MWh
		Long-term	- Install motion sensors for controlling lights in public places	1%	25% * 1% * 533 = 1.3 MWh
			- Replace existing bulbs with efficient alternatives (e.g., LEDs)	50%	25% * 50% * 533 = 66.6 MWh
	35% equipment	Short-term	- Use office equipment (PCs, printers, etc.) efficiently	1%	35% * 1% * 533 = 2 MWh
		Long-term	- Use high-efficiency equipment through green procurement	10%	35% * 10% * 533 = 18.6 MWh
	40% HVAC	Short-term	- Adjust air cooling units according to the thermal calendar - Maintain equipment and appliances	30%	40% * 30% * 533 = 64 MWh
Fuel (Diesel) Consumption 5.64 MWh	Space heating	Long term	- Improve roof and wall insulation	30%	30%* 5.46= 1.6 MWh
				Calculated energy saving	**161 MWh/a**

Energy saving (MWh) = Electricity consumption (MWh) x consumption per original source of consumption (%) x Energy savings based on assumptions (%)

The monetary energy savings have been calculated according to the energy costs at the time of preparing this report.

Expected funding resources:

- Total annual energy savings is around 533 MWh (at EGP 712/MWh), amounting to around EGP 383,182 (EUR 21,075).
- Budget: The calculated cost for this action is considered low and mainly focuses on the conduction of energy audits, the adoption of low-cost measures and the promotion of behavioural change, applying green procurement and following manufacturers' recommendations on the operation and maintenance of equipment. The budget will be covered by the city's resources.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 89.4 tCO2-eq/a, accounting for 357.6 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual bill by EUR 6,301, representing 20.8% of annual consumption costs.
- Source of finance: Most of the actions in municipal buildings can be achieved at an affordable cost to the city. The expected funding resources will come from the municipal budget.

Energy Source	Consumption, MWh	Annual Energy Savings, MWh	Annual Monetary Savings, EGP (EUR)	Emissions Mitigation, tCO2-eq
Electricity	533	159.4	712*159.4 = EGP 113,493 (EUR 6,242)	159.4*0.559=89
Fuel (Diesel)	5.46	1.6	1.6*6.75*1000/10= EGP 1,080 (EUR 59.40)	1.6* 0.268=0.4
Total	**538.46**	**161**	**EGP 114,573 (EUR 6,301)**	**89.4**

Annual savings = Annual energy savings (MWh) x cost of electricity (EGP 712/MWh)
Annual savings diesel = Annual energy savings (MWh) x cost of diesel (6.75*1000/10 EGP/MWh)

5.1.2 New Municipal Buildings: Implementing & Promoting the Green Building Code

Background

The building sector is the leading contributor to energy consumption and represents the main area to be addressed in the SEACAP.

Green building practice goes beyond enacting legislation. Introducing a new buildings code provides incentives for environmentally friendly green buildings which conserve energy and rationalise consumption.

Energy consumption in the municipal buildings sector reached 538.46 MWh in 2019 and is expected to increase by 2030 to 716.2 MWh.

The suggested measures are to be applied through national authorities and the Governorate. They vary between applying green building codes on new buildings, using renewable energy, using electricity and water-saving appliances, insulating buildings and greening areas surrounding the buildings by growing plants requiring minimal water.

Energy efficiency processes can be applied to the design, renovation, and operation of buildings.

Mitigation			
MWh/a		tCO2/a	
26.4		14.7	
Total Consumption savings			
31%			
Implementation Cost			
Not identified			
Stakeholder Involvement	LA		H
	External		L
	Other		L
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Energy bill			
Measurement Units			
MWh			
Intervention Area			
Energy efficiency			
Policy Instrument			
Green building code			
Action Origin			
Local authority			
Action Priority			

ANNUAL ENERGY CONSUMPTION & EMISSIONS OF MUNICIPAL BUILDINGS, EQUIPMENT, & FACILITIES

Energy Source	2019 Consumption, (MWh)	2019 CO2 Emissions, tCO2-eq	2030 BAU Consumption, MWh	2030 BAU Emissions, tCO2-eq	New Building Consumption Estimate, MWh	New Building Emissions Estimate, tCO2-eq
Electricity	533.0	297.9	708.9	396.3	87.0	48.7
Fuel (diesel)	5.5	1.5	7.3	1.9	0.9	0.2
Total	**538.5**	**299.4**	**716.2**	**398.2**	**87.9**	**48.9**

Description of the action

Energy efficiency of buildings

Ten steps are suggested to improve the energy efficiency of buildings – and implies also adopting measures regarding both thermal and electric energy (e.g., reducing wall transmittance in the former and using efficient appliances in the latter). This approach needs the full adherence of relevant national authorities and the Governorate. It leaves ample freedom to designers while supporting them in adopting solutions involving local climate, culture, and materials:

1. Define the building objectives explicitly with a focus on thermal comfort.
2. Assess microclimatic factors and intervention the site layout and features which can affect indoor comfort.
3. Control the heat gains at the external surface of the building envelope.
4. Control and modulate heat transfer through the building envelope.
5. Control the internal gains from appliances and lighting.
6. Allow for local and individual adaptation.
7. Use passive means and strategies to deliver and remove thermal energy to/from the building.
8. Use HVAC systems assisted by natural (and renewable) energy sources.
9. Use high-efficiency active conventional cooling plants, if still necessary.
10. Train building managers and occupants on how to use, monitor the performance and adequately operate and maintain the building.

Indicative suggestions for improvement of the envelope and other aspects

One of the most common strategies for energy retrofit of buildings usually consists in reducing both thermal losses through the envelope and cooling loads and in controlling the solar heat gains.

The losses of energy through the envelope may be reduced by implementing several measures related to wall and roof characteristics:

- Internal and external thermal insulation of walls reduces their transmittance values according to specific needs and the location of the buildings. Commonly used types of insulation in building construction include fibreglass, polyurethane foam, polystyrene foam, cellulose insulation, and rock wool, in addition to the traditional use of mud brick, which is now suitable only for rural buildings. These materials also reduce the effect of thermal bridges as well as improve sound insulation and thermal inertia.
- Abatement of cooling loads is achieved by reducing solar radiation penetration using shading devices such as movable devices controlled manually or automatically, or internal and external blinds helping to control lighting level and uniformity plus stopping solar radiation from penetrating a room.
- Increased energy performance of buildings is achievable by operating on the heating system. The overall efficiency of the space heating/cooling system includes the efficiency of the generator and the losses of distribution, emission, and inaccurate control systems.

General objectives

The city aims to promote a green building code by raising awareness and guiding investment in energy efficiency measures in municipal buildings yielding energy savings.

Financial analysis

In the table below, the calculations for energy savings are presented based on assumptions which can be verified and revised at the time of implementation.

ENERGY SAVINGS CALCULATION

Energy Source	New Building Consumption Estimate, MWh	New Building Emissions Estimate, tCO2-eq	Energy Consumption Estimated Reduction from Green Building Code	Calculated Energy Consumption Savings, MWh/a	Calculated Emissions Savings, tCO2-eq
Electricity	87.0	48.7	30%	26.1	14.6
Fuel (Diesel)	0.9	0.2	30%	0.27	0.06
Total	**87.9**	**48.9**	**30%**	**26.4**	**14.7**

The monetary energy savings have been calculated according to the energy costs at the time of preparing this report.

Expected funding resources

- Budget: Further studies are needed to calculate the cost for this action, which mainly focuses on applying the green building code to new buildings to be constructed in the coming period, promoting behavioural change, applying green procurement, and following the manufacturers' recommendations on operation and maintenance of equipment, all in coordination with the Governorate and central authorities.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 14.7 tCO2-eq/a, accounting for 58.8 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual bill of EUR 1,032 per year, representing 30% of annual consumption cost.
- Source of finance: Most of the actions in the new municipal buildings can be achieved at an affordable cost to the city. The additional construction cost following the green building code will be considered in the municipal budget related to these activities.

Energy Source	Consumption, MWh	Annual Energy Savings, MWh	Annual Monetary Savings, EGP (EUR)	Emissions Mitigation, tCO2-eq
Electricity	87.0	26.1	712*26.1 = EGP 18,583 (EUR 1,022)	26.1*0.559=14.6
Fuel (Diesel)	0.9	0.27	0.27*6.75*1,000/10= EGP 82 (EUR 10)	0.27*0.268=0.07
Total	87.9	26.4	EGP 16,027 (EUR 1,032)	14.7

5.1.3 Existing Residential Buildings: Awareness Raising Activities

Mitigation			
MWh/a		t CO2-eq /a	
14,161		7,777	
Total Consumption savings			
14.5%			
Implementation Cost			
EUR 340,000			
Stakeholder Involvement	LA		H
	External		L
	Other		H
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Energy bill			
Measurement Units			
MWh			
Intervention Area			
Energy efficiency			
Policy Instrument			
Awareness-raising			
Action Origin			
Local authority			
Action Priority			

Background

Citizen engagement is of utmost importance since almost 28.7% of energy consumption is due to the residential sector. The city's role should support its citizens in reducing their energy consumption bills, increasing their living standards, and preserving local natural resources. Awareness campaigns can influence customer consumption patterns and modify purchasing behaviour towards more energy-efficient products. The city can use licensed ads and publish them at different times and has the initiative and ability to raise awareness in collaboration with various governmental parties, communities, and residents.

The suggested measures are to be applied through national authorities and the Governorate.

The residential sector is responsible for 37.8% of the city's emissions; therefore, it is essential to encourage citizens to consider energy saving as the most important action at the household level.

ANNUAL ENERGY CONSUMPTION OF RESIDENTIAL BUILDINGS

Energy Source	2019 Consumption, MWh	2019 Emissions, tCO2-eq
Electricity	78,294	43,766.34
Fuel (LPG)	41,938.6	9,520
Total	**120,232.6**	**53,286.34**

Description of the action

Awareness-raising campaigns for the city's residents should be organised frequently by the city through 2030, such as:

- Organising "Energy Days" stressing the importance of energy saving and protecting the environment through simple actions such as modifying energy behaviour, exchanging incandescent lamps with fluorescent or LED lamps, purchasing high-efficiency appliances, and installing solar panels for water heating in existing buildings.
- Delivering freely available environmental documentaries.
- Participating in the WWF's "Earth Hour", where people across the world turn their lights off for one hour on a designated day.
- Issuing and distributing a booklet to households with tips for saving water and energy.

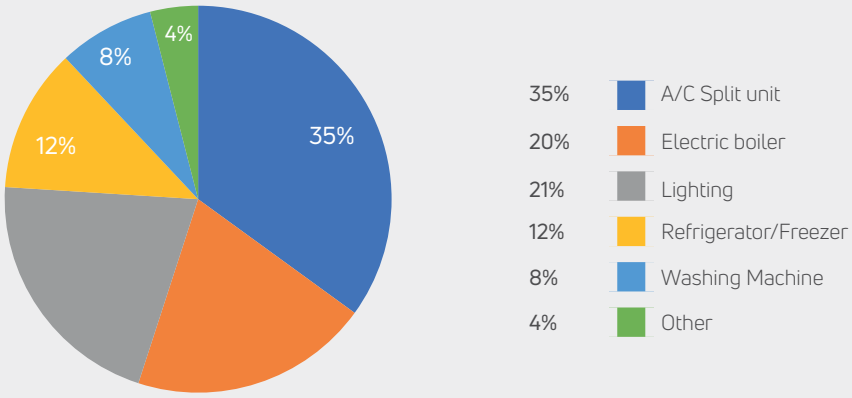
Holding awareness campaigns through audio-visual communication means social media, lectures in schools as well as places of worship to motivate citizens to pursue sustainability and highlight its positive effects on the economy and society, such as:

- **Water**: Rationalizing water consumption; demonstrating methods to reduce water consumption; holding campaigns to encourage residents to obtain a permit allowing them to build water harvesting tanks to store water within the existing residential structure, conforming with modern building principles.
- **Electricity:** Encouraging residents to install solar water heaters, using energy-efficient lightings such as LED and setting air-conditioners at moderate temperatures in the summer or winter.
- **Insulating Buildings:** The importance of building insulation and the benefits.
- **Agriculture:** Greening the areas around private buildings and growing plants requiring minimum water.
- **Solid Waste:** Promoting sorting at the source, using degradable trash bags, and using reusable grocery bags.
- **Cooking:** Promoting the use of responsible cooking methods, rationalising food waste and the use of kitchen utensils, and achieving savings in the consumption of oils and fuels such as LPG using devices such as pressure cookers.

In the table below, the calculations for energy savings are presented based on assumptions which can be verified and revised at the time of implementation.

	Assumed Consumption Estimation	Action Term	Proposed actions	Energy Savings Calculation Assumption	Annual Energy Savings
Electricity Consumption 78,294 MWh	26% artificial lighting	Short-term	Use natural lighting whenever possible, turn off lights after leaving place	5%	26% * 5% * 78,294 = 1,018 MWh
		Long-term	Replace existing inefficient lights with efficient types like LEDs (assuming 50% of households already have efficient LED lights)	50%	26% * 50% * 50% * 78,294 =5,089 MWh
	Home appliances: - 17% refrigeration - 13% washing machines - 4% TV, computers, mobile chargers	Long-term	Replace refrigerators and freezers with new energy-efficient A+++ rated ones (assuming 50% of households already have energy-efficient refrigerators)	50%	17% * 50% * 50% * 78,294 = 3,328 MWh
			Replace existing washing machines with new energy-efficient A+++ rated ones (assuming 20% of households will be able)	10 %	13% * 10% * 20% * 78,294 = 204 MWh
		Short-term	Use electronics and equipment efficiently	1%	4% * 1% * 78,294= 31 MWh
	40% air-conditioning	Short-term	Adjust cooling units to thermal calendar, and maintain equipment and appliances (assuming 30% of households will be able)	30%	40%*30%*30%* 78,294 = 2,819 MWh
		Long-term	Apply wall and roof insulation and replace old air-conditioner with efficient one (assuming 20% of households will be able to implement some of the action's components)	20%	40% * 20% * 20% * 78,294 = 1,253 MWh
Fuel (LPG) Consumption 41,938.6 MWh	Cooking	Long-term	IPromote the use of responsible cooking methods, and use pressure cookers (assuming 10% of households will be able)	10%	10% * 10% * 41,938.6 = 14,161 MWh
				Calculated energy saving	**10%**

Assumptions for electrical consumption and savings are based on Ruble & Karaki Energy Policy 52(2013)608-617 https://www.sciencedirect.com/science/article/pii/S0301421512008749



The following table indicates annually mitigated emissions and energy savings:

Energy Source	Consumption as in MWh	Annual Energy saving in MWh	Annual Monetary Savings, EGP (EUR)	Emissions Mitigation, tCO2-eq
Electricity	78,294	13,742	712 * 13,742 = EGP 9,784,304 (EUR 538,136)	13,742 * 0.559 =7,682
Fuel (LPG)	41,938.6	419	5.2 * 419 * 1000 / 13.7 = EGP 159,036 (EUR 8,747)	419*0.227=95
Total 21%	**120,232.6**	**14,161**	**EGP 9,943,340 (EUR 546,878)**	**7,777**

Average consumer prices for LPG year 2019 equal to 5.2 EGP/12 kg
Emissions factor tCO2-eq/MWh LPG 0.227; conversion factor for LPG 13.7 kWh/kg (IPCC 2006 defaults)

The return on investment is estimated at approximately EUR 38,344 per year.

Expected funding resources:

- Total annual energy savings from the residential sector is around 14,161 MWh amounting to around EGP 9,943,340 (EUR 546,878).
- Budget: Estimated to cost EUR 340,000 for awareness-raising activities by 2030.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 7,777 tCO2-eq/a, accounting for 31,108 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual bill by EUR 546,878.
- Source of finance: The homeowner should pay for all costs for greening the building, however, the city (led by the Governorate) has a role in promoting the greening of the existing buildings, either from the municipal budget or through innovative outsourcing, such as promoting the use of energy-efficient products in houses, plus encouraging companies selling household appliances to promote energy savings products through their annual advertisement programmes.

5.1.4 New Residential Buildings: Implementing & Promoting the Green Building Code

Background

Energy consumption in the city's residential buildings reached 120,232.6 MWh in 2019 and is expected to reach 159,909 MWh by 2030 based on a business-as-usual scenario and without a plan to reduce the energy demand.

