Clima-Med
Acting for Climate in South Mediterranean

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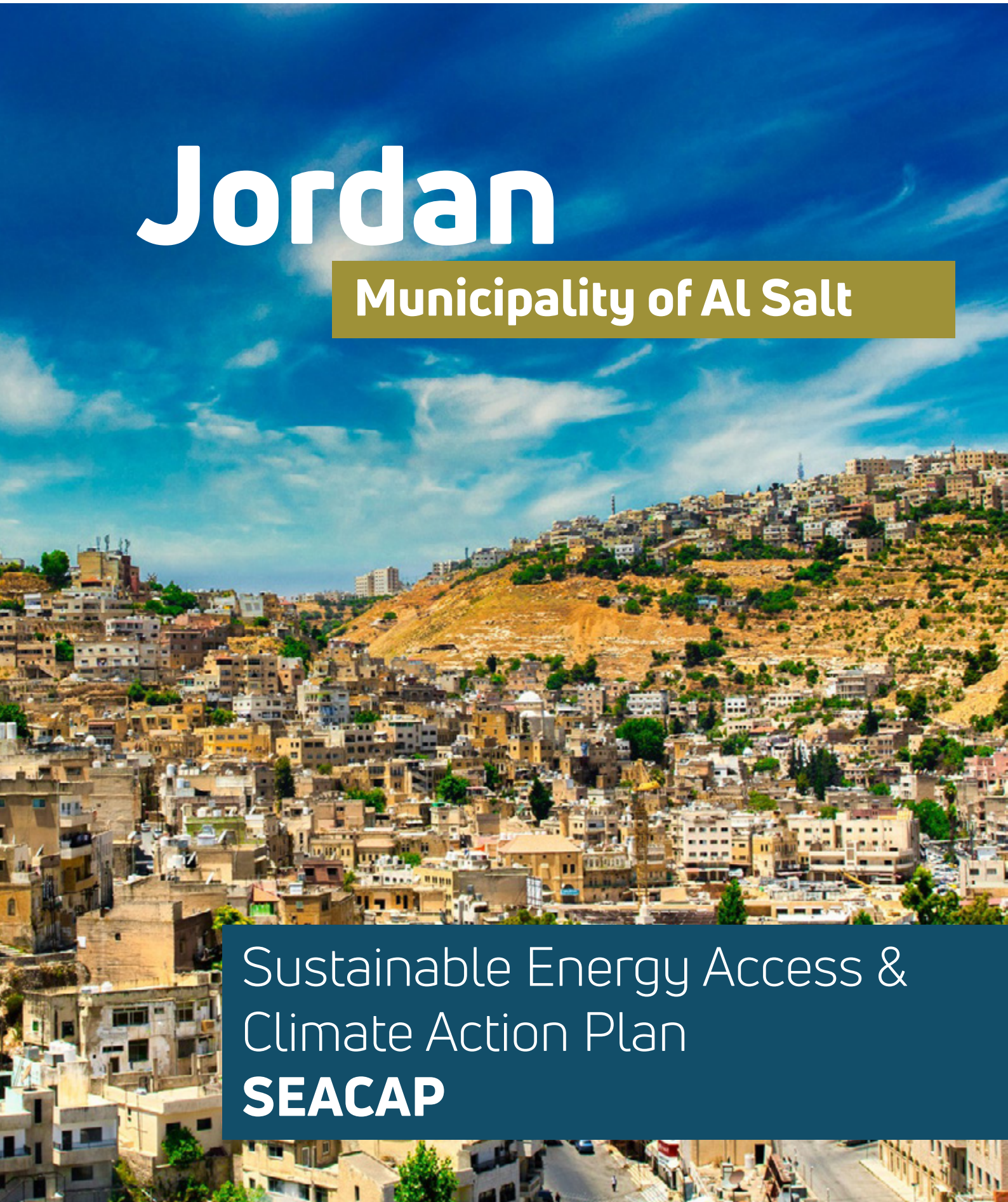
# Jordan

## Municipality of Al Salt



# Sustainable Energy Access & Climate Action Plan

# SEACAP

This municipality is a signatory of the Covenant of Mayors for the Mediterranean, CoM Med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# Glossary

| | |
|---|---|
| **AFOLU** | Agriculture, Forestry, and Other Land Use |
| **BEI** | Baseline Emissions Inventory |
| **CAP** | Citizens Awareness Plan |
| **CAS** | Climate Action Strategy |
| **CBD** | Convention on Biological Diversity |
| **CoM** | Covenant of Mayors |
| **CoM Med** | Covenant of Mayors for the Mediterranean |
| **GHG** | Greenhouse Gases |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **JRC** | Joint Research Centre of the European Union |
| **MSW** | Municipal Solid Waste |
| **NDC** | Nationally Determined Contributions |
| **RCP** | Representative Concentration Pathways |
| **SCP-NAP** | The Jordanian Sustainable Consumption and Production National Action Plan |
| **SWDC** | Solid Waste Disposal Sites |
| **SWM** | Solid Waste Management |
| **TNC** | Third National Communication on Climate Change |
| **UNCCD** | United Nations Convention to Combat Desertification |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **VTMS** | Vehicle Tracking & Monitoring System |

# Executive Summary

Al Salt is an ancient agricultural town and administrative centre in west-central Jordan, 29 km west of Amman with a population of 143,626 covering a 48 km2 mountainous area. It's location on the old main highway leading from Amman to Jerusalem makes it a strategic historical place as an important trading link between the eastern desert and the west.

Al Salt is famous for its fertile soil and the quality of its fruit and vegetable harvests, particularly olives, tomatoes, grapes, and peaches. The city has also an active tourism sector with a number of facilities and sites giving the area a touristic character with a lot of heritage and religious locations.

The unemployment rate is 19.3% (higher than the national rate of 18.5%). However, the locality enjoys decent infrastructure and governmental services.

Situated at about 800-1,100 meters above sea level, the climate is mild and cold in winters and mild in summers with an average rainfall of 600 mm. However, the city has been facing gradually increasing summer temperatures which have caused forest fires. Other changes such as decreased snow precipitation has also left a serious impact on several sectors, including agriculture, public health, and water.

The municipality plans expanding public services to construct and maintain roads, street lighting, and reforestation. Creating infrastructure by supporting the Green March and participating in large-scale urban regeneration and expansion is the city's primary focus.

This document comprises the municipality'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 municipality's leadership, its technical team, and in collaboration with the National Coordination Group led by the Ministry of Environment, the Clima-Med National Focal Point.

By preparing the SEACAP and by joining the CoM-Med, the municipality 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 village with a clear vision, objectives, targets, and actions.

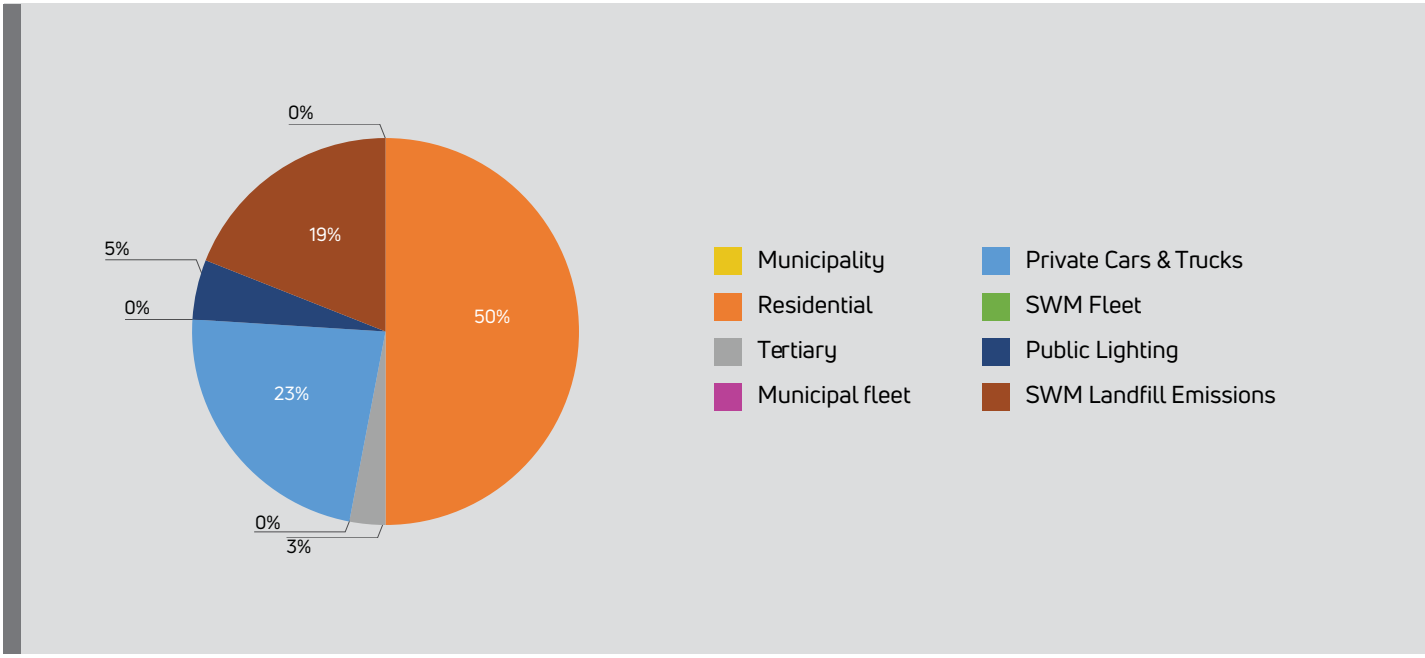
This SEACAP includes seven sections:

- Chapter 1: Municipality 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 municipality's main goals of reducing air pollution, implementing mitigation actions and measures to reduce CO2 emissions as well as 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 prioritizing mitigation measures. The BEI is used in Chapter 5 to measure the plan's potential impact. For a one-time investment of EUR 19 million, the plan's implementation would create an annual GHG emission abatement of 46,584 tCO2-eq – mitigating 15.46% of emissions and saving EUR 10.43 million annually as well. If the plan is not to be implemented, the city's CO2 emissions could reach 301,256 tCO2-eq by 2030.

***Figure 1:*** Emissions contribution by sector




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.

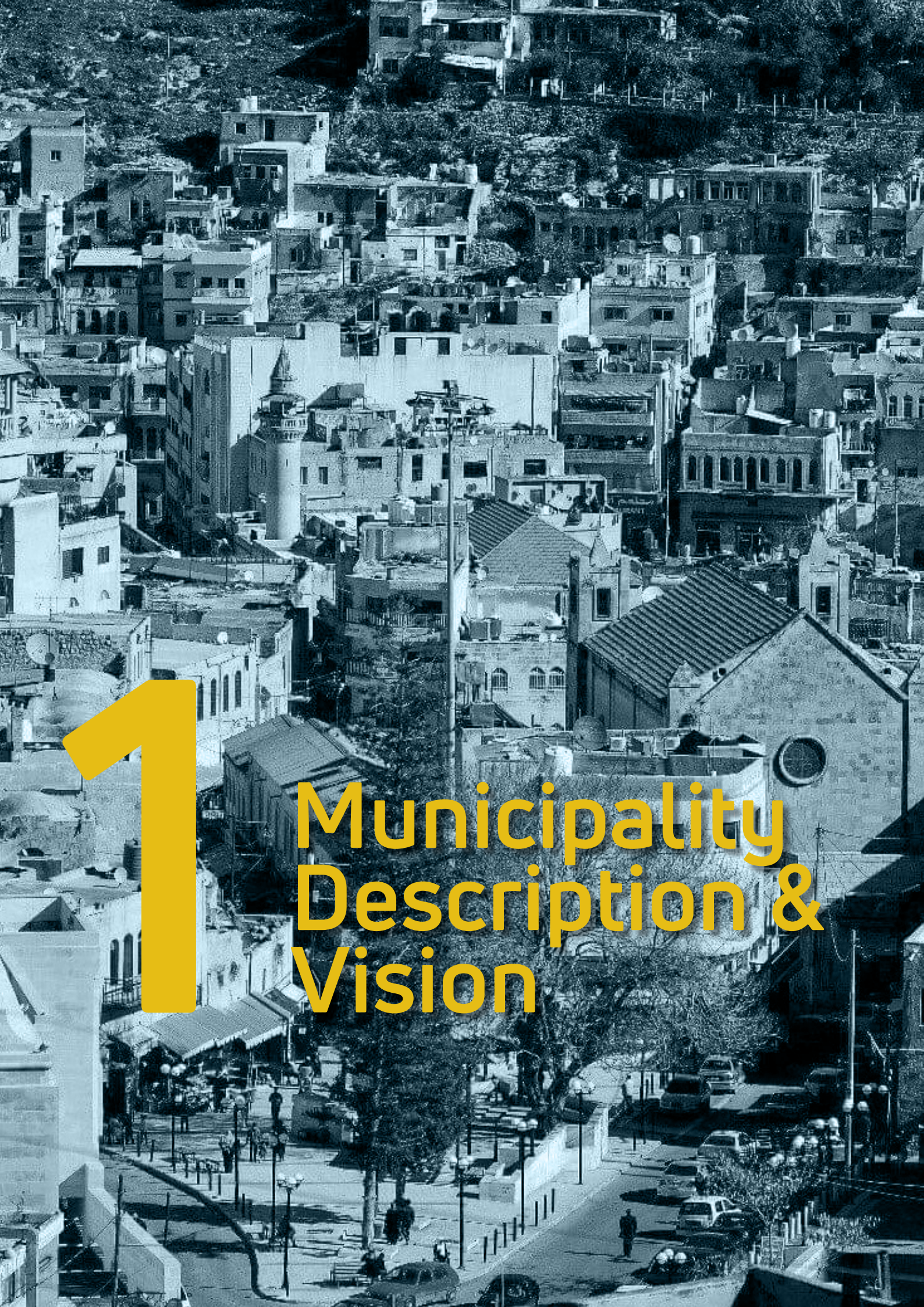
Chapter 4 focuses on capacity building and local governance, especially for actions related to sustainable energy, climate change adaptation, and greening the city.

Chapters 5 and 6 detail mitigation actions by sector -- particularly the impact of a green building code – and quantifies adaptation actions. The table below summarizes the proposed measures and their emissions impacts, costs, and benefits by 2030.

Chapter 7 provides an overall plan to motivate the municipality and its people with the information covered in chapters 1-6.

*Table 1:* Proposed mitigation measures and their emissions impacts, costs, and benefits by 2030

| Sector | Action | Mitigation, MWh/a | Mitigation, tCO2-eq/a | Implementation Cost, EUR | Annual Monetary Savings, EUR | BAU Emissions, tCO2-eq (2030) | Climate Cost Efficiency (2030) |
|---|---|---|---|---|---|---|---|
| **Municipal** | 5.1.1 Existing Municipal Buildings: Consumption Saving Measures | 214.9 | 149.4 | N/A | 38,686 | 646 | N/A |
| | 5.1.2 New Municipal Buildings: Implementing & Promoting the Green Building Code | 50.1 | 34.8 | N/A | 9,018 | | N/A |
| **Residential** | 5.1.3 Existing Residential Buildings: Awareness-raising Activities | 19,108.7 | 12,594.3 | 1,000,000 | 3,243,956 | 152,073 | 79.4 |
| | 5.1.4 New Residential Buildings: Implementing & Promoting the Green Building Code | 18,678.4 | 8,204.8 | 800,000 | 2,000,177 | | 97.5 |
| **Tertiary** | 5.1.5 Existing Tertiary Buildings: Awareness-raising Activities | 1,570.3 | 1,064.5 | 200,000 | 274,780 | 8,330 | 187.9 |
| | 5.1.6 New Tertiary Buildings: Implementing & Promoting the Green Building Code | 706.7 | 449.4 | 100,000 | 114,991 | | 222.5 |
| **Public Street Lighting** | 5.2 Municipal Public Lighting | 8,964.5 | 6,230.0 | 6,679,667 | 1,613,610 | 13,689 | 268 |
| **Transport** | 5.3.1 Road Asset Planning & Management with Smart Mobility Measures | 19,373.8 | 4,864.2 | 3,000,000 | 1,963,502 | 69,489 | 616.7 |
| | 5.3.2 Municipal Transportation Solid Waste Sector | 1,161.0 | 311.0 | 2,300,000 | 62,694 | 1,037 | 1,848.9 |
| **Solid Waste Management** | 5.4 Solid Waste Management | | 8,398.9 | N/A | | 55,993 | N/A |
| **Renewable Energy Production** | 5.5 Local Energy Production | 6,162.3 | 4,282.9 | 4,981,500 | 1,109,214 | | 1,163.1 |
| **Total contribution to emissions reduction 46,584.2 / 301,256 = 15.46 %** | | **75,990.7** | **46,584.2** | **19,061,167** | **10,430,628** | **301,256** | **-** |



# 1 Municipality Description & Vision

# Chapter 1: Municipality Description & Vision

## 1.1 Municipal & NDC Targets

Al Salt municipality, as part of the Covenant of Mayors Mediterranean (CoM-Med), is committed to reducing its emissions 15% by 2030 (with 2018 as the baseline), surpassing the unconditional commitment of Jordan's Nationally Determined Contribution (NDC), which is 5%.

The overall target set by the local government emphasizes working closely with all community actors. It will take all necessary measures with its facilities to establish a good example for the community while collaborating with the public and achieving significant reductions from the residential, tertiary, and transportation sectors as well as from solid waste, water waste, and agriculture.

## 1.2 Overview of City

### 1.2.1 Geographical Location

The city of Al Salt is 25 km northwest of Jordan's capital, Amman, and covers 119.092 km2 located in the Balqa governorate and also includes Al-Yazidya, Wadi Al-Hur, Al-Ramimin, Umm Goza, Yarqa, Aira, and Aira. Sitting at an altitude ranging from 740 to 1,060 meters, the region's Mediterranean climate prevails with the highland areas having mild, rainy, cold winters and mild summers with an average annual rainfall of 600 mm, and its contrast varies between flat plains, hills, mountains, and very steep valleys.

### 1.2.2 Population & Employment

In 2017, Salt and its districts had an estimated 143,626 people – 52.2% male, 47.8% female – accounting for 27.6% of the Balqa governorate, and 1.4% of the nation's total population. The average number of family members in the municipality and regions is 4.7 individuals – less than the national rate of 4.8 individuals/families. Additionally, more than half of the population is reported to be in the 15-64 age group at 63.7% which is above the national level (62%). Unemployment in the governate at 19.3% is also higher than the national rate of 18.5% with the rate among males at 17.6%, and for females at 26.6%..

