



AMMAN CLIMATE ACTION PLAN

AUGUST 2024

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ACRONYMS

BRT	Bus Rapid Transit
CAP	Climate Action Plan
CCDR	Country Climate and Development Report
CCP	Climate Change Policy
CIRIS	City Inventory Reporting and Information System
CPER	Climate Public Expenditure Review
DRR	Disaster Risk Reduction
EBRD	European Bank for Reconstruction and Development
EE	Energy Efficiency
GAM	Greater Amman Municipality
GCAP	Green City Action Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GGGI	Global Green Growth Initiative
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IPPU	Industrial Processes and Product Use
JEF	Jordan Environment Fund
JEPCO	Jordanian Electric Power Company Limited
JERIS	Jordan Electronic Reporting Information System
JNBC	Jordanian National Building Council
JREEEF	Jordan Renewable Energy and Energy Efficiency Fund
JSMO	Jordan Standardization and Meteorological organization
KHF	King Hussein Foundation
LTS	Long Term Strategy
MRV	Measurement-Reporting-Verification
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
PPP	Public-Private Partnership
PV	Photovoltaic
SBU	Sustainable Building Unit
SDG	Sustainable Development Goal
SuDS	Sustainable Drainage System
TOD	Transient-oriented Development
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
UNFCCC	United Nations Framework Convention on Climate Change
VLR	Voluntary Local Review

MESSAGE FROM THE MAYOR OF AMMAN THE GREATER AMMAN MUNICIPALITY



Dr. Yousef Al Shawarbeh
H.E Mayor of Amman

It is with great pleasure that the City of Amman presents its second Climate Action Plan. The first Climate Action Plan was developed in 2019 following the adherence of Amman to its commitments to C40 Cities. The inaugural Climate Action Plan presented an ambitious first step towards creating a sustainable and prosperous city. Since then, many valuable lessons have been learned regarding the mainstreaming of climate change across the entire spectrum of work that is carried out by the Greater Amman Municipality, to enhance the City's sustainability. As a leader on climate change action, these lessons learned have enabled the City to strengthen its responsibilities towards its people and the planet. The steadfast resolve of Amman is to reach carbon neutrality by 2050 and that will squarely contribute to the Kingdom's overall Climate Change Policy as well as the objectives of the Paris Agreement, under the UNFCCC and the 2030 Agenda on Sustainable Development Goals. One of the lessons learned, which is reflected in the present Climate Action Plan, is that a more balanced approach should be given to the treatment of climate change adaptation and disaster risk management, which may have been underestimated in the inaugural Climate Action Plan.

The year 2050 may seem far away, but it is the decisions we make now that will determine the kind of future the city will face. Undoubtedly, there remains more to be done and to learn; many shocks and uncertainties can happen as evidenced by large influxes of refugees, and, more recently, the COVID-19 pandemic. Yet the resilient character of Amman translates into optimism, and the City of Amman is well set to meet challenges that will crop up along the way. It is through being pragmatic regarding the City's current capabilities to address climate change, and in anticipation of future challenges, that the second Climate Action Plan identifies areas of improvements to be carried out in the future. This reflects the distinctive attitude of the City and the Greater Amman Municipality to be learning entities, and to nurture a disposition of transformation in the face of complex challenges. It is needless to mention that any solutions to complex challenges occurring in the future will require collaboration among all stakeholders and partners.

The development of the second Climate Action Plan was initiated and led by UNDP through the GEF-funded project "Sustainable Urbanization and Resource Efficiency", with the collaboration and support of UN-Habitat, through the UNEP funded project: "Inclusive, safe, resilient and sustainable development in urban areas hosting Syrian refugees in Jordan and Turkey". C40 Cities provided technical assistance and guidance at every step of the process.¹

GAM partners contributed significantly, not only directly in the process of developing the Climate Action Plan, but also in the numerous reports and plans that have been developed under the aegis of GAM since 2019. I would like to thank them all for their contributions of time and knowledge. I would also like to thank the employees of GAM for their tireless work on behalf of this initiative and primarily I would like to recognize the work of the GAM Sustainable Development and Amman Resilience Unit, which coordinated the development of the Climate Action Plan.

Our Vision is for the City of Amman to be carbon-neutral and climate-resilient by 2050 driven by a green and circular economy for the prosperity and wellbeing of all its citizens. It will demonstrate leadership through fairness, inclusivity and respect for its cultural and natural heritage in transitioning to a sustainable city. The City of Amman is committed to carrying out regular monitoring and evaluation of the Climate Action Plan, and to update this as the city's context changes and new opportunities become available. The Climate Action Plan is a living document that the City of Amman will continue to build on, until we achieve our plan of carbon-neutrality and climate-resilience. The Climate Action Plan will be updated every 5 years to assess the comprehensive progress of actions to meet the climate goals of Amman.



Foreword by Ms. Shruti Narayan

Regional Director, South and West Asia, C40 Cities

Amman, a C40 city has developed a Climate Action Plan (CAP) setting a roadmap becoming carbon neutral by 2050 aligned to the Paris Agreement. Amman is leading the path of climate actions in the region becoming a lighthouse city influencing other cities to follow the way of sustainable development. Aligned to C40 Climate Action Planning Framework, Amman CAP showcases an ambitious yet achievable plan and vision of the political leadership - HE Mayor of Amman for the carbon-neutral and climate-resilient city.

Amman is confronted with a slew of climate-related issues such as change in rainfall patterns leading to flash floods, rising temperatures, and an increase in extreme weather occurrences. To address the issue, Amman is committed and has developed a series of planning and strategic reports such as Resilience Strategy 2017, Climate Action Plan 2019 and Green City Action Plan 2021. This highlights Greater Amman Municipality's (GAM) allegiance to improving the quality of life for its residents by integrating climate change adaptation and mitigation strategies across all sectors.

The uniqueness of Amman CAP is its focus on mainstreaming the climate actions by integrating with its strategy documents, proposing policies and incorporating actions as part of master planning to ensure effective implementation. Apart from GCAP, GAM has collaborated with C40 on several engagements such as C40 Cities-Mayors Migration Council, the Global Mayors Task Force on Climate and Migration and Students Reinventing Cities. Amman has also committed to C40's Clean Air Cities Accelerator, Pathway towards zero waste and Urban Nature Accelerator.

I appreciate Amman's efforts on engaging with global and local stakeholders to expand access to green livelihood opportunities for both refugees and vulnerable residents and its focus on children for climate education. C40 also acknowledges support by UNDP and UN-Habitat to GAM for developing this plan. C40 looks forward to collaborating with Amman to achieve the goals of this plan by developing solutions and implementing actions towards transformational, city-wide resilience to the impacts of climate change and build healthy, equitable and resilient communities to remain within a 1.5°C rise.



EXECUTIVE SUMMARY

Picture source: UN-Habitat

The second Climate Action Plan (CAP) for the City of Amman reflects the commitment of the Greater Amman Municipality (GAM) to integrate climate change adaptation and mitigation across all its operations in order to enhance the quality of life of the citizens of Amman. It also reflects the evolving context of increasing human and institutional capacities for mainstreaming climate change, and for applying the C40 CAP Framework. As a learning organisation, GAM has endeavoured to apply the CAP Framework to the best of its capabilities, while recognising that there are improvements that will be brought about in future updates that are expected to be carried out at least

every 5 years. It is also expected that completion of the Long term Strategy for Sustainable Low Carbon Development in Jordan in 2024 will provide more guidance for GAM to formulate long-term climate strategies in alignment with national priorities.

In any case, the updated CAP has been formulated in alignment with the Climate Change Policy (CCP) 2022 – 2050. Based on stakeholder consultations, the CAP presents an Amman Vision 2050 as: “The City of Amman is carbon-neutral and climate-resilient by 2050 driven by a green and circular economy for the prosperity and wellbeing of all its citizens. We will

demonstrate climate and sustainability leadership regionally and globally through fairness, inclusivity and respect for our cultural and natural heritage in transitioning to a sustainable city.”

The identification and prioritisation of climate strategies and actions was based on the expert knowledge of GAM technical departments that were familiar with the mitigation analysis and climate risk assessments carried out in a CAP development process. Also, the identification of climate strategies and actions drew from the multi-criteria analysis that had been carried out under the Green City Action Plan (GCAP) in 2019.