Therefore, it is important to reduce energy consumption and conserve resources through sustainable development by adopting the green building model for modern buildings, as it is estimated that a green building will use 25-35% less energy than traditional buildings and use approximately 40% less water. This means lower electricity and water bills for those living in such buildings as well as less reliance on imported energy overall.

Mitigation			
MWh/a		t CO2-eq /a	
5,891		2,611	
Total Consumption savings			
29%			
Implementation Cost			
EUR 260,000			
Stakeholder Involvement	LA		H
	External		H
	Other		H
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Start implementation			
Measurement Units			
Number of new green licenses			
Intervention Area			
Integrated action			
Policy Instrument			
Building standard			
Action Origin			
LA			
Action Priority			

ANNUAL ENERGY CONSUMPTION & EMISSIONS OF RESIDENTIAL BUILDINGS

ENERGY SOURCE	2019 Consumption, (MWh)	2019 CO2 Emissions, tCO2-eq	2030 BAU Consumption, MWh	2030 BAU Emissions, tCO2-eq	New Building Consumption Estimate, MWh	New Building Emissions Estimate, tCO2-eq
ELECTRICITY	78,294.0	43,766.3	104,131.0	58,209.2	12,787.3	7,148.2
Fuel (LPG)	41,938.6	9,520.0	55,778.3	12,661.6	6,849.6	1,554.8
Total	**120,232.6**	**53,286.3**	**159,909.4**	**70,870.8**	**19,636.9**	**8,703.0**

Average consumer prices for LPG in 2019 equal to 5.2 EGP/12 kg)
Emissions factor tCO2-eq/MWh LPG 0.227; conversion factor for LPG 13.7 kWh/kg (IPCC 2006 defaults)

Suggested measures vary between promoting green building and other measures, including:

- Using water storage tanks in modern buildings during winter and in other scarcity periods
- Installing solar water heaters to reduce electricity consumption
- Using thermal insulation to reduce energy consumption in buildings by preventing heat loss
- Greening areas surrounding the buildings and growing plants requiring minimal water
- Providing car parking for buildings
- Using surface rebound and construction ratios
- Using heat-insulated windows

Description of the action

The following indicative measures can be reviewed and updated by the municipal council and stakeholders:

- Work through the Governorate, national authorities and stakeholders to prepare a green building recommendations guide which can be used with new building licences.
- In coordination with the Governorate, conduct awareness-raising campaigns addressing citizens on the importance of green buildings, aimed at protecting the environment as well as reducing costs and encouraging citizens to impose pressure on real estate developers. This would be achieved through audio-visual communication means, social media, and lectures held in schools and places of worship to encourage them to use environmentally friendly renewable energy sources and recognise their positive effects on the economy and society.

General objectives

The aim of the actions undertaken by the city (with the Governorate) is to reduce consumption and pollution caused by fossil fuels to generate electricity as well as save consumption costs while reducing government subsidies to support the energy sector, thus easing the burden on citizens in multiple ways.

Financial analysis

In the table below, the calculations for energy savings are presented based on assumptions which can be verified and revised at the time of implementation.

ENERGY SAVINGS CALCULATION

ENERGY SOURCE	New Building Consumption Estimate, MWh	New Building Emissions Estimate, tCO2-eq	Energy Consumption Estimated Reduction from Green Building Code	Calculated Energy Consumption Savings, MWh/a	Calculated Emissions Savings, tCO2-eq	Annual Monetary Savings, EGP (EUR)
Electricity	12,787.3	7,148.2	30%	3,836.2	2,144.5	712*3,836.2= EGP 2,731,374 (EUR 150,226)
Fuel (LPG)	6,849.6	1,554.8	30%	2,054.9	466.4	5.2*2,054.9*1000/13.7= EGP 779,962 (EUR 42,898)
Total	19,636.9	8,703.0	30%	5,891.1	2,610.9	EGP 3,511,336 (EUR 193,124)

Average consumer prices for LPG year 2019 equal to 5.2 EGP/12 kg

Emissions factor tCO2-eq/MWh LPG 0.227; conversion factor for LPG 13.7 kWh/kg (IPCC 2006 defaults)

The energy savings have been calculated according to the energy costs at the time of preparing this report.

Expected funding resources:

- Total annual energy savings from the residential sector is around 5,891 MWh amounting to around EGP 3,511,336 (EUR 193,124).
- Budget: Estimated to cost EUR 260,000 for awareness-raising by 2030.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 2,611 tCO2-eq/a, accounting for 10,444 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will reduce the annual bill by EUR 193,124.
- Source of finance: The homeowner should pay for all costs for greening the building; however the city has a role in promoting the greening of the existing buildings, either from the municipal budget or through innovative outsourcing. For example, the city can amend the contracts signed with advertising companies to allocate days for unpaid advertisements promoting the use of energy-efficient products in houses, plus encouraging companies selling household appliances to promote energy-saving products through their annual advertisement programmes.

5.1.5 Existing Tertiary Buildings: Awareness Raising Activities

Background

The tertiary sector represents the non-municipal and non-residential buildings, equipment, and facilities (e.g., example shops, offices, banks, commercial and retail activities, schools, hospitals) which consume around 21.4% of the energy consumed in the building sector.

The city's role, along with the stakeholders, should be to support the tertiary sector in reducing its energy consumption bill by highlighting the most important measures to change their consumption behaviour and to take actions toward energy efficiency and renewable energy use.

ANNUAL ELECTRICAL CONSUMPTION & EMISSIONS OF TERTIARY BUILDINGS

ENERGY SOURCE	2019 Consumption, MWh	2019 Emissions, tCO2-eq
Electricity	31,200	17,440.8
Fuel (LPG)	2,119.3	481
Total	33,319.3	17,921.8

Mitigation			
MWh/a		t CO2-eq /a	
9,416		5,193	
Total Consumption savings			
29.50%			
Implementation Cost			
EUR 350,000			
Stakeholder Involvement	LA		H
	External		H
	Other		H
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Start implementation			
Measurement Units			
Number of new green licenses			
Intervention Area			
Integrated action			
Policy Instrument			
Building standard			
Action Origin			
Local authority			
Action Priority			

Description of the action

This action will be conducted in coordination and in complementarity with the Governorate's action.

Awareness-raising campaigns for the city's residents should be organised frequently by the city through 2030 and involve common actions for all types of tertiary buildings:

a. **Replacement of inefficient old lamps:** Indoor illumination of tertiary sector buildings uses the largest proportion of electrical energy. The most common strategy is replacing old inefficient lamps with new, better-performing ones. In a typical lighting system, only 30% of the lumens emitted by the lamp contribute to the lit environment with huge losses due to the luminaire, the light absorption on surrounding surfaces and the light redirection to avoidable areas. Additional factors are influencing energy consumption due to lighting: (1) the choice of the type of lamp; (2) the displacement of lamps; (3) the relation between lamp and luminaires; and (4) the lumen per watt. Plus, using natural light during daylight hours limits the use of artificial light, reducing electrical consumption and thermal load while improving comfort.

b. **Smart use and adopting thermometer calendars** in air-conditioning with programmable timers will help reduce energy consumption as every degree matters! Setting your thermostat at a comfortable temperature won't make your unit work too hard but will still make you feel comfortable.

c. **The use of inverter type air-conditioning** reduces energy consumption and lowers energy bills.

d. **Regulate water use** and use of a tap adaptor to reduce water consumption. This could be applied in public areas and can be heavily implemented in mosques, and will rationalise water consumption.

e. Replace electrical water heaters **with solar water heaters** in restaurants, clinics, mosques, etc.

f. **Efficient office appliances:** Energy savings in appliances are possible through selecting energy-efficient products.

More specific actions for large and more complex buildings such as hospitals, shopping malls, etc. include:

a. **Behavioural changes:** Adequate behaviour of large building occupants may also generate significant savings.

b. **Handling of technical installations in large modern buildings** may lead to energy savings: make sure cooling is turned off during weekends, holidays, and after work—also, fine-tune cooling by setting temperatures. For simple buildings, a technician or an energy manager could be appointed for such tasks. For complex buildings, the help of a specialised company may be necessary. Therefore, it may be necessary to renew or set up a new contract with a competent maintenance company with adequate requirements in terms of energy performance.

c. **Improving the performance of large modern buildings through retro-commissioning:** This process improves the efficiency of an existing large building's equipment and systems (e.g., hotels and hospitals) and involves a systemic evaluation of opportunities to improve energy-using systems. It can often resolve problems occurring during design or construction or address problems developed throughout the building's life as equipment has aged or as building usage has changed (e.g., bringing equipment up to its proper operational state, improving indoor air quality, increasing equipment lifespan, improving maintenance operations).

d. **Improving the building's thermal envelope** through walls and roof insulation, white reflective paints on roofs, and integration of double-glazed windows. Promoting efficient pressure cookers in restaurants, hospitals, hotels, etc.

There is no official study available at the time of this report's preparation regarding energy consumption in the tertiary sector and the estimated contributions of lighting, office equipment, etc. The calculations for energy savings are presented in the table below based on assumptions using information from the European Council for an Energy Efficient Economy,(2) and will be verified and revised at the time of implementation.

	Assumption consumption estimation	Term of action	Proposed actions	Energy saving calculations	Energy saving
Electricity Consumption 31,200 MWh	25% artificial light	Short-term	Use natural lighting whenever possible, turn off lights after leaving place	5%	25 % * 5% * 31,200 = 390 MWh
		Long-term	Install motion sensors for controlling lights in public places	1%	25 % * 1% * 31,200 = 78 MWh
			Replace existing inefficient lights with efficient types	50%	25 % * 50% * 31,200 = 3,900 MWh
	35% electrical equipment	Long-term	Use of efficient office appliances; replace electrical water heater with solar one	10%	35 % * 10% * 31,200 = 1,092
	40% air-conditioning	Short-term Long-term	Adjust cooling units to thermal calendar, and maintain equipment and appliances	30%	40 % * 30% * 31,200 = 3,744 MWh
			Use inverter type a/c, Improve roof and wall insulation		
Fuel (LPG) Consumption 2,119.3 MWh	Cooking	Long-term	Promote the use of responsible cooking methods, and use of pressure cookers (assuming 10% of households will be able)	10%	10%* 2,119.3= 211.9
				Calculated Energy Savings	**9,415.9 MWh**

Financial analysis

The return on investment is estimated at EUR 364,853 per year.

Expected funding resources:

- Total annual energy savings from the tertiary sector is around 9,416 MWh amounting to around EGP 6,663,677 (EUR 364,853).
- Budget: Estimated to cost EUR 350,000 for awareness-raising activities by 2030.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 5,193.1 tCO2-eq/a, accounting for 20,772.4 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual bill by EUR 364,853.
- Source of finance: The tertiary building owners should pay for all costs for greening the building; however the city has a role in promoting the greening of the existing buildings, either from the municipal budget or through innovative outsourcing.

(2) https://www.eceee.org/static/media/uploads/site-2/library/conference_proceedings/eceee_Summer_Studies/2007/Panel_6/6.178/paper.pdf

Energy Source	Consumption, MWh	Annual Energy Savings, MWh	Annual Savings, EGP (EUR)	Emissions Mitigation, tCO2-eq
Electricity	31,200	9,204	712 * 9,204 = EGP 6,553,248 (EUR 360,429)	9,204*0.559=5,145
Fuel (LPG)	2,119	211.9	211.9* 5.2 * 1000/13.7= EGP 80,429 (EUR 4,424)	211.9*0.227=48.1
Total	33,319	9,415.9	EGP 6,633,677 (EUR 364,853)	5,193.1

5.1.6 New Tertiary Buildings: Implementing & Promoting the Bioclimatic Building Practices

Background

In 2019, the city's energy consumption in the tertiary sector was 33,319.3 MWh and is expected to reach 45,105 MWh by 2030.

Therefore, it is important to work on reducing energy consumption and conserving resources through sustainable development and adopting a green building model for modern buildings as it is estimated a green building uses 25-35% less energy than traditional buildings and approximately 40% less water. This means lower electricity and water bills for those who will live in such buildings, as well as less reliance on imported energy.

Mitigation			
MWh/a		t CO2-eq /a	
1,632.5		878.2	
Total Consumption Contribution			
30%			
Implementation Cost			
EUR 240,000			
Stakeholder Involvement	LA		H
	External		H
	Other		H
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Start implementation			
Measurement Units			
Number of new green licenses			
Intervention Area			
Integrated action			
Policy Instrument			
Building standard			
Action Origin			
Local authority			
Action Priority			

ANNUAL ENERGY CONSUMPTION & EMISSIONS OF TERTIARY BUILDINGS

Energy Source	2019 Consumption, (MWh)	2019 CO2 Emissions, tCO2-eq	2030 BAU Consumption, MWh	2030 BAU Emissions, tCO2-eq	New Building Consumption Estimate, MWh	New Building Emissions Estimate, tCO2-eq
Electricity	31,200.0	17,440.8	41,496.0	23,196.3	5,095.7	2,848.5
Fuel (LPG)	2,119.3	481.0	2,818.7	639.7	346.1	78.6
Total	**33,319.3**	**17,921.8**	**44,314.7**	**23,836.0**	**5,441.8**	**2,927.1**

Description of the action

In coordination with the Governorate, the core activities for raising awareness about a green building code plays important roles in promoting green building standards benefitting the city, which can encourage practices lowering the city's environmental footprint as well as developers and owners who can invest in green buildings offering lower utility bills and attracting corporations wanting to demonstrate their commitment to sustainability. The city, with the support of stakeholders, can play a vital role in reducing energy demand in the tertiary sector.

The following indicative approach for green buildings was obtained from the World Green Council:

Taking an intelligent approach to energy

- Minimising energy use in all stages of a building's lifecycle, making new and renovated buildings more comfortable and less expensive to run, and helping building users learn to be efficient too.
- Integrating renewable and low-carbon technologies to supply buildings' energy needs once their design maximises inbuilt and natural efficiencies.

Safeguarding water resources

- Exploring ways to improve drinking and wastewater efficiency and management, harvesting water for safe indoor use in innovative ways, and generally minimising water use in buildings.
- Considering the impact of buildings and their surroundings on storm water and drainage infrastructure, ensuring these are not put under undue stress or prevented from doing their job.

Minimising waste and maximising reuse

- Using fewer, more durable materials and generating less waste, as well as accounting for a building's end-of-life stage by designing for demolition waste recovery and reuse.
- Engaging building users in reuse and recycling.

Promoting health and wellbeing

- Bringing fresh air inside, delivering good indoor air quality through ventilation, and avoiding materials and chemicals creating harmful or toxic emissions.
- Incorporating natural light and views to ensure building users' comfort and enjoyment of their surroundings while reducing lighting energy needs in the process.
- Designing for ears as well as eyes. Acoustics and proper sound insulation play important roles in helping concentration, recuperation, and peaceful enjoyment of a building in educational, health, and residential buildings.
- Ensuring people are comfortable in their everyday environments, creating the right indoor temperature through passive design or building management and monitoring systems.

Keeping our environment green

- Recognising that our urban environment should preserve nature while ensuring diverse wildlife and land quality are protected or enhanced, by, for example, remediating and building on polluted land or creating new green spaces.
- Looking for ways we can make our urban areas more productive, bringing agriculture into our cities.

Creating resilient and flexible structures

- Adapting to our changing climate, ensuring resilience to events such as flooding, earthquakes, or fires so that our buildings stand the test of time and keep people and their belongings safe.
- Designing flexible and dynamic spaces, anticipating changes in their use over time, and avoiding the need to demolish, rebuild, or significantly renovate buildings to prevent them from becoming obsolete.

Financial analysis

ENERGY SAVINGS CALCULATION

SITE CATEGORY	New Building Consumption Estimate, MWh	New Building Emissions Estimate, tCO2-eq	Energy Consumption Estimated Reduction from Green Building Code	Calculated Energy Consumption Savings, MWh/a	Calculated Emissions Savings, tCO2-eq	Annual Monetary Savings,
Electricity	5,095.7	2,848.5	30%	1,528.7	854.6	712*1,528.7= EGP 1,088,441 (EUR 59,864)
Fuel (LPG)	346.1	78.6	30%	103.8	23.6	5.2*103.8*1000/13.7= EGP 39,410 (EUR 2,168)
Total	**5,441.8**	**2,927.1**	**30%**	**1,632.5**	**878.2**	**EGP 1,127,851 (EUR 62,031)**

Average consumer prices for LPG year 2019 equal to 5.2 EGP/12 kg

Emissions factor tCO2-eq/MWh LPG 0.227; conversion factor for LPG 13.7 kWh/kg (IPCC 2006 default factors)

The monetary energy savings have been calculated according to the current energy costs at the time of preparing this report.