### 1.2.3 Economic Sectors

The municipality and its districts produce a range of crops – grain, fruits, citrus, and vegetables – and Al Salt is famous for olive trees, vineyards, and other rain-fed trees and irrigated agriculture supported by valley springs. It is also famous for its poultry farms, olive groves, honey mill, and grain mill. This sector faces a number of challenges including the absence of national policies on water scarcity, the absence of technology for producing agricultural crops with small amounts of water (e.g., hydroponics), and the lack of interest in expanding water harvesting and dam projects.

Livestock is composed of cows, sheep, goats, and some small poultry farms. This sector is suffering from the lack of water resources and the high costs of veterinary and feed treatments for cows, goats, and other livestock as well as the weakness of the technical and supervisory talent on livestock farms.

There are a number of factories in the municipality and its districts, including pharmaceutical factories, paints, food industries, two artisans, toddies as well as manufacturing of building materials from laboratories and quarries. Al Salt has also an industrial development area under construction. The main problems faced by the sector are the indiscriminate spread of enterprises without regulation, the lack of compliance by the owners of the craft shops with the health and environmental requirements for public safety, and infringements of some activities on public roads. All of which impact the cleanliness and integrity of the area. Other challenges include the lack of clear and accurate information, the absence of good marketing outlets, and weak purchasing power.

Al Salt won a tourist destination award and has a large number of facilities and tourist sites adding to the area's heritage and religious character including the Shrine of the Prophet Ayyub, Salt Castle, and others. The area has historic architecture and beautiful villages for hiking and recreation such as Zee, with a variety of heritage and tourist sites. The sector faces a number of challenges, including traffic congestion, the lack of tourism bus parking, the lack of tourism investment compared to the size of archaeological tourist sites, the need for many tourist sites for infrastructure and the absence of comprehensive tourism programs for tourist sites.

### 1.2.4 Infrastructure & Key Services

The Jordanian Electricity Company is the main provider of electricity for the municipality and its surrounding areas. The percentage of the population connected to the electricity grid in the municipality and its district is 99.9% – equal to the percentage at the governorate and kingdom levels.

Regarding access to drinking water, the water network covers more than 98% of the municipality and the governorate compared to 93% of the kingdom. However, there are fears concerning water shortages and supplies in the region. The rate of loss is high and the number of artesian wells is declining. Rainwater is the main source of irrigation for agriculture and livestock in the city.

The municipality deals with 130 tons of mixed solid waste daily. The solid waste is transported to the Al Hamra landfill in the Al Kasaba district.

Regarding wastewater and rainwater infrastructure, the existing sewage and rainwater networks do not cover all the housing units. The existing wastewater treatment plant capacity is not enough for the daily sewage

produced. Some of the housing units are still using cesspits and septic tanks causing a lot of pollution and threatening health.

The municipality and its surrounding communities have a major road network and sub-road and agricultural networks of 1,620 km: main roads (216 km), secondary roads (136 km), rural roads (218 km), paved agricultural roads (750 km), and various unpaved roads (300 km).

Finally, Jordan's telecom and information technology sector comprises 17.4% of Jordan's GDP and 82,000 jobs.

## 1.3 Strategy

### 1.3.1 Vision for the Future

The vision stems from the municipality's history and intends to capitalise on the city's identity as an active commercial city with sustainable tourism.

The challenges facing the municipality's long-term vision of sustainability are issues related to sustainable growth and population increase.

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

The municipality'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, modern water harvesting systems, 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 Jordanian 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, SEACAP is in line with the National Strategy and Action Plan for Sustainable Consumption and Production for Jordan (2016-2025) which is mainstreaming sustainable consumption and production into agriculture/food production, transport, and waste management.

### 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. The municipality has an active technical services department and an environmental committee and the necessary 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, will engage in plan preparation and implementation beyond the current council mandate.

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

### 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 (property, school, and licensing) 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 grants or loans to implement planned activities.

### 1.3.5 Implementation & Monitoring Process

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

# 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 prioritizing 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 municipality has been using Intergovernmental Panel on Climate Change (IPCC) emission 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 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 municipality is planning to include mitigation measures in these sectors.

Under the guidelines for the Maghreb and Mashreq countries, 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 utilizes the standard emission approach in line with the IPCC principles and complies with the UNFCCC reporting system.

### 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 municipality has selected 2018 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 Emission Factors & Conversion Rates

The emission factors expressed as tCO2-eq/MWh are coefficients quantifying the emissions per category of activity data. The emission factors used by the local authority are the last updated emission factors provided by JRC and attributed to electricity consumption. The JRC-CoM-NEFE dataset includes the 1990-2015 time series of the National Emission Factors for Electricity Consumption (NEFE). Considering the lack of availability of more recent data, and following consultation with the JRC, the emission factor for 2015 (IPCC approach) is used for calculations in this report. **The emission factor is 0.695 tCO2-eq per MWh.**

Besides electricity, the fuel emission 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 Emission Factors, 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 municipality has many buildings under its direct control and management – notably the main municipal buildings, gardens, and storage building. Overall, the municipality is consuming 720 MWh per year, for lighting, space heating, 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 | 720 | 500.4 |

HVAC units are used so there is no fuel consumption for space heating as it is already accounted for in the total annual electrical consumption for municipal buildings.

### 2.2.2 Residential Buildings

The municipality believes there are approximately 30,559 households in its area. Utility company data reflects annual electricity consumption of 116,904.38 MWh, resulting in an annual electricity consumption of 813.94 kWh per capita. The table below presents the annual electricity consumption and emissions of residential buildings:

***Table 5***: Residential Building Annual Electricity Consumption & CO2 Emissions

| Site Category | Annual Consumption, MWh | Annual Emissions, tCO2-eq |
|---|---|---|
| Residential Buildings | 116,904.38 | 81,248.54 |

*Emissions factor for electricity consumption is 0.695 tCO2-eq/MWh (CoM-JRC)*

The households consume LPG for space heating and cooking. The data provided by the municipality shows each household consumes about 18 kg of LPG per month for cooking and 30% of the households consume 12 kg per month for space heating during a four-month heating period. Based on these assumptions, the table below presents the annual fuel consumption and CO2 emission for cooking and space heating:

***Table 6***: Residential Annual Fuel Consumption & CO2 Emissions for Cooking & Space Heating

| Fuel Type | Fuel Consumption, litres | Fuel Consumption, kg | Fuel Consumption, MWh | Annual Emissions, tCO2-eq |
|---|---|---|---|---|
| Diesel | 5,500,620 | | 55,006.2 | 14,741.7 |
| LPG | | 7,040,793.6 | 96,459.0 | 21,896.0 |
| Total | | | 151,465.2 | 36,637.7 |

### 2.2.3 Tertiary Buildings, Equipment, & Facilities

The tertiary sector includes commercial buildings, private offices, banks, commercial and retail activities, private and government schools, hospitals, and other activities offering services beyond the control of the municipality. 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 7 :*** Tertiary Buildings' Annual Energy Consumption & CO2 Emissions

| Site Category | Annual Consumption, MWh | Annual Emissions, tCO2-eq |
|---|---|---|
| Tertiary Buildings | 8,767.82 | 6,093.63 |

*Emissions factor for electricity consumption is 0.695 tCO2-eq/MWh (CoM-JRC)*

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

***Table 8*** :Tertiary Buildings' Annual Fuel Consumption & CO2

| Fuel Type | Fuel Consumption, litres | Fuel Consumption, kg | Fuel Consumption, MWh | Annual Emissions, tCO2-eq |
|---|---|---|---|---|
| Diesel | 121,563.7 | - | 1,215.64 | 325.79 |
| LPG | - | 12,156.37 | 166.54 | 37.81 |
| Total | | | 1,382.18 | 363.60 |

*Emissions factor for diesel is 0.268 in (tCO2-eq/MWh)*
*Emissions factor for LPG is 0.227 (tCO2-eq/MWh)*

### 2.2.4 Buildings, Equipment, & Facilities Synopsis

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

*Table 9*: Buildings & Facilities Annual Electricity Consumption & Emissions

| FINAL ENERGY CONSUMPTION [MWh] | | | | | | |
|---|---|---|---|---|---|---|
| Sector | Electricity | Fossil Fuels | | | Total (MWh) | Emission tCO2-eq |
| | | Diesel | Gasoline | LPG | | |
| BUILDINGS, EQUIPMENT/FACILITIES | | | | | | |
| Municipal Buildings | 1,396 | | | | 1,396 | 970.22 |
| Residential Buildings | 457,892 | | | 4,022,933.7 | 860,185.37 | 409,555.54 |
| Tertiary Buildings | 34,341.9 | | | 8,850.5 | 43,192.4 | 25,876.6 |
| **Subtotal** | **493,629.9** | | | **4,031,784** | **904,773.77** | **436,402.36** |

## 2.3 Municipal Public Lighting

The municipality'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 10*: Public Lighting Annual Electricity Consumption & CO2 Emissions

| Type of Street Lamp | Quantity | Watts per Lamp | Annual Consumption, MWh | Annual Emissions, tCO2-eq |
|---|---|---|---|---|
| HPS | 5,000 | 250 | 5,500 | 3,822.5 |
| HPS | 18,000 | 70 | 5,544 | 3,853.08 |
| MH | 6,000 | 125 | 3,300 | 2,293.5 |
| LED | 3,000 | 70 | 924 | 642.18 |
| **Total** | | | **15,268** | **10,611.26** |

*Emission factor for electricity consumption is 0.695 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 municipality, the municipal fleet is comprised of 68 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 municipality based on the total numbers 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 the commercial vehicles. Based on the numbers provided by the municipality, the table below presents the estimated data for annual diesel and gasoline consumption.

*Table 11*: Municipal, Private, & Public Transport Fuel Consumption & CO2 Emissions

| Fuel Type | Municipal Fleet, litres | Private Transport, litres | Public Transport, litres | Fuel Consumption, litres | Fuel Consumption, MWh | Annual Emissions, tCO2-eq |
|---|---|---|---|---|---|---|
| Diesel | 296,530 | 981,600 | 0 | 1,278,130 | 12,781.30 | 3,425.38 |
| Gasoline | 0 | 21,931,265 | 0 | 21,931,265 | 201,767.63 | 50,441.90 |
| **Total** | | | | **23,209,395** | **214,548.93** | **53,867.29** |

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 consumes significant diesel. With a population of 143,626, the solid waste produced is about 47,450 tons annually, 130 tons daily, and is steadily increasing due to the growing population. Solid waste produced in Al Salt is 57% organic waste and 43% other materials. The table below shows the annual fuel consumption of garbage vehicles:

*Table 12*: Transport Emissions from Solid Waste Management

| Municipality | Vehicles | Days/a | L/km | Diesel/a | Consumption in MWh | tCO2-eq |
|---|---|---|---|---|---|---|
| Al Salt | 39 | 317 | **0.4** | **300,000** | **3,000** | **804** |

*Table 13*: Total Transport Emissions

| Sector | Fuel Consumption, MWh | Emissions tCO2-eq |
|---|---|---|
| Municipal Fleet | 2,965.30 | 794.70 |
| SWM Fleet | 3,000 | 804 |
| Private Cars/Trucks | 211,583.63 | 53,072.59 |
| **Total** | **217,548.9** | **54,671.29** |

## 2.5 Solid Waste Landfill Emissions

The municipality collects its solid waste and transfers it to the Al Hamra landfill in Al Kasaba district.

Converting organic waste to compost is one solution for 57% of the municipality'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 more stable, hygienic, and beneficial for agriculture and recycling 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 in which the waste is disposed. 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) = ($MSW_T$ x $MSW_F$ x MCF x DOC x DOCF x F x 16/12-R) x (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 wasteD = Fraction of MSW that is wood or straw

D = Fraction of MSW that is wood or straw

The table below analyses composition of material in landfills [1] in Jordan:

| Material | Percentage of waste |
|---|---|
| Paper and cardboard | 15% |
| Plastic | 15% |
| Metal | 2% |
| Glass | 2% |
| Wood | 1% |
| Clothes | 1% |
| Organic Materials | 57% |
| Other Materials or Residues | 7% |
| **Total** | **100%** |

[1] https://mena.fes.de/fileadmin/user_upload/pdf-files/publications/Your_Guide_to_Waste_Management_in_Jordan.pdf

DOC= (0.4 x 0.15) + (0.17 x 0) + (0.15 x 0.57) + (0.3 x 0.01)

DOC= 0.1485

$DOC_F$: 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) = (47.45 Gg x 0.8 x 0.6 x 0.1485 x 0.77 x 0.5 x 16/12-0) x (1-0))

Methane emissions (Gg/yr) = 1.73621448 Gg/yr

| Methane Emissions, Gg/yr | Methane Emissions, tCO2-eq/a | 2030 BAU,vtCO2-eq/a |
|---|---|---|
| 1.73621448 | 1.73621448*1000*25= 43,405.36 | 43,405.36*1.29= 55,992.92 |

## 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 14*: Emissions from Fossil Fuel & Non-Energy Activities in 2018

| Sector | MWh | tCO2-eq |
|---|---|---|
| Buildings, Equipment, & Facilities | 279,239.6 | 124,843.8 |
| Municipality | 720.0 | 500.4 |
| Residential | 268,369.6 | 117,886.1 |
| Tertiary | 10,150.0 | 6,457.2 |
| Transport | 217,548.9 | 54,671.3 |
| Municipal Fleet | 2,965.3 | 794.7 |
| Private Cars/Trucks | 211,583.6 | 53,072.6 |
| SWM Fleet | 3,000.0 | 804.0 |
| Public Lighting | 15,268.0 | 10,611.3 |

An overview of emissions breakdown by sector is presented in the following figures.

***Figure 2:*** Emissions breakdown by sector

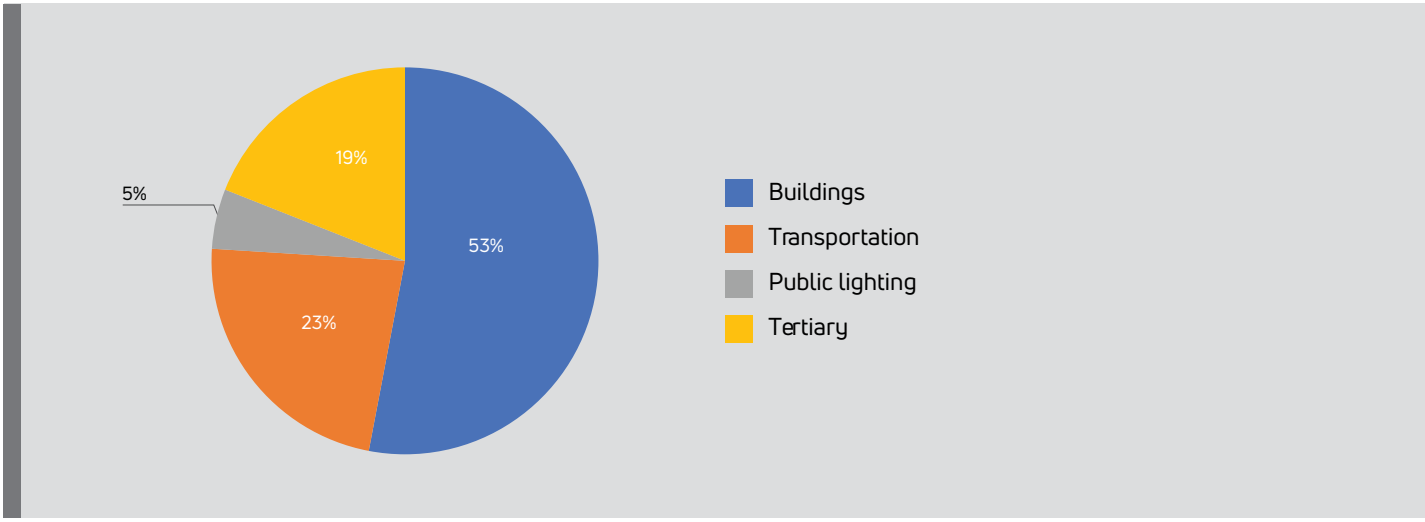



***Figure 3:*** Emissions breakdown in the building sector

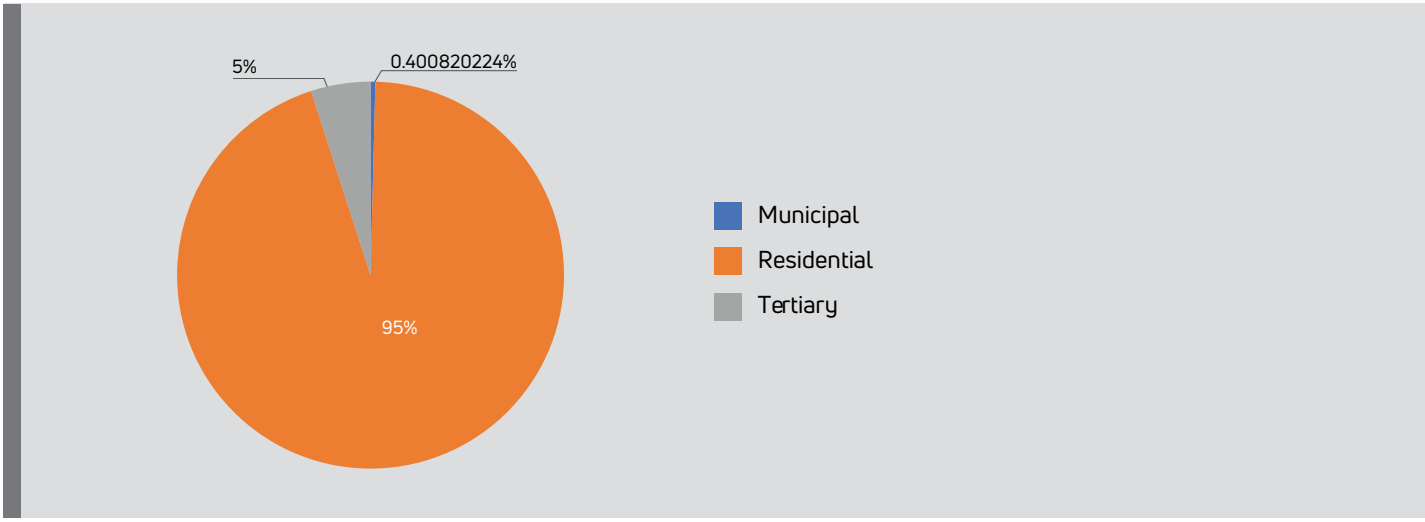
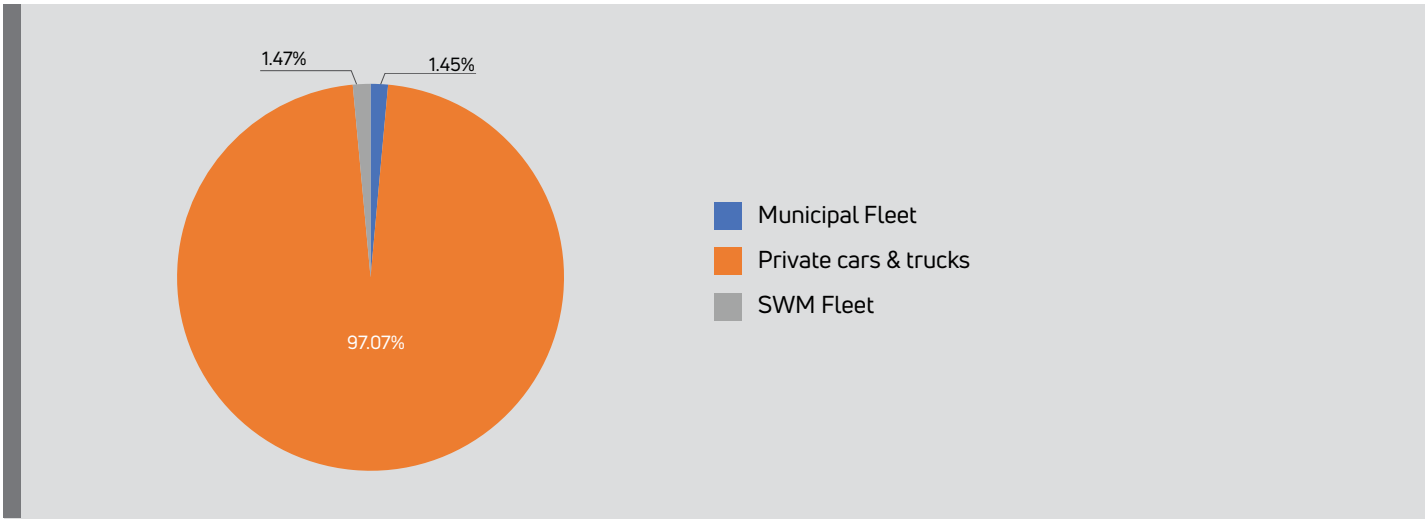