The climate risks facing Amman should be framed within the broader country context. Jordan is facing irregular patterns of rainfall swinging between the extremes of drought to excessive rain over a short period of time, rising temperatures in summer and lower temperatures in winter, and a significant increase in extreme weather events. Heavy rain events are leading to flooding in lower-lying areas of the city, hazardous blizzards have closed schools, and heat waves and water shortages have directly impacted the health of the population and operation of businesses. National level data shows that the Governorate of Amman (which contains the GAM jurisdiction) is one of the most impacted regions. The profile of multi-

hazard events reported for Amman between 1981 and 2020 shows that floods and flash floods represent 29% of reported extreme events followed by snowstorm (19%), drought (13%) and frost (12%). A qualitative assessment of these climate hazards shows that likelihood and impact of extreme heat, drought and flood events are expected to increase in the future. In recent years, flash floods have become a serious problem, making roads dangerous and affecting an increasing number of residential and commercial areas. There are concerns that it could also affect water supply and sanitation. The 2019 flash flood remains vivid for the inhabitants of Amman. It caused significant material losses to property, infrastructure and inventory that have been estimated to at least JD 9,115,326. Extreme heat affects 70-80% of the population, while snow and ice affect between 50% and 60% of the population.

The climate adaptation and DRR strategies and actions have been proposed based on the GCAP, and the recommendations arising from UN-Habitat’s Flood Risk Mapping project and the GAM Strategy 2022-2026. The seven adaptation strategies are summarised in the table below, including the timeframe (ST - Short-term; MT - Medium-term; LT - Long-term) for implementation and their contributions to the SDGs.

Adaptation strategies	Time frame	SD0pported
Strategy 1 - To reduce flood risk in critical areas by 50% by 2040	ST-MT	SDG3; SDG5; SDG9; SDG10; SDG11; SDG13; SDG17
Strategy 2 – Early Warning System for Flooding	ST - MT	SDG3; SDG5; SDG9; SDG10; SDG11; SDG13; SDG17
Strategy 3 – Reduce water network losses by 70% by 2040	ST	SDG3; SDG5; SDG6;SDG9; SDG10; SDG11;SDG13; SDG17
Strategy 4 – Improve water efficiency in buildings by 25% by 2030	ST	SDG3; SDG5;SDG6; SDG7;SDG10; SDG11;SDG13; SDG17
Strategy 5 – Safeguard water supply	MT - LT	SDG3; SDG5;SDG6; SDG7;SDG9; SDG10; SDG11; SDG13; SDG17
Strategy 6 - Mitigate or maintain the urban heat island effect and carbon emissions in Amman through blue and green infrastructure & Improve the quality of green spaces	ST - MT	SDG3; SDG5;SDG9; SDG10; SDG11; SDG13; SDG17
Strategy 7 - Improve urban food security	ST - MT	SDG2;SDG3; SDG5; SDG10; SDG11; SDG13; SDG17
Strategy 8 – Track change in communicable diseases through online system	ST	SDG3; SDG5; SDG10;SDG13; SDG17

Table. 1: Adaptation strategies

The second CAP marks the transmigration from the CURB tool to the PATHWAYS modelling tool for mitigation analysis. The baseline year for mitigation analysis is 2019, representing the pre-COVID19 benchmark. In 2019, the total greenhouse gas (GHG) emissions for the City of Amman was 9.271 MtCO_{2e} giving a per capita emission of 2.4 tCO_{2e} per inhabitant. Stationary emissions were the most significant at 4,529,451 tCO_{2e} followed by transportation at 3,711,624 tCO_{2e}. In the absence of any mitigation strategies and actions, the growth in population and economic activity will result in an increase in baseline emissions from 7,392,996 tCO_{2e} (GPC BASIC emission) to 9,546,333 tCO_{2e} (2030) to 12,415,571 tCO_{2e} (2040) to 16,383,451 tCO_{2e} (2050). The per capita emissions will increase from 1.916 tCO_{2e}/inhabitant in 2019 to 1.963 tCO_{2e}/inhabitant in 2030 to 2.284 tCO_{2e}/inhabitant in 2050.

Mitigation strategies and actions for GPC BASIC emissions have been developed for three scenarios: Existing and Planned Scenario; Ambitious Scenario; and Extended Scenario. In general, the three scenarios contain strategies and actions for decarbonising the electricity grid, adoption of circular waste economy, shift towards public transportation and low carbon modes, integrated urban planning, and adoption of energy efficiency measures (buildings, industry, transportation), albeit with progressively increasing levels of decarbonisation.

Since Amman is considered to be in the category of 'late peak' cities, this level of emission reductions is sufficient to meet the target in 2030 (8,770,024 tCO_{2e} allowable emissions). However, Existing and Planned mitigation strategies and actions fall short of achieving the ambitious target of 32.4% emissions reductions relative to the baseline that the city has set itself with an achievement gap of 699,618 tCO_{2e} in 2030, and 8,403,422 tCO_{2e} in 2050. In turn, the Ambitious Scenario By increasing the level of ambition in the Ambitious Scenario across all sectors, except for grid electricity in 2030 that is not within the control of the city, Amman target emission reductions in 2030 (32.4%) and 2040 (52.7%) are achieved. However, it is noted the reductions of just over 5.87 MtCO_{2e} in 2040 fall short of the 2020 Deadline Trajectory value (5,541,356 tCO_{2e}), and with residual emissions in 2050 being just over 4 MtCO_{2e}.

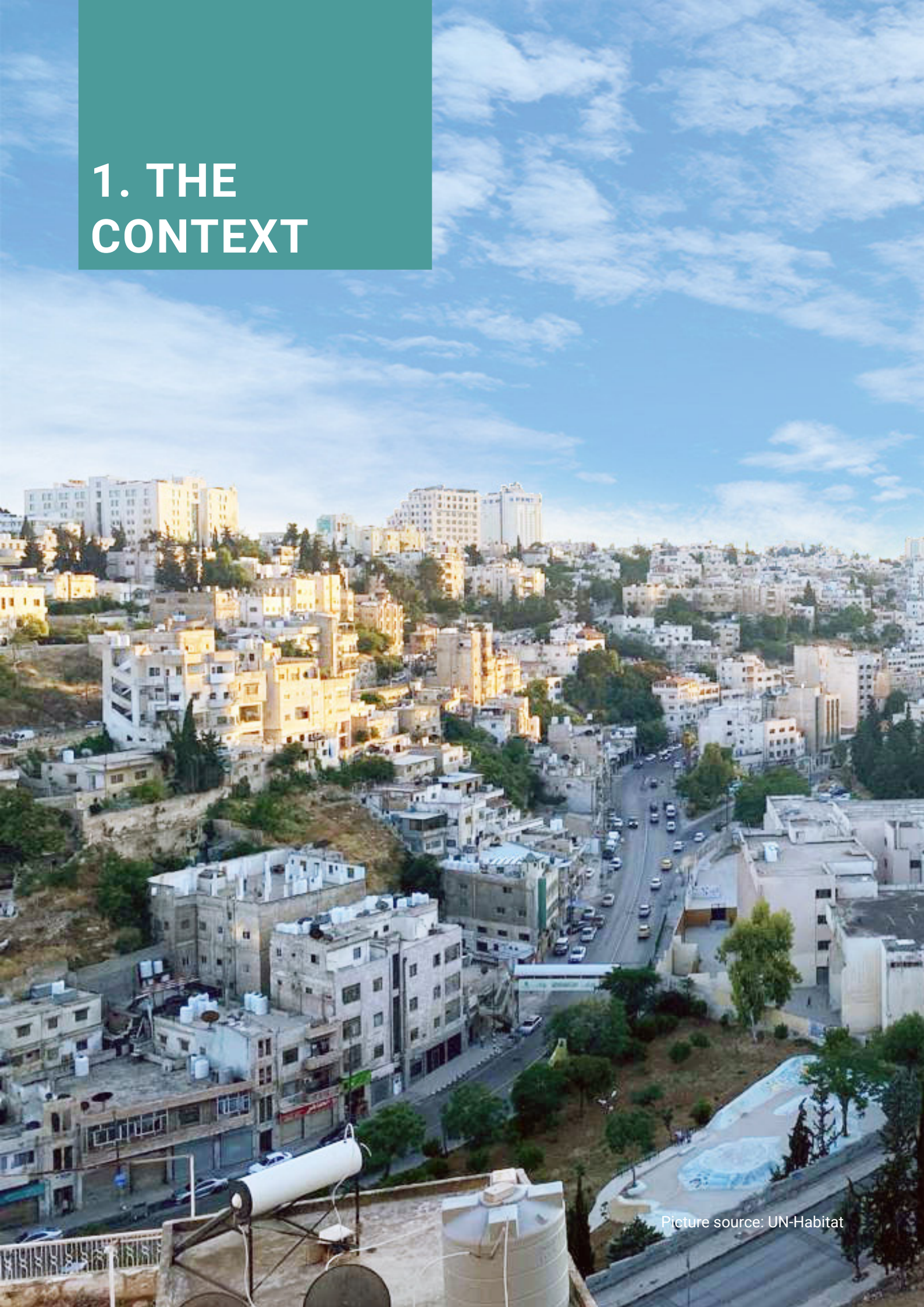
The Extended Scenario proposes strategies that are for all practical purposes prospective, and they provide