Expected funding resources:

- Total annual energy savings from the tertiary sector is around 1,632 MWh amounting to around EGP 1,127,851 (EUR 62,031).
- Budget: Estimated to cost EUR 240,000 for awareness-raising activities by 2030.

- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 878.2 tCO2-eq/a, accounting for 3,512.8 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will reduce the annual bill by EUR 62,031.
- Source of finance: The tertiary building owner should pay for all costs for greening the building; however the city has a role in promoting the greening of the existing buildings, either from the municipal budget or through innovative outsourcing.

5.2. Municipal Public Lighting

Background

With outdated, inefficient street lighting systems, a significant amount of municipal energy bills goes on street lighting.

Modern LED lighting solutions are advancing rapidly and can deliver significant energy savings. Increasing efficacy, optimised luminaire design, and flexible lighting control enable enhanced performance at a lower cost for different lighting and traffic conditions.

Advanced technology nowadays can offer 30-70% of electrical energy savings from the public lighting sector. The street lighting improvement project can include using LED technology, smart LED drivers, and astronomical timers. Intelligent control systems create additional savings as the lighting level can be adjusted depending on the time of day and other requirements.

Mitigation			
MWh/a		tCO2/a	
315.23		176.21	
Total Consumption Contribution			
37.2%			
Implementation Cost			
N/A			
Stakeholder Involvement	LA		H
	External		L
	Other		H
Staff Capacity	L	M	L
Implementation Years			
Key Performance Indicator			
Start implementation			
Measurement Units			
Number of replaced lights			
Intervention Area			
Energy efficiency			
Policy Instrument			
Energy management / Public procurement			
Action Origin			
Local authority			
Action Priority			

Description of the action

Replacing old street lighting with a modern type, saving energy will provide better quality lighting, reduce light pollution, and lower maintenance costs. The municipality should:

- **Develop a master plan** for the city identifying streets and paths with recommended types and models of street light luminaires to be used.
- **Modernise the protection components** of street light systems by installing:
  - Surge protection on feeders and pole sides
  - Proper grounding systems
  - Overload and short-circuit protections
  - Astronomical timers
  - Switching components
  - Energy consumption metering
  - Differential relays
  - Permanent over-voltage protection
- **Procure, install, and maintain the new lights** along with necessary protection devices and control systems. The procurer should specify the streets and paths for which the street lighting system will be designed, or lighting system components will be procured. The system will be specified based on the standard EN13201 and related national standards. Among other things, the procurer will determine illuminance levels, uniformity levels, and system maintenance factors.
- **Obtain the measurement for light distribution** before and after the work is completed.
- **Setup an operational and maintenance plan** for public lighting.
- **Conduct training on operation and maintenance** for the technical staff to ensure quality of services and to extend the lifespan of the components.

General Objectives

Modern public lighting systems positively impact social aspects of the city including traffic safety, crime rates, productivity (due to security at night) as well as cost-oriented aspects such as reduced costs due to energy efficiency, plus environment-related parameters such as reduced toxic gases and emissions.

BEI consumption (MWh)	BAU consumption (MWh)	Annual consumption after replacement (MWh)	Energy Savings (MWh)
637.39	847.7	382.43	254.95

The expected results from replacing the street lighting system are shown in the table below:

Key Actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	
Sectoral & Field of action Number	**MWh/a**	**tCO2/a**	**MWh/a**	**tCO2/a**		**Cost in Euro**
Public Street Lighting	**847.7**	**473.9**	**315.23**	**176.21**	**37.18**	
Developing master plan	847.7	473.9				5,000.00
Modernize the protection components of street lights system			60.28			
Procuring, installing, maintaining the new lights			254.95			
Obtaining the measurement for light distribution						2,000
Setup the Operational and Maintenance Plan						2,000
Conduct training on operation and maintenance						2,000

Expected funding resources

- Total annual energy savings from the street lighting sector is around 315.23 MWh amounting to around EGP 224,444 (EUR 12,344).
- Budget: To be identified.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 176.21 tCO2-eq/a, accounting for 704.84 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will reduce the annual energy cost by EUR 12,344

  Source of finance: The city can finance the project whenever changing any lamp by changing it to LED; through partnerships with the private sector; through an energy performance contract (EPC); and many other forms of financial mechanisms.

5.3 Transport

The transport sector in the city includes only road transport and comprises subcategories such as the municipal fleet and private transport, while there are no public transport services in the city. According to the city, the municipal fleet of vehicles includes passenger vehicles; light, medium, and large trucks; construction machinery; and other vehicles. The fuels used for the municipal fleet are gasoline and diesel. Regarding private cars, fuel consumption is calculated by the city based on the total number of cars in the region, the average travelled distance and the average consumption per kilometre for each type of vehicle. The same approach is used for commercial vehicles and private/ public transportation.

The table below presents the estimated data for annual diesel and gasoline consumption: (3)

ANNUAL FUEL CONSUMPTION & CO2 EMISSIONS OF MUNICIPAL & PRIVATE TRANSPORT

Transportation sector	Diesel (L)	Gasoline (L)	Fuel Consumptions MWh	Emissions tCO2-eq	2030 BAU Energy Demand, MWh	2030 BAU Emissions, tCO2-eq
Municipal Fleet	119,136	8,162	1,266.45	338	1,684	450
Private Sector	14,573,650	12,342,850	259,290.72	67,446	344,857	89,703
Total	14,692,786	12,351,012	260,557	67,784	346,541	90,153

Emissions factor for diesel is 0.268 tCO2-eq/MWh; emissions factor for gasoline is 0.25 tCO2-eq/MWh
Conversion factor for diesel is 0.010 MWh/L; conversion factor for gasoline is 0.0092 MWh/L

5.3.1 Road Asset Planning & Management with Sustainable Mobility Measures

Background

In the city, private vehicles are moving daily, emitting a considerable quantity of CO2. The peak hours of congestion are limited in the morning around 8:00 am and in the afternoon between 2:00 pm and 4:00 pm as residents are moving to their jobs and students to their schools then returning homes. During the working hours, there is limited traffic congestion the whole day. In addition to the absence of public transportation in the region makes citizens' transport between the regions costly and sometimes difficult. Implementing measures and actions to improve and enhance citizens' transport is important in establishing a sustainable and environmentally friendly transport system.

In the table below, the transportation sector contributes 62.3% of city emissions:

ANNUAL FUEL CONSUMPTION OF TRANSPORT SECTOR

SITE CATEGORY	2019 Consumption, (MWh)	2019 CO2 Emissions, tCO2-eq	2030 BAU Consumption, MWh	2030 BAU Emissions, tCO2-eq
TRANSPORT SECTOR	260,557	67,784	346,541	90,153

Mitigation			
MWh/a		t CO2-eq /a	
24,258		6,311	
Total Consumption Contribution			
7%			
Implementation Cost			
EUR 1,750,000			
Stakeholder Involvement	LA		H
	External		L
	Other		L
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Start of planning & progress in work			
Measurement Units			
Number of users			
Intervention Area			
integrate urban & public transport services			
Policy Instrument			
Land use planning regulation			
Action Origin			
Local authority			
Action Priority			

Description of the Action

This action will be conducted in coordination and in complementarity with the Governorate's action after assessing the sector's capacity and plans to be modernized and upgraded:

1. **Long-term vision** for road asset management at the township level, securing road connectivity to form a continuum of arterial field paths, and reliable access to social, economic, and administrative services. (4)
2. **Improve road network planning** to develop rural areas based on best practices from urbanisation, agriculture, and industry as well as livelihoods promotion, passenger transportation, access to socio-economic services, and achieving SDGs. Strengthen local community and governance institutions to play a proactive role in planning and maintaining public transportation services and road safety. (5)

(3) Journal of Nature Science and Sustainable Technology ISSN 1933-0324 Volume 2, Issue 3
(4) https://www.teriin.org/sites/default/files/2019-05/rural-roads-sdgs.pdf
(5) https://www.teriin.org/sites/default/files/2019-05/rural-roads-sdgs.pdf

3. **Road asset management** is the strategic and systemic process of operating, maintaining, upgrading, and expanding physical road assets throughout their lifecycle while improving network efficiency. This may require introducing a hierarchy of roads, integrating with other transport modes, and incorporating economic growth and strategic requirements.

4. Sustainable mobility measures for minimising the use of conventional private vehicles and increasing sustainable transportation means. The measures can be taken under 3 pillars:

   - **Active mobility.** People can shift their mobility habits from car to walking and cycling, as a large portion of car trips cover less than 5 km. These two options can contribute both to achieving energy and climate goals and to a number of benefits for personal health, the city, etc. Some of the benefits are improved public health, reduced road temperature, better air quality, low noise levels, reduced congestion, more free spaces, and reduced road accidents.
   - **Shared/collective mobility.** Shared mobility means a bold promotion of the solutions based on the public transportation system and the collective use of the available cars. Public transport must be established and put at the forefront of sustainable mobility measures, both environmental/health issues and car reduction goals. Moreover, it encourages accessibility and equity, providing low-income people (with no car) with affordable mobility solutions and breaking the isolation barriers of distant communities. Apart from public transportation, other collective forms of mobility can be taxi multi-use, car-sharing, ride-sharing, bike-sharing, and demand-responsive transport, helping people be less reliant on private vehicles.
   - **Sustainable mobility awareness.** This pillar includes "soft measures" toward changing travel attitudes and behaviours to reduce single-occupancy car use. Such measures can be public/business incentives to increase cycling and walking to work, awareness-raising campaigns, info points, school/authority/ company travel plans, and apps for mobility gamification. Soft measures can pave the way for the effectiveness of hard measures and, moreover, requires only a small portion of the total transportation investments.

General objectives

1. Combat social exclusion by providing an opportunity to travel for all in rural areas
2. Improve access between villages and urban centres
3. Optimise resources by efficient routing, ride-matching, and dispatching
4. Integrate rural transport services with existing transport options

Financial analysis

In the table below, the calculations for energy savings are presented based on assumptions which can be verified and revised at the time of implementation.

ENERGY SAVINGS CALCULATION

SITE CATEGORY	2030 BAU Energy Demand, MWh	2030 BAU Emissions, tCO2-eq	Estimated Savings Assumption, %	Calculated Energy Savings, MWh/a	Calculated Emissions Savings, tCO2-eq
TRANSPORT SECTOR	346,541	90,153			
Improve road network planning			2%	6,931	1,803
Road asset management			3%	10,396	2,705
Sustainable mobility measures			2%	6,931	1,803
Total			**7%**	**24,258**	**6,311**

Average Consumer Prices in Palestine for fuel (Gasoline) year 2019 equal to 6.14 (local currency) per litre and equal to 1.5964 euro per Litre.
Emission factor for diesel 0.268 in (tCO2-eq/MWh) *Emission factor for Gasoline 0.25 in (tCO2-eq/MWh) *Conversion factor for diesel 0.010 in (MWh/L)
Conversion factor for Gasoline 0.0092 in (MWh/L)

Energy Source	Consumption, litres	BAU 2030	Annual Monetary Savings, EGP (EUR)
Fuel (Diesel)	14,692,786	19,541,405	EGP 9,233,314 (EUR 507,832.30)
Fuel (Gasoline)	12,351,012	16,426,846	EGP 10,636,383 (EUR 585,001.10)
Total	**27,043,798**	**35,968,251.3**	**EGP 19,869,697 (EUR 1,092,833.40)**

Expected funding resources:

- Total annual energy savings from the transportation sector is around 24,258 MWh amounting to around EGP 19,869,697 (EUR 1,092,833).
- Budget: Estimated to cost EUR 1,750,000.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 6,311 tCO2-eq/a, accounting for 25,244 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual energy cost by EUR 1,092,833.
- Source of finance: The Governorate and the municipality are the main implementors using funds, either from the municipal budget or outsourcing to the national budget or grants. Sustainable mobility can be implemented through the participation of the private sector or investors. The Governorate, in coordination with concerned national authorities, must enact the necessary legislation for the private sector to facilitate and support the action.

5.3.2 Transportation Solid Waste Sector

Background

As with all environmental problems, the increase in solid waste production goes hand in hand with a growing population and rising consumption. Along with these rising levels, the investment, management, and maintenance of solid waste collection and transport vehicles is seeing a continual increase in financial outlays.

Solid Waste Management: The city collects and transfers solid waste using different types of garbage vehicles consuming significant diesel.

The city has a total population of 65,000 people, annually producing solid waste of about 16,425 tons and is steadily increasing due to the continuously increasing population.

The table below presents the annual fuel consumption and CO2 emissions for solid waste collection:

ANNUAL FUEL CONSUMPTION & CO2 EMISSIONS OF SOLID WASTE GARBAGE VEHICLES

City	Diesel/a	Consumption MWh	tCO2-eq	BAU Consumption (MWh)*	BAU Emissions tCO2-eq
Al Zayniyyah	57,915	579.15	155.21	770,27	206.35

Annual consumption x BAU coefficient (1.33 JRC 2019)

Mitigation			
MWh/a		t CO2-eq /a	
231		62	
Total Consumption savings			
30%			
Implementation Cost			
EUR 1,300,000			
Stakeholder Involvement	LA		
	External		
	Other		
Staff Capacity	L	M	H
Implementation Years			
Key Performance Indicator			
Start of planning			
Measurement Units			
Fuel saving /Percentage of sorting			
Intervention Area			
Managing resources			
Policy Instrument			
Waste management			
Action Origin			
LA			
Action Priority			

Description of the Action

This action will be conducted in coordination and complementarity with the Governorate's action after assessing the sector's capacity and plans to be modernised and upgraded.

1. Optimise fuel consumption for municipal solid waste collection through routing design and control.

   The procedure will be based on developing a GIS-based model integrated into the nearby agglomerations to calculate the fuel consumption of vehicles collecting municipal solid waste. The model will then be used to explore optimal conditions for waste collection in the city and to improve the efficiency of the waste management system, thus reducing the cost of waste collection and resulting in environmental benefits.

   First, the city should collect detailed data on the routes used in waste collection, the cost of operations and maintenance, the amount of waste collected, the number of garbage bins and their locations as well as details related to solid waste collection and transportation management (e.g., for example, what is incinerated and dumped in a landfill or recycled). This information will be used to assess the progress of work in the next stages when implementing measures related to better waste management.

   Second, the city should equip collection vehicles with GPS, and use a GIS-based model to explore and test different collection scenarios and ensure effective solid waste management. The GPS-based Vehicle Tracking & Monitoring System (VTMS) will confirm in real-time the movement of vehicles and provide live compliance for vehicles using data feeds.

Third, IP cameras should be installed at landfill entries and exits and linked with the Integrated Weighbridge Vehicle Monitoring System (IWVMS).

Fourth, VTMS should be integrated with the control centre in the municipal administration building, and stakeholders should be trained on managing the entire ecosystem of the VTMS system.

Fifth, a GIS-based model should be developed to explore different scenarios to reach the optimal way to collect waste. This will include calculating fuel consumption and greenhouse gas emissions under current conditions and for scenarios explored without changing waste bin numbers or locations, investigating the adequacy of the number and positions of existing collection bins, conducting route improvement for the location of the proposed bins, implementing the new municipal solid waste collection plan, reviewing the results, and making an update necessary when needed.

2. Optimise fuel consumption for municipal solid waste collection by sorting at the source

   Sorting at the source requires understanding the nature of people, preparing a long-term plan, creating the appropriate conditions, securing containers, conducting awareness campaigns, encouraging community participation with training courses, motivating workers, and support from national authorities as well as past experiences in the same context with other municipalities.

General Objectives

To better manage urban waste by solving the daily challenges of planning, managing, and operating municipal solid waste programs and facilities, handling city waste in an environmentally acceptable way, raising public awareness of waste-related problems, incorporating good practices in the waste management systems, reducing emissions resulting from lower fuel consumption, reducing costs related to waste management, and creating new job opportunities for the local community.