***Figure 4:*** Emissions breakdown in the transport sector



| | | |
|---|---|---|
| SWM Landfill Emissions | | 43,405.4 |
| **TOTAL** | **512,056.5** | **233,531.7** |

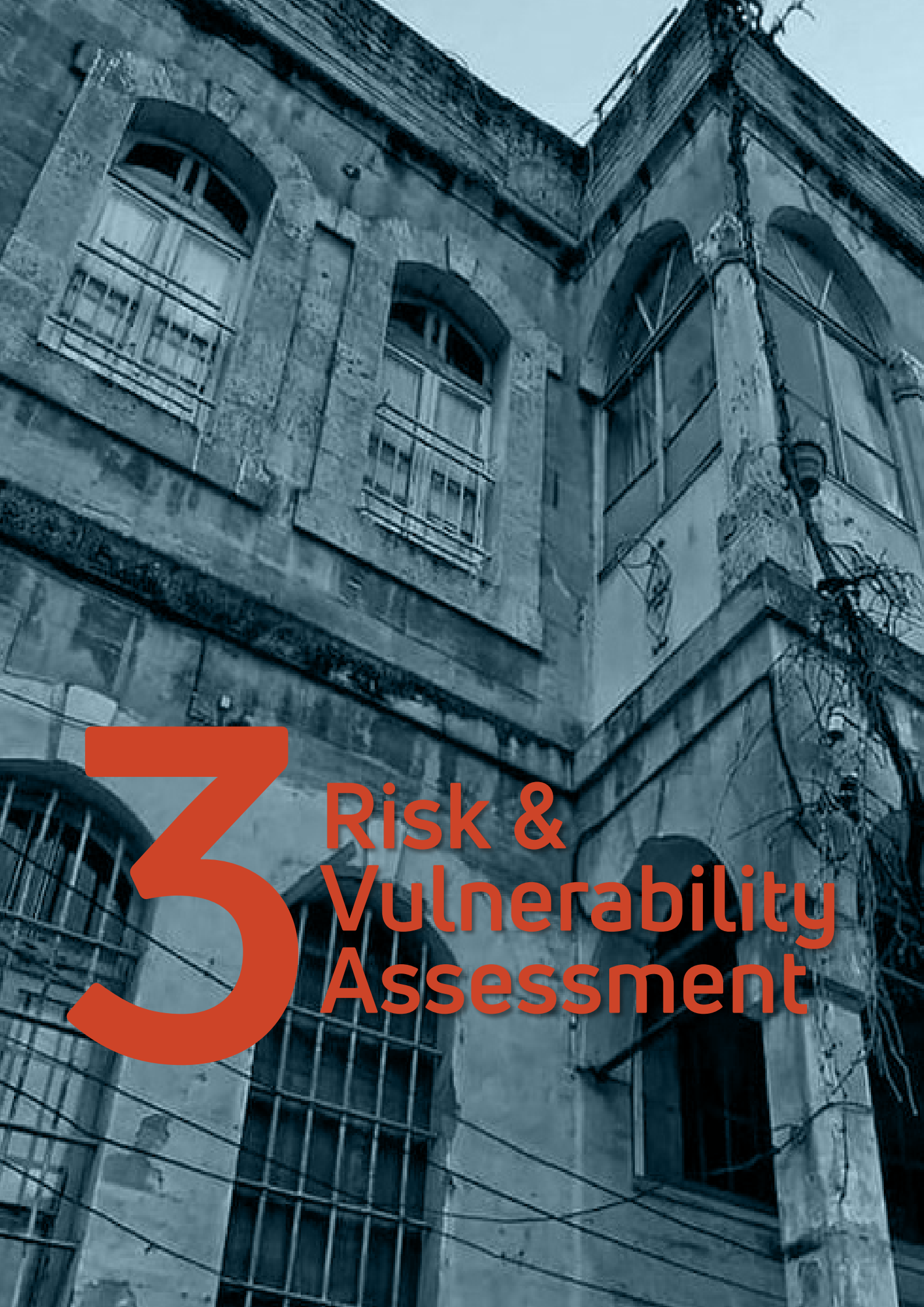
## 2.7 BAU Scenario & 2030 Targets

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

***Table 15***: Emissions CO-2eq as BAU Scenario & 2030 Target

| Municipality Final Energy & Non-energy Activities | | | BAU 2030 |
|---|---|---|---|
| Sector | MWh | tCO2-eq | tCO2-eq |
| Buildings, Equipment, & Facilities | 279,239.6 | 124,843.8 | 161,048.5 |
| Municipality | 720.0 | 500.4 | 645.5 |
| Residential | 268,369.6 | 117,886.1 | 152,073.1 |
| Tertiary | 10,150.0 | 6,457.2 | 8,329.8 |
| Transport | 217,548.9 | 54,671.3 | 70,526.0 |
| Municipal Fleet | 2,965.3 | 794.7 | 1,025.2 |
| Private cars and trucks | 211,583.6 | 53,072.6 | 68,463.6 |
| SWM Fleet | 3,000.0 | 804.0 | 1,037.2 |
| Public Lighting | 15,268 | 10,611.3 | 13,688.5 |
| SWM Landfill Emissions | | 43,405.4 | 55,992.9 |
| **TOTAL** | **512,056.5** | **233,531.7** | **301,255.9** |

Annual Consumption x BAU Coefficient (1.29 JRC 2018)



# 3 Risk & Vulnerability Assessment

# Chapter 3: Risk and Vulnerability Assessment

## 3.1 Introduction to 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 and especially the coastal areas. Additionally, phenomena taking place, especially in the Southern Mediterranean countries (such as cultivating marginal land, overgrazing, and firewood harvesting), puts 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:

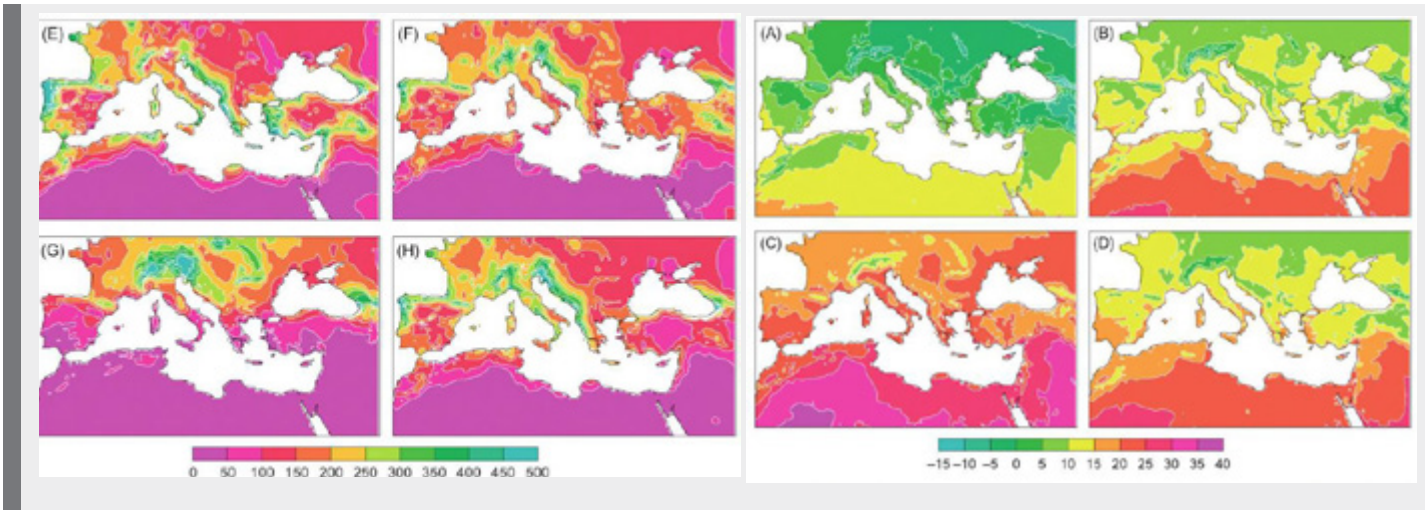
According to a 2008 EIB report, for the Mediterranean region climate experts anticipate during this century:

- 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 it's also due to the temperature

***Table 5***: Seasonal (winter: December-January-February; spring: March-April-May; summer: June-July-August; autumn: September-October-November) mean temperature (°C, panels A-D) and total precipitation (mm per season, panels E-H) maps for 1990- 1961 based on CRU data. (Source: Lionello 2012)



increase encountered (Plan Bleu 2009).
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 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 minimize 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 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 National & Regional Strategy on Climate Change Adaptation

### 3.2.1 National Level Commitments

Jordan ratified Kyoto Protocol on 17 January 2003. The Kyoto Protocol, an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC), commits state parties to reduce greenhouse gas emissions, based on the premise global warming exists and human-made CO2 emissions have caused it.

The Kyoto Protocol implemented the UNFCCC objective to fight global warming by reducing greenhouse gas concentrations in the atmosphere to, "a level that would prevent dangerous anthropogenic interference with the climate system." The Protocol is based on the principle of common but differentiated responsibilities. It puts the obligation to reduce current emissions on developed countries as they are historically responsible for the current levels of greenhouse gases in the atmosphere.

Jordan submitted its Nationally Determined Contribution (NDC) with a new climate action plan to the UNFCCC in advance of a new universal climate change agreement. The agreement went into effect in 2020, empowering all countries to act to prevent average global temperatures from rising more than 2°C and to reap the many opportunities arising from a necessary global transformation to clean and sustainable development.

### 3.2.2 Jordan's NDC Summary

Jordan is determined to reduce its greenhouse gas emissions 31% by 2030. Jordan can achieve an unconditional 5% reduction, but conditionally, it can achieve an additional 26% with the adaptation actions proposed for the targeted sectors.

### 3.2.3 National Strategy – Goals, Commitments, Sectors

In 2009-2013, Jordan conducted "Adaptation to Climate Change to Sustain Jordan's MDG Achievements," a major joint program for the water and health sector. The program's outcomes were to develop sustained access to improved water supply sources despite increasing water scarcity due to climate change and to strengthen the capacity for health protection and food security

under water scarcity.
Afterwards, Jordan developed its National Climate Change Policy of 2013-2020. The policy set advanced concrete strategic objectives, measures, and instruments to adapt the country to climate change impacts in each involved sector (water, coastal areas, agriculture/food security, health, tourism, biodiversity, and socioeconomic situation/poverty).
Moreover, the country mainstreamed climate change in its National Strategy and Action Plan to Combat Desertification (2015-2020) which was recently aligned with the United Nations Convention to Combat Desertification (UNCCD) 10-year strategy. Jordan also mainstreamed climate change into the National Biodiversity Strategy and Action Plan (2015-2020) which was also recently aligned with the global Convention on Biological Diversity (CBD) 10-year strategy.

**Also, the long-term "Jordan 2015 National Vision and Strategy"** was set. It charts a path for the future and determines the integrated economic and social framework that will govern the economic and social policies based on providing opportunities for all.

In line with the Jordan 2015 vision, the **Jordanian Sustainable Consumption and Production National Action Plan (2016-2025)** (SCP-NAP) is mainstreaming sustainable consumption and production into agriculture/food production, transport, and waste management.

Jordan's SCP-NAP address key human activities which have a particular impact on the Jordanian environment including marine and coastal areas (albeit the very limited coastline) and related transversal and crosscutting issues. It defines common objectives and identifies actions guiding the implementation of the Sustainable Consumption and Production SCP at the national level.

As a first step is a shift to sustainable patterns in the three priority areas of consumption and production. Such mainstreaming processes will be designed according to:

1. The harmonization between the provisions of Jordan's 2025 National Vision and Strategy (2015) and the actions and instruments of the SCP-NAP plan;
2. Their relevance in the main framework of the Barcelona Convention and its Protocols;
3. Their contribution as mainstream drivers of pollution generation and environmental pressures on the national environment, marine and coastal ecosystems; and
4. Their contribution to the Mediterranean economies and social well-being.

## 3.3 Climate Data & Climate Projections

Jordan's Third National Communication on Climate Change report identifies some climate projections and scenarios. Based on historical data obtained from the Jordan Metrology Department (JMD), climatic variables are changing significantly at both the national and station level, indicating climate change is becoming more apparent. Both the Mann-Kendall rank trend test and linear regression trends indicate annual precipitation tends to decrease significantly with time at a rate of 1.2 mm per year. Simultaneously, the mean, maximum, and minimum air temperature tends to increase significantly by 0.02, 0.01, and 0.03 °C/year, respectively. The relative humidity tends to increase significantly by an average of 0.08%/year, while class A-pan evaporation seems to have non-realistic estimations decreasing significantly by 0.088 mm/year.

The number of days of dust storms tends to decrease significantly by 0.09 days/year and 0.06 days/year for visibility less than 1km and 5km. Additionally, the historic data tested on both an annual and monthly basis indicated precipitation reduction is highly significant during the whole rainy season except for January. Similarly, during the dry seasons of June, July, and August, the precipitation has tended to increase over time, although this increase is considered negligible in its quantity as indicated by the magnitude of the slope. Interpolated spatial maps show the locations of these changes to be more apparent in both northern and southern parts. (Environment-Jordan 2014)

Also, the report mentions future dynamic projections predict extremely likely warmer summers compared to other seasons, more extremely likely heat waves where the analysis of summer temperatures, monthly values, and the inter-annual variability reveal some thresholds could be exceeded especially for a summer month where the average maximum temperature for the whole country could exceed 42-44°C. Drought events are likely predicted as indicated by the two indices of consecutive dry days and SPI. The maximum number of consecutive dry days would likely increase in the reference model by more than 30 days for 2070-2100.

Al Salt is located in the Balqa highland, 800-1100 meters above sea level. It is known as an ancient agricultural town, with a Mediterranean climate having mild and cold winters and a mild summer climate with an average rainfall of 600 mm. In recent years, Al Salt has been facing gradual summer temperature increases which is the main cause of some forest fires. Climate change has also decreased snow precipitation leaving a serious impact on the agriculture, public health, water, and other sectors..

## 3.4 Climate Change Vulnerability Analysis & Risk Assessment

The main climate hazards the municipality faces are extreme heat and forest fires. The municipality is already dealing with these issues which are expected to be aggravated in the short-term. These climate hazards affect sectors such as public health, infrastructure (transport, building, water), and the local economy, especially agriculture. The vulnerability analysis conducted is presented in the table below.