a list of targets for different actions in order to bridge the emissions gap in 2050. So the approach used does not preclude alternative mitigation strategies and actions to be developed in future analysis. This is important to note since Jordan is in the process of developing a national long-term mitigation strategy, the results of which may provide new mitigation pathways for consideration. The bundle of Extended strategies lower 2050 emissions to 92.7% below the baseline scenario, leaving residual emissions of 1,191,998 tCO_{2e} – i.e. 7.3% of the 2050 BAU emissions. Since the Extended strategies face significant barriers, the updated CAP contains detailed barriers analysis of the prospective strategies.

In order to arrive at GAM's ambitious yet achievable target of net-zero emissions by 2050, Amman commits for the interim targets of emission reduction of 14% by 2030 and 30% by 2040 (compared to the base year 2019-level emissions). GAM is well-placed to implement the climate strategies and actions contained in the updated CAP. First, there is highest level commitment in the GAM Administration. Also, the strategies and actions are integrated in the GAM Strategy 2022-2026, and which are budgeted and updated every four years, thereby providing continuity in terms of actions. Further, the organisational structure is appropriate for the mainstreaming of the strategies and actions within respective technical bodies in the GAM organogram. Based on the GAM organogram, the updated CAP provides a matrix of responsibility for its implementation. Importantly, the GAM Sustainable Development and Amman Resilience Unit, which coordinated the development of the CAP, will also coordinate its implementation. Further, the GAM Urban Observatory measures and tracks the city performance against a host of indicators that are captured in the set of C40 Inclusive Planning Indicators.

A number of issues have been identified for enhancing the institutional capacity for GAM to mainstream climate change. The main areas that will require more work in the future are multi-hazard risk analysis within the GAM jurisdiction, quantification and target setting for sustainable development co-benefits and improved integration of climate change in GAM policies and strategies. A multi-hazard climate risk analysis was ongoing at the time of completing the updated CAP, the results of which will be integrated in the next CAP version.

1. THE CONTEXT



Picture source: UN-Habitat

1.1 CITY CLIMATE ACTION REINFORCING MUNICIPAL MANDATE AND SUPPORTING NATIONAL PROCESSES

The responsibilities of the Municipality are prescribed in the Greater Amman Municipality (GAM) Law No. 18 of 2021. Under this law, GAM, operating under the oversight of the GAM Council through the Administrative Authority of the Mayor of Amman, has the responsibility for (among others):²



City sustainability by developing programs and following up on their implementation to achieve sustainable development with the participation of local communities; managing all local services, facilities, and projects



Strategic Planning through preparation of strategic and development plans and needs assessment documents



Land use planning which includes constructing, cancelling and modifying streets, maintaining, cleaning and lighting streets, monitoring open lands, and identifying the need for infrastructure, including green infrastructure, parks, recreation spaces and playgrounds



Building Licences for monitoring the construction and demolition of buildings; and ordering changes in their design; installation of elevators in buildings; granting of licences for such works; determining the form and shape of a building and its area relative to the land on which it is to be built; and ensuring the existence of sanitary conditions in buildings;



Managing power and gas supply to inhabitants and participating in identifying sites of transfer plants



Provision of Water by managing and organizing water supply to inhabitants and monitoring the quality of the water supply



Risk Prevention and disaster management by taking all necessary precautions to protect individuals and properties; preventing damage and harm caused by any acts, including flooding and snow, and taking necessary steps to protect the lives of citizens; this also includes coordination with the national level related parties e.i. The civil Defence and The National Center for security and Crisis management;



Transportation by contributing to the upgrading of public transport networks



Sanitation through collection, transportation, treatment and disposal of waste



Public Health by taking all measures and necessary precautions to maintain public health and prevent the spread of diseases

The GAM Law no. 18 of 2021 confers a special status to the City of Amman among other cities and local administration in Jordan. It provides for a higher level of independence and autonomy to the city administration, including its finances. At the same time, Law no 18 of 2021 increases the onus on GAM to ensure that climate change mitigation is carried out and city-resilience is increased to face the impacts of climate change and climate variability, including the management of disaster risks within the broader ambit of sustainable development. The leadership of Amman on climate action and sustainable development is prominent as illustrated in Figure 1.

The Climate Action Plan for the City of Amman is, therefore, not just another document produced by GAM. Rather, it is a synthetic document that captures the latest approaches for integrating climate change city-wide in the delivery of the municipal functions

laid out in the Law no. 18 of 2021 through increased autonomy for action. Since the City of Amman is embedded in the larger country geography, the Climate Action Plan also serves to contribute towards broader national processes related to meeting the objectives of the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), the Sendai Framework for Disaster Risk Reduction (DRR) 2015–2030, and the 2030 Agenda for Sustainable Development. The updated Nationally Determined Contributions (NDCs) aims at driving Jordan's post COVID-19 recovery process into a lower-carbon and more climate-resilient development pathway steered by national green growth priorities, and paving the way for a future climate change Long Term Strategy (LTS). The LTS will be guided by the Climate Change Policy (CCP) 2022 – 2050 which has the following Vision:

“By 2050, Jordan will be better prepared and more resilient to the impacts of climate change. It will achieve a high level of energy security commensurate with a sustainable path to maintain the momentum towards carbon neutrality through investments in low-carbon and climate-responsive initiatives and ramping up clean energy domestic use and export to drive the green economy for the wellbeing of all, including vulnerable communities, using the principles of inclusiveness and fairness, while simultaneously contributing to the global effort of stabilizing the climate system under the principle of common-but-differentiated responsibilities and respective capabilities.”



Fig. 1: Amman leadership on climate action.

Amman's Green City Action Plan 2021, provides more details of the existing plans and local governance, especially section 4 on Summary of City and Environmental Context.

2. UPDATING PROCESS OF AMMAN CAP

2.1 ALIGNMENT WITH THE CLIMATE CHANGE POLICY 2022-2050

Stakeholders were agreeable that the Amman City Climate Action Plan should be aligned and supportive of the CCP (Country Climate Change Policy) 2022-2050. There was a need for harmonisation of climate actions at all levels of governance and updating the CAP provided such an opportunity. BOX 1 lists selected country facts that provide information of the larger context in which the Climate Action Plan has been developed.

Both the updated NDC and the CCP 2022-2050 have proposed a balanced approach regarding the mainstreaming of climate change mitigation and adaptation in national planning. Stakeholders engaged in the process of developing the Climate Action Plan have expressed concern regarding the narrow coverage of climate change adaptation and disaster risk management in the first Climate Action Plan that was developed in 2019.