Fuel Saving Calculation

Some municipalities have saved about 10% of their fuel by adjusting the routing, and up to 30% when sorting-at-the-source is adopted. Reducing collection to 3 times a week, returns from recycling materials, and creating jobs also leads to increasing conservation and environmental improvements.

Financial analysis

In the tables below, the calculations for energy savings are presented based on assumptions which can be verified and revised at the time of implementation.

ENERGY SAVINGS CALCULATION

SITE CATEGORY	2030 BAU Energy Demand, MWh	2030 BAU Emissions, tCO2-eq	Estimated Savings Assumption, %	Calculated energy saving MWh/a	Calculated saving emissions tCO2-eq
TRANSPORT SECTOR	770	206			
Routing design and control.			10%	77	21
Applying sorting from source			20%	154	41
Total			**30%**	**231**	**62**

Average consumer price for diesel in 2019 equal to 6.75 EGP/L
Emissions factor for diesel is 0.268 tCO2-eq/MWh; emissions factor for gasoline is 0.25 tCO2-eq/MWh
Conversion factor for diesel is 0.010 MWh/L; conversion factor for gasoline is 0.0092 MWh/L

Source of energy	Consumption, litres	BAU 2030	Annual Monetary Savings, EGP (EUR)
Fuel (Diesel)	57,915	57,915 *1.33 =77,027	30% * 77,027 * 6.75 = EGP 155,980 (EUR 8,579)

Expected funding resources:

- Total annual energy savings from the SWM transport sector is around 231 MWh amounting to around EGP 155,980 (EUR 8,579).
- Budget: Estimated to cost EUR 1,300,000.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 62 tCO2-eq/a, accounting for 248 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual bill by EUR 8,579.
- Source of finance: The city is the main implementor using funds, either from the municipal budget or outsourcing to the national budget or grants. (There are many EU and international programmes supporting sorting-at-the-source.)

5.4 Solid Waste Management

Egypt is the most populated country in the Middle East, with around 102 million inhabitants generating around 26 million tons of municipal solid waste annually. Around 60% of solid waste is collected in Egypt, and less than 20% is disposed of or recycled. The rest of the waste is disposed of in rivers, canals, open areas, and on the streets. This has a significant environmental risk, such as affecting water, soil, and air pollution. As with all environmental problems, the increase in solid waste production goes hand in hand with a growing population and rising consumption and has become a focus of great concern.

Al Zayniyyah has a total population of around 65,000 people, producing around 91.81 tons of solid waste daily. The solid waste produced is 56% organic waste as well as 10% paper and cardboard, 13% plastics, 4% glass, 2% metal, and 15% other materials.

Converting organic waste to compost is one solution for 56% of the city's waste. Composting is the process of controlling biological maturity under aerobic conditions where the organic matter is decomposed into materials with shorter molecular chains that are more stable, hygienic, and beneficial for agriculture and recycling of organic soil matter.

At the solid waste disposal sites (SWDS), the degradable organic carbon in waste is decomposed by bacteria under anaerobic conditions into methane (CH4) and other compounds. The CH4 emissions from SWDS are important contributors to global anthropogenic CH4 emissions. The BEI and BAU emissions are presented in the table below:

Methane Emissions, Gg/yr	Methane Emissions, tCO2-eq/a	2030 BAU, tCO2-eq/a
1.02397335	1.02397335*1000*25= 25,599.33	25,599.33*1.33 = 34,047.11

Description of the Action

This action will be conducted in coordination and complementarity with the Governorate's action after assessing the sector's capacity and plans to be modernised and upgraded.

Waste management practices provide effective mitigation of GHG emissions. A wide range of mature, environmentally-effective technologies is available to mitigate emissions and provide public health, environmental protection, and sustainable development co-benefits. These technologies directly reduce GHG emissions through landfill gas recovery, improved landfill practices, and avoid significant GHG generation through controlled composting of organic waste and state-of-the-art incineration. In addition, waste minimisation, recycling, and reuse represent an important and increasing potential for indirect reduction of GHG emissions by conserving raw materials, improving energy and resource efficiency, and avoiding fossil fuels.

Municipal solid waste management presents potential GHG reduction options and has links to other sectors (e.g., energy, industrial processes, forestry, and transportation) with further GHG reduction opportunities. Solid waste management deals with the way resources are used as well as with end-of-life deposits in the waste stream, often complex decisions are made regarding ways to collect, recycle, transport, and dispose of municipal solid waste impacting cost and environmental releases.

At the outset, the city should reinforce the idea that solid waste is one of the important local resources that must be preserved and invested in, and not disposed of in landfills. Involving the local community in the responsibility and giving it the role for better waste management will pave the way towards successfully implementing waste

(6) Safwat Hemidat 1*, Ouafa Achouri 2, Loubna El Fels 3, Sherien Elagroudy 4, Mohamed Hafidi 3, Benabbas Chaouki 5, Mostafa Ahmed 4, Isla Hodgkinson 6 and Jinyang Guo 7. Solid Waste Management in the Context of a Circular Economy in the MENA Region. (Sustainability 2022) 2-6.

management and creating a new concept which is the preservation and investment of local resources. This action includes raising awareness of the importance of sorting-at-the-source and engaging the community, especially youth, which must be trained and given tools for implementation. The continuation of this awareness periodically will establish the commitment of the largest number of the population to start sorting-at-the-source.

Complementing the Governorate plans, the city can study its options and develop a local strategic plan to manage the waste, considering the national plans and integration with neighbouring towns. One or a set of measures can be considered, for example, recycling, composting, landfilling with the gas collection and recovery energy, and/or reducing greenhouse gas emissions.

In all steps, the city needs to prepare the ground for efficient management of solid waste and identify the methodology based on the following but not limited to these indicative measures:

1. **Waste reduction, reuse, and recycling through a solid waste sorting plant and sorting-at-the-source, in complementarity with the Governorate plans, namely covering neighbouring agglomerations.**

   Recycling reduces GHG emissions through lower energy demand for production (avoiding fossil fuels) and by substitution of recycled feedstocks for virgin materials. This is especially true for products resulting from energy-intensive production processes such as metals, glass, plastic, and paper. The magnitude of avoided GHG emissions benefits from recycling is highly dependent on the specific materials involved, the recovery rates for those materials, the local options for managing materials, and (for energy offsets) the specific fossil fuel avoided.

2. **Biological treatment including composting, anaerobic digestion, and mechanical biological treatment.**

   Composting decomposes waste aerobically into CO2, water, and a humic fraction. Some carbon storage also occurs in the residual compost. However, CH4 and N2O can both be formed during composting by poor management and the initiation of semi-aerobic (N2O) or anaerobic (CH4) conditions. Thus, it is important to plan the composting process to avoid increasing emissions.

   Depending on compost quality, there are many potential applications for compost in agriculture, horticulture, soil stabilization, and soil improvement (increased organic matter, higher water-holding capacity).

3. **Landfills with gas collection and energy recovery.** Commercial recovery of landfill CH4 as a source of renewable energy has been practised at full scale in many countries as landfill gas recovery and complementary measures (increased recycling, decreased landfilling, and use of alternative waste-management technologies).

General Objectives

The main objective of solid waste management is to define a waste routing system assisted by a solid waste plan sorting-at-the-source, a sorting plant, and a composting plant. These could aid in minimizing solid waste methane emissions or avoiding contamination of ground water, decreasing the number of trucks and routes thus decreasing fuel consumption, reducing annual municipal costs, increasing municipal income, and benefiting from compost as an organic fertilizer that enhances soil and crop quality.

Financial analysis

Integrated strategies involving recycling, composting, waste-to-energy combustion, and landfills with gas collection and energy recovery play a significant role in reducing GHG emissions by recovering materials and energy from municipal solid waste.

In the tables below, the calculations for GHG emissions reduction are presented based on assumptions which can be verified and reviewed at the time of implementation:

GHG EMISSIONS REDUCTION

SITE CATEGORY	2030 BAU Emissions,tCO2-eq	Estimated Mitigation Assumption, %	Calculated Mitigation Emissions, tCO2-eq
Solid waste management	**34,047.11**	**15%**	**5,107.1**

Expected funding resources:

Source of finance: The city is the main implementor using funds, either from the Governorate and/or municipal budget or outsourcing to the national budget or grants. Solid waste management can be implemented through the participation of the private sector or investors. The city must enact the necessary legislation for the private sector to facilitate and support the action starting with a feasibility study identifying the finance.

5.5 Local Energy Production

Background

Electricity consumption in the city is about 112 GWh (in 2019). Demand is expected to increase more than three times the current consumption by 2030, according to the business-as-usual scenario. The city receives annual sunshine of 3,800 hours at an average global horizontal radiation of 6.4 kWh/m2/day. The typical average production factor for PV systems is between 1,971 to 2,591 kWh/kWp per year.

Mitigation			
MWh/a		tCO2/a	
6,337.2		3,542.6	
Implementation Cost			
EUR 3,220,000			
Stakeholder Involvement	LA		
	External		
	Other		
Staff Capacity	L	M	H
Implementation Years			
2023			
Key Performance Indicator			
Installed renewable energy			
Measurement units			
Green energy produced			
Intervention Area			
Renewable energy			
Policy Instrument			
Renewable energy			
Action Origin			
Local level			
Action Priority			

Description of the Action

This action will be conducted in coordination and complementarity with the Governorate's action after assessing the sector's capacity and plans to be modernised and upgraded.

The experiences in the use of renewable energy in the country are many and varied, and this helps in popularising the use of renewable energy. Moreover, the investment in renewable energy requires high capital investment, experience as well as knowledge of the latest technologies. Where the city does not have the technical expertise and financial resources, the city can work with the private sector and enter into partnerships with investors who have successful experiences in implementing renewable energy projects and possess sufficient financial assets guaranteeing the implementation of long-term projects.

It is important here to pay attention to the need for a third party to ensure the design, implementation, and operation of these projects. Hence, the importance of securing contracts that guarantee this work is not only for its implementation, but also to ensure the sustainable operation and the efficiency of the desired results from this project. Thus, the investor guarantees the economic return on his investment and the city guarantees the sustainable operation of the project..

Below is the suggested list of projects the municipality should implement:

- Use online grids for municipal buildings with a connected PV system varying from 5 to 9 kWp based on their average daily consumption. Such projects in municipal buildings are important even if they are small in size as they develop confidence in the use of renewable energy and give practical experience to individuals working in the city and make them talk about the project's success with others and help in understanding the new technologies. The payback period for the investment in grid-connected photovoltaic systems ranges from 4 to 7 years and is considered a good investment.
- Use PV systems with water pumping stations for drinking water and irrigation water to ensure stability in water supply reducing energy bills and dependence on fossil fuels. The city can work with EU and international programs to implement such projects in the city as well as the city can partner with the private sector to implement similar projects through energy performance contracts to guarantee such projects. The payback period for the investment in grid-connected photovoltaic systems ranges from 4 to 7 years and is considered a good investment.
- Upon regional coordination with the governorate, a PV solar farm could be created to secure electricity stability and reduce dependence on fossil fuels. A PV farm project should be coordinated with national authorities and IEC to secure the stability of the grid during the daytime and guarantee the return on investment.

Indicatively, the gross estimated costs and benefits of the green energy program are summarised in the table below:

SOLAR PV FARM ANNUAL ELECTRICITY PRODUCTION

Site Category	System type	Annual Production (MWh)	CO2 emissions saving in tCO2-eq	Project cost In Euro
PV system on municipal building	7 x 9 kWp	63 kWp x 6.4 average operation hours per day x 365 days / 1,000 to convert to MWh =146.8 MWh	146.8 * 0.559 = 82.1	70,000
PV systems with water pumping stations	150 kWp	150 kWp x 6.4 average operation hours per day x 365 days / 1,000 to convert to MWh =350.4 MWh	350.4 * 0.559 = 195.9	150,000
Solar PV farm	2.5 MW (2,500 kWp)	2,500 kWp x 6.4 average operation hours per day x 365 days / 1,000 to convert to MWh =5,840 MWh	5,840 * 0.559 = 3,264.6	3,000,000
		6,337.2 MWh	**6,337.2 * 0.559 = 3,542.6**	**3,220,000**

Financial analysis

Energy Source	Green Energy Production	Annual Earnings, EGP (EUR)
Renewable Energy	6,337.2	712 * 6,337.2 = EGP 4,512,086 (EUR 248,162)

The return on investment is estimated to be of EUR 248,162 per year.

Expected funding resources:

- Total annual energy savings is around 6,337 MWh amounting to around EGP 4,512,086 (EUR 248,162).
- Budget: Estimated to cost EUR 3,220,000.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 3,542.6 tCO2-eq/a, accounting for 14,170 tCO2-eq until 2030. (The climate cost efficiency equals the implementation cost divided by the abatement according to the Paris Agreement.)
- Energy savings will approximately reduce the annual bill by EUR 248,162.
- Source of finance: The city can build long-term partnerships with the private sector in concordance with the Governorate and national plans and regulatory framework.

6 Adaptation Actions

Chapter 6: Adaptation Actions

6.1 Climate action challenges, strategies, and planned adaptation actions in Egypt

The Egyptian Government is strongly committed to undertaking necessary actions to face climate change effects and for climate adaptation. As early as 2011, Egypt had launched its "National Strategy for Adaptation to Climate Change and Disaster Risk Reduction".

Headed by the Prime Minister, the National Council of Climate Change (NCCC) was established in 2015. It is leading the NAP process in Egypt and aims to create more political support and closer cooperation between a larger number of directly or indirectly concerned ministries. This Council replaces its predecessor, the National Committee on Climate Change, established in 2007.

As recent as May 2022, Egypt has recently launched the "Egypt National Climate Change Strategy 2050" (ENCCS) to further support a stronger, greener Egyptian economy. The ENCCS lays out risks, disasters, and crises generated by climate change in each sector, mainly the impact on the coastal areas, water resources, agriculture, health, population, and tourism, and ends with a presentation of the risks related to food security. It is a flexible and living strategy, adopting a twin-track approach. The first five years address the urgent issues that cannot be deferred, followed by three five-year plans.

The ENCCS proposes adaptation and mitigation programs in all sectors until 2050, the most important of which are: Energy, transportation, agriculture, and water resources. The total cost of mitigation programs is estimated at $211 billion, while adaptation programs will cost $113 billion.

A new National Adaptation Plan is being prepared to facilitate the coherent integration of adaptation measures into existing and new policies, programs, and activities. Moreover, an interactive map is being prepared to help the decision-makers pinpoint the most vulnerable areas to climate change impacts.

6.2 Key sectors affected by climate change

Water Sector

Egypt is a unique country concerning its water resources and has a crucial need to adapt to climate change regarding water availability. More than 95% of the water budget of Egypt is generated outside its territory. Although the impact of climate change on the Nile Basin cannot be predicted at this stage, there are indications that the impacts will be significant. Any decrease in the total supply of water, coupled with the expected increase in consumption due to the high population growth rates, will have drastic impacts.

Agriculture sector

Egypt's National Climate Change Strategy 2050 gives high priority to agriculture. It recommends agriculture adaptation measures covering biodiversity conservation, sound management of soil and arable land, improved crop irrigation, promotion of tailored livestock and fish resourcing, thoroughly adjusting economic agricultural systems and improving the rural community's conditions.

In Luxor Governorate, adaptation of agriculture to climate change is a foremost necessity, with more than 25% of the population working in the agricultural sector. It is already clear that climate change has impacted agriculture productivity, crops' quality and nutritional values and is a major cause of soil pollution and reduction of land fertility.

6.3 Development of a Climate Action Unit

Climate change has been gradually integrated into a larger number of ministries to become one of the pillars of their strategic planning, in addition to working with development partners to attract climate finance in many fields.

Considering that the implementation of national climate strategies and actions is expected to be largely delegated – through the Ministry of Local Government – to regional and local authorities, i.e. Governorates, Markaz and cities, in a way to gradually integrate climate mitigation and adaptation into these authorities' sustainable development programs and plans.