***Table 16***: Vulnerability Analysis

| Receptors | | Extreme Weather Event | Potential Impacts | Who/What Impacted |
|---|---|---|---|---|
| Population | Public Health | Extreme heat | Deaths due to cardiovascular diseases | Everyone, especially elderly, babies, children, workers in outdoor environments, sensitive groups |
| | | | Spread of vector-borne & infectious diseases | |
| | | | Altered allergic pattern | |
| | | | Heat stress | |
| | | Forest fires | Deaths due to cardiovascular diseases | Firefighters, people living around burned areas |
| | | | Increased respiratory-related diseases | |
| Infrastructure | Transport | Extreme heat | Damaged road network | Roads, people mobility |
| | | | Changed behaviour patterns | |
| | | | Air quality problems | |
| | | | Higher maintenance costs | |
| | Energy | Extreme heat | Altered electricity peaks/demands | Electricity providers, consumers |
| | | | Cooling problems | |
| | | | Reduced efficiency yield from conventional power plants & distribution grids | |
| | | | Higher maintenance costs | |
| | Water | Extreme heat | Higher water demand | Public health, water infrastructure |
| | | | Water quality issues | |
| | | | Higher maintenance costs | |
| | | Forest fires | Altered water quality | Public health, water infrastructure |
| | Social | Extreme heat | Higher electricity demand to cover cooling needs | Hospitals, schools, public places, municipal facilities & infrastructure, athletic facilities |
| | | | Changed behaviour patterns (e.g., living outdoors) | |
| | | | Increased patients burdening health care facilities | |
| Built Environment | Building Stock & Materials | Extreme heat | Damaged concrete | All building infrastructure |
| | | | Increased cooling demands | |
| | | | Higher maintenance costs | |
| | | | Urban heat island effect | |
| Economy | Tourist | Extreme heat | Increased cooling demand | Tourists, tourist infrastructure, tourist related economy |
| | | | Lower tourist flows during impacted seasons | |
| | | | Higher water demand | |

| | | | | |
|---|---|---|---|---|
| Economy | Agriculture | Extreme heat | Changed growth cycle | Farmers, food industry, consumers |
| | | | Damaged/lost harvest | |
| | | | Lost livestock & health impacts | |
| | | | Lower crop yields | |
| | | Forest fires | Decreased crop quality | Farmers, food industry, consumers |
| | | | Lost crops | |
| | | | Decreased productivity | |
| Biodiversity | Green Zones & Forests | Extreme heat | Fires & destroyed ecosystem, flora, & fauna | Ecosystem |
| | | Forest fires | Lost green areas | Ecosystem |

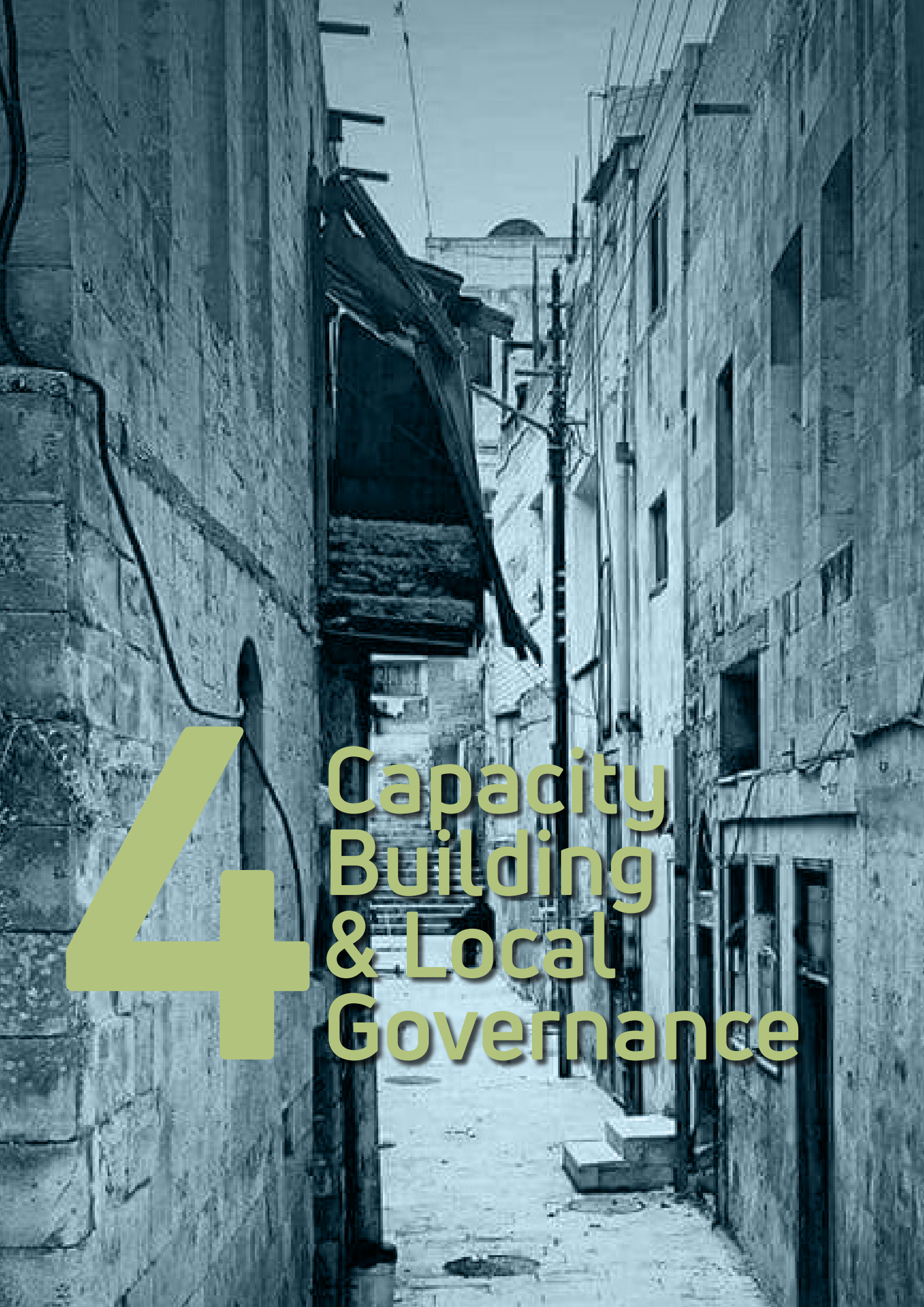
*In the table below, the municipality's risk assessment outlines the impact of each climate hazard on the sectors identified above:*

***Table 17***: Risk Assessment

| Receptors | | Weather Sensitivity | Future Risk | Impacted |
|---|---|---|---|---|
| Population | Public Health | Extreme heat | Increased deaths | High |
| | | | Reinforced heat stress | |
| | | | Increased infectious diseases | |
| | | | Altered allergic patterns | |
| | | Forest fires | Increased respiratory & cardiovascular diseases | Medium |
| | | | Increased spread of infectious diseases | |
| Infrastructure | Transport | Extreme heat | Damaged road networks | High |
| | | | Modified transport frequency & means | |
| | | | Air quality problems | |
| | | | Higher maintenance costs | |
| | Energy | Extreme heat | Blackouts & inability to cover demand load | High |
| | Water | Extreme heat | Water scarcity | Medium |
| | | | Water quality issues | |
| | | Forest fires | Altered water quality | Medium |
| | Social | Extreme heat | Increased need for air-conditioned spaces | Medium |
| Built Environment | Building Stock & Materials | Extreme heat | Damaged concrete | Low |
| | | | Increased cooling demands | |
| | | | Higher maintenance costs | |
| | | | Urban heat island effect | |
| Economy | Tourist | Extreme heat | Changed tourism season, less tourists | Medium |
| | | | Reduced tourism-related economy | |

*Table 17*: Risk Assessment

| Receptors | | Weather Sensitivity | Future Risk | Impacted |
|---|---|---|---|---|
| Economy | Agriculture | Extreme heat | Changed growth cycles | High |
| | | | Damaged/lost harvest | |
| | | | Lost livestock & health impacts | |
| | | | Lower crop yields | |
| | | | Increased fire risks | |
| | | Forest fires | Lost crops | Medium |
| Biodiversity | Green Zones & Forests | Extreme heat | Destroyed ecosystem, flora, & fauna | Medium |
| | | Forest fires | Increased loss of green areas | Medium |



# 4 Capacity Building & Local Governance

# Chapter 4: Capacity Building and Local Governance

## Developing Capacity for Local Governance

The municipality 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 to ensure the ownership, update and all-encompassing implementation the SEACAP by the local authority.

### Action

The development of SEACAP handling capacity cannot be undertaken individually by a municipality. This is to be part of a joint, mutual, interactive, and committed proceedings that involves several climate change local, national, and global actors; and would be part of wide ranged national local development engagement.

In such configuration, focus will be on formulating and accomplishing a Capacity Building National Programme to raise the SEACAPs' implementation capacities of cities that prepared them (and partly those that are planning to prepare theirs), in synergy with a SEACAP Support Mechanism, which principally associates national authorities that are responsible for NDC implementation and regional authorities (Governorate and Districts).

The first step is the identification of local capacity building needs, including specific skills to develop; and the organisational set up to consolidate and apply. After which, the methodology to employ would be broadly based on:

- Human resource development (HRD), which is the process of equipping the municipal team (and its partners from above national and regional actors) with the needed understanding of the SEACAPs and skills to implement it, with access to the necessary information and knowledge to fulfil this task. Some of the knowledge and skills required to carry out these tasks may be readily available. Others, such as working with the financial sectors will need to be developed before they can be applied.
- Instituting the organisational structure to appropriate, update and implement the SEACAP, which is the process to get things done collectively within the municipal orderliness. It is to do with management practices and procedures, rules and regulations and job descriptions. This also deals with legal and regulatory institutional changes that must be made and generally needs the patronage of national government legislative and executive authorities.
  - Associating community-based organisations and/or local NGOs, as they rank very close to formal local government in correlating priorities for capacity building, next to their role in mobilizing communities towards implementing the SEACAP.

Policies' support is necessary to bring about the proposed Capacity Building National Program, which necessitates to overcome constraints caused by outdated legislations, restrictive practices, outmoded equipment, and inappropriately trained staff; and to 're-tool' the local authorities, their national partners, enterprises and citizens to enable them to initiate and sustain the SEACAP operations, and to motivate and associate best professionals, technicians and managers (https://www.urbanet.info/tag/governance-2/).

There are situations, however, where the private sector - notably SMEs - need assistance in the form of training-guidance to best practices, next to application of legislative deregulation and provision incentives to enter the climate action market.

In the proposed Program context, the roles and practices of training establishments (e.g. universities, vocational training centres) would be reviewed and re-defines, leading to the development of a 'demand-led' training institutions that can support areas related to urban development planning and management in general and climate actions in particular. Their role is to go well beyond the traditional conduct of training or the design of performance improvement programmes. It must be much more proactive, assisting local authorities to initiate and implement managerial and, where necessary, structural changes, that will enable them to operate effectively in the context of the SEACAPs.

**The operation of the proposed program, which would target municipalities that prepared the SEACAPs, will be addressed with both the NCG and the municipalities along the continuity of Clima-Med project (2022-2025).**

Local policies wise, the proposed Capacity Building Program and the SSM would support enhancing the capacity of the municipality

- to promote and if feasible undertake SEACAP's investments in municipality-owned assets, and set Public Private Partnerships (PPP), such as in energy efficiency and local energy generation based on renewable energy sources
- to associate different partners in the processes;
- to decide upon and provide, when feasible, climate action oriented urban services;
- to select and/or influence over infrastructure development, first and foremost as prescribed in the SEACAP;
- to influence and lay down supportive climate-related urban planning regulations.

To apply public procurement that is green, sustainable, energy efficient and thus climate action, first and foremost, in SEACAPs and municipal actions to design, construct, and manage SE buildings, energy consuming equipment (HVAC, vehicles, and electrical equipment), and to the purchase of energy (e.g., electricity, gas) and to practices such as lifecycle costing, setting of minimum energy-efficiency standards, and use of energy-efficient criteria in the tendering process.

As explained in detail in Chapter 7 of this SEACAP, the proposed Capacity Building Program and the SSM would support enhancing of the municipality:

- Web-based platforms, whose popularity is growing.
- online tools to calculate CO2 reduction or energy savings estimations.
- Make use of databases containing examples of energy efficiency applications.
- Promote or conduct events related to SEACAP's actions, such as Energy Days and Info Points.

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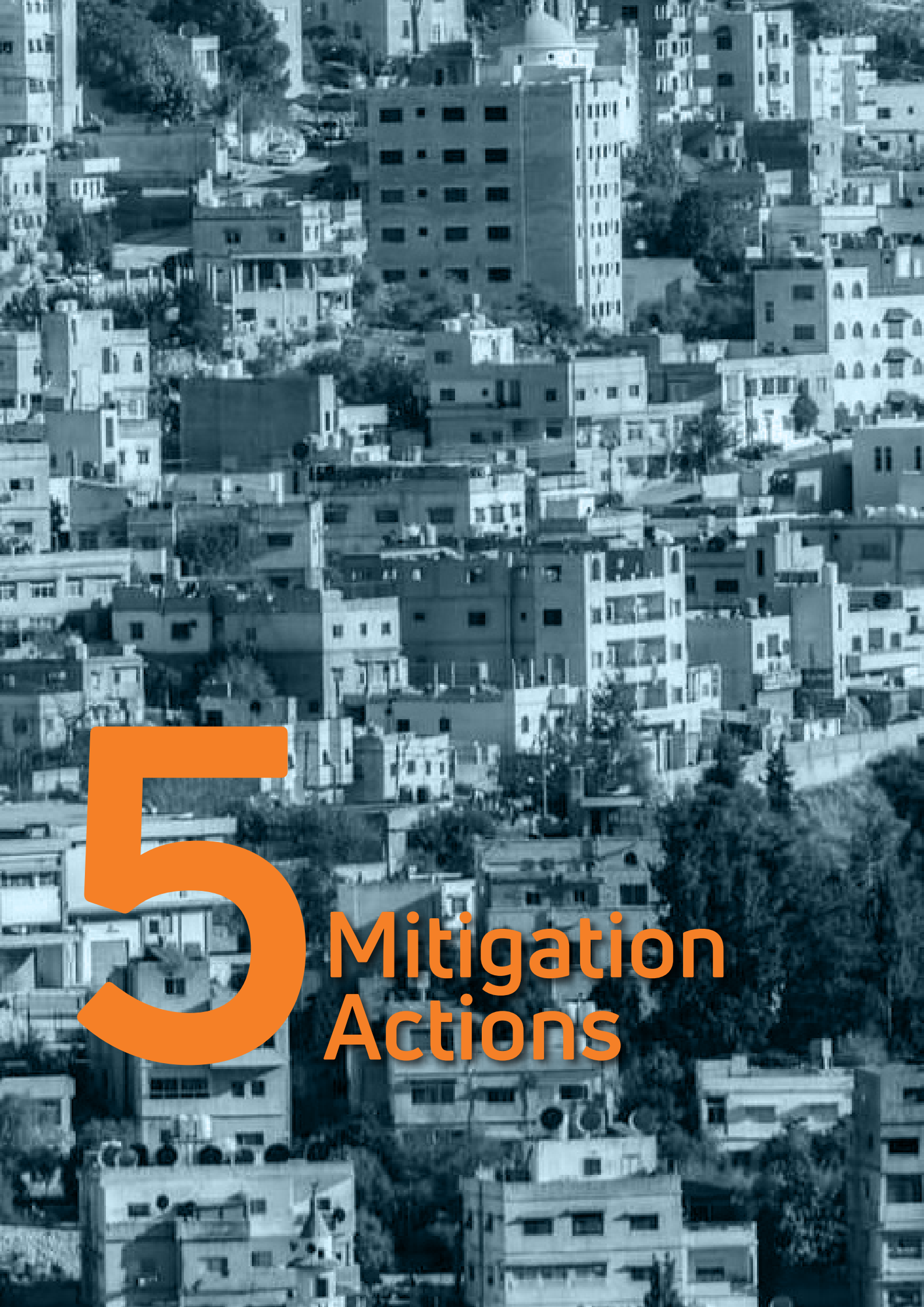


# 5 Mitigation Actions

# 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 important 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 municipality has many buildings under its direct control and management consuming 720 MWh per year (2018) producing 500.40 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 set of 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 municipality's proposed energy efficiency actions:

**Mitigation**

| MWh/a | | tCO2-eq/a | |
|---|---|---|---|
| 214.92 | | 149.37 | |
| **Total Consumption Contribution** | | | |
| 29.85% | | | |
| **Implementation Cost** | | | |
| N/A | | | |
| **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 action

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 achieving 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 municipality should assign an energy engineer able to lead the development of measures, identify the steps of implementation, and monitor the results.

Measures to be taken by the municipality 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 source of funding and apply the measures and monitor the implementation with the 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 and heating 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 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 Estimate | Action Period | Proposed Actions | Energy Savings Calculations Assumption | Annual Energy Savings |
|---|---|---|---|---|---|
| Electricity Consumption 720 MWh | Artificial lighting accounts for 25% of municipal buildings' electrical consumption | Short-term | - Turn off the lights after leaving<br>- Use natural lighting | 5% | 25% * 5% * 720 = 9 MWh |
| | | Long-term | - Install motion sensors for controlling lights in public places | 1% | 25% * 1% * 720 = 1.80 MWh |
| | | | - Replace existing bulbs with efficient alternatives (e.g., LEDs) | 50% | 25% * 50% * 720 = 90 MWh |
| | Equipment accounts for 35% of municipal buildings' electrical consumption | Short-term | - Use office equipment (PCs, printers, etc.) efficiently | 1% | 35% * 1% * 720 = 2.52 MWh |
| | | Long-term | - Use high-efficiency equipment through green procurement | 10% | 35% * 10% * 720 = 25.20 MWh |
| | HVAC accounts for 40% of municipal buildings' electrical consumption | Short-term | - Adjust air cooling units according to the thermal calendar<br>- Maintain equipment and appliances | 30% | 40% * 30% * 720 = 86.40 MWh |
| | | | | **Calculated Energy Savings** | **214.92 MWh/a** |

*Energy savings (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.

The energy savings have been calculated against the BEI consumptions and emissions for this category, although they are expected to be significantly more. The energy consumption of the existing buildings will increase and partly contribute to the BAU increased emissions, due to the more intensive use of the buildings, their further expansion etc. Such estimations will be more accurately depicted in future updates of the SEACAP.

### Expected fundinsg resources

- Total annual energy cost is around JOD 108,000 (EUR 129,600), with the monetary energy savings calculated at approximately EUR 38,686.
- 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 the manufacturer's recommendation 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 2025, the expected abatement generated is 149.37 tCO2-eq/a accounting for 896.22 tCO2-eq until 2030. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: Most of the actions in municipal buildings can be achieved at an affordable cost to the municipality. The expected funding resources will come from the municipal budget.

| Source of energy | Consumption, MWh | Annual Energy Savings, MWh | Annual Monetary Savings, JOD (EUR) | Emissions Mitigation, tCO2-eq |
|---|---|---|---|---|
| Electricity | 720 | 214.92 | 150*214.92 = JOD 32,238.15 (EUR 38,685.78) | 214.92*0.695= 149.37 |

*Annual Monetary Savings = Annual energy savings (MWh) x cost of electricity (JOD 150/MWh)*

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

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 50.1 | | 34.8 | |
| Total Consumption Contribution | | | |
| 5.4% | | | |
| Implementation Cost | | | |
| N/A | | | |
| 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 | | | |
| | | | |

### 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 rationalize consumption.

Energy consumption in the municipal buildings sector reached 720 MWh in 2018 and is expected to increase by 2030 to 928.8 MWh if no actions to reduce energy consumption are taken.