BOX 1 – Selected Country Factoids



Total country emissions ~0.06% of global emissions (28 MtCO₂e in 2012)



World Risk Index = 3.48 (rank = 108 out of 193 countries, 2022); highest score = 44.89
(lack of Adaptive Capacities)



Water availability <500 m³/person/year
98% of population living in water scarcity during the driest month



Non-Jordanians (mainly refugees) in total population: ~27% (2020); ~30% (2030)

Picture source: UN-Habitat

2.2 METHODOLOGICAL APPROACH

The formulation of the present Amman City Climate Action Plan was initiated and led by UNDP through the GEF-funded project “Sustainable Urbanization and Resource Efficiency” and in collaboration with UN-Habitat, through the UNEP funded project: “Inclusive, safe, resilient and sustainable development in urban areas hosting Syrian refugees in Jordan and Turkey”. C40 Cities provided technical assistance and guidance at every step of the process.³

Mitigation Planning: The PATHWAYS modelling tool of C40 was customized for the City of Amman through close interactions with technical departments of the Greater Amman Municipality, and other stakeholders as discussed in the next section. The identification and prioritisation of mitigation strategies and actions was based on the expert knowledge of GAM technical departments that were familiar with the mitigation analysis carried out in a CAP development process (see Section 2.3 for more details). Also, the identification of mitigation strategies and actions drew from the multi-criteria analysis that had been carried out under the GCAP in 2019.

The baseline year for the mitigation analysis was chosen as 2019, representing the latest pre-COVID-19 year for which the City inventory was carried out. The City Inventory Reporting and Information System (CIRIS) tool was used to calculate the City’s inventory of greenhouse gas emissions. The mitigation scenario analysis reported in the Climate Action Plan has included ‘Global Protocol for Community-Scale Greenhouse Gas Emission Inventory (GPC)’- with ‘BASIC’ emissions, which is scope 1 and 2 emissions from stationary energy and transportation, and scope 1 and 3 emissions from waste. The mitigation strategies and actions for these emissions are either under the operational and/or financial control of the Greater Amman Municipality or achieved with collaboration and alignments with national stakeholders.

Adaptation and Resilience Planning: The process of updating the Climate Action Plan did not produce new studies for informing City adaptation and resilience planning. In this case, information for the City of Amman has been curated from the existing body of work (Table 1). These studies reinforce the Amman Resilience Strategy that has been implemented since 2017.⁴ The identification and prioritisation of adaptation strategies and actions was based on the expert knowledge of GAM and development partners, combined with the multi-criteria analysis that had been carried out under the GCAP in 2019.

UN-Habitat Flood Risk Analysis

In 2021, UN-Habitat carried out a project entitled ‘Developing a Preliminary Design for Flood Mitigation and Performing a Flood Risk Assessment and Flood Hazard Mapping for Downtown Amman’.⁵ The project led to proposals to carry out regular maintenance of the main culvert and waterways and the provision of new flow interceptors in the short term. For the medium term, the proposal is for sustainable solutions using green infrastructure by encouraging landscaped, vegetated areas and pools which could absorb some of the flood water. The main long-term proposal, which should provide a solution to all the flooding in the area, is for additional culverts to better handle the flow of water.

Green City Action Plan

The Amman Green City Action Plan (GCAP),⁶ released in May 2021, was developed based on GAM’s effort in improving the environmental performance and taking a more systematic approach to addressing its existing and emerging urban environmental challenges. The plan aims to support the city in identifying, prioritising and addressing the city’s most acute climate change and environmental challenges, including: solid waste management, water and wastewater, urban transport and building energy efficiency. As a result, the city has elaborated on 37 initiatives that are now to be implemented until 2025, based on an intensive stakeholder engagement process (see section 2.3). The GCAP was developed by integrating the recommendations of the Amman Resilience Strategy 2017 and Amman’s inaugural Climate Action Plan 2019.

Jordan Country Climate and Development Report (CCDR)

The World Bank Group published its Jordan Country Climate and Development Report in November 2022.⁷ The CCDR assesses the interplay between the country's development goals and climate change. While taking a national level and macroeconomic perspective, the CCDR provides a deep-dive into the low-carbon urban development of Amman and its linkages with the transport and energy sectors. In so doing, the CCDR also produced two Background Papers on: (i) Amman Urban Growth Scenarios, and (ii) Jordan Urban Climate Risk Analysis, among others.

Jordan's Fourth National Communication to the UNFCCC

Jordan is in the process of developing and submitting its Fourth National Communication (NC4) to the UNFCCC. The NC4 project is funded by the Global Environment Facility (GEF) and implemented by the UNDP. In addition to carrying out the national GHG inventory, the NC4 contains mitigation scenario analysis for emissions reductions using the sectoral scope of the Intergovernmental Panel on Climate Change (IPCC). For instance, the Existing and Planned mitigation strategy for decarbonisation of the national grid that is used in the present CAP has been aligned with the information given in the NC4. Further, the NC4 is in the process of carrying out multi-hazard climate risks analysis at the level of districts in the City of Amman.

Table. 1: Existing studies used to inform adaptation and resilience plan.

2.3 STAKEHOLDER INCLUSIVENESS

2.3.1 RELEVANT JORDANIAN STAKEHOLDER ENGAGEMENT REQUIREMENTS AND LEGISLATION

Stakeholder engagement at the national level in Jordan is linked to the preparation of an Environmental (and Social) Impact Assessment (ESIA/EIA) and is a requirement of the EIA Regulation No. (37) of 2005.⁸ This is a requirement for projects including infrastructure development, i.e. roads, rail, housing and other building types, as well as development of landfills, waste treatment centres and industrial plants.

Under the ESIA/EIA regulation there should be a scoping session with potentially affected stakeholders at the onset of the project, in order to provide project details and allow stakeholder involvement in the process.

The Ministry of Environment requires the involvement of the following stakeholders: national government entities; local governmental agencies; non-governmental organisations; academic and research institutions; and local community representatives. It is responsible for ensuring that the outcomes of the ESIA are announced to stakeholders and the public in a suitable manner.

2.3.2 STAKEHOLDER ENGAGEMENT IN GAM

There is a bidirectional flow of interactions between GAM and its stakeholders. On the one hand, stakeholders are beneficiaries of the services that are provided by the city administration. On the other hand, stakeholders support GAM to deliver these services. On account of this interdependent relationship, the expectations, needs and

interests of these stakeholders need to be accounted for in all work that is carried out by GAM, including infrastructure development, strategies and plans. The level of community engagement is dependent on the nature of the project.

An example of a project with a strong community outreach is the GIZ-led and sponsored project “Improving Living Conditions in Disadvantaged Areas in Amman via the Implementation of green infrastructure” (ILCA),⁹ which was jointly carried out by GAM and GIZ in partnership with the Jordan Ministry of Environment. This project was carried out with strong involvement of community representatives and local residents (including women, children, elderly, and individuals with special needs). By integrating their valuable inputs throughout all stages of the project, such as design, planning, and management processes of the rehabilitated areas, the ILCA project aimed to foster a sense of ownership among the local residents.

A primary objective of the project was to prioritize the specific requirements of women, girls, and children, ensuring their safety, security, and access to convenient facilities. By meticulously addressing these needs, the project aimed to create an

environment that fosters cohesion and convenience for all community members. The overarching goal was to enhance the quality of life in disadvantaged areas of Amman and promote equitable opportunities for social development. Moreover, the ILCA project served as a vital platform to raise awareness about the immense potential of green infrastructure in mitigating and adapting to climate change.

Through targeted outreach and engagement, community members were educated about the environmental benefits of implementing sustainable practices, such as green infrastructure. This educational component aimed to empower residents with the knowledge and understanding necessary to embrace and advocate for eco-friendly approaches in their daily lives. By successfully engaging the community, considering the unique requirements of diverse groups, and highlighting the significance of green infrastructure, the ILCA project effectively demonstrated how collaborative efforts can bring about positive change. It serves as a model for future projects seeking to improve living conditions, foster community ownership, and create sustainable environments in disadvantaged areas.



Pictures source: GAM

Fig. 2: Community Workshops for ILCA



Picture source: GAM

Fig. 3: Prioritisation workshop for the GCAP.

2.3.3 STAKEHOLDER ENGAGEMENTS IN THE CAP FORMULATION PROCESS

The inclusiveness of stakeholders, including citizens, in the process of formulating the CAP has been accounted in two ways, namely: (i) direct involvement in the CAP formulation process; and (ii) engagements in parallel initiatives that have been used to inform the updated CAP. The involvement of citizens took place through the parallel initiatives, the results of which have been used to develop the CAP.