The role of local authorities is projected to be crucial in the areas of water and agriculture bearing in mind that Chapter 6 of the 2050 Strategy indicates as necessary: to identify the best methods and programs to support the capacity of small farmers in adapting to climate change through the multi-stakeholder approach (farmers, civil society, agricultural extension, agricultural cooperatives and others); more developed participation of rural communities in the management of their resources (soil, water, fertiliser and outputs), as well as their participation in decisions related to the expected changes in climate indicators and their impact on the productivity of the rural family,

together with the capacity improvement of rural communities to participate in the development and implementation of national policies in the field of adaptation and disaster and crisis risk reduction.

Based on the above, the creation and tasking by the Governorate of a central "Climate Action Unit" (CAU) that would affiliate a smaller task force in each Markaz or main city is recommended.

The role of the CAU will be to support the implementation of the 2050 Strategy and the Adaptation Plan's programs as integrated into the governorate's plans of climate change adaptation in various fields, e.g., water, agriculture, housing, buildings, roads, tourism and in the health sector, starting by overall raising awareness about those climate issues and their plans and integrate them into the city's actions, in addition to accompanying the implementation of the SEACAP's activities.

The formation and function of the proposed unit is of particular importance concerning water and agriculture given the range of undertakings required and the large number of stakeholders involved. comprising crisis and disaster reduction management, conservation of biodiversity; adaptation related to soil, arable land, water resources, crop irrigation, livestock and fish resources, and altogether the improvement of the rural community's conditions.

The CAU would also support the climate role of civil society organizations, community participation and Climate Action cooperation among various actors such as state agencies (through the governorate), private sector, and members of non-governmental organizations, professional associations, trade and agricultural unions, local and popular committees.

The formation and tasking of the CAU will necessitate a detailed assessment of feasibility and setup requirements including legal, financial, resources, tasking, training, and capacity to increase its members and staff, including to conduct the aforementioned awareness-raising activities.

6.4 Population & Public Health

Extreme heat events can be dangerous to health – even fatal. These events result in increased hospital admissions for heat-related illnesses as well as cardiovascular and respiratory disorders.

- Extreme heat events can trigger a variety of heat stress conditions, such as heat stroke. Heat stroke is the most serious heat-related disorder. It occurs when the body becomes unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. This condition can cause death or permanent disability if emergency treatment is not given. Small children, the elderly, and certain other groups including people with chronic diseases, low-income populations, and outdoor workers, have a higher risk for heat-related illness.
- Higher temperatures and respiratory problems are also linked. One reason is that higher temperatures contribute to the build-up of harmful air pollutants.
- One of the most important effects of climate change is water shortage. One of the adaptation measures to cope with water shortage includes reusing grey or treated wastewater to irrigate trees and vegetables. This could increase the transmission risk of several pathogens through crop contamination leading to outbreaks like typhoid or hepatitis if the water is not treated.
- Rising temperatures due to climate change increase microorganism growth leading to increases in water- and food-borne diseases. In contrast, flooding as a result of extreme rainfall concentrating annual rainfall in a small interval disrupts water purification with contamination from sewage disposal systems leading to increased epidemics due to water- and food-borne diseases.
- Climate change may also influence the seasonal pattern for respiratory diseases, cardiovascular diseases, and mortality. The most visible effect of climate change on respiratory diseases is chronic respiratory diseases, including bronchial asthma and chronic obstructive pulmonary diseases. Acute infectious respiratory diseases seem not to be directly impacted.
- Impacts on the health sector range from insignificant (malnutrition) to catastrophic emerging epidemics (haemorrhagic fevers). Young children and the elderly are the most sensitive group, mainly to food- and water-borne diseases where admission rates will increase, followed by respiratory diseases resulting in increased mortality rates.
- Increased temperatures from climate change will increase the frequency of days with unhealthy levels of ground-level ozone, which is a harmful air pollutant and a component in smog resulting in damaging lung tissue, reducing lung functioning and resulting in premature deaths.

Main adaptation measures suggested at the national level:
These measures will be applied at regional (governorate) down to districts (Markaz) and cities levels.

- Establish an early warning system.
- Adopt healthy buildings using building guidelines which include instructions for advanced sanitary installation that separates grey water from black water.
- Sustain and improve sanitary conditions.

The following table explains the adaptation actions related to population and public health:

Adaptation
Develop a health action plan for extreme events the municipality is facing (e.g., extreme heat) Develop an early warning system to alert citizens of extreme weather events or natural disasters (e.g., heat waves, floods) Conduct educational and awareness campaigns about health-related effects of heat waves, vector-borne diseases, etc. while informing residents on ways to protect their health and prevent infection or impact
Provide instruction to the public on staying hydrated and avoiding strenuous outdoor exercise during heat alerts

6.5 Water related infrastructure

Climate change has the potential to impact the safety of existing structures, increase the frequency of weather-related disasters, increase premature weathering regionally, and significantly change design criteria and engineering of structures. Because infrastructure built in current times is intended to survive for decades to come, it is critically important adaptation options for climate change be developed today, incorporated into the design, and implemented as soon as possible. Prioritisation of required adaptation actions will need to account for existing and future vulnerabilities, the variable lifecycles of structures and replacement, and maintenance cycles.

"No regrets" types of adaptation actions available today need to be applied as soon as possible. These include measures to reduce uncertainties in climatic design values, regularly updated climatic design values, maintenance of climate data records and networks, consistent forensic analyses of infrastructure failures, regular maintenance scheduling, and community disaster management planning. However, given the potential changes expected, it is also likely that many impacts on communities and infrastructure will lie outside of the coping ranges of infrastructure. When this occurs, engineering and planning practices will need to account for these growing uncertainties while new adaptation options are developed over time.

Water resources:

The main climate hazards the water sector faces are increased temperatures, decreased precipitation, increased incidents of drought, and increased evaporation. Climate impacts on the water sector include reduced groundwater recharge, deteriorating groundwater quality, reduced stream flow, and increased water demand.

Adaptation strategies and measures suggested for the water sector at the national level are:

- Rainwater harvesting
- Wastewater treatment
- Increasing efficiency of irrigation technologies
- Grey water reuse
- Public awareness

The following table explains the adaptation actions related to the water sector, which the city will work towards under the guidance and in close collaboration with the governorate:

Adaptation
Develop a water and wastewater management plan Develop guides and awareness campaigns to save water and energy, especially during a crisis Integrate sustainable drainage systems Collecting rainwater

The main objectives of the action are:

- Saving the underground water tables from depletion, and ameliorating water quality
- Supplying water for domestic service use, public green spaces, farms, and flocks
- Preventing over pumping of the aquifers
- Maintaining crop levels
- Maintaining livestock level in the city by providing drinkable water

6.6 Agriculture, Forestry, & Other Land Use (AFOLU)

Agriculture is important to the majority of people living in the area. The land supports banana trees, dates, and various vegetables. Even the commerce of the village relies on agriculture, although the absence of adaptation actions can lead to disasters such as cold weather at night impacting directly on the growth cycle of plants and trees.

The **major climate exposure risks** associated with agriculture in the municipality have been identified as:

1. Temperature increases during the day
2. Temperature increases during the night
3. Water scarcity

The key adaptation measure to climate change is **setting and implementing a sustainable agriculture policy**. Adaptation measures vary horizontally according to the agricultural subsectors and their vulnerability to climate change. Generally, the most important adaptation measures in agriculture are:

- Modifying cropping patterns
- Modifying crop calendar including planting and harvesting dates
- Implementing supplemental irrigation and water harvesting techniques
- Improving water use efficiency
- Using different crops varieties
- Modifying policies and implementing action plans

Most of the **interventions** to **upgrade rain-fed agriculture** can be cost-effective in farming systems, especially where irrigated agriculture is not feasible. For example, supplemental irrigation (watering rain-fed crops with small amounts when rainfall fails to provide sufficient moisture) has proven to be a drought-proof strategy in most areas.

Increased water available for supplementary irrigation can be achieved through **on-farm rainwater harvesting and management system**, i.e., small farm ponds for micro-irrigation using drip or sprinkler irrigation systems. Larger rainwater storage structures can also be constructed to provide supplementary irrigation water to a number of small farms or fields by using micro-dams.

Conservation agriculture, on the other hand, is very efficient, leading to increased crop yield. In this adaptation measure, several techniques are used to enhance soil water storage. Water conservation is usually enhanced through mulching and crop residue retention through zero or minimum tillage, stubble mulch tillage, strip tillage, and crop rotation. Conservation agriculture, however, requires extension programs such as training and providing equipment.

The following Chapter 7 of the SEACAP contains a guide to the method of designing awareness-related processes that are applicable in several areas.

7 Communication

Chapter 7: Communication

I - Background

Climate Change is one of the greatest threats facing humanity. A recent report from the Intergovernmental Panel on Climate Change (IPCC) on global warming identifies the southern Mediterranean region (including the Maghreb and Mashreq countries) as a climate change hotspot. The region is increasingly subject to the numerous effects of climate change such as increasing water scarcity, droughts, agricultural and food risks, rising temperatures, and growing rates of desertification. Among the common challenges Mediterranean cities face are changing behaviour, building climate awareness, and accessing complex and sometimes inaccessible scientific climate change information as public awareness and social engagement is pivotal. Achieving them requires breaking psychological barriers so specific measures can be applied to change behaviour and provide education.

Awareness about the important link between environment and development in the Mediterranean is increasing.[1] Existing authorities have the capacity and means to inspire, motivate, and engage citizens in global challenges and good practices towards sustainable development by promoting and supporting relevant initiatives in different fields and integrating policies to increase public awareness. Thus, they can become drivers for change as natural leaders of awareness-raising at the local level.

Additionally, young people - who constitute the largest segment of the MENA population - are becoming involved in climate change through new information technology.[2] They are more than ever much more likely to believe climate change will have a severe negative impact. More effective education and awareness is one way to provide them with more effective ways to take action on climate issues.

As hundreds of cities are developing and launching their Sustainable Energy Access and Climate Action Plans (SEACAPs), they undeniably need to build impactful and compelling communication strategies and awareness actions. This chapter guides local authorities and cities in communicating their SEACAPs with a step-by-step action plan and strategy, planning guidelines, communication tools, modes, methods, and channels. It also includes guiding principles to set up the vision of the cities, survey templates, and examples of sector-specific awareness actions to implement awareness-raising campaigns successfully.

[1] https://www.eib.org/attachments/country/climate_change_energy_mediterranean_en.pdf
[2] https://www.arabnews.com/node/1564706/middle-east

II- Developing a Communication and Awareness Plan (CAP)

The Communication and Awareness Plan (CAP) is a pillar of a SEACAP. The CAP serves as a practical, action-oriented guide to cities developing systematic and effective approaches to communicating support for their local SEACAP and its related projects.

In the long run, developing a successful CAP and maintaining it can be a significant challenge as it can encounter inertia or active opposition, particularly from audiences who are climate sceptics, as well as due to a lack of staff, skills, and budget.

Providing information and raising public awareness is therefore vital for inspiring voluntary changes in behaviour, generating stakeholder support for local authorities' policies, and addressing the arguments of those who oppose specific actions.

The CAP is an essential measure that should be feasible, efficient, and adapted to local needs and cultural contexts. It is based on the following six steps:

Step 1: Set the city's vision

When committing to developing a SEACAP, the municipality must have a vision of what needs to be achieved to engage partners and stakeholders, connect with citizens, plus design and execute the awareness campaign.

The vision will define the identity and uniqueness of a city and its communities and imagines what it will look like decades from now. It should be structured around storytelling and a slogan as a "concept idea" reflecting the city's values.

To achieve the new vision for the city, developing the communication and awareness plan and goals should include broad public involvement, community consultation, and engaging community members on issues affecting them.

Figure 6:Examples Of Slogans From Cities' Vision In The Seacaps

See Annex 1 for guidelines on developing a city's vision.

Step 2: Identify priority actions and measures

During the development of a SEACAP, cities identify and validate several priority adaptation and mitigation projects in the relevant sectors including energy, transport, waste management, water management, agriculture, public lighting, etc. They need to communicate these projects effectively by launching a customised range of communication actions and products from brochures, radio programmes, and social media outreach by elaborating on educational curricula for secondary schools, publishing training manuals for technical staff, etc., that will be adapted to each one of them. Some of these activities will require significant investments and ambitious campaigns. In contrast, others can be successfully carried out in collaboration with local NGOs and associations within existing capacities and with minimum funding.

A clear strategy with understandable actions includes inspiring messages related to concrete and achievable action plans establishing a sustainable and long-term climate awareness programme.

Step 3: Conduct a local needs assessment

Awareness-raising actions and campaigns are most likely to succeed if developed in cooperation with local stakeholders and citizens with various roles throughout the local economy. Their views and insights about climate change as well as environmental and energy issues may differ from or possibly complement those of the municipality. As potential partners, they can play a key role in implementing and supporting the local outreach programme.

Observing audiences' behaviours, perceptions, and socio-demographic characteristics is the best way to anticipate barriers impacting their choices and preferences. It is essential to (1) identify target audiences and dig deeper into their true motivations (possibly rooted in cultural norms and beliefs) and present the message to reflect them; and (2) identify the situation, goals, drivers, and challenges while being clear about precisely what behaviour we want to change.

For this reason, a questionnaire survey must be developed and used to:

- Test the audience's opinions and capabilities for exploring climate change priorities, awareness levels, perceptions, social/peer groups influence as well as assess existing resources for communicators, socio-cultural influences, and environmental practices.
- Help define a few population characteristics regarding age, urban environment, degree of education, employment, family situation and income, receptiveness and level of awareness, willingness to change behaviour. This will allow the communicators to gather the resources responding to those specific situations.
- Identify current attitudes to environmental issues, barriers to action (possibly including cost; "not my problem as an individual"-attitudes; performance and effort expectancy; absence of facilitating conditions; lack of information; etc.).
- Guide the awareness-raising strategy, messaging, and materials to be developed and communication channels used to convey the information.

See Annex 2 for a sample questionnaire adaptable to specific local needs.

Step 4: Analyse the risks, challenges, and opportunities

When promoting an action, it is likely needed to communicate both the consequences and solutions it will generate. As a follow-up to the survey, it is necessary to review and validate the needs assessment findings, agree on a list of priority activities to be conducted, bring recommendations on how to implement these activities, and allocate necessary resources. Then, produce a coordinated strategy and action plan to establish a long-term well-balanced climate awareness programme in communicating local impacts of climate change so citizens could grasp what this issue may mean for their well-being and how they can join forces to fight it.
It is important to:

Some identified barriers to change include economics; differing management views; insufficient, inadequate, or conflicting information; doubts over likely success; age and/or health of the individual; lack of government incentives; lack of time; and lack of financial resources.

1. Review some existing or previous actions and the issues that may have negatively impacted the success of the communication. A SWOT analysis may help identify potential threats or risks for that purpose;
2. Draft a list of tools through which the audience should be reached; and
3. Draw an action plan to implement key actions.

On the other hand, the driving factors may involve those drawn from social networks and influencers' support. Therefore, to be better received, an awareness campaign should focus on the audience's needs, address the whole community, and empower them with knowledge.

Step 5: Design the Strategy

The communication strategy seeks to answer the following questions:

- Who are the stakeholders with whom the local authorities need to engage?
- What changes in opinions or behaviour do we seek?
- What messages should be used?
- What communication channels will be most efficient?
- How are the communications-related responsibilities shared among the different actors?
- What are the best processes for internal coordination?

The communications strategy should focus on strengthening internal communications among government agencies and identifying non-governmental allies with whom the local authorities need to engage. The strategy also considers the types of behavioural changes required by stakeholders along with the messages that might trigger change.

To bring about behaviour change in environmental practices, the strategy should:

- Build broad-based public awareness and increase it in all aspects of the city policies and the SEACAPs while promoting its actions.
- Raise the profile of the cities' SEACAPs regionally and internationally, particularly among policymakers and donors.
- Spread awareness about understanding the impact of climate change.
- Target different groups and cover several environmental sectors.
- Elaborate on a communication strategy and methodology tailoring strong key messages to each target group.
- Inform, inspire, and convince the public of the need and benefits for allocating resources in climate change adaptation (sooner rather than later) from public and private investments to get more significant support.
- Support civil action to educate and mobilise citizens on climate change by providing them with tools, resources, and opportunities.

The strategy can also draw on the wide range of experiences and best practices other organisations and governments have had in conducting outreach in the areas of environment, climate, and clean energy as well as take inspiration from regional and international experiences. Countries and cities worldwide are integrating strategic communications into their climate change plans, providing a wealth of best practices from which to draw.