Currently, there is no obligatory legislation in the country, although it is a topic under consideration. The municipality will work nevertheless towards applying green building practices in the new buildings planned. The suggested measures 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.

Assuming that the additional consumption within the BAU scenario will be originating to approximately 80% from new buildings, these practices are estimated to reduce the BAU energy consumption and emissions by approximately 30%, as presented in the table below.

ANNUAL ENERGY CONSUMPTION OF MUNICIPAL BUILDINGS, EQUIPMENT, & FACILITIES

| Energy Source | 2018 Consumption, (MWh) | 2018 CO2 Emissions, tCO2-eq | 2030 BAU Consumption, MWh | 2030 BAU Emissions, tCO2-eq | Energy increase between BEI & BAU years | Emissions' increase between BEI & BAU years. |
|---|---|---|---|---|---|---|
| Electricity | 720.0 | 500.4 | 928.8 | 645.5 | 208.8 | 145.1 |

### 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 explicitly the building objectives with a focus on thermal comfort
2. Assess microclimatic factors and intervene with 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 heating and cooling plants, if still necessary
10. Train building managers and occupants on how to use, monitor the performance of, 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 glazing and framing as well as wall and roof characteristics:

- Internal and external thermal insulation of walls reduce their transmittance values according to specific needs and 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 the 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, emissions, and inaccurate control systems.

### 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.

SAVINGS' CALCULATION FOR CONSUMPTION & EMISSIONS OF NEW MUNICIPAL BUILDINGS, EQUIPMENT, & FACILITIES

| | New buildings' BAU consumption (MWh) | New buildings' BAU emissions (CO2 eq) | Savings due to green building code | Energy savings (MWh) | Emissions savings (CO2 eq) |
|---|---|---|---|---|---|
| Electricity | 167.04 | 116.1 | 30% | 50.1 | 34.8 |

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 cost is estimated at JOD 25, 058 (EUR 30,069), with the monetary energy savings amounting to approximately EUR 9,018 annually.
- Budget: Further studies are needed to calculate the cost for this action which mainly focuses on applying green building code to new municipal buildings, promoting behavioural change, applying green procurement, and following the manufacturer recommendations on the operation and maintenance of equipment, all in coordination with the Governorate and central authorities.
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 34.8 tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: Most of the actions in the new municipal buildings can be achieved at an affordable cost to the municipality. The expected funding resources are the municipal budget used to finance the construction of the new infrastructure.

| Energy Source | Consumption, MWh | Annual Energy Savings, MWh | Annual Monetary Savings, JOD (EUR) | Emissions Mitigation, tCO2-eq |
|---|---|---|---|---|
| Electricity | 167.04 | 50.1 | 150*50.1= JOD 7,515 (Euro 9,018) | 50.1 *0.695=34.8 |

## 5.1.3 Existing Residential Buildings: Awareness Raising Activities

### Background

Citizen engagement is of utmost importance since almost the 50.5% of energy consumption is due to the residential sector. The municipality'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 municipality 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 may need to be applied in collaboration with national authorities and the Governorate.

The residential sector is responsible for 50.5% of the city's emissions, therefore it is important to encourage citizens to consider saving energy as the most important action at the household level.

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 19,108.7 | | 12,594.3 | |
| Total Consumption Contribution | | | |
| 10.7% | | | |
| Implementation Cost | | | |
| EUR 1,000,000 | | | |
| 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 | | | |
| | | | |

ANNUAL ENERGY CONSUMPTION OF RESIDENTIAL BUILDINGS

| Energy Source | 2018 Consumption, MWh | 2018 Emissions, tCO2-eq |
|---|---|---|
| Electricity | 116,904.4 | 81,248.5 |
| LPG | 96,459.0 | 21,896.0 |
| Diesel | 55,006.2 | 14,741.7 |
| **Total** | **268,369.6** | **117,886.2** |

### Description of the action

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

- Organizing"Energy Days" stressing the importance of saving energy 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 lighting 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.
- **Tree-planting:** 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, rationalizing 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.

Note that Guidelines for the design and implementation of Citizens' Awareness Plans are detailed in Chapter 7 of this SEACAP.

*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 116,904.38 MWh Electricity Consumption 116,904.38 MWh | 20% electric water heaters | Long-term | Replace electric water heaters with solar water heaters (assuming 20% will apply) | 70% | 70% * 20% * 20% * 116,904.38= 3,273.33 MWh |
| | 21% artificial lighting | Short-term | Use natural lighting whenever possible, turn off lights after leaving place | 5% | 21% * 5% * 116,904.38 = 1,227.50 MWh |
| | | Long-term | Replace existing inefficient lights with efficient types like LEDs (assuming 50% of households will apply) | 50% | 21% * 50% * 50% * 116,904.38 =6,137.48 MWh |
| | Home appliances: - 12% refrigeration - 8% washing machines - 4%, computers, mobile charges | Long-term | Replace refrigerators and freezers with new energy-efficient A+++ rated ones (assuming 20% of households will apply) | 50% | 12% * 50% * 20% * 116,904.38 = 1,402.85 MWh |
| | | Long-term | Replace existing washing machines with new energy-efficient A+++ rated ones (assuming 20% of households will be able) | 10% | 8% * 10% * 20% * 116,904.38 = 187.05 MWh |
| | | Short-term | Use electronics and equipment efficiently | 1% | 4% * 1% * 116,904.38= 46.76 MWh |
| | 35% air-conditioning | Short-term | Adjust cooling and heating units to thermal calendar, and maintain equipment and appliances (assuming 30% of households will apply) | 30% | 35%*30%*30%* 116,904.38= 3,682.49 MWh |
| | | Long-term | Replace old air-conditioner with efficient one (assuming 20% of households will be able) | 20% | 35% * 20% * 20% * 116,904.38= 1,636.66 MWh |
| Space Heating & Cooking Consumption with LPG and diesel, 151,465.2 MWh | Space Heating & Cooking | Long-term | Improve roof and wall insulation, promote the use of responsible cooking methods, and use of pressure cookers (assuming 10% of households will be able) | 10% | 10% * 10% * 151,465.2 = 1,514.6 MWh |
| **Calculated energy saving** | | | | | **19,108.7 MWh** |

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, MWh | Annual Energy saving in MWh | Annual Monetary Savings, JOD (EUR) | Emissions Mitigation, tCO2-eq |
|---|---|---|---|---|
| Electricity | 116,904.4 | 17,594.1 | 150 * 17,594.1= JOD 2,639,115 (EUR 3,166,938) | 17,594.1 * 0.695 = 12,227.9 |
| Fuel (LPG) | 96,459.0 | 964.6 | 0.56* 964.6 * 1000 / 13.7 = JOD 39,429 (EUR 47,315) | 964.6 *0.227= 219 |
| Fuel (Diesel) | 55,006.2 | 550.06 | 0.45*550.06*1000/10 = JOD 24,752.70 (EUR 29,703.24) | 550.06*0.268 = 147.42 |
| **Total** | **268,369.6** | **19,108.7** | **JOD 2,703,297 (EUR 3,243,956)** | **12,594.3** |

Average consumer prices in Jordan for LPG in 2018 equal to 0.56 JOD/kg (0.67 EUR/kg)
Emission factor tCO2-eq/MWh LPG 0.227 with fuel conversion factor for LPG of 13.7 kWh/kg using IPPC defaults (2006)

The return on investment is estimated at EUR 3,243,956per year.

**Expected funding resources:**

- Total annual energy savings from the residential sector is around 19,108.7 MWh amounting to around JOD 2,703,297 (EUR 3,243,956).
- Budget:Estimated to cost EUR 1,000,000.
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 12,594.3 tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The homeowners should pay for all costs for greening the buildings. However, the municipality has a role in promoting the greening of the existing buildings, either from the municipal budget or through innovative outsourcing. For example, the municipality can promote the use of energy-efficient products in houses, plus encourage 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 268,369 MWh in 2018 and is expected to reach 346,196 MWh by 2030 based on a business-as-usual scenario and without a plan to reduce the energy demand.

Currently, there is no obligatory legislation on the topic in the country, although it is under consideration. The municipality will work towards promoting green building practices and applying the legislation, which is expected to be mandatory by 2030.

If green building practices are applied, it is estimated that 25-35% less energy than traditional buildings in the country will be used and 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.

Assuming that the additional consumption within the BAU scenario will be originating to approximately 80% from new buildings, these practices are estimated to reduce the BAU energy consumption and emissions by approximately 30%, as presented in the table below.

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 32,231.6 | | 12,659 | |
| Total Consumption Contribution | | | |
| 8.3% | | | |
| Implementation Cost | | | |
| EUR 800,000 | | | |
| 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 OF THE RESIDENTIAL SECTOR

| Energy Source | 2018 Consumption, MWh | 2018 Emissions, tCO2-eq | 2030 BAU Consumption, MWh | 2030 BAU Emissions, tCO2-eq | Energy increase between BEI & BAU years | Emissions' increase between BEI & BAU years. |
|---|---|---|---|---|---|---|
| Electricity | 116,904.4 | 81,248.5 | 150,806.7 | 104,810.6 | 33,902.3 | 23,562.1 |
| LPG | 96,459.0 | 21,896.0 | 124,432.0 | 28,245.8 | 27,973.0 | 6,349.8 |
| Diesel | 55,006.2 | 14,741.7 | 70,958.0 | 19,016.7 | 15,951.8 | 4,275.0 |
| **Total** | **268,369.6** | **117,886.2** | **346,196.7** | **152,073.1** | **77,827.1** | **34,186.9** |

Average consumer prices in Jordan for LPG in 2018 equal to 0.56 JOD/kg (0.67 EUR/kg)
Emissions factor tCO2-eq/MWh LPG 0.227 with fuel conversion factor for LPG of 13.7 kWh/Kg using IPPC defaults (2006)

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

- Using water storage tanks in modern buildings during summer, 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, lectures held in schools and places of worship to encourage them to use environmentally friendly renewable energy sources and recognize their positive effects on the economy and society.

### General objectives

The city aims to reduce consumption and pollution caused by burning fuel 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.

MONETARY 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 Mitigation, tCO2-eq | Monetary Energy Savings, JOD (EUR) |
|---|---|---|---|---|---|---|
| Residential Buildings Annual Electricity Consumption | 27,121.8 | 18,849.7 | 30% | 8,136.5 | 5,654.9 | 150*8,136.5= JOD 1,220,475 (EUR 1,464,570) |
| Space Heating & Cooking Fuel Consumption (LPG) | 22,378.4 | 5,079.8 | 30% | 6,713.5 | 1,523.9 | 0.56*6,713.5 *1000/13.7= JOD 274,420 (EUR 329,305) |
| Space Heating & Cooking Fuel Consumption (Diesel) | 12,761.4 | 3,420.0 | 30% | 3,828.4 | 1,026.0 | 0.45* 3,820.4 *1000/10= JOD 171,918 (EUR 206,302) |
| **Total** | **62,261.7** | **27,349.5** | **30%** | **18,678.4** | **8,204.8** | **JOD 1,666,814 (EUR 2,000,177)** |

Average consumer prices in Jordan for LPG in 2018 equal to 0.56 JOD/kg (0.67 EUR/kg)
Emission factor tCO2-eq/MWh LPG 0.227 with fuel conversion factor for LPG of 13.7 kWh/kg using IPPC defaults (2006)

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 from the residential sector is around 18,678.4 MWh amounting to around JOD 1,666,814 (EUR 2,000,177) monetary savings.
- Budget: Estimated to cost EUR 800,000.
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 8,205 tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The homeowners should pay for all costs for greening the buildings. However, the municipality has a role in promoting these actions, either from the municipal budget or through innovative financing tools.

## 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 3.6% of the energy consumed in the building sector.

The municipality'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 ENERGY CONSUMPTION & EMISSIONS OF TERTIARY BUILDINGS

| Energy source | 2018 Consumption, MWh | 2018 Emissions, tCO2-eq |
|---|---|---|
| Electricity | 8,767.8 | 6,093.6 |
| LPG | 166.6 | 37.8 |
| Diesel | 1,215.6 | 325.8 |
| Total | 10,150.0 | 6,457.2 |

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 1,570.3 | | 1,064.5 | |
| Total Consumption Contribution | | | |
| 16.5% | | | |
| Implementation Cost | | | |
| EUR 200,000 | | | |
| 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 organized frequently by the municipality through 2030 and involve common actions for all types of tertiary buildings:

a. **Replacement of inefficient old lamps:** Indoor ilumination of tertiary sector buildings use 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 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 in reducing 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 like you're comfortable.

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

d. **Regulate water useand** 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. **Behaviour and building management:** Adequate behaviour of building occupants may also generate significant savings.

b. **The management 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 buildings through retro-commissioning:** This process improves the efficiency of an existing building's equipment and systems 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). Retro-commissioning will identify and fix: (1) Equipment or lighting on when unnecessary; (2) systems that simultaneously heat and cool; (3) belts and valves not functioning properly; (4) thermostats and sensors out of calibration; (5) air balancing systems less than optimal; 6) economizers not working as designed; (7) control sequences functioning incorrectly; (8) variable-frequency drives operating at unnecessarily high speeds or at a constant speed even though the load being served varies).

d. **Improving the building 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.

Note that Guidelines for the design and implementation of Citizens' Awareness Plans are detailed in Chapter 7 of this SEACAP.

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.

| | Assumed Consumption Estimate | Action Period | Proposed Actions | Energy Savings Calculations Assumption | Annual Energy Savings |
|---|---|---|---|---|---|
| Electricity Consumption 8,767.82 MWh | 25% artificial light | Short-term | Use natural lighting whenever possible, turn off lights after leaving place | 5% | 25 % * 5% * 8,767.82 = 109.60 MWh |
| | | Long-term | Install motion sensors for controlling lights in public places | 1% | 25 % * 1% * 8,767.82 = 21.92 MWh |
| | | | Replace existing inefficient lights with efficient types (assuming 50% will apply) | 50% | 25 % * 50% *50% *8,767.82 = 548 MWh |
| | 35% electrical equipment | Long-term | Use of efficient office appliances; replace electrical water heater with solar one (assuming 30% will apply) | 10% | 35 % * 10% * 30%* 8,767.82 = 92.1 MWh |
| | 40% air-conditioning | Short-term | Adjust cooling and heating units to thermal calendar, and maintain equipment and appliances (assuming 70% will apply) | 30% | 40 % * 30% * 70%* 8,767.82 = 736.5 MWh |
| | | Long-term | Use inverter type a/c | | |
| Space Heating & Cooking Consumption (LPG & Diesel), 1,382.17 MWh | Space heating & cooking | Long-term | Improve roof and wall insulation and use efficient cooking methods (assuming 15% will apply) | 30% | 1,382.17*30% * 15%*= 62.2 MWh |
| | | | | **Calculated Energy Savings** | **1,570.3 MWh** |

The energy savings have been calculated against the BEI consumptions and emissions for this category, although they are expected to be significantly more. The energy consumption of the existing buildings will increase and partly contribute to the BAU increased emissions, due to the more intensive use of the buildings, their further expansion etc. Such estimations will be more accurately depicted in future updates of the SEACAP.

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

### Financial analysis

| Energy Source | Consumption, MWh | Annual Energy Savings, MWh | Annual Monetary Savings, JOD (EUR) | Emissions Mitigation, tCO2-eq |
|---|---|---|---|---|
| Electricity | 8,767.8 | 1,508.1 | 150 * 1,508.1 = JOD 226,215 (EUR 271,458) | 1,508.1* 0.695 = 1,048.1 |
| Fuel (LPG) | 166.6 | 7.5 | 7.5*0.56*1000/13.7 = JOD 307 (EUR 368) | 7.5* 0.227 =1.7 |
| Fuel (Diesel) | 1,215.66 | 54.7 | 54.7*0.45*1000/10 = JOD 2,462 (EUR 2,954) | 54.7*0.268 = 14.7 |
| **Total** | **10,150.0** | **1,570.3** | **JOD 228,984 (EUR 274,780)** | **1,064.5** |

The return on investment is estimated at EUR 274,780 per year.

**Expected funding resources:**

- Total annual energy savings from the tertiary sector is around 1,570.3 MWh amounting to around JOD 228,984 (EUR 274,780) monetary savings.
- Budget: Estimated to cost EUR 200,000.
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 1,064.5 tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The tertiary building owners should pay for all relevant costs. However, the municipality has a role in promoting the greening of the existing buildings, either from the municipal budget or through more innovative ways.

## 5.1.6 New Tertiary Buildings: Implementing & Promoting the Green Building Code

### Background

In 2018, the city's energy consumption in the tertiary sector was 10,149.99 MWh and is expected to reach 13,093.4 MWh by 2030.

Currently, there is no obligatory legislation on green building codes in the country, although it is under consideration. The municipality will work towards promoting green building practices and applying the legislation, which is expected to be mandatory by 2030.

If green building practices are applied, it is estimated that 25-35% less energy than traditional buildings in the country will be used and 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.

Assuming that the additional consumption within the BAU scenario will be originating to approximately 80% from new buildings, these practices are estimated to reduce the BAU energy consumption and emissions by approximately 30%, as presented in the table below.

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 706.7 | | 449.4 | |
| Sectoral Emission Reduction | | | |
| 5.4% | | | |
| Implementation Cost | | | |
| EUR 100,000 | | | |
| 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

The core activities for raising awareness about a green building code plays important roles in promoting green building standards benefitting the municipality 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 municipality with the support of stakeholders can play a vital role in reducing energy demand in the tertiary sector.

ANNUAL ENERGY CONSUMPTION & EMISSIONS OF TERTIARY BUILDINGS

| Energy Source | 2018 Consumption, (MWh) | 2018 CO2 Emissions, tCO2-eq | 2030 BAU Consumption, MWh | 2030 BAU Emissions, tCO2-eq | Energy increase between BEI & BAU years | Emissions' increase between BEI & BAU years |
|---|---|---|---|---|---|---|
| Electricity | 8,767.8 | 6,093.6 | 11,310.5 | 7,860.8 | 2,542.7 | 1,767.2 |
| Fuel (LPG) | 166.6 | 37.8 | 214.8 | 48.8 | 48.2 | 11.0 |
| Fuel (Diesel) | 1,215.6 | 325.8 | 1,568.2 | 420.3 | 352.6 | 94.5 |
| **Total** | **10,150.0** | **6,457.2** | **13,093.5** | **8,329.9** | **2,943.5** | **1,872.7** |

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 has maximised 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.