Stakeholders were identified in discussion with GAM Sustainable Development Unit, UNDP and UN-Habitat. The GAM Climate Change Committee was constituted with stakeholders from within GAM, and mainly involved with planning projects for the city related to mitigation and adaptation. The majority of the members of this committee have prior experience working on the first CAP and the GCAP. Additional stakeholders were identified from national and international organizations and educational establishments that are external stakeholders to GAM. The external stakeholders are the same as identified in the GAM Strategy 2022 – 2026.¹⁰

An Inception Workshop was held on 7 November 2022 in Amman to engage stakeholders in the update of the CAP and for formulating the Vision for the city. There were 45 participants, including members of GAM Climate Change Committee, who are considered to be Task Force Members for the CAP update process; representatives of all technical departments of GAM; and partners i.e. UN-Habitat, UNDP and C40 Cities. The inception workshop served to familiarize GAM personnel of the data requirements for carrying out mitigation scenario analysis using the PATHWAYS tool, and for discussing the approach for a more balanced treatment of climate change

adaptation and DRR in the updated CAP. It was also an opportunity for stakeholders to start the process of prioritizing mitigation and adaptation strategies and actions. Incidentally, most participants in the Inception Workshop had prior experience participating in the similar process used for developing the GCAP, which facilitated the process significantly

Further to this workshop, several meetings were held with key directorates and departments in GAM, including the Sustainable Development and Amman Resilience Unit, the Public Transport Directorate, the Environmental Studies and Awareness Department, the Comprehensive Planning Department and the Projects Sustainability Unit to discuss all the proposed and desired projects in their respective sectors, and how they could affect key assumptions on urban dynamics to be included in the PATHWAYS tool. Also, discussions were held with external stakeholders for strategies and actions not under the control of GAM, such as buildings, electricity generation (national grid and rooftop solar PV generation), industrial energy use, and wastewater treatment. Training on the GHG inventory (CIRIS) was carried out with UNDP. This included discussions on the best approach to be used for each sector for future work.

Stakeholder engagements in parallel initiatives

There are several parallel initiatives that GAM has carried out since the inaugural CAP was developed and that have been used to inform the CAP update. Two examples are given in Table 2 to provide a gist of the types and breadth of stakeholder engagements, including citizens that have been undertaken.



Picture source: GAM

Amman Green City Action Plan (GCAP), 2021 ¹¹

A highly participatory approach was used for developing the GCAP. A Stakeholder Engagement Plan was put in place following the mapping of key stakeholders. A Project Steering Committee (PSC) for providing political guidance and support was set up at the level of GAM comprised of executive level management. A Technical Committee made up of GAM's departmental expert was established for implementing the project. A total of 275 stakeholders from municipal government agencies, research centres, academics, embassies, civil society groups, Jordan-based companies, national government agencies, international NGOs, donor agencies, and International Financial Institutes participated in the process of elaborating the GCAP. The GCAP also benefitted from city-wide communication and awareness campaigns using social media platforms (the Amman in Green Online Campaign that reached nearly 500,000 inhabitants), a campaign mural in Rainbow Street and the Green Amman Contest. Besides the five formal stakeholder engagement activities listed below, bilateral meetings were held with the Global Green Growth Initiative (GGGI), King Hussein Foundation (KHF), Jordan Environment Fund (JEF) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

- Kick-off meeting – Carried out in December 2018 and involving GAM officials and representatives of donor agencies. It included an introduction to the process and enabled a discussion of environmental strengths and challenges in GAM.
- Launch – Official launch in February 2019 to provide high political support and visibility for the process. Two stakeholder engagement activities were carried out, namely: (1) an online poll in which 400 residents of Amman participated, and (2) a half-day stakeholder workshop covering activities on (a) what does a green city look like?, (b) what is important for Amman's GCAP?, (c) review of existing documents, and (d) further stakeholder identification.
- Prioritisation workshop: A one-day workshop was held in June 2019 with the Technical Committee (25 participants) to review and agree on the highest priority environmental challenges in Amman. This workshop included the following engagement activities:
 - a. Review of Amman's Existing Visions and development of strategic objectives: Visions for the city were separated into their core elements to be used as prioritisation criteria for identifying the most pressing environmental issues.
 - b. Validation of the Technical Assessment: The conclusion of the Technical Assessment outlined a long list of environmental challenges, based on the state of the environment and pressures acting upon it,
 - c. Identifying Amman's PECs: This was the main focus, to prioritise which challenges were most pressing to address in relation to meeting the objectives of the various Amman visions.
 - d. Development of strategic objectives: A set of strategic objectives were developed to guide the action development phase.
- Policy and Action Workshop: In July 2019, two workshops and one stakeholder roundtable were held to identify a long-list of potential actions to be included in the GCAP, and to establish a short-list of prioritised actions using multi-criteria analysis.
- GAM sector-lead meetings: To finalise the GCAP, actions were finalised working closely with respective technical departments of GAM (Environment and Solid Waste Development, Public Transport and Infrastructure Transport Projects Directorate, Public Facilities and Gardens Directorate, Social Media Team, Cultural Department, Planning Directorate and Execution Department) that would own the actions

Amman Spatial Profile, 2021¹²

- Spatial Profile Validation Workshop using a hybrid modality (via Zoom and in-person) in January 2022 including representatives from relevant ministries and governmental entities, partners from Greater Amman Municipality, private sector, development banks and agencies, and urban professionals.
- Stakeholder voting process to choose pilot neighbourhood for deep-dive assessments of needs, challenges and opportunities.
- Neighbourhood Validation Workshop held in March 2022 that included 28 participants most of whom were residents of the Al Hashmi Al Janoubi neighbourhood, including the head of the neighbourhood (Mukhtar Al Hara), as well as women, youth, elderly, refugees, and people with disabilities, to ensure the inclusion of diverse age groups, sex, nationalities, and abilities within the neighbourhood.
- Interviews with residents in three neighbourhoods (Al Hashmi Al Janoubi, Al Qweismeh, and Al Yadoudeh) carried out for their profiling.
- Interactive exercise with representatives of the Al Hashmi Al Janoubi neighbourhood to better understand their needs and challenges, and to identify opportunities (public facilities, urban environment, basic services/infrastructure, and accessibility and public transport).

Table. 2: Selected examples of stakeholder engagements in parallel initiatives.

3. AMMAN CITY PROFILE



BOX 2 – AMMAN VISION 2050

The City of Amman is carbon-neutral and climate-resilient by 2050 driven by a green and circular economy for the prosperity and wellbeing of all its citizens. We will demonstrate climate and sustainability leadership regionally and globally through fairness, inclusivity and respect for our cultural and natural heritage in transitioning to a sustainable city

Picture source: UN-Habitat

The City of Amman is located in the Governorate of Amman, which is one of twelve governorates in the Hashemite Kingdom of Jordan. Geographically, the Governorate of Amman is situated in the Mountain Heights Plateau, which is the highland that extends through the entire length of the western part of the country, and which separates the Jordan Valley and its margins from the plains of the Eastern Desert.¹³ A distinction needs to be drawn between the City of Amman, over which GAM has jurisdiction, comprising 22 Districts, and the Governorate of Amman, which is a larger spatial region made up of 27 Districts. The Amman Urban Profile (2022) provides a detailed urban profile for the City of Amman, and should be referenced for more details.¹⁴

The City of Amman is the capital and economic and cultural hub of the Hashemite Kingdom of Jordan. It hosts the political, judicial and administrative branches of the Jordanian government and it hosts around 43 percent of the country's population. At the end of 2021, the population of GAM was estimated at 3,999,009¹⁵ with population growth expected at a rate of about 2.2 percent per annum. The male to female ratio was 1.14:1. Amman has a predominately young population, with those aged 24 years old and younger representing the city's largest group and greatest

asset. According to the Amman Spatial Profile (2022), Greater Amman's built footprint reached 237.86 km² in 2017, and it was expected to grow by another 41.44 km² (i.e. 14%) between 2015 and 2030, equivalent to 41.44 km². Some 17km² expansion is expected to take place outside planned areas, leading to a loss of arable land in the South and East of Amman.¹⁶ In general, the quality of the city's natural system is severely degraded and there is limited natural cover remaining. While this is an obvious weakness, it also presents opportunities for enhancing the city's green infrastructure and ecosystem services. This is especially relevant given that 40% of the land within Amman's built-up area is vacant.¹⁷

Refugees from neighbouring geopolitical disturbances comprise a significant part of the city's population (Box 3).¹⁸ The vast majority are Palestinian refugees (1,080,716) who live in camps, which despite benefiting from municipal services and forming an integral part of the city's social and urban fabric, remain excluded from municipal land use and development plans.¹⁹

East Amman is the older part of the capital and is where the majority of the city's historic and cultural sites are located. It is more compact in development, and it is considered the less prosperous part of the

BOX 3 – GAM in Figures



Population (2021) – 3,999,009

(Source: DOS, 2022).