Section III addresses steps for communications and awareness campaigns.

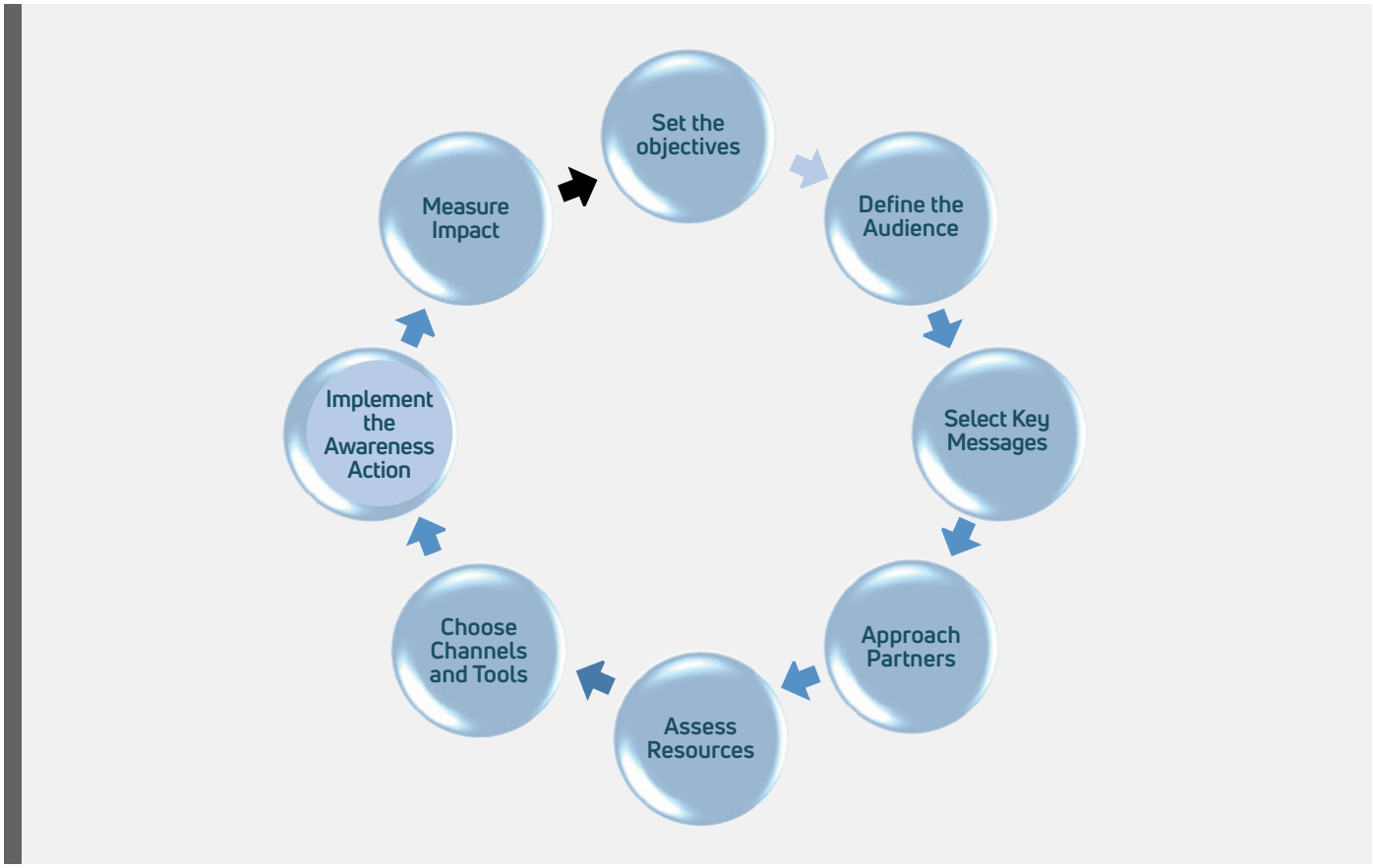
Step 6: Assess sustainability

Sustainability is a significant challenge for CAP and outreach campaigns. Funding, mobilisation, and collaborative partnerships secured during an awareness campaign must be maintained over the long term. The effectiveness of awareness-raising activities and the overall communication strategy needs to be assessed through formal surveys or informal means that will lead the communication team to revise its original strategy and plans if necessary. Monitoring feedback from the field and implementing the activities can contribute to the CAP's overall success.

III- Designing and implementing the communication and awareness campaign

A- Set the main communication objectives
B- Identify key audiences, both internally and externally
C- Develop key messages
D- Approach potential partners
E- Assess and strengthen your resources
F- Select the most effective and available communication tools, modes, methods, and channels
G- Implement the awareness campaign
H- Evaluate, amend, and monitor the impacts and results of the communication campaign\

Figure 7: The eight key components of a communications strategy



Effective communication is essential to a municipal plan or project, both internally among different departments of the local authorities, associated public authorities, and all those involved as well as externally with relevant stakeholders including citizens, associations, and NGOs. It should be driven from the bottom up and involve a broad community group.

From the very beginning, a carefully designed communication/outreach strategy should be integrated into the SEACAPs. This will ensure that its objectives and implementation will align with the Action Plan and its supporting activities.

This section guides local authorities in designing and implementing a well-conceived and impactful communication and awareness-raising campaign by setting the objectives; identifying key target audiences and potential partners; defining key messages; selecting the most effective modes, methods and channels; creating a realistic action plan, timing, and deadlines for each activity stage; planning the resources and the budget; evaluating the campaign's impacts; monitoring results; and amending as necessary.
The strategy should also draw on previous and current communications activities, and establishing an internal communication department within the municipality may be crucial too.

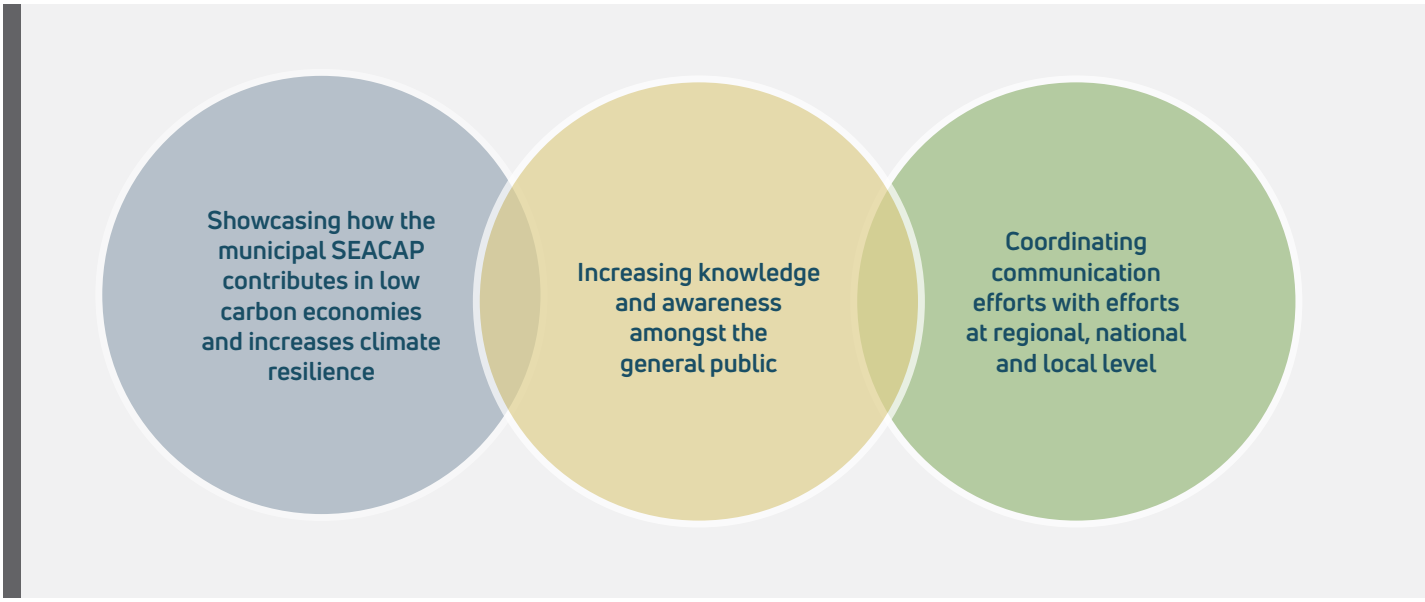
A- Set the main communication objectives

Setting objectives are the key to the success of the communications strategy.

Ensure communication objectives are "**SMART**": **Specific** (what, why, who, where), **Measurable** (how much and how many), **Achievable** (how realistic is it), **Relevant** (is it applicable), and **Time-bound** (when).

The strategy can be designed to meet one or more clear, measurable, and specific objectives, such as:

- Build broad-based public awareness of the city's climate change policies and frameworks.
- Plan a course of action providing specific public information on all aspects of the SEACAPs, promote its priority actions addressing climate change and communicate the new vision of the city.
- Raise the profile of the cities' SEACAPs regionally and internationally, particularly among policymakers and donors.
- Encourage a municipality-driven approach to adapt to climate change so that the target population and other stakeholders act in concert and speak with one voice, and actively contribute in a collaborative effort to develop and implement climate change policies.
- Raise the EU profile and actions in the South Neighbourhood and internationally.
- Help build and solidify partnerships with key actors between governments and civil society including local communities, women's groups, and the private sector.
- Promote regional coordination with other local/national authorities and stakeholders.
- Provide general information to the community of the opportunities and threats brought about by climate change and raise the level of awareness about its impact and risks to the public.
- Support civil action to educate and mobilise citizens on climate change by demonstrating the practical steps they can take while empowering them with tools, resources, and opportunities. Provide advice and examples of best practices for communicating adaptation to climate change and mitigation through reducing emissions.
- Build on the work on awareness-raising actions previously implemented.
- Link awareness activities to other capacity-development activities.



B- Identify key audiences, both internally and externally

Climate change should concern everybody, but in truth, some people will feel more concerned than others because they face specific risks or because they can play a particular role in solving problems.

- Consider the benefits of identifying the possible target audience's primary groups (and sub-groups), including policymakers, community leaders, business and industry leaders, farmers, technical experts, youth, religious leaders, citizens at large, opinion shapers, women, academia, funding institutions, and the media.
- Identify the profile of the audience (primary and secondary target groups) based on relevant data such as age, social, and economic status, education level, current behaviour, level of environmental awareness and knowledge, preferred methods for receiving information, motivation/barriers to hearing and accepting the information.
- Assess their knowledge, attitudes, behaviours, and interest focusing on the needs of your target audience: Why should they care about climate change? What is it in for them? The profile of each potential target group can be assessed through formal surveys or informal conversations with small but representative samples of individuals. (See the survey questionnaire in Annex 2).
- Aggregate information and resources responding to specific situations and their communication goals, the audience, the subject matter, and the available media.

As climate change is a global problem with wide-ranging impacts, the climate change messages must be communicated successfully with many different groups, including residents, partners, opinion formers, and stakeholders.

Do not overlook the importance of engaging youth in long-term campaigns against climate change. Schools and local organisations such as the Scouts can offer useful channels for reaching young people. Teaching kids at a very early age how to respect and protect their environment will preserve their future as adults, plus they will also encourage their elders and relatives to apply it too.

Religious groups are also important as their views often shape attitudes toward the natural world.

Partnerships with key actors are often necessary to develop and successfully implement a SEACAP project. Together with specialised groups such as NGOs, media, academia, and businesses, the general public is also a priority. NGOs, media, and journalists can prove to be valuable partners in promoting climate change awareness because of their extensive outreach networks. Industries should be involved as key partners because of their contribution to emissions and their potential contribution to effective responses.

C- Develop key messages

Effective messaging passed through an awareness campaign is the foundation of any well-built campaign. When elaborating a message, make sure to keep it as simple as possible, easy to understand in the local language, adequate and attractive to the target group, and inspiring.

Consider what your different audiences care about and the messaging that will help reach them and develop messages designed for each specific target. By tailoring to each audience, you get their engagement and break the barriers

preventing them from responding as you wish. Remember, people should be able to recognise their own values, interests, aspirations, and benefits in the messages they receive.

The effectiveness of an information campaign relies mainly on the effectiveness of the delivered messages.

- With an uninformed public, communication focusing on raising basic awareness on climate change, the messages should recommend simple actions the audience can take to reduce emissions or reduce risks. Messages with a strong sense a social norm supports action can be more effective in encouraging the adoption of new behaviours.
- With an audience already motivated to change behaviour, the most appropriate messages may focus on providing practical or logistical information.

Messages with a strong sense a social norm supports action can be more effective in encouraging the adoption of new behaviours.

- With an audience already motivated to change behaviour, the most appropriate messages may focus on providing practical or logistical information.
- With an audience already taking action, it may be helpful to provide encouragement and guidance on how to overcome perceived obstacles. A target audience successfully involved in the new behaviours may benefit from reinforcement and reminders on the benefits of sustaining the behaviour.

Base the messages on the "Four E's" approach:

- **Encourage**: offer benefits/praise. Epower stakeholders with knowledge, skills, and open fresh ideas in the process.
- **Enable**: the first step to changeshould be easy. Emphasise short-term gains as well as long-term benefits.
- **Engage**: involve in the whole community, use the schools and academia, and involve young people and women.
- **Exemplify**: utilise community leaders to set by example, to discuss their approches; chose a likable, and inspirational messenger that people relate to.

The most effective public outreach campaigns tend to establish a "human face" for an issue. When building the narrative, four main aspects need to be considered:

Emotions and rational arguments: Emotions are a very appropriate way to raise awareness. Once the target group is aware of the problem and its own role, it makes sense to provide rational arguments supporting a change of behaviour. Citizens will be able to link their issues directly to their day-to-day concerns and, in particular, to how they manage their lives. This can help motivate and empower people to act themselves.

Tone: pessimistic and catastrophic messages do not necessarily translate into positive behavioural changes. Messages need to be tailored, positive, and must engage the audience based on cooperation and self-responsibility. Positive messages providing solutions can be more effective than negative messages simply sounding the alarm bell without giving information on what people can do to contribute.

Feasibility: This may be the most important aspect to be addressed to ensure the effectiveness of measures. Citizens need to be informed and motivated, but they need to be able to adopt the measures. The role of the authorities is to provide opportunities for feasible actions. Outreach messages can also encourage support for specific projects or public expenditures.

Repeated messages: The issue of climate change has gained prominence with increasing repetitive media coverage and has helped raise awareness of local and global environmental issues, generating climate actions worldwide. People are preoccupied primarily with their daily issues (economic, internal crisis, health, etc.) To overcome this, motivation, recognition, promotion, and constant dialogue must become familiar tools used whenever you try to convince people to change their behaviours in ways that will mobilise them and change their attitudes. Repetition of the messages is recommended as it generates constant exposure and keeps them in the target group's minds, and this favours success.

Types of messages that may be appropriate in a climate change campaign targeting the general public or key stakeholders:

- Even minor changes in personal and consumer habits reduce emissions and promote adaptation to climate impacts.
- Using public transport and turning off electrical appliances when not in use reduces greenhouse gas emissions.
- As farms are highly vulnerable to a potentially drier and hotter climate, agricultural policymakers and farmers should incorporate climate change concerns into their strategic planning.
- Energy efficiency and renewable energy sources reduce air pollution and improve industrial efficiency, thereby reducing both health problems and business/household costs.
- At work, energy awareness leads to cost savings, higher profit margins, and increased job security.

D- Approach potential partners

NGOs, academics, public personalities, and journalists concerned about climate change are potential partners for climate change outreach. They can often reach out effectively and serve as powerful champions and ambassadors of the climate issue. They may also have networks, skills, resources, or credibility to contribute to the outreach campaign. Non-governmental organisations tend to benefit from being flexible, cost-effective, very helpful in identifying participants, and are highly motivated. For example, establishing a Climate Change Committee drawing together local NGOs and associations and engaging the entire local citizens more fully in the issue of climate change can help to develop and support outreach activities.

Institutions, civil society representatives, businesses, and the media, in general, are all positioned to draw society's attention to issues of public concern.16 This makes them "mediators" whose operating principles, status, and objectives must be clearly identified. Social groups that may already exist (e.g., schools, communities) and established networks are vital for awareness-raising and initiatives as well.