**Connecting communities and people**

Whenever realistically applicable

- Creating diverse environments that connect and enhance communities, asking what a building will add to its context in terms of positive economic and social effects, and engaging local communities in planning.
- Ensuring transport and distance to amenities are considered in design, reducing the impact of personal transport on the environment, and encouraging environmentally friendly options such as walking or cycling.

### Considering all stages of a building's lifecycle

Whenever realistically applicable

- Seeking to lower environmental impacts and maximise social and economic value over a building's whole lifecycle (from design, construction, operation, and maintenance, through to renovation and eventual demolition).
- Ensuring resources such as energy or water used to produce and transport the materials in the building are minimised so that buildings are truly low impact.

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 | Monetary energy savings, JOD (EUR) |
|---|---|---|---|---|---|---|
| Electricity | 2,034.2 | 1,413.8 | 30% | 610.3 | 424.1 | 150 * 610.3 = JOD 91,545 (EUR 109,854) |
| Fuel (LPG) | 38.6 | 8.8 | 30% | 11.6 | 2.6 | 11.6 * 0.56 * 1000 /13.7 = =JOD 474 (EUR 569) |
| Fuel (Diesel) | 282.1 | 75.6 | 30% | 84.6 | 22.7 | 84.6 * 0.45 * 1000/ 10 = =JOD 3,807 (EUR 4,568) |
| **Total** | **2,354.9** | **1,498.2** | **%30** | **706.5** | **449.4** | **JOD 95,826 (EUR 114,991)** |

*Average Consumer Prices in Jordan for LPG in 2018 equal to 0.56 JOD/kg and equal to 0.67 EUR/kg*
*Emission factor tCO2-eq/MWh LPG 0.227 Fuel: conversion factor for LPG 13.7 kWh/kg (the default factors of IPCC (2006) Fuel).*

### Financial analysis

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 706.5 MWh amounting to around JOD 95,826 (EUR 114,991) of monetary savings.
- Budget: Estimated to cost EUR 100,000
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 449.4 tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The tertiary building owners should pay for all extra costs of applying the green building code. However, the municipality has a role in promoting these practices, either from the municipal budget or through more innovative ways.

## 5.2. Municipal Public Lighting

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 8,964.5 | | 6,230.4 | |
| Total Consumption Contribution | | | |
| 45.5% | | | |
| Implementation Cost | | | |
| EUR 6,679,666 | | | |
| Stakeholder Involvement | LA | | H |
| | External | | L |
| | Other | | L |
| Staff Capacity | L | M | H |
| | | | |
| 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 | | | |
| | | | |

### Background

With outdated, inefficient street lighting systems, a significant amount of the municipal energy budget goes to street lighting.

Modern LED lighting solutions are advancing rapidly and can deliver significant energy savings. Increasing efficacy, optimized 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.

### 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 specify 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 service quality 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.

| EXISTING TYPES OF PUBLIC STREET LIGHTS (2019) | | | | BAU |
|---|---|---|---|---|
| Type of Street Lamps | Quantity | Watt per Lamp | Annual Consumption, MWh | Annual Consumption |
| HPS | 5,000 | 250 | 5,500 | 7,095 |
| HPS | 18,000 | 70 | 5,544 | 7,151.76 |
| MH | 6,000 | 125 | 3,300 | 4,257 |
| LED | 3,000 | 70 | 924 | 1,191.96 |
| **Total** | | | **15,268** | **19,695.72** |

*Emission factor for electricity consumption is 0.695 tCO2-eq/MWh*
*Annual consumption x 2018 BAU coefficient 1.29*

| PLANNED REPLACEMENT FOR PUBLIC STREET LIGHTS | | | | |
|---|---|---|---|---|
| Type of Street Lamps | Quantity | Watt per Lamp | Annual Consumption, MWh | Energy Savings, MWh |
| HPS | 5,000 | 100 | 2,200 | 3,300 |
| HPS | 18,000 | 40 | 3,168 | 2,376 |
| MH | 6,000 | 70 | 1,848 | 1,452 |
| LED | 3,000 | 70 | 924 | 0 |
| **Total** | | | **8,140** | **7,128** |

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

| Key Actions & Measures | BAU Scenario | | Mitigation | | Mitigation, % | Cost, EUR |
|---|---|---|---|---|---|---|
| | MWh/a | tCO2/a | MWh/a | tCO2/a | | |
| **Public Street Lighting** | **19,696** | **13,689** | **8,964.49** | **6,230.4** | **45.5** | **6,679,666** |
| Developing master plan | | | | | | 5,000 |
| Modernize protection components | | | 1,836.5 | 1,276.4 | | 618,666 |
| Procure, install, maintain new lights | | | 7,128.0 | 4,954.0 | | 6,050,000 |
| Obtain measurements for light distribution | 19,696 | 13,689 | | | | 2,000 |
| Setup operational & maintenance plan | | | | | | 2,000 |
| Conduct training for operations & maintenance | | | | | | 2,000 |

**Expected funding resources**

- Total annual energy savings from the street lighting sector is around 8,964.5 MWh amounting to around JOD 1,344,675 (EUR 1,613,610) of monetary savings.
- Budget: Estimated to cost EUR 6,679,666.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 6,230.4 tCO2-eq/a accounting for 24,921.6 tCO2-eq until 2030. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: Municipality can finance the project whenever changing any lamp, change it to LED; partnerships with the private sector; through 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 municipality, the municipal fleet has many vehicles including 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 municipality based on the total 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

| Transport Sector | Diesel, litres | Gasoline, litres | Fuel Consumption, MWh | Emissions, tCO2-eq | 2030 BAU Energy Demand, MWh | 2030 BAU Emissions, tCO2-eq |
|---|---|---|---|---|---|---|
| Municipal Fleet | 296,530.00 | 0.00 | 2,965.30 | 794.70 | 3,825.2 | 1,025.2 |
| Private Sector | 981,600.00 | 21,931,265.00 | 211,583.64 | 53,072.60 | 272,942.9 | 68,463.7 |
| **Total** | **1,278,130.00** | **21,931,265.00** | **214,548.94** | **53,867.30** | **276,768.1** | **69,488.8** |

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 Smart Mobility Measures

#### Background

In the city, private vehicles are moving on daily basis emitting a considerable quantity of CO2. The peak hours of congestion are 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 traffic congestion the whole day. In addition to the absence of public transportation in the region makes citizens' transport between the regions difficult and costly. Implementing measures and actions to improve and enhance citizens' transport is crucial in establishing a sustainable and environmentally friendly transport system.

*In table below, the transportation sector contributes 23.7% of city emissions:*

ANNUAL FUEL CONSUMPTION OF TRANSPORT SECTOR

| SITE CATEGORY | 2018 Consumption, MWh | 2018 CO2 Emissions, tCO2-eq | 2030 BAU Consumption, MWh | 2030 BAU Emissions, tCO2-eq |
|---|---|---|---|---|
| Transport Sector | 214,548.94 | 53,867.30 | 276,768.1 | 69,488.8 |

#### Description of the Action

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

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 19,374 | | 4,864 | |
| Total Consumption Contribution | | | |
| 7% | | | |
| Implementation Cost | | | |
| EUR 3,000,000 | | | |
| 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 | | | |
| | | | |

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.
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.

[3] Journal of Nature Science and Sustainable Technology ISSN 1933-0324 Volume 2, Issue 3

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** measures for minimising the use of conventional private vehicles and increasing sustainable transportation means. The measures can be taken under three 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 five km. These two options can contribute both to achieving energy and climate goals, and to a number of benefits to personal health, the city, etc. Some of the benefits are improvement in 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 taxis, 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" for 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 requires only a small portion of the total transportation investments.

### General objectives

1. Combat social exclusion by providing 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 Emission Mitigation, tCO2-eq |
|---|---|---|---|---|---|
| TRANSPORT SECTOR | 276,768.10 | 69,488.80 | | | |
| Improve road network planning | | | 2.0% | 5,535.36 | 1,389.78 |
| Road asset management | | | 3.0% | 8,303.04 | 2,084.66 |
| Sustainable mobility | | | 2.0% | 5,535.36 | 1,389.78 |
| **Total** | | | **7.0%** | **19,373.77** | **4,864.22** |

Average consumer prices in Jordan for fuel (gasoline) in 2018 equal to 0.80 JOD/litre

| Energy Source | Consumption, litres | BAU 2030 | Annual Monetary Savings, JOD (EUR) |
|---|---|---|---|
| Fuel (Diesel) | 1,278,130.00 | 1,648,787.70 | 7% * 1,648,787.7 * 0.45 = JOD 51,937 (EUR 62,324.4) |
| Fuel (Gasoline) | 21,931,265.00 | 28,291,331.85 | 7% * 28,291,331.85 * 0.80 = JOD 1,584,315 (EUR 1,901,178) |
| **Total** | **23,209,395.00** | **29,940,119.55** | **JOD 1,636,252 (EUR 1,963,502.4)** |

**Expected funding resources:**

- Total annual energy savings from the transportation sector is around 19,373.77 MWh amounting to around JOD 1,636,252 (EUR 1,963,502.4) of monetary savings..
- Budget: Estimated to cost EUR 3,000,000.
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 4,864.22 tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The municipality is the main implementor using funds either from the municipal budget or outsourcing to the national budget or grants. Smart mobility can be implemented through the participation of the private sector or investors. The municipality must enact the necessary legislation for the private sector to facilitate and support the action, noting that this can only be done in close cooperation and under the Governorate and concerned national authorities.

## 5.3.2 Municipal Transportation Solid Waste Sector

### Background

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

Solid Waste Management: The municipality collects and transfers solid waste using different types of garbage vehicles consuming significant diesel. The municipality collects solid waste and transports it to a specific site, and often these wastes are disposed of through direct burning.

The municipality has a total population of 143,626 people annually producing solid waste of about 47,450 tons (130 tons daily) 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

| Municipality | Vehicles | Days/year | Litres/km | Diesel/year | Consumption, MWh | tCO2-eq |
|---|---|---|---|---|---|---|
| Al Salt | 39 | 317 | 0.4 | 300,000 | 3,000 | 804 |

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 1,161 | | 311 | |
| Total Consumption Contribution | | | |
| 30% | | | |
| Implementation Cost | | | |
| EUR 2,300,000 | | | |
| Stakeholder Involvement | LA | | |
| | External | | |
| | Other | | |
| Staff Capacity | L | M | H |
| | | | |
| Implementation Years | | | |
| | | | |
| Key Performance Indicator | | | |
| Start of planning | | | |
| Measurement units | | | |
| Fuel saving & sorting percentage | | | |
| Intervention Area | | | |
| Managing resources | | | |
| Policy Instrument | | | |
| Waste management | | | |
| 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 and after assessment of the sector's capacity and plans to be modernized and upgraded.

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

   The procedure will be based on the development of a GIS-based model, integrated to that of 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 resulting in environmental benefits.

   First, the municipality 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., what is incinerated and dumped in a landfill or recycled). This information will be used is to assess the progress of work in the next stages when implementing measures related to better waste management.

   Second, the municipality 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. **Optimize 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 savings 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 Savings, MWh/a | Calculated Emissions Savings, tCO2-eq |
|---|---|---|---|---|---|
| TRANSPORT SECTOR | 3,870 | 1,037 | | | |
| Routing, design, & control | | | 10% | 387 | 103.7 |
| Applying sorting-at-the-source | | | 20% | 774 | 207.4 |
| **Total** | | | **30%** | **1,161** | **311** |

Average consumer prices in Jordan for diesel in 2018 equal to 0.45 JOD/litre (0.54 EUR/litre)
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

| Energy Source | Consumption, litres | BAU 2030 | Annual Savings, JOD (EUR) |
|---|---|---|---|
| Fuel (Diesel) | 300,000 | 300,000 *1.29 = 387,000 | 30% * 387,000 * 0.45 = JOD 52,245 (EUR 62,694) |

### Expected funding resources:

- Total annual energy savings from the municipal SWM transport is around 1,161 MWh amounting to around JOD 52,245 (EUR 62,694).
- Budget: Estimated to cost EUR 2,300,000.
- Climate cost efficiency: If these measures are implemented by 2027, the expected abatement generated is 311 tCO2-eq/a accounting for 1,244 tCO2-eq until 2030. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The municipality is the main implementor using funds either from the municipal budget or outsourcing to the national budget or grants.

## 5.4. Solid Waste Management

The municipality collects its solid waste and transfers it to the Al Hamra landfill in Al Kasaba district.

Converting organic waste to compost is one solution for 57% of the municipality'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 more stable, hygienic, and beneficial for agriculture and recycling 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 ($CH_4$) and other compounds. The $CH_4$ emissions from SWDS are important contributors to global anthropogenic $CH_4$ emissions and are presented below for the BEI and BAU years.

| Methane Emissions, Gg/yr | Methane Emissions, tCO2-eq/a | 2030 BAU, tCO2-eq/a |
|---|---|---|
| 1.73621448 | 1.73621448*1,000*25= 43,405.36 | 43,405.36*1.29= 55,992.92 |

| Mitigation | | | |
|---|---|---|---|
| tCO2/a | | | |
| 8,398.94 | | | |
| Total Consumption Contribution | | | |
| 15% | | | |
| Implementation Cost | | | |
| N/A | | | |
| Stakeholder Involvement | LA | | |
| | External | | |
| | Other | | |
| Staff Capacity | L | M | H |
| | | | |
| Implementation Years | | | |
| | | | |
| Key Performance Indicator | | | |
| Start of planning | | | |
| Measurement units | | | |
| Quantity of treated waste | | | |
| Intervention Area | | | |
| Managing resources | | | |
| Policy Instrument | | | |
| Waste management | | | |
| Action Origin | | | |
| Local authority | | | |
| Action Priority | | | |
| | | | |

### Description of the action

Thisaction will be conducted in coordination and in complementarity with the Governorate's action and after assessment of the sector's capacity and plans to be modernized and upgraded.

Waste management practices provide effective mitigation of GHG emissions. A wide range of mature, environmentally effective technologies are 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 minimization, 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 options for GHG reduction 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 deposition of materials in 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 municipality should reinforce the idea 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 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, who 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.

The municipality can study its options and develop a local strategic plan to manage the waste, considering the national plans and integration with neighbouring towns.

In all steps the municipality 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 measuress:

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 neighboring 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).

### 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 and composting, 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:

| Site Category | 2030 BAU Emissions, tCO2-eq | Estimated Mitigation Assumption, % | Calculated Mitigation Emissions, tCO2-eq |
|---|---|---|---|
| Solid Waste Management | 55,992.92 | 15% | 8,398.94 |

### Expected funding resources

Source of finance: The municipality 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 municipality 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

Jordan's high potential for renewable energy (especially solar) makes investment in local solar projects attractive if supported by government regulations[4].

Electricity consumption in the municipality is about 141.7 GWh (in 2018). Demand is expected to increase significantly by 2030 according to the business-as-usual scenario. The city receives annual sunshine of 3,000 hours at an average global horizontal radiation of 6.19 kWh/m2/day. The typical average production factor for PV systems is 1,670 kWh/kWp per year.

The municipality should work with investors to promote the use of renewable energy in public and private buildings:

| Region | Altitude, m | Latitude, degree | Longitude, degree | GHI, kWh/m2 |
|---|---|---|---|---|
| Al-Salt | 795 | 32.05 | 35.72 | 6.19 |

| Mitigation | | | |
|---|---|---|---|
| MWh/a | | tCO2/a | |
| 6,162 | | 4,283 | |
| Implementation Cost | | | |
| EUR 4,981,500 | | | |
| Stakeholder Involvement | LA | | |
| | External | | |
| | Other | | |
| Staff Capacity | L | M | H |
| | | | |
| 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 in complementarity with the Governorate's action and after assessment of the sector's capacity and plans to be modernized and upgraded.

The experiences in the use of renewable energy in the country are many and varied, and this helps in popularizing the use of renewable energy. Moreover, investment in renewable energy requires high capital investment, experience as well as knowledge of the latest technologies. Where the municipality does not have the technical expertise and financial resources, the municipality 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 there to be 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 municipality 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 municipality and make them talk about the success of the project 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 fuel. The municipality can work with EU and international programs to implement such projects in the city as well as the municipality 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 fuel. A PV farm project should be coordinated with national authorities and IEC to secure the stability of the grid during the daytime and guarantee a return on investment. A long-term EPC should be applied along with a third party to monitor the performance, guarantee long-term operation, and protect the interests of both the municipality and the investors.

[4] Economic Assessment of PV Investments in Jordan by Loiy Al-Ghussain*

*The 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 | Emissions Savings, tCO2-eq | Project Cost, EUR |
|---|---|---|---|---|
| PV system on municipal building | 10 x 9 kWp | 90 kWp x 1,670 kWh/kWp= 150,300 kWh /1,000=150.3 MWh | 150.3 * 0.695 = 104.5 | 121,500 |
| PV systems with water pumping stations | 2 x 50 kWp | 100 kWp x 1,670 kWh/kWp= 167,000 kWh /1,000= 167 MWh | 167 * 0.695 = 116.1 | 135,000 |
| Solar PV farm | 3.5 MW (3,500 kWp) | 3,500 kWp x 1,670 kWh/kWp= 5,845,000 kWh/1,000=5,845 MWh | 5,845 * 0.695 = 4,062.3 | 4,725,000 |
| | | **6,162.3 MWh** | **4,282.9** | **4,981,500** |

### Financial analysis

| Energy Source | Green Energy Production | Monetary earnings, JOD (EUR) |
|---|---|---|
| Renewable Energy | 6,162.3 | 150 * 6,162.3 = JOD 924,345 (EUR 1,109,214) |

The return on investment is estimated to be EUR 1,109,214 per year

### Expected funding resources

- Total annual energy generation is around 6,162.3MWh amounting to around JOD 924,345 (EUR 1,109,214).
- Budget: Estimated to cost EUR 4,981,500.
- Climate cost efficiency: If these measures are implemented by 2030, the expected abatement generated is 4,282.9tCO2-eq/a. (The climate cost efficiency is equal to the implementation cost divided by the abatement according to the Paris Agreement.)
- Source of finance: The municipality can build long-term partnerships with the private sector.