Non-Jordanians (2020) – 1,422,077

(Source: World Bank, 2020).



GDP – USD 19 billion

(Source: CIRIS Inventory)



Public open space – 2.5 m² per person

(Source: Amman Spatial Profile, 2021)



City climate: Mediterranean

(~250 mm annual rain)

city. On the other hand, West Amman is less densely populated and is considered the more prosperous part of the city. West Amman is also where much of the city's economic activity happens and where the city's 5 and 4 star hotels are located. An evident division exists between the more affluent districts of West Amman and the lower socioeconomic districts of East Amman. This is demonstrated by the discrepancy in infrastructure. West Amman, for example, has significant road infrastructure, including the iconic eight circles that connect the districts.²⁰

The climate in Amman is sub-tropical arid, and the city experiences hot dry summers and cold, wet winters. Amman has a varied topography and diverse climate, with extreme micro-climates in the city. The rainy season is in January and February when almost all of the rain for the year falls. The city is considered dry, with around 250 millimeters (mm) of rain a year.

GAM has embarked on sustainable development as evidenced in the Voluntary Local Review (VLR) of Sustainable Development Goals (SDGs) that was carried out in 2022.²¹ An interesting element of the VLR has been on the linkages between the achievement of the SDGs and post-COVID-19 recovery. Further, Amman has adopted the GCAP that sets the trajectory for a climate-aligned green economy transition that should deliver a broad range of sustainable development benefits.

The National Government has formulated the Climate Change Policy 2022 – 2050 to which Amman has aligned its Vision and Climate Action Plan. This model of development is crucial for rapid urbanization and the challenges that it brings from the multiple perspectives of socioeconomic and environmental development. It is at the juncture of these developmental challenges that sustainability and resilience take their rightful meaning. The quality of life or wellbeing of its residents is dependent on taking action to reduce any shocks that the City may face, including the impacts of climate change and related natural disasters. Of course, there is the other side of the coin of climate change to contend with, namely reducing the emissions of greenhouse gases that perturb the climate system in the first place. But reducing emissions should also be seen as a way to increase the resilience of the City and the country from energy dependence on imported fossil fuels.



Picture source: UN-Habitat

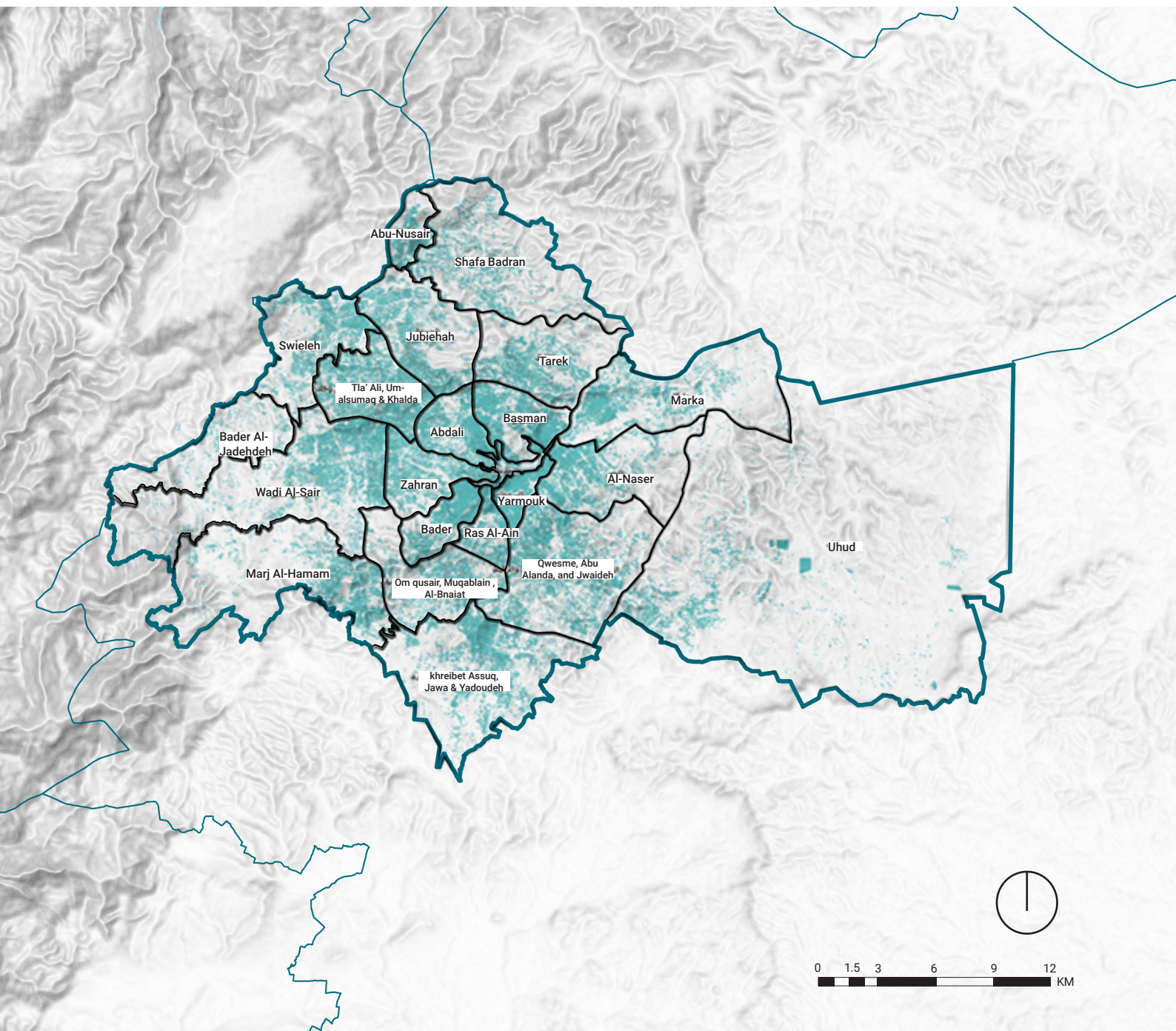


Fig. 4: Map Showing the Built-Up Area of the City of Amman.
(Source: GIS Dept., GAM, 2023)

3.1 GOVERNANCE

Amman is divided administratively into 22 districts, each with a high level of autonomy to deliver city services. GAM maintains central control with regard to zoning and planning, as well as infrastructure design and construction. Amman is governed by a City Council that is chaired by the Mayor on appointment by Cabinet for a period of four years. The Mayor of Amman reports directly to the Prime Minister. The City Council is comprised of 42 members, of whom 22 representatives of the 22 Districts of the city are elected and a further 14 members appointed by Cabinet represent public organisations that operate within the GAM jurisdiction. The GAM Law no. 18 of 2021 is gender responsive, as it requires at least 25% of the elected City Council membership to be female candidates who ranked highest in the municipal elections.

Currently, there are 7 female members on the City Council. The highest-ranking administrative official in Amman is the City Manager, who manages the daily operations of the GAM municipal administration.

GAM is financially independent, with a large percentage of its revenues self-generated from a wide range of sources, including property taxes, levies and fines, return on investments, central government grants,²² grants from foreign partners, interest on cash investments, and income from the sale of land and property leases.²³ It also has a long track record of direct engagement with international development institutions for the development of city infrastructure. The organisational structure of GAM is shown in Figure 5.