Similarly, businesses can encourage responsible behaviour by consumers, forge partnerships with the stakeholders, and/or provide accurate quantitative information on consumption practices (e.g., energy, green products).

Lastly, media (in general) and journalists (in particular) can make decisive contributions to public awareness-raising and act as opinion formers. You can use them to lobby, convey your message, and run your campaign. Workshops, conferences, and trainings provide opportunities to continue to build new relationships with the media and invite them to deliver articles and capitalise on climate change messages. However, many journalists are unfamiliar with climate issues, therefore it is essential to appoint a credible and recognised voice on climate change.

A potential drawback to working with partners may be a lack of control over the message and how it is delivered. When choosing a partner, it is essential to consider its particular interest in the issue and its knowledge, credibility, reputation, and image.

E- Assess and strengthen your resources.

Early consideration should be given to the budget and staffing available for the awareness campaign. Establishing an internal communication department with assigned responsibilities may be crucial to facilitate collaboration between the services and stakeholders involved.
It is worth considering the benefits of providing training in communications skills to key staff early in the process or bringing in specialists where necessary.

Estimate the time and money involved in your awareness campaign. It is recommended 5% of the total funded research budget be allocated for communication. Ensure good value by targeting communication effectively through prioritising the audiences and channels while focusing on high impact/low-cost activities.

In addition to budget and staff, other resources should be considered such as equipment, contact lists, and other databases. Communication budget and staff resources are usually limited, so the communication effort should be adjusted to focus more intensely on one or two key goals rather than spreading them around. Other ways to leverage limited resources could be partnering with other stakeholders (NGOs, local associations) and emphasizing synergies with other initiatives, projects, or themes. For example, tapping into local or international resources including expertise, copyright-free materials, and funding opportunities, can also be valuable.

F- Select the most effective and available communication tools, modes, methods, and channels

Start considering the best way to transmit your message. One of the most important factors to be considered in the planning phase is selecting the communication channel and tool. This is based on cost-efficiency, media coverage and access, cultural factors, long-term view, and repetition.

You must make sure citizens have an adequate opportunity to learn about projects affecting their lives through the choice of communication tools. To engage the citizens' interest, think about the actual and preferred channels your target audiences might use and whether you plan to use the right ones for maximum impact. It is crucial to specify the most appropriate communication channels (i.e., the most accessible and the easiest to implement and finance) for each target group. Moreover, you should also attract media attention.
There are several communication and dissemination tools available for implementing selected communication and awareness activities related to selected SEACAP actions such as: Face-to-face, networking, advertising, mail, email, internet and social media, blogs, talks/meetings, films, brochures, posters, newsletters, printed publications, media releases, newspapers articles, public relation, sponsorship, broadcast media (TV/radio spots), educational material, high impact events, factsheets, promotional material, contests, as well as organising capacity-building workshops, competitions, etc.

[16] P. Favre 1992

Digital social platforms enable users to exchange information and allow people to network. Their unique feature is the systematic collection and analysis of data and its associated network effects which facilitates exchanges between several groups, creates an exchange of experiences, information and ideas, creates a network community, and promotes cooperation between users.

However, pure information doesn't necessarily result in behavioural changes. Allowing people to reproduce a new behaviour, information materials must be accompanied by actions and events such as exhibitions, public meetings, demonstrations, site visits, citizen juries, public meetings, teleconferences, surveys and questionnaires, media events and press conferences, social events (like screenings, concerts, plays, etc.), discussion groups, forums, open houses, etc.

Public awareness aims at early results and is often pursued via the media and outreach campaigns as communicating with the public, and engaging stakeholders is very important. It should be coupled with education programmes to get to more profound, long-term change in habits, particularly among the young. These programmes tend to use formal methods and settings to transmit a more substantial understanding of the climate change problem and its potential solutions and scientific, technical, and municipal personnel training. Widespread involvement in shaping policy and implementing climate change programmes can contribute enormously to effective action.

Driving factors include those that tap into existing social networks and provide social support. Campaigns that focus on the needs and address the community as a whole are better received and provide more incentives and influence. Empower stakeholders with knowledge, skills, and confidence in the new practice, have the tools to help, and ensure the technology aligns with their views and interests.

Exploit seasonality to maximum benefit: Climate change issues are most likely to be raised in people's minds at times of extreme weather, winter storms, floods, summer droughts, water shortages, hurricanes, heat waves, etc.

G- Implement the awareness campaign

Once the tools are selected, and the planning above is done, you may start designing and implementing the awareness campaign. This is where we go into more specificity in the objectives, detailed target, messages, content, etc. Implementation requires coordination among all actors and open channels of communication with non-government stakeholders in civil society and the private sector. In many cases, successful implementation will also entail persuading stakeholders of the benefits from early action.

Awareness campaigns must be simple and emotional and use understandable language for most people as they have an essential role to play in achieving significant change across cities in the pursuit of change. They should have their own identity, tone of voice, and creative look and feel.

Key aspects of a campaign require a series of tactical concepts when designing them:

- Create a common visual campaign identity by designing a logo that will be a visual representation of your campaign and communicates your values and principles. The logo will be used through all your communication channels as well as promotional materials and as a symbol, will create consistency and make people recognise and remember your campaign quickly.
- Develop a creative theme or 'big idea' that will capture your audience›s attention and encourage engagement.
- Engage audiences with graphically appealing campaigns using real photos with real people. Stand out with eye-catching infographics bringing data to life, clean and airy designs, and easy to read fonts.
- Make your content coherent and consistent– repeat structures, colours, and the images and infographics style. Well organised content keeps the reader's attention and makes the content more attractive and readable.

Every city has its own issues, culture, and priorities; thus it is important to reflect these in your communications.

- Images work, so visualise your message with a graphic, an icon, or a photographic image summing up your campaign.
- Use testimonials or human-interest personal stories to add depth from real people, ambassadors, and heroes. That will give people a voice.
- Make it a positive light and feel-good campaign by adding humour and using illustrations.
- Tap into data if you have got some big numbers or killer facts you can use to captivate people.

- Build an interactive space where your audience can share their views and give the campaign a human dimension.
- Make it visually attractive with a catchy slogan.

If you're hosting an event, this involves excellent planning, management, and evaluation. To make it successful, choose an appealing event name, a concept, a slogan, or a hashtag that fits your broader awareness campaign and messaging and connects with your overall campaign look and feel.

You may choose to go for large events which are an opportunity to reach a bigger audience, create impact, attract media and raise visibility, present a wide range of topics, and invite renowned experts worldwide. Smaller events are more effective in bringing people closer, and creating bonds.

Don't forget to promote your event, send formal invitations, and "save the date" notes and other reminders.

H- Evaluate, amend, and monitor the impacts & results of the communication campaign

Since successful communication is about sharing the correct information, at the right time, with the right audience, evaluating the effectiveness and the impact of a communication campaign on public perception is well worth the effort.

Once the message has been communicated to the audience after a campaign phase, monitoring and evaluating the communication and awareness actions is the next step. It entails sharing quantitative and qualitative information about how activities are performing and the impact they have produced. It also investigates increased awareness, increased pride, and willingness to get involved and ensures the lessons drawn from that analysis reach the right people at the right time.

The key questions to be asked are: Has the message been heard/understood/pursued? Credible feedback on these questions from the target audience can be obtained through follow-up interviews or surveys and close observation of behaviour changes. Such monitoring and feedback about how communication and awareness actions are performing helps evaluate how the strategy is being implemented and adapt a campaign as you go along, improving it for next time, and justifying future budgets.

The qualitative evaluation is very useful and needs to be made at three levels:

- Increased awareness: Polling stakeholders before, during, and after a campaign assesses the shift in awareness over time. For example, if launching an awareness campaign in the local area to help residents understand the value of the biosphere reserve, conducting a street poll with a sample of residents that includes questions on their level of understanding of what a biosphere reserve is would indicate the change in the level of awareness.
- Increased pride: Asking questions about what they value most about the local area and how they feel about living there, points towards their feeling of belonging and their level of satisfaction.
- Increased willingness to get involved: Asking stakeholders how likely they are to want to get involved or what more they might need to participate are good ways to gauge their willingness to participate.

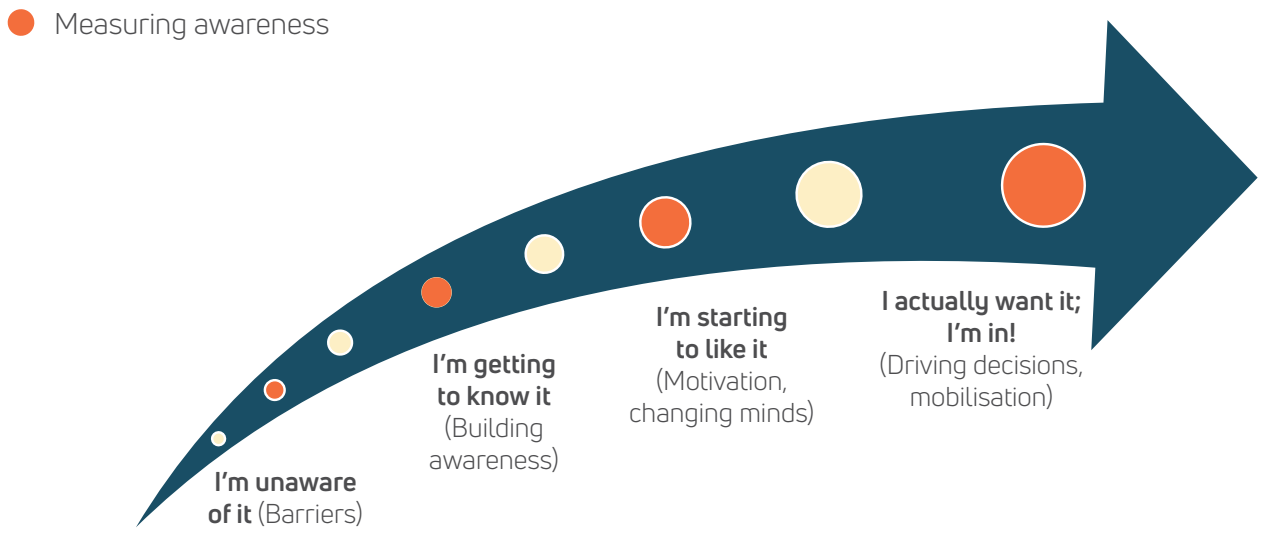
The quantitative evaluation should measure:

- Reach: Determines the number of people directly targeted by your communication and the number of people indirectly contacted by your communications.
- Impact: Assesses the increase in awareness and changes in the behaviour and the increased willingness of people to get involved in the action.
- Investment: Accounts for the funds provided for the awareness activity

The monitoring and evaluation step must be integrated into the planning phase, especially when adapting or modifying human behaviour. Evaluating the effectiveness of the communication and awareness action requires choosing an evaluation method. There might not be harmonised worldwide methods for comparing behavioural measures, so the current challenge is to find better ways to evaluate measures effectiveness and establish indicators such as a headcount at a seminar, quantitative/qualitative surveys, video views on YouTube, hits on the website, social media interactions, feedback via e-mails, press clippings, etc. This will:

- Evaluate the impacts of the communication.
- Measure if higher awareness is translated into more energy-efficient/environmentally friendly individual behaviours.
- Collect the data.
- Conduct the evaluation, report results, and disseminate the results to improve the effectiveness of future programs.

Figure 8: Awareness Process: Building Levels Of Awareness Leading To A Change In Attitude



Overall recommendations and best practices

There is still a lack of knowledge among end-consumers about how the information is provided. It might be deduced that previous approaches such as the price-based approach (save money) and the environmental approach (save the planet) were not completely successful. People need to be inspired, engaged, and have fun when receiving the message.

Repeated exposure to the message is especially important and favours simultaneous reception from multiple sources. Repetition or further development of the campaign is recommended to keep the message in the target group's minds.

Set up internal communication to improve collaboration among all municipal departments.

Establishing an internal communication department responsible within the local authority may be crucial for facilitating and improving collaboration between the services and stakeholders involved.

Adhering to the Covenant of Mayors for the Mediterranean (CoM-Med), and building a regional network with other local authorities, especially CoM signatories, allows sharing experiences and best practices. It is highly recommended as it accelerates learning and highlights the actions taken by each local authority which may also attract investors and additional funding to support pilot and demonstration projects.

Develop a better understanding of consumer behaviour across genders, integrating lessons learned from behavioural insights and an up-to-date survey on gender differences in consumer attitudes to sustainability and their drivers. Men and women express different preferences, perceptions, and beliefs when acting in environmentally friendly ways. Mainstreaming gender equality in environmental strategies/policies is therefore crucial in advancing towards a fairer and more sustainable form of development.[1]

Encouraging individual actions, citizen initiatives, and volunteering; facilitating more affective and experiential engagement (personal stories) are also helpful.

Turning principles into practice requires communication and mediation efforts driven by public authorities: informing, raising awareness, influencing perceptions and behaviour, and relaying and legitimising the implementation of public policies are all among the objectives for the communication efforts of institutional actors. [2]

[1] Gender and the Environment; Building Evidence and Policies to Achieve the SDGs
[2] R. Debray 1993; C. Ollivier-Yaniv 2000

Taking into account

Consumption and behaviour patterns can be heavily influenced via effective public communications campaigns. Building on behavioural insights can support consumers in reaching more sustainable consumption choices by adapting messages across different social groups. Media and citizen engagement can play a significant role in changing unsustainable consumption patterns and transitioning towards a sustainable economy.

Targeting gender roles and behavioural preferences in climate actions is recognising that women's exposure to environmental stress factors need to be considered in this effort.[1]

Facilitate ongoing communication between the city and the citizens and carrying out a public consultation to ensure they learn about projects affecting their lives and assure their involvement and engagement.

Scientific information is critical to telling the climate change story, but it needs to be translated in an accessible or entertaining way for the general non-scientist public.

Dramatic visual portrayals of climate change are persuasive, even in animated form. However, it is not necessary to emphasise fear to create urgency and response.

Avoid duplication of actions. If there are parallel initiatives already in process, it will be efficient to collaborate in a joint, unified effort.

Awareness-raising takes time. All of the most successful public awareness campaigns are sustained consistently over a number of years. During the process, the positive message needs to be constantly reinforced.

[1] Sorensen et al., 2018 [17]

Bibliography

- Government of Saint Lucia, Department of Sustainable Development, Ministry of Education, Innovation, Gender Relations and Sustainable Development, 2018, 'Saint Lucia's Climate Change Communications Strategy, Under the National Adaptation Planning Process', Accessed June2020,<https://www4.unfccc.int/sites/NAPC/Documents/Parties/Saint%20Lucia%20Climate%20Change%20Communications%20Strategy.pdf>.

- VanSlyke, J; Turk L 1999, 'Fifteen case studies in international public relations, The Evolution of Public Relations: Case Studies from Countries in Transition', The Institute for Public Relations, H. Scanlan Editors, Accessed February 2021, <https://pdf4pro.com/view/fifteen-case-studies-in-institute-for-public-relations-316441.html>.

- Abbasi, D R. 2006, 'Americans and Climate Change, Closing the Gap Between Science and Action. A Synthesis of Insights and Recommendations', Yale School of Forestry & Environmental Studies, 2006, Accessed November 2022, <http://environment.yale.edu/climate/americans_and_climate_change.pdf _>.

- LADDER project, 2005, '26 Ways to turn your Local Authority more sustainable', Accessed August 2021, <http://www.ladder-project.eu/wp-content/uploads/2016/04/4.-26-ways-to-turn-your-local-authority-more-sustainable.pdf>.

- OECD, '25 Actions on Climate', <https://www.oecd.org/stories/climate-action/key-sectors>.

- Shafi, N. 2019, 'The Arab's World best weapon against Climate Change? Its young people', World Economic Forum, Accessed January 2021, <https://www.weforum.org/agenda/2019/01/the-arab-worlds-best-weapon-against-climate-change-its-youth↗.

- European Commission, 'You control Climate Change', 2006, <https://ec.europa.eu/environment/archives/networks/greenspider/doc/climate_change_campaigns/ccc_EC.pdf>.

- Danone Manifesto, 2016, Annual Financial Report, Accessed January 2022, <http://wikirate.s3.amazonaws.com/files/3153906/13569365.pdf>.