# 6 Adaptation Actions

# Chapter 6: Adaptation Actions

## 6.1 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 higher temperatures contribute to the build-up of harmful air pollutants.
- One of the most important effects of climate change is the shortage of water. 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 opportunity for transmission risk of several pathogens through crop contamination leading to outbreaks like typhoid or hepatitis if the water is not treated[5].
- 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 an increased probability of 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 on 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 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 which reduce lung functioning and results in premature deaths.

**Main adaptation measures suggested at the national level:**

In coordination with national and regional related action:

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

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

| Action Type | Adaptation measures in complementarity with national and regional actions |
|---|---|
| **Strategic** | Develop a health action plan for extreme events the municipality is facing (e.g., extreme heat) |
| | Provide access to air-conditioned public buildings during heat waves or other extreme events for citizens lacking protective infrastructure (e.g., people living in underground apartments lacking AC during extreme temperatures) |
| | Update building codes and landscaping laws to increase energy efficiency and improve the ability of buildings to provide protection against extreme heat events (e.g., green roofs and strategically located shade trees) |
| | Reorganize working hours and reschedule the working time to avoid mid-day work |
| | Collaborate with regional medical services to increase preparedness level |

| | |
|---|---|
| **Alerts & Communication** | Develop an early warning system to alert citizens of extreme weather events or natural disasters (e.g., heat waves, floods) |
| **Educational** | 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 (see Guidelines in Chapter 7 of this SEACAP) |
| | Provide instruction to the public on staying hydrated and avoiding strenuous outdoor exercise during heat alerts |
| | Provide easy access to public drinking fountains, swimming pools, and spray pads, also take preventive action like opening cooling centres where the public can gather for relief from the heat |
| **Technical** | Clean and maintain sewage and drainage systems |
| | Identify potential hot spots for the development of vector-borne diseases |
| | Cultivate urban forests, including street and wooded areas |
| | Monitor frequently water and air quality |

| Implementation Years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |

## 6.2 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 change significantly 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. Prioritization 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 in complementarity with national and regional actions. These may include measures to reduce uncertainties in climatic design values, regularly updated climatic design values, enforcement of codes and standards, 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 in complementarity with national and regional level are:**

- Rainwater harvesting, where quantitatively justified and feasible.
- Wastewater treatment
- Increasing efficiency of irrigation technologies
- Grey water reuse
- Public awareness
- Flood water retention

The following table explains the adaptation actions related to the water sector:

| Action Type | Adaptation measures in complementarity with national and regional actions |
|---|---|
| **Strategic** | Develop a water and wastewater management plan |
| | Model predicted supply changes in the electricity from locally available resources |
| | Monitor frequently infrastructure to spot and quickly repair any damages |
| | Reduce uncertainties in climatic design values, regularly updated climatic design values, enforcement of codes and standards, maintenance of climate data records and networks, consistent forensic analyses of infrastructure failures, regular maintenance scheduling, and community disaster management planning. |
| **Alerts & Communication** | Issue alerts when infrastructure has been severely damaged and should be avoided |
| **Educational** | Develop guides and awareness campaigns saving water and energy, especially during crisis |
| **Technical** | Integrate sustainable drainage systems |
| | Establish underground water reservoirs |
| | Cultivate green roofs on top of impermeable surfaces to deal with rainwater storage and heat |
| | Rehabilitate springs |
| | Increase use of renewable energy to decrease pressure on the public grid and contribute to ameliorating power plant failures |
| | Develop flood management zones and harvest flood waters |
| | Use advanced tap water such as the aerator tap to regulate water flow |
| | Improve efficiency of water storage systems to reduce evaporation |
| | Collect rainwater through building roofs for household usage |

| Implementation Years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |

## 6.3 Built Environment

Adaptation actions improve the resilience of the built environment in the face of climate change and also protect the wellbeing of communities through targeted policy initiatives and better urban and building design, ensure appropriate institutional arrangements facilitating adaptation, realise economic benefits from early adaptation through effective strategic planning and risk minimization, advances sustainability through better resource and risk management strategies, and increases community education and awareness about climate change risks and adaptation.

### Urban Sector:

According to Jordan's Third National Communication on Climate Change (TNC), at the kingdom level, the overall exposure in RCP 4.5 is low and moderate in RCP 8.5. Although the exposure is low, the events concentrate in certain geographic areas and thus the kingdom exposure is not the best representation for specific urban areas like Amman and Al Salt. The main factor, which reduced the exposure score, is the confidence of occurrence due to the large geographic coverage which is not uniform in exposure. For a better representation of climate change's impact on communities, the exposure has been assessed for the pilot area specifically and for the kingdom to cover the adjacent urban centres; Amman and Salt.

Adaptation measures suggested for the urban sector in complementarity with national and regional levels are:

- Introduce climate responsive building techniques and elements to reduce the effect of heat and reduce demand on energy for cooling;
- Promote the use of energy saving devices, and raise awareness on the long-term benefits of energy efficiency and saving devices;
- Amend sector policies and regulations, such as building codes, to reflect climate change risks and direct people towards insulating buildings to reduce energy demand;

- Construct proper storm water network to discharge storm water from built environment;
- Adjust zoning and development regulations to address vulnerability of specific locations and/or resources.

*The following table explains the adaptation actions related to the urban sector:*

| Action Type | Adaptation measures in complementarity with national and regional actions |
|---|---|
| **Strategic** | Modify building codes allowing more energy-efficient and heat-tolerant structures |
| | Modify building codes against seismic activity |
| | Reduce municipal taxes for adopting adaptation measures for their houses |
| **Alerts & Communication** | Not applicable |
| **Educational** | Conduct educational campaigns informing citizens on the benefits of adopting the suggested actions |
| **Technical** | Build greening infrastructure such as buildings' roofs and walls |
| | Increase the amount of shade and green areas in the city by planting trees to reduce the heat island effect |
| | Build exemplary districts with adapted urban forms and buildings |
| | Paint roofs white (or other cooling colours) and introduce shading and bioclimatic design |
| | Collect rainwater while adopting methods to reduce water demand |
| | Use water-resistant construction materials |
| | Update sewage system by separating grey and black water while benefitting from recycling grey water with several household applications |
| | Adopt flood resistance techniques applied to buildings, such as building elevation or wet flood proofing |

| Implementation Years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |

## 6.4 Economy

### Socio-economic Analysis

The Third National Communication on Climate Change (TNC) has developed a socioeconomic analysis to determine the expected impacts of climate change on local communities and their adaptive capacities by employing socio-economic and adaptation analysis tools on the pilot area composed of four villages in the Amman-Zarqa Basin near Irbid.

The study used an income assessment as the main critical indicator of the local community's sensitivity to climate change. The importance of these indicators are linked to the impacts of climate change on agricultural productivity at the study site. Notably, 54.47% of the community income is based on agriculture making it the most sensitive sector to climate change.

The main results of the analysis include:

- Communities with less agricultural experience such as Subeihi and Bayoudah will suffer severe impacts due to climate change and it is expected that they will lose 10-20% of their income due to the decrease of their crops' productivity;
- Farmers above 60 years old are less impacted than others by external factors. This explains the importance of local knowledge and experience in agricultural practices;
- Seehan will suffer the least significant impact as it is the community scoring the highest in agricultural experience;
- Seehan will not suffer major impacts on their livelihoods because of their diversified income sources
- Al-Irmemeen was an exception among the other communities where younger farmers (between 20- 40 years) have reported higher income from agriculture compared with older age groups. The reason behind this is that the dominant production system is irrigated agriculture and farmers used modern technology and protected agriculture.

Further measures are required to explore the linkages between socio-economic studies and climate change impacts

to enhance the adaptive capacity in communities.

Such measures include:

- Increasing women's skill-development and capacity building opportunities through training in community and political participation skills and link them to general literacy and education initiatives
- Taking measures to increase the labour productivity of rural women through improved access to training, extension services, and technology
- Prioritizing by national governments of inclusive economic growth which does not exclude the rural poor
- Mainstreaming the role of media in climate change and supporting NGOs and community-based organizations well placed to spearhead awareness efforts in different community segments, and in their climate change media-targeting activities
- Conducting a pilot study on vulnerability to food security due to climate change using a multilevel approach including an analytical and relatively comprehensive chain of logical events regarding the impacts of climate change on farm households is needed.

## 6.5 Agriculture, Forestry, & Other Land Use (AFOLU)

The municipality has a Mediterranean climate with mild rainy winters and mild summers supporting a wide variety of agriculture currently threatened by severe climate changes such as increasing temperatures and repeated heat waves invading the city.

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

1. Temperature increase
2. Rainfall decrease
3. Droughts
4. Rainy season shifts
5. Floods

The **major sectors of high climate sensitivities** are:

1. Cropping systems
2. Livestock production
3. Livelihood and food security

The key adaptation measure to climate change is **setting and implementing a sustainable agriculture policy in concert with national and regional authorities**.

Adaptation measures vary horizontally according to the agricultural subsectors and their vulnerability to climate change. These measures vary vertically according to the different actors involved in the development and implementation of this policy.

The adaptation strategies to a changing climate include:

- Agronomic and crop strategies intended to offset either partially or completely the loss of productivity caused by climate change by applying protection through different temporal scales (e.g., short-term adjustments and long-term adaptations), and spatial scales (e.g., farm, regional, or national level adaptation)
- Socio-economic strategies meeting agricultural costs of 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 (the watering of 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 the 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.

Further measures are required to explore the linkages between socio-economic studies and climate change impacts to enhance the adaptive capacity in communities.

Such measures include:

- Increasing women's skill-development and capacity building opportunities through training in community and political participation skills and link them to general literacy and education initiatives
- Taking measures to increase the labour productivity of rural women through improved access to training, extension services, and technology
- Prioritizing by national governments of inclusive economic growth which does not exclude the rural poor
- Mainstreaming the role of media in climate change and supporting NGOs and community-based organizations well placed to spearhead awareness efforts in different community segments, and in their climate change media-targeting activities
- Conducting a pilot study on vulnerability to food security due to climate change using a multilevel approach including an analytical and relatively comprehensive chain of logical events regarding the impacts of climate change for farm households is needed

*The following table explains the adaptation actions related to agriculture:*

| Action Type | Adaptation |
|---|---|
| **Strategic** | Elaborate a drought, water, and ground water management plan |
| | Assess agriculture land for soil quality |
| | Adopt integrated land use planning for tourism |
| **Alerts & Communication** | Prepare a protective system for any fire hazard |
| | Improve forecasting and become familiar with forecasting information available via the media and on internet-weather radar and lightning detectors |
| **Educational** | Educate farmers and tourism personnel on conserving natural resources, especially during extreme weather events |
| | Adopt awareness sessions on agricultural sustainability, and encourage the participation of youth and young farmers and their integration with the old farmers to benefit from their experiences |
| **Technical** | Use drought-resistant crops |
| | Adopt agroforestry systems |
| | Use drip irrigation practices |
| | Adopt energy-efficient and water conservation programs at resorts |
| | Reduce cooling needs in resorts by installing automations and setting thermostats at given temperatures |
| | Promote renewable energy sources in resorts |
| | Adopt the fertigation technique (dripping chemical and/or organic fertilizers with water) |
| | Adopt Groasis Waterboxx tech to minimize water and improve plant growth |
| | Conserve organic agriculture by combining zero or low tillage with permanent soil cover |
| | Protect forests and prevent overgrazing |

| Implementation Years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |

**Additional Actions for the Agriculture Sector**

Study the modernization of agricultural production, practices, and tools; enhance the quality of agricultural fertilizers and pesticides; and improve the marketing of agricultural products through the following measures and actions:

- Conduct feasibility studies on potential new crops.
- Include financing and developing alternative crops suitable to the region.
- Establish an agricultural equipment cooperative providing modern equipment suitable to the characteristics of the land and the cultivated crops.
- Establish an agricultural observatory to conduct soil analysis and measure humidity and other weather indicators affecting production and select optimal crops and the best fertilizers as well as their optimal amounts and the timing of their application.
- Follow up on the wastewater treatment plant project to produce and provide agricultural fertilizers at competitive prices.
- Encourage local authorities and agricultural cooperatives to establish packaging and cooling centres in the most prominent fruit production zones responsive to farmers' needs.
- Establish firms specializing in labelling and exports.
- Conduct studies on the exploitation of the arable lands.
- Organize awareness campaigns on the techniques of using fertilizers and pesticides.
- Organize marketing campaigns for the crops.
- Establish composting projects to aerobically compost unused biomass from agriculture such as harvest residuals, fruit-food waste, pruning material, and manure.
- Launch a field agricultural school to build the capacity of farmers.
- Introduce agroforestry to manage and integrate trees, crops, and livestock and control run-off and soil erosion, reduce water loss, soil material, and organic nutrients.
- Improve water quality and management, protect natural water resources, reduce water losses, and establish water harvesting systems.
- Install new irrigation techniques reducing water consumption

### 6.5.1 City Greening

**Background**

The city of Al Salt covers 119.092 km2 located in the Balqa governorate. The region's Mediterranean climate prevails with the highland areas having mild, rainy, cold winters and mild summers with an average annual rainfall of 600 mm, and its contrast varies between flat plains, hills, mountains, and very steep valleys. Increasing green areas in the city will lead to improving the city's beauty and citizens' health. Greening urban areas will enhance the city's beauty and improve citizens' health.

**Description of the Action**

The municipality aims to green itself by planting trees in streets, around buildings, and in unused lands to improve public health, urban beauty, and connect the community to the green environment by encouraging residents to plant trees around their houses by linking new building permits to the availability of green space. The municipality is preparing a master plan for city greening including, but not limited to, the following steps:

- Mapping the points and areas to be planted with trees
- Selecting trees adaptable to local climate (minimal water required in summer and unlikely to pose preservation problems)
- Creating a tree census (location, species, size, number, and condition)
- Studying the possibility to plant trees in the soil or in Groasis Waterboxx
- Financing program elaboration
- Acquiring plant stock
- Planting program in collaboration with specialized institutions and experts
- Deploying proper irrigation systems using new technologies like water dripping systems
- Conserving trees through proper irrigation and protection

The project consists of planting 20,000 trees throughout the city in 5 phases over 5 years (4,000 trees per year). An average tree absorbs 43.6 kg of CO2 per year meaning the project will absorb 174,400 kg annually.

**General objectives**

Planting trees and green spaces are associated with better air quality, reduced traffic noise, cooler temperatures, and greater diversity. Trees:

- Improve emotional and psychological health
- Beautify the environment
- Provide shade, keep the earth cool, and reduce cooling costs
- Reduce greenhouse gases by capturing carbon dioxide during growth
- Improve air and water quality by absorbing air pollutants like ozone and nitrogen oxides while intercepting particulates like dust and smoke
- Reduce energy consumption and cool the atmosphere
- Decrease topsoil erosion
- Increase economic stability
- Conserve soil carbon while storing more carbon in the soil
- Reduce storm water runoff
- Foster a safer and more sociable neighbourhood environment

### 6.5.2 Public Learning Garden

**Background**

Public gardens are at the forefront of organizations committed to promoting the conservation of plants and their habitats, developing sustainable environmental management practices, and providing green spaces where residents can reconnect with the natural world.

Al Salt's local communities suffer from the lack of green recreational areas such as public gardens and parks. Hence, it is crucial to establish public gardens in the city.

**Description of the Action**

The municipality aims to establish public gardens with multipurpose including awareness-raising for climate change as well as social activities, sports, and pilot projects.

The project development and implementation steps are:

- Choose the garden site
- Assess the proposed site (size, neighbourhood, landowners, soils, water availability, etc.)
- Select the garden type and mode for a public garden composed of three areas:
  - Climate change demonstration area
    - Experiment with new species, planting, and harvesting dates, manage water, protect plants against frost, be aware of any new threats, reduce and replace nitrogen fertilizers, plant strategically, etc.
  - Biking and hiking area
    - Construct biking and hiking paths and walkways for the local community and visitors
  - Pilot projects related to mitigation and adaptation to climate change
    - Organic matter composting, crop residues mixed with animal manure, organic waste composting
    - Solid waste sorting-at-the-source, separation of plastics, cartons, glass, organic matters, hazardous materials
    - Aquaponics combining aquaculture (raising fish) and hydroponics (soil-less growing of plants)
    - Solar PV cells illuminating the garden and for water pumping
    - Water management through water harvesting rainwater tanks
    - Sustainability using recycled and local materials and growing a variety of plants for biodiversity
    - New irrigation technologies
- Create your management plan and garden layout
  - Design garden involving a professional landscape architect to lead the discussion in meetings and ensure all ideas are heard and the resulting plan will be something all can own
  - Apply and receive approval for funding by developing a budget and considering potential financial resources like sponsorship by local businesses of a section of the garden, grants from the city or other bodies, donations from local businesses for materials, plants, trees

- Construct garden and develop garden group, grow plants and trees, install water tanks and pumps, construct biking pathways, construct hiking paths, etc.
- Install signage to educate the community on energy consumption awareness-raising, efficient water usage, renewable energy use, solid waste sorting, etc.
- Provide guided tours for school children and other groups
- Establish pilot projects
- Promote the garden through the municipality website, media releases, publications, and events
- Monitor and maintain the garden

**General Objectives**

Public gardens are a unique form of open space managed by the municipality to encourage a healthier lifestyle within the local community and to contribute to a sustainable urban environment. They are the place to learn about climate change and can be used to understand the global impacts of a changing climate. Public gardens have a lot of benefits such as:

- Place for physical activities, provide hiking and biking trails and other amenities designed to get people active
- Place for kids to be outside, being outside and playing in nature is crucial for the healthy development of children
- Mental health boost, a place where people are able to make connections, meet new friends, and participate in recreational activities, in addition to physical activities
- Centre of community, provide space for neighbourhood residents to interact with each other and meet new people
- Storm water collection, trees and grass are a far more efficient and less expansive method of managing storm water than sewers and drainage ditches made of concrete
- Clean air and reduced CO2 emissions, trees and plants remove pollutants from the air and eat CO2 during growth
- Create job opportunities for the local community

## 6.6 Biodiversity

**Biodiversity and Ecosystems:**

The expected impacts from climate change on ecosystems in Jordan are droughts, forest dieback, community composition change, expansion of drier biomes into marginal lands, habitat degradation, and species loss.

According to the TNC's exposure and vulnerability analysis, the highest exposure to climate change impacts is expected to be in Jordan's eastern and southern areas and in the mountainous areas of the north.

The highest sensitivity based on vegetation type is expected to be in the northern highlands and across the middle areas, especially the Jordan Valley.