The commitment of the City of Amman towards climate change action is witnessed by the setting up of the Sustainable Development and Amman Resilience Unit to enhance local governance for city-wide sustainability initiatives, including the mainstreaming of climate change, this unit is responsible for the following:

- Develop, update and follow up the implementation of the Amman Climate Action Plan.
- Participation and cooperation with international agencies and networks on climate change.
- Work in collaboration with the Ministry of Environment to coordinate efforts in the national

and local commitments on climate change actions.

- Updating the inventory of climate data and measuring emissions for the city of Amman
- Follow-up and initiate assessment reports on environmental risks related to climate change.
- Provide initiatives and solutions to adapt/mitigate to climate change.
- Cooperation with the relevant sectors within Amman Municipality to support and follow up the implementation of projects that contribute to fulfilling Amman's commitment in reducing GHG emissions.

The Sustainable Development and Amman Resilience Unit works under the Planning and Economic Development sector, yet due to the nature of cross-cutting responsibilities, all work and follow-up duties are carried out in multi-sectoral manner; internally with GAM related departments and externally with the local and international partners, this collectively supports developing and implementing Amman's climate actions and gives the opportunity for GAM team to learn from other and showcase the work that is achieved in Amman.

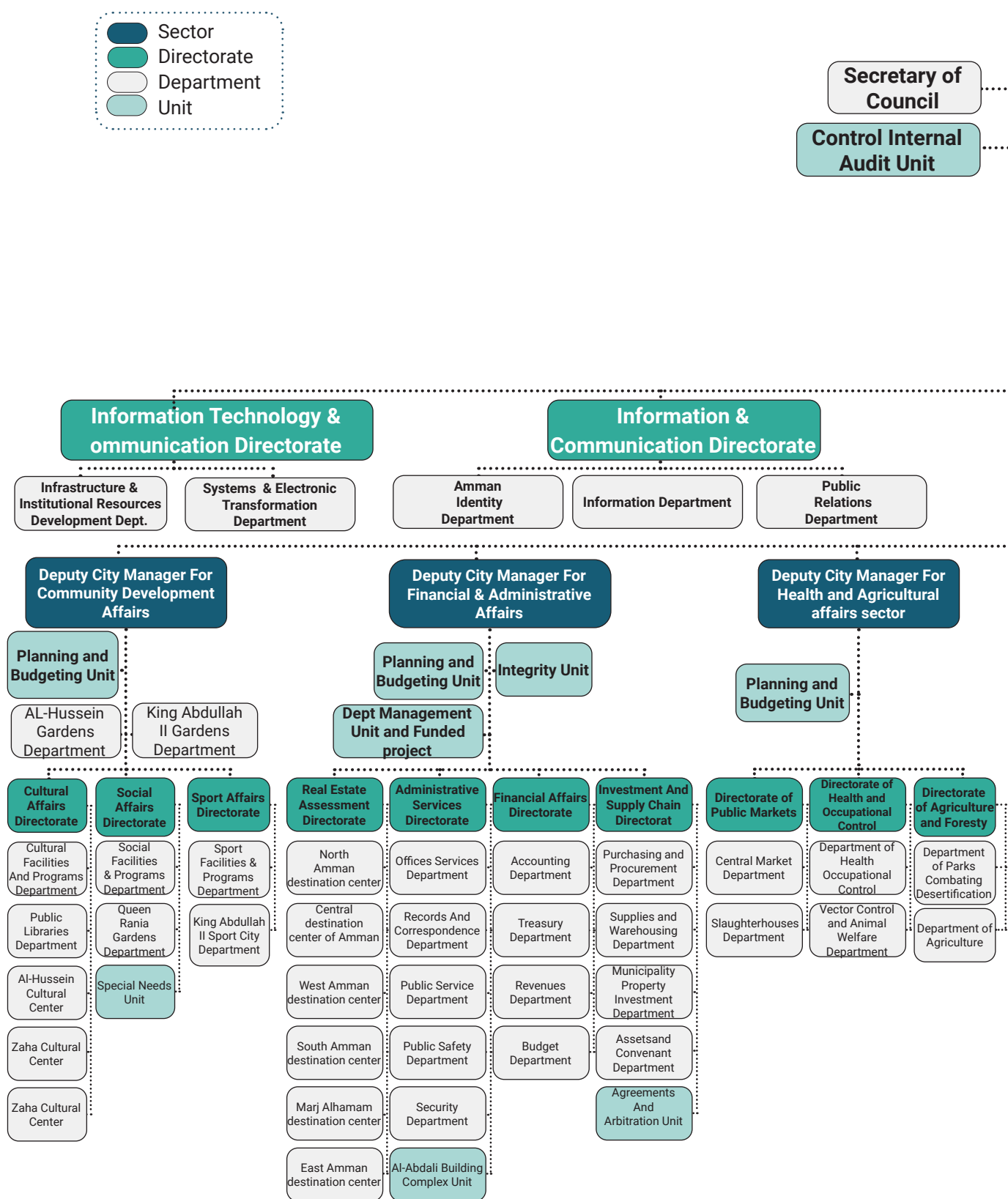
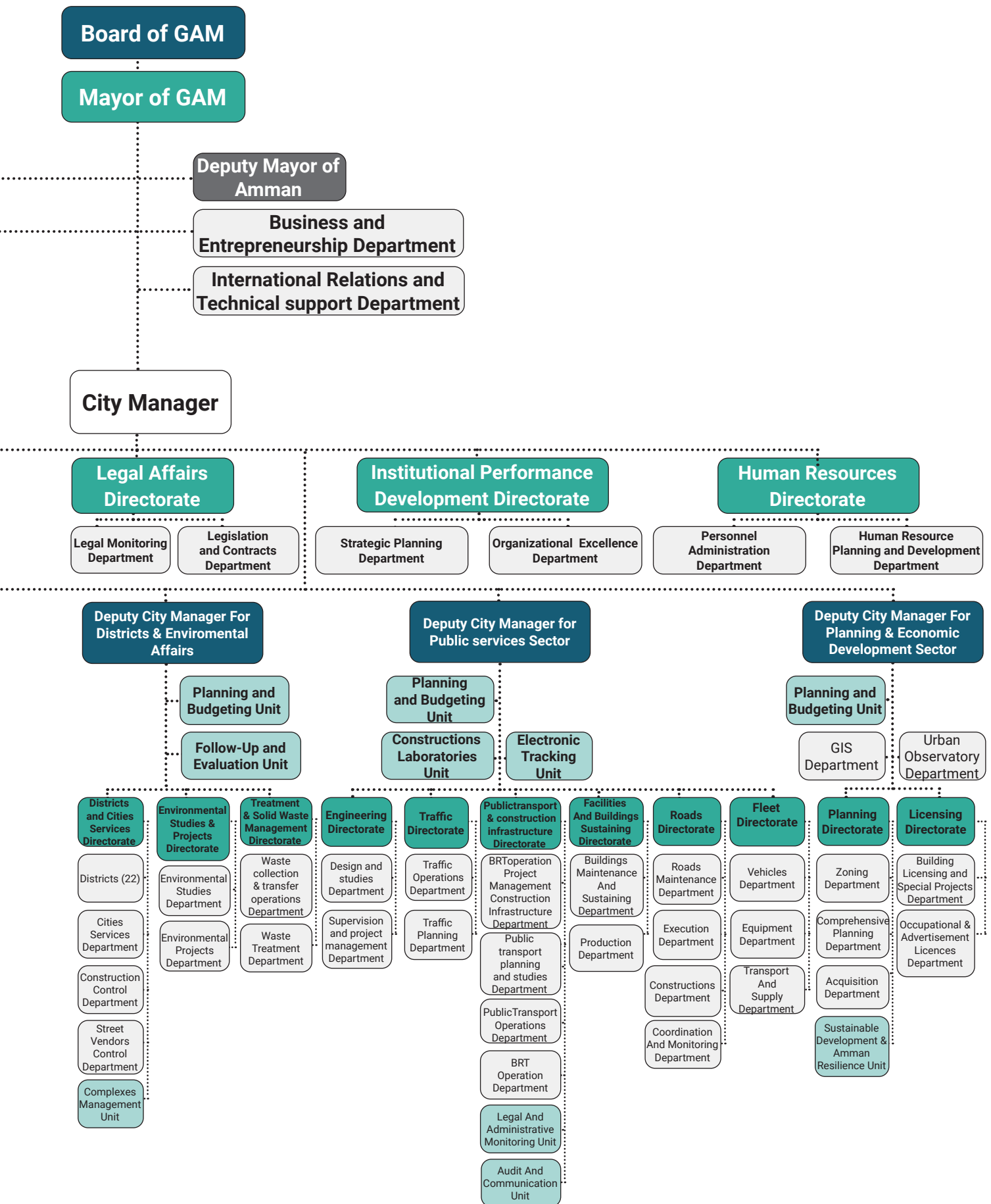


Fig. 5: Organisational structure of GAM.
(Source: Human Resources Dept.,GAM, 2023)



3.2 PARTNERSHIPS

The GAM Strategy 2022 – 2026 details the external stakeholders of GAM,²⁴ while the Voluntary Local Review, VLR (2022) provides an up-to-date review of partnerships that GAM has in place for supporting the implementation of the SDGs, including climate actions.²⁵ The VLR includes the target to: “Enhance North-South, South-South and triangular regional and international cooperation on, and access to, science, technology and innovation and enhance knowledge-sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism.”

National partnerships
Citizens of Amman The inhabitants of Amman constitute the most important group of stakeholders for GAM. In essence, GAM has a legal duty to deliver high quality services to the city inhabitants according to GAM Law no. 18 of 2021. Understanding the concerns, expectations and interests of its citizens is primordial to GAM. Section 2.3 of the VLR discusses the several ways in which the city administration includes its inhabitants in the decision-making process. Property tax is also the main source of revenue for the municipality.²⁶
National Government and public institutions There are three main ways in which GAM partners with national Government (ministries and public institutions) for the delivery of services. First, it receives grant financing from central government as already mentioned. Second, GAM’s mandate does not include education, public security, or water and electricity provision, which are managed by other governmental organizations and utility companies. For instance, electricity, water and wastewater fall under the jurisdiction of the Jordanian Electric Power Company Limited (JEPCO) and Jordan Water Company/Miyahuna, respectively. Third, GAM has to ensure enforcement of national codes and standards that are set at the national level. One example is the application and enforcement of building energy codes, and other civil engineering codes
Private sector GAM partners with private companies for delivering services for a win-win outcome. There is a strong business case for private sector investments that is coupled with the element of cost-sharing in order to reduce the investment burden on GAM. In order to increase the productivity of private sector collaboration, GAM has set up the Amman Vision Company in 2019 for streamlining procurement procedures and for contract management of project investors. Collaboration with the private sector has become more prominent with the 2020 amendment of the Public-Private Partnership Law no. 31 of 2014.²⁷
International partnerships GAM’s Department of International Relations plays a central role in ensuring Amman’s presence in the international arena, including through developing regional and international partnerships. The City of Amman has twinning agreements with over 42 cities in the Arab region and beyond. One example is the long-term collaboration with the City of Istanbul in the transportation sector.²⁸ It also has membership to several international organisations such as the 100 Resilient Cities Network and C40 Cities Climate Leadership Group. GAM also partners with a host of development partners for leveraging technical and financial assistance as witnessed by the many technical studies that have informed the formulation of the second CAP.

Table. 3: Partnerships for purposeful actions.

3.3 CHALLENGES AND OPPORTUNITIES

The Amman Spatial Profile (2022)²⁹ provides a detailed chapter on the urban challenges and opportunities for the City of Amman. The challenges and opportunities are similar to those identified in the Country Climate Development Report, and they are summarized in Table 4.



Challenges

Strategic challenges



- Unequal urbanisation (weak planning practices, social and spatial divide between East and West Amman)
- Demographic profile (high influx of refugees, young population places high demands on public infrastructure, unemployment and food insecurity)
- Climate change (see section 4.2)

Spatial challenges



- Urban sprawl and population density (high and increasing urban footprint and decreasing vegetation areas, high density areas host high levels of refugees)
- Housing (supply trails demand, price inflation of rental and property)
- Accessibility and connectivity (heavy reliance on private transportation, traffic congestion increasing air pollution and reduced pedestrian mobility, public transport is slow, costly and time consuming and impacting inhabitants on the low socioeconomic rung)
- Facilities and infrastructure (pressure on the water supply and distribution network, inadequate storm water drainage, levels of waste generation increased by refugees, ~21% of inhabitants not connected to sewer network)



Opportunities

Strategic opportunities



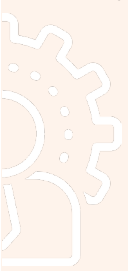
- Youth dividend of the population for growing labour market and less demand on certain public infrastructures such as health care
- Availability of a bundle of policies and strategies supporting sustainable urbanisation and development in general
- Decentralisation of decision making and financial autonomy
- Seeing refugees as a pool of human talent that can contribute positively to the city's development
- Amman Urban Observatory in GAM provides a platform for harmonising and sharing of data and information for integrated policy-making

Spatial opportunities



- COVID-19 pandemic demonstrated the need for integrated land use planning and importance of open and green spaces
- Some 40% of built-up area is vacant providing an opportunity for intensification and enhancing green spaces
- Possibility to enhance accessibility and mobility through urban planning that decrease travel trips and environmental impacts
- A gendered approach to mobility can be pursued based on the Gender Action Plan for Equitable Mobility³⁰

Governance & Administrative challenges

- 
- Overlapping institutional mandates resulting in sub-optimal coordination and services delivery (lack of National Urban Policy, weak integrated policy planning and monitoring & evaluation, lack of data to inform the integrated policy planning process)
 - Land management & planning boundaries (outdated planning laws, privatization of land related to unsustainable land uses, prevailing land ownership and inheritance practices are disadvantageous to women, Palestinian refugee camp sites remain outside the purview of municipal land use and development plans)

Environmental challenges (see section 4.2)

- 
- Vulnerability to earthquakes
 - Vulnerability to climate impacts and natural disasters
 - Water scarcity

Socioeconomic challenges

- 
- Highest numbers of poor people and 'working poor' are concentrated in Amman
 - High unemployment rate among youth and refugees drive the informal market with insecure working conditions

Conflict between host and refugee communities

- 
- Increasing competition for affordable housing and rental apartments
 - Increased competition for work resulting in more conflict between host and refugee communities. This is exacerbated by the fact that refugees rely on the humanitarian support in the short-term, and the lack of legal recognition drives them to partake in the informal economy that depresses working conditions and wages

Governance & Administrative opportunities

- 
- Mainstreaming
 - Collaboration & leaning on strengths of other departments / institutions
 - Financial and administrative independency under GAM's own law No. 18 of 2021
 - Highest-level commitment in Amman's Administration.
 - The organisational structure is appropriate for the mainstreaming of the strategies and actions within respective technical bodies in the city's organigram.

Environmental opportunities

- 
- Abundant solar energy resources that can be used to reduce dependency on fossil fuel-generated electricity
 - The GCAP has proposed 37 strategic projects for enhancing the green economy of Amman
 - 120 sites have been identified for flood control in Amman by UN-Habitat's Flash Flood Resilience project
 - Green spaces and rooftop gardens can be viable options towards sustainable management of pluvial floods

Socioeconomic opportunities

- 
- High levels of education attainment can support skilled job markets
 - Home-based businesses are being promoted to enhance residents' socioeconomic conditions, including for refugees
 - GAM is virtually financially autonomous which augurs well for the city administration's financial and management competencies, as well as demonstrating the capacity for public-private partnerships to increase local wealth creation
 - State-owned land can be used to promote urban and peri-urban agriculture that will increase local income generation and increase urban food security
 - Advanced health care infrastructure bodes well for medical tourism
 - There are opportunities for increasing investments in a sustainable water and sewerage systems, public transport, green/open and public spaces, and pedestrian infrastructure that will increase well-being of inhabitants and increase the productivity factor for the green economy

Table. 4: Urban challenges and opportunities.

Source: Amman Urban Profile, 2022

4. CLIMATE CHANGE ADAPTATION