- Kim, KH 2007, 'Overview on Public Benefit Campaigns to Promote Energy Conservation and Energy Efficiency', United Nations Forum on Energy Efficiency and Energy Security, Accessed July 2018, <https://sustainabledevelopment.un.org/content/documents/1477background2.pdf>.

- ICLEI Local Governments on Sustainability, 2009, 'Outreach and Communication', ICLEI Resource Guide, Accessed August 2020, <https://climate-adapt.eea.europa.eu/metadata/tools/climate-change-outreach-and-communication-guide/04_iclei-cap-outreach-communications-guide_0.pdf>.

- OECD, 2021, 'Gender and the Environment; Building Evidence and Policies to Achieve the SDGs', Accessed November 2021,<https://www.oecd-ilibrary.org/environment/gender-and-the-environment_3d32ca39-en>.

- UK Department of Communities and Local Government, Climate-ADAPT 2016, 'Climate Change Communication Strategy: A West Sussex Case Study', Accessed January 2022, <https://climate-adapt.eea.europa.eu/metadata/publications/climate-change-communication-strategy-a-west-sussex-case-study >.

- Grant, C 2014, 'Kakanui Catchment Project, Behaviour Change Review', NZ Landcare Trust; Accessed December 2018, <https://www.landcare.org.nz↗.

- KPMG International, 2014, The Future of Cities: Creating a Vision', Magnet Cities Report, Accessed February 2019, <https://assets.kpmg/content/dam/kpmg/pdf/2016/04/the-future-of-cities-creating-a-vision.pdf>.

- C40, 2020, Climate Action Planning Communications Toolkit, Accessed February 2022, <https://resourcecentre.c40.org/resources/communicating-climate-action-plans>.

ANNEX 1

The Vision of Your City / What You Want to Achieve

The vision for your city is based on what you see today and what you hope for tomorrow.

Creating your city's vision defines the city's desired future, a vision of "A Community for a Lifetime" – a great place to live, learn, work, and play, a "city with a sustainable future," etc.

- A vision is a broad statement of the desired outcome for a target community or audience.
- A vision should be:
  - Specific enough to describe what life might be like if the vision were implemented and guide goal-setting activities.
  - Broad enough to encompass many goals and implementation strategies.
  - Ambitious enough to articulate a measurable Action Plan.
- It includes themes like sustainable development, healthy communities, and quality of life.
- It is one of the required ingredients in realising a comprehensive SEACAP and making it succeed together with leadership, action, and partnerships.
- It is one of the key elements in articulating the communication plan.

The Importance of a City's Vision

For a city to develop a strong magnetic pull, its leaders need to:

- Make conscious decisions together with its city council about WHAT they want to become as a community.
- Establish the priorities that need to be addressed.
- Shape the vision for the future and set the direction to develop achievable strategies and plans

Creating the Vision

Ask yourselves and the community a real question as to whether anyone would want to live in such a place as your city, whether it is a place to "be in".

Look further ahead, imagining what your city will look like decades from now.

My city will be a city of....

- Conservation and use of our natural resources and environment
- Active citizens and business partnering with city government
- Mobility for citizens, businesses, tourists by coordinating alternative transport
- Safety for our people
- Health with a focus on the well-being of people and our environment

The Vision of your "city of tomorrow" should be structured around storytelling with a slogan. It all depends on the world you want to centre the story around. If you have a story that centres on climate change, you need to imagine and remake your city in that image.

An Example from Jordan's Aqaba Special Economic Zone Authority (ASEZA)

The slogan: "Go green – The future of Aqaba city"
Aqaba is a rapidly growing city that has almost doubled its population within a decade. This trend is expected to continue though at a lower rate. This population increase poses significant pressures on the existing and future infrastructure and the city's further development. The ASEZA is deeply committed to a sustainable future for the city.

The storytelling: Its vision expressed through the actions selected in its SECAP focuses not only on reducing energy consumption through energy efficiency or producing more clean energy, but also on "greening" the existing as well as future infrastructure at the municipal level.

The image Aqaba projects are strikingly clear in showing a perspective of what a green city will look like.

A) Guiding principles when setting up the vision of the city

- Always maintain a **long-term view**.
- **Put people and community well-being at the centre of the vision**: engage, inform, and create opportunities for people to participate in achieving a shared vision.
  Citizens also play a role in establishing the direction of the city and creating a compelling vision for the community. Listen to what people have to say to develop a shared project vision. Think of young wealth creators and becoming highly attractive to educated, ambitious young people.
- Keep in mind **places, heritage, culture, environment**: celebrate and share the great features in the city that mean the most to its citizens.
- Think about **prosperity, economic development, transportation, and infrastructure**: encourage the growth of the local economy where there is an opportunity for everyone to contribute and succeed.
- Connect to **other cities**.
- Cultivate **new and innovative ideas**.

It is easy to focus on short-term gains and lose sight of the potential to make long-term changes. A good city manager stays in the post for only a few years, but they can affect the lives of citizens for much longer. A thriving city is one that goes further and creates a sense of belonging and purpose.

B) Where to start

A city should identify the needs to shape its vision, recognise the opportunities to answer the needs and determine the priorities leading to actions.

An Example from Lebanon's Kab Elias-Wadi El Delm
A Sustainable Pilot City

Needs: With 75,000 people in 2013 producing 19,162 tons of municipal solid waste (MSW) per year, the MSW in Kab Elias is collected and transported by municipality trucks and then manually sorted in the landfill. The unsorted wastes are disposed of in an unsanitary waste landfill.

Opportunities: Changing behaviour in solid waste management and transitioning to a smart way to sort solid waste at the source.

Recommendations: Ensuring capacity development and enhancing public awareness; enhancing plans for sorting solid waste at the source; developing a waste strategy plan with a waste management plan to overcome the high cost in collection and transportation and look for a solution to the landfill either by converting it to a sanitary landfill or utilising another one near the city; and implementing waste power generation from solid waste to feed energy to a future solid waste plant.

C) Planning requirements for your city

One of the most important actions any organisation can take is to focus on what they want to be and how they will get there. With this in mind, the city council will place considerable time and effort into adopting a mission statement, vision statement, values statement, and strategic goals for the city.

Vision

Define the City's identity:

The city should promote the uniqueness of its founding communities, heritage, rivers, environment, cultures, and common future. It should be clear that a city's identity reflects its residents' values, interests, and skills.

Looking into the future:

A city should own its identity and celebrate it.
A city can refine, re-establish, or entirely reinvent what a city is known for. A totally new identity can be established for a city if its old identity is lost.

Develop a vision statement (slogan):

The slogan is a mental picture of the city's possible or desirable future state.
Example:
The City of X will become a vibrant community focused on a booming town centre while preserving its natural character and agricultural roots.

Mission

The city's mission is an important statement describing why the city staff, council, and members exist as an organisation. **A mission statement** is the purpose or role of the organisation describing the organisation's reason for its existence (working together, serving our community...)

"As the world moves toward a focus on a Sustainable Pilot City and a low-carbon approach to meet the growing energy requirements, Kab Elias-Wadi El Delm is taking action to create a conservative culture and ensure a sustainable economic future and clean environment. (...) Kab Elias-Wadi El Delm is looking forward to building a future where it can be confident that the decisions taken today ensure its citizens grow up in an environment that is productive and protected by all."

Core Values

A city's values enable the development of its vision. The city has to commit to its core values (i.e., ethics and integrity, open and honest communication, respect of the citizen, professionalism...); These values will set the example and play an essential role in the decisions and actions of the city. (For example, if sustainability is one of the city's core values, we need to have all municipal employees think and act in such a manner.)

Sometimes a values statement describing those values is necessary to fulfilling the city's mission.

Strategic Plan & Goals

Developing long-term strategies and initiatives to achieve the vision should include broad public involvement, community consultation, and engagement of the community members on issues affecting it.
The strategic plan represents a base for decision making, connects the community's vision and goals with the corporate mission, values, and actions of the city, allows debates and fosters collective responsibility. The Strategic Plan can be developed in three phases:

- Phase 1: Reach out to the community and hear from them about what should be focused on to make life in it better (could be done online or during consultations).
- Phase 2: Get a summary of community feedback and next steps on the categories for developing the strategic plan (heritage & architecture, environment, transportation, infrastructure...)
- Phase 3: Drafting recommendations, goals, and objectives of each main point; the process of implementation, financial impacts...

"Sometimes, the people who make a lot of noise against something drown out the larger number of people who support an idea and recognise the long-term benefit to the city. True leadership is about being prepared to work to achieve that long-term dividend and remembering that a resilient city is one that plans for the future."

George Ferguson, Mayor of Bristol

ANNEX 2

SURVEY QUESTIONNAIRE FOR CONDUCTING A LOCAL NEEDS ASSESSMENT

An awareness campaign is likely to succeed if we address the right messages to the right stakeholders and have them play a key role in its implementation.

The following survey questionnaire will help identify the possible audiences in your city, assess their level of awareness, knowledge, attitudes, interests, and behaviour, plus explore climate change priorities, existing resources for communicators, barriers to action, etc.

According to the findings, the information revealed in the survey will help you design audience-specific messages and build your awareness and communication campaign.

The survey can be carried out through in-person and informal telephone conversations or a formal written questionnaire with small but representative samples of people. Moreover, you may enhance it with additional questions related to further investigations and goals.

GENERAL ENVIRONMENTAL CONCERNS

What is your level of agreement with the following regarding global warming/climate change?				
	Completely agree	**Not fully agree**	**Completely disagree**	**Don't know**
It is a real threat to the population around the world.				
It is a serious threat to you and your family				
It is caused by human activities				
Its impacts are underestimated in the news				
The government should increase the incentives for people who try to reduce climate change				
I am ready to reduce my energy usage to tackle climate change				
The global temperatures have changed compared to the previous decade				
Climate change is happening right now				

In your opinion, how important do you think the following issues are on a global scale?				
	Very Important	Important	Slightly Important	Don't know
Air pollution				
Pollution of rivers and seas				
Flooding				
Litter				
Poor waste management (e.g., overuse of landfills)				
Traffic/congestion				
Temperature rise or drop				
Hole in the ozone layer				
Using up the earth's resources				
Radioactive waste				

Do you think that climate change is caused by natural processes, human activity, or both?		
	Yes	No
By natural processes		
By human activity		
Equally by both		
Climate change is not happening		
Don't know		

Which strategies reduce greenhouse gas emissions?		
	Yes	No
Turning off lights when leaving a room		
Walking or riding a bicycle instead of driving short distances		
Turning down the thermostat by at least 1°C.		
Using energy-saving lights		
Turning off stand-by switches on appliances		
Taking shorter showers		

GLOBAL ENVIRONMENTAL ISSUES

Which alternative energy sources do you think will be the most important in [city]?	
Wind	
Solar	
Nuclear	
Natural gas	
Coal	
Other	

How worried are you that energy may be too expensive for many people in [city]?	
Very worried	
Somewhat worried	
Not at all worried	
Don't know	

Regarding the environment, would you say:	
	Environmental issues don't interest me
	Environmental issues are interesting to me, but the subject is complex, and I don't understand or master it
	Environmental issues worry me, I think about them, but I don't know what to do
	Environmental issues worry me, I think about them, and I am careful in my behaviour
	Environmental issues are a challenge to me, I think about them, I am committed and mobilized within associations

GENERAL VIEWS ABOUT THE ENVIRONMENT

How concerned are you about air pollution?	
Very concerned	
Slightly concerned	
Not at all concerned	

How concerned are you about the extinction of endangered species?	
Very concerned	
Slightly concerned	
Not at all concerned	

How willing are you to change your lifestyle to reduce environmental damage?	
Very willing	
Not so willing	
Not willing at all	
Don't know	

What actions do you implement in your mobility choices?	
	I try to reduce the usage of my car
	I prefer public transport for my daily journeys
	I do car sharing
	Other

How often do you recycle?	
Always	
Most of the time	
Occasionally	
Never	

PERSONAL AWARENESS

Do you tend to buy the most energy-efficient home appliances?	
Most of them	
Some of them	
Not at all	

Do you think that limiting your own energy use would help reduce climate change?	
Very likely	
Not at all	
Don't know	

In your daily life, how often do you do things to reduce your energy use?	
Always	
Very often	
Sometimes	
Never	
Cannot reduce	
Don't know	

In your residential choice, do you consider the following items as important?					
	Very important	Important	Not very important	Unimportant	Don't know
Energy-saving housing					
Technology for tracking energy consumption					
Low carbon heating system production					
Energy production system (i.e., PV)					
Smart and recycling system for water management					

In your residential choice, do you consider the following items as important?					
	Very important	Important	Not very important	Unimportant	Don't know
Presence of a green space (e.g., garden)					
Shared green space					
Presence of green walls					
Ecological maintenance of natural areas					
Facilities for fauna and flora (e.g., beehives)					

Are you aware of the global policies or initiatives taken by various organisations to reduce climate change/global warming?	
Yes	No

Are you aware of the environmental policies in your country/city?	
Yes	No

ABOUT YOU

Tell us more about yourself.	
Gender	
Age group	
Education level	
With/without children	
Occupation/profession	

References

European Investment Bank (2008). Study on Climate Change and Energy in the Mediterranean, July 2008

Giannakopoulos, C., Bindi, M., Moriondo, M., Lesager, P., & Tin, T. (2005). Climate change impacts in the Mediterranean resulting from a 2 C global temperature rise. A report for WWF.

Gruber et al. (2007). Detailed analysis of electricity consumption in tertiary buildings as a basis for energy efficiency policies. ECEEE 2007.

IPCC (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

Lionello P. (2012), The Climate of the Mediterranean region, from the past to the future, Elsevier Books, ISBN: 978-0-12-416042-2

Lo Vullo, Eleonora; Muntean, Marilena; Duerr, Marlene; Kona, Albana; Bertoldi, Paolo (2020): GHG Emission Factors for Electricity Consumption. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/919df040-0252-4e4e-ad82-c054896e1641

Luterbacher, J., et al. (2006). Mediterranean climate variability over the last centuries. A review. In: Lionello, P., Malanotte-Rizzoli, P., Boscolo, R. (Eds.), Mediterranean Climate Variability. Elsevier, Amsterdam, pp. 27–148.

Malek K. (2019), Why Middle East publics have mixed views on climate change. Arab News. https://www.arabnews.com/node/1564706/middle-east

Peyron, O., Guiot, J., Cheddadi, R., Tarasov, P., Reille, M., de Beaulieu, J. L., ... & Andrieu, V. (1998). Climatic reconstruction in Europe for 18,000 yr BP from pollen data. Quaternary research, 49(2), 183-196.

Plan Bleu-UNEP (2009). Etat de l'environnement et du développement en Méditerranée – 2009

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the Clima-Med project and do not necessarily reflect the views of the European Union.

Each SEACAP has been developed jointly by members of Al Zayniyyah technical staff and the Clima-Med team of experts led by Naguib Amin (Team Leader). Core members are Oussama Kassamani (Key Expert, Local Sustainable Development specialist), Ramadan Seddik (Director General of Environment, Luxor Governorate, & SEACAP Action Coordinator), Alexandra Papadopoulou (Climate and Sustainable Energy Expert), Myriam Makdissi (Key Expert, Communication and Networking). Other contributors include Simon El Hachem (SEACAP Preparation Expert), Paul Tabet (Junior Expert, SEACAP preparation), Rania Kassamani (Junior Expert, SEACAP preparation), and Malek Mardam Bek (Clima-Med Office Manager, Mashreq region).

Clima-Med is an EU-funded project implemented by a DAI led Consortium as part of the activities of the European Union's project for ENP South Countries EUROPEAID / 139067 / DH / SER / MULTI.

Nadya Boneva is Clima-Med Project Director (DAI Practice Leader: Planet).

The authors of the publication regret any errors or omissions that may have been unwittingly made.

A digital copy of this document is available on the project website: www.climamed.eu

This project is labelled by the UfM

Union for the Mediterranean
Union pour la Méditerranée
الإتحاد من أجل المتوسط

Design: Purple Advertising Agency

Images: Wadih Chehaibar

Published by Clima-Med, Acting for Climate in South Mediterranean, August 2022

www.climamed.eu

Project implemented by
a DAI led Consortium

DAI
Shaping a more livable world.