For water vegetation, the analysis expects reduced growth and reduced growth range due to lower soil moisture. Evergreen oak and pine forests are expected to have lower regeneration rates, change in community composition, and shrinkage in geographic range.

Mediterranean non-forest vegetation is expected to have reduced growth in lower elevations and shift toward higher elevation with time.

The highest adaptive capacity was noticed in desert vegetation, tropical vegetation, and to a lesser extent in marginal vegetation types such as steppe vegetation.

**Description of the Action**

The priority adaptation interventions should be in the most vulnerable areas **– forests** (especially in the north) and **freshwater ecosystems** (especially in Jordan Rift Valley).

Adaptation measures and programs that can be adopted at the national level and implemented in the framework of the SEACAP actions in Jordan include:

- Restoring degraded forests and encouraging the establishment of community forests to control soil erosion;
- Introducing diverse conservation governance forms including Protected Areas (PAs), Hima, and Special Conservation Areas (SCAs) empowering local communities to conserve their natural resources and improve their livelihoods;

- Protecting and enhancing ecosystem services in conservation areas; improving access to ecosystem services of high quality which empower local communities and increase the resistance/resilience of local communities to climate change impacts;
- Preserving water quality and flows in water catchment areas using buffer zones surrounding PAs and SCAs;
- Restoring and protecting rangelands to reduce the vulnerability of livestock to drought; and
- Adopting water management procedures providing alternative water sources for fauna and avifauna such as retention dams.

According to the prioritization done by the TNC, it was found that enhancing ecosystem services provided by conservation areas and empowering local communities is the most important adaptation measure in Jordan followed by diversification of conservation methodologies and governance systems.

*The following table explains the adaptation actions related to biodiversity*

| Action Type | Adaptation |
|---|---|
| **Strategic** | Establish a fire management plan |
| **Alert & Communication** | Create an early warning system for flooding or fire hazards |
| **Educational** | Educate citizens |
| **Technical** | Divide the forest into sections to allow better fire management |
| | Plan, construct, and maintain forest roads |
| | Plant trees |

| Implementation Years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |

## 6.7 Water Harvesting System

### Background

Surface water harvesting is the technique of gathering or accumulating and storing rainwater, and it provides drinking water, domestic water, water for livestock, water for irrigation, and a way to increase groundwater levels.

In the area around Al Salt, the main water sources are the artesian wells that are declining rapidly, and there are real fears of water shortage in the region. The Mediterranean climate prevails in Al Salt with its highland areas have a mild, rainy, cold winter and mild summer climate with an average rainfall of 600 mm, and its contrast varies between flat plains, hills, mountains, and very steep valleys.

Hence, it is crucial to establish a water harvesting system in the city to supply the citizens with service water as well as the farmers with irrigation water.

### Description of the action

To meet multiple water demands, and to reduce the water shortage for residents and farmers, the municipality is establishing a multi-purpose water harvesting system including the construction of new reservoirs or ponds in farms, urban areas, streams, and valleys.

The project development and implementation steps are:

- Determine the location of the ponds of the concrete reservoirs
- Draft study plans with specialized engineers
- Construct the water reservoirs or ponds as per plans
- Construct a water distribution system to deliver the water to its proposed destinations
- Equip the water harvesting system with PV cells to solar power the new pumping system.

### General objectives

Collecting rainwater from natural seasonal streams during winter and spring seasons is important to secure a strategic amount of water needed for agriculture while reducing the use of ground water for a certain period.

The main objectives of the project are:

- Creating a water run-off harvesting system
- 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
- Controlling seasonal floods
- Expanding tourism by increasing the green areas related to tourism
- Providing a model for nationwide application
- Increasing green areas reducing air pollution, CO2 quantities, and dust levels
- Raising awareness among citizens and tourists regarding water harvesting to counter expected droughts.

## 6.8 Society

### 6.8.1 Gender Equality and Climate Change as applied I the SEACAP

**"Climate change is not gender neutral and neither should climate action be". Women not only have a role to play in tackling the climate change threats but also their knowledge, experiences and views can better guide the actions adopted. Excluding women from the process and overlooking their needs, interests and creativity isolates fifty percent of the world and marginalize potential innovative solutions that can generate more environmental justice while bridging gender gaps and overcoming gender specific barriers".**

*(Gender Equality and Climate Change in Jordan: Explanatory Gender Analysis Report (2022) - Ministry of Environment and the United Nations Development Programme (UNDP)).*

#### Background

Initial evidence indicates that Jordanian women and girls are more vulnerable to the risks of climate change. Men and women within vulnerable communities experience climate change differently and have varying coping mechanisms that are restricted by social norms and values, particularly for women and girls. Women are also most affected during extreme natural weather events (drought, flood, heat waves and snowstorms).

Women's voices, interests and needs are frequently marginalized in climate change actions even though their knowledge and experiences can be pivotal in advancing environmental stewardship, resilience, behavioural change and adoption of new technologies and practices that advance adaptation and mitigation strategies and solutions.

Women are also marginalized from strategic and community discussions that relate to climate change, management of resources, and defining of coping, adaptation, and mitigation strategies. The situation is further exacerbated by the regional political instability, influx of refugees and growing tensions over natural resources, most notably water, and who controls it.

Jordan's engagements to advancing gender mainstreaming efforts in climate change policy and action is well confirmed. The Kingdom fulfils the commitments articulated in the UNFCCC, Paris Climate Accord, and Enhanced Lima Climate workplan for Gender. it was the first country in the region to integrate a gender equality perspective in its National Climate Change Policy (JNCCP), the National Adaptation Plan (NAP) and the Third National Communication Report (TNC).

#### General Objectives

**In practice, Jordan is engaged in mainstreaming a gender perspective in climate change adaptation and mitigation policies, strategies, and actions, including at local level, namely within the SEACAPs.**

To translate this into SEACAP action, this calls for approaching priorities, design projects' design, planning, implementation, and monitoring of progress in a more responsive and targeted manner towards gender equality. This can be applied through a number of approaches presented hereafter.

#### Description of the action

Generate a strong local discourse on gender equality in climate change

- Selectively collect data and identify gender related indicators along the planning, design and implementation of SEACAP actions. The aim is to understand and address in each one the different impact of climate change on women, men, girls and boys, which is pivotal to adopt a more gender responsive, equitable solutions that ensures inclusive solutions that leaves 'no one behind'.

Develop strong synergies among and between gender equality and climate change actors,

- It is essential that synergies are drawn to find the common grounds between gender equality, women empowerment and the practices climate change activists and practitioners that are responsible for executing the SEACAPs, towards mitigating climate change impacts on women.

Enhance capacities to mainstream gender in the seacap climate change actions

- Within the SEACAPs direct or indirect capacity building activities, mainstream the concept of gender in climate change applications, including to experts as well as national and local authorities' personnel.

Enhance awareness of communities, and decision makers

- Within all the SEACAPs communication and awareness raising activities - including as directly prescribed in Chapter 7 of this document - about the gender dimension and how communities are affected by climate change differently, towards strengthening women and girls' resilience and engaging them in identifying gender climate just solutions.

### 6.8.2 Creating a Climate Adaptation Network

**Background**

The climate is changing, and challenges to society in the form of floods, heatwaves and landslides are becoming more common. The municipalities play a crucial role individually in efforts to ensure Jordan is adapted to climate change, as they are de facto facing and responsible for adaptation actions on a local level.

Several of the municipalities that prepared the SEACAPs felt that there was a need for more collaboration and more support regarding their SEACAPs work, plus and in particular regarding climate adaptation. This is crucial considering that those who work with climate adaptation in a municipality often work alone, thus makes it important to identify forms of collaboration.

In this context, it is recommended to form a Climate Adaptation Network associate local authorities that prepared SEACAPs, through which the municipalities can learn from each other and support each other

Create a Climate Adaptation Network associating the 10 Jordanian municipalities that prepared SEACAPs. each municipality will be represented by a Climate Adaptation Team.

The role of the network will be closely related to that of national and regional authorities dealing with Climate Change and with municipal staff leading the implementation of the SEACAPs. Moreover, the network activities will complement and interact with those of the proposed SEACAP Support Mechanism.

The purpose of the network is to allow members to share their experiences and to learn from one another, thereby creating a common knowledge base and consensus. The members come from different backgrounds, and they have different skills that they are able to share.

The network will give new members clear perspectives of adaptation problems and the chance to find solutions and will enable them to stay updated about other parts of their region and other regions, which means that they can identify areas where they can cooperate, create synergies, and avoid conflicts of interest.

The network will also provide an arena for shared external monitoring and dialogue with other organisations and networks (nationally, regionally and globally), and will function as a facilitator of external support of work on climate adaptation, and further complementing the role of sectoral agencies and that of the SSM.

It is highly recommended that an Expert Group be associated with the Network. This Group can comprise researchers from nearby universities and specialists representing sectoral agencies.

Specific issues to confront and challenges through the Network includes

- the incorporation of the climate change adaptation dimension at local and municipal levels,
- the creation of a community of municipal officers, aware of the issue and trained in the use of tools for decision support in adaptation,
- the promotion and provision of local knowledge on adaptation to climate change, particularly building links with national authorities and specialists towards developing strategies, planning and implementation of adaptation action,
- the reduction of barriers and constraints to the involvement of local actors in processes of adaptation; and f
- promote the integration of adaptation policies into planning and decision processes at the municipal level.


# 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.


[5] https://www.eib.org/attachments/country/climate_change_energy_mediterranean_en.pdf
[6] 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.

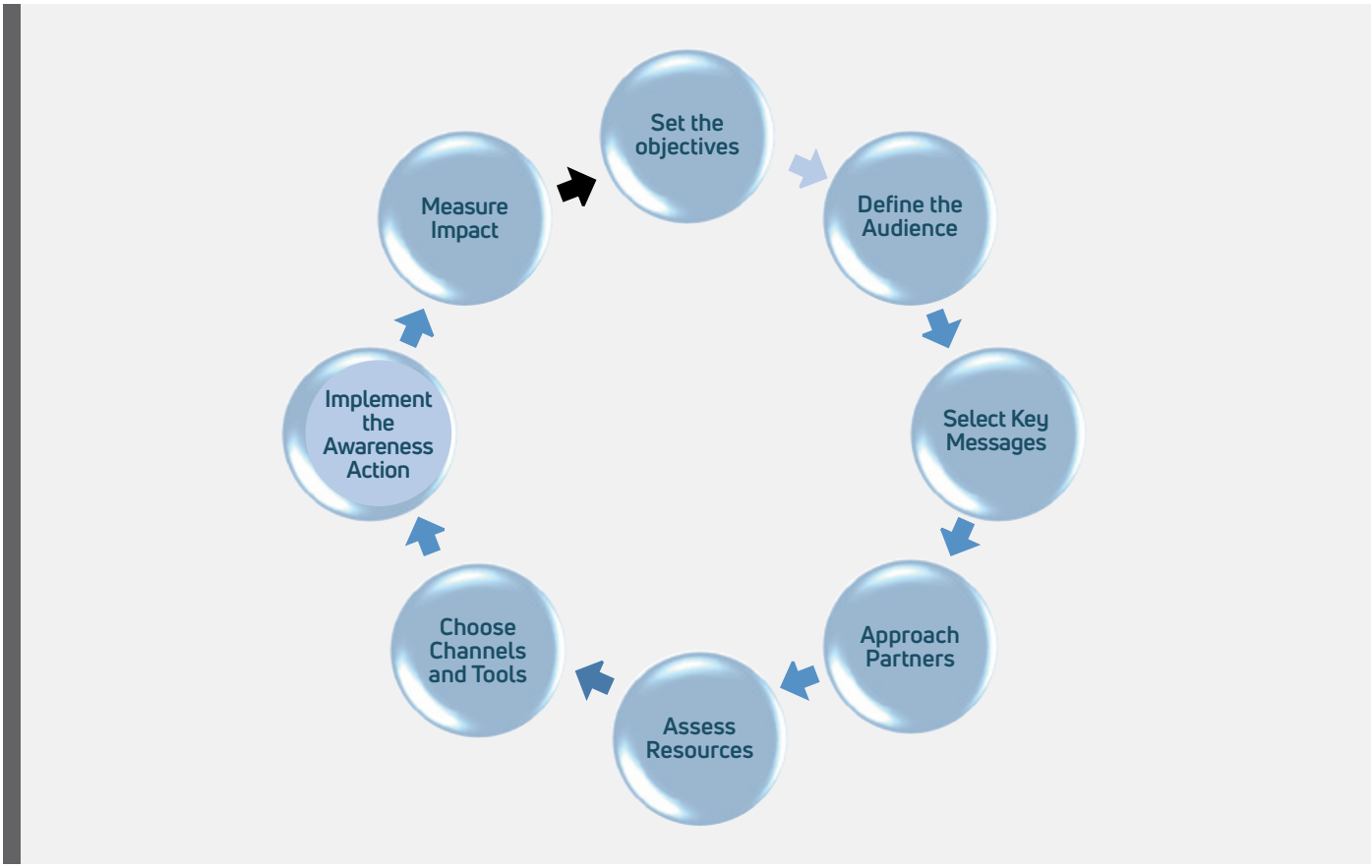
### Step 6: Assess sustainability

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.

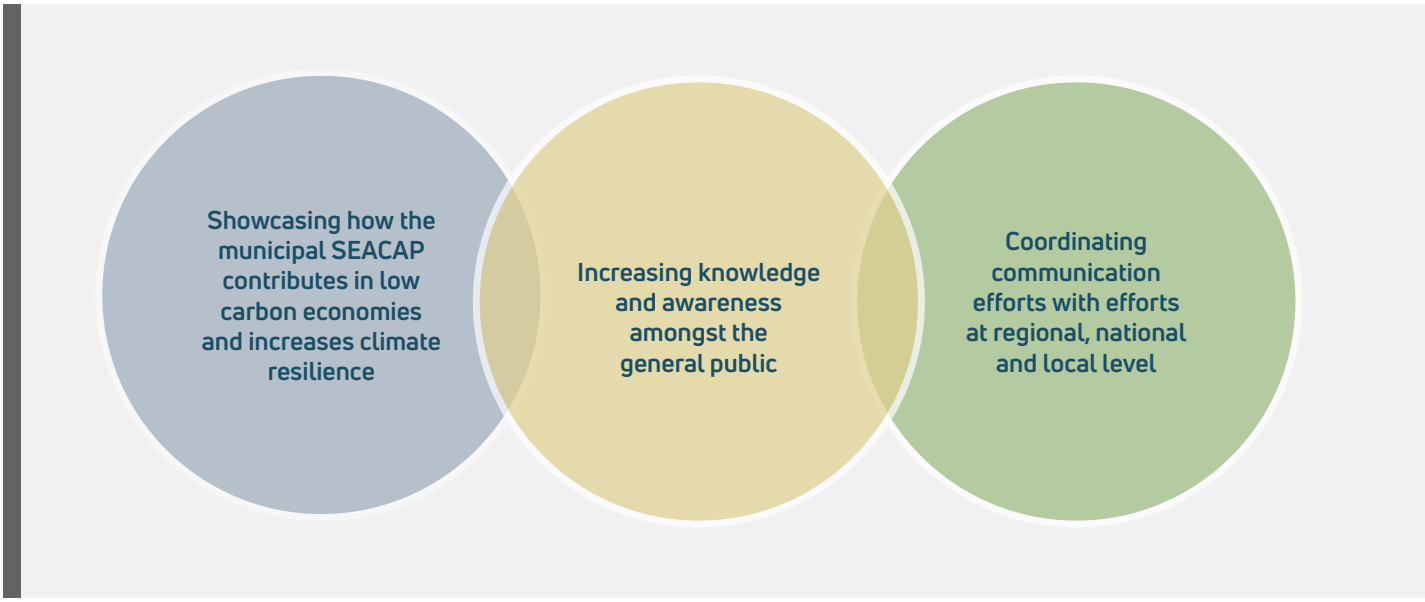
### A- Set the main communication objectives

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.

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- 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[5] 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.

[7] 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.

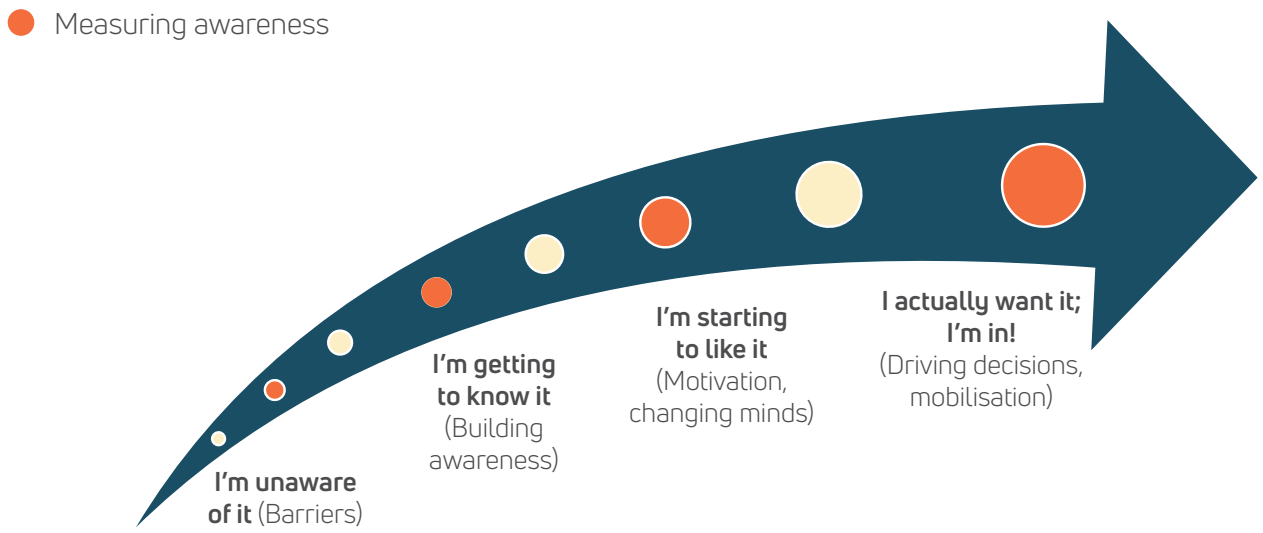
**The quantitative evaluation should measure:**

- 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]

[8] Gender and the Environment; Building Evidence and Policies to Achieve the SDGs
[9] 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.

[10] Sorensen et al., 2018

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# 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 | |

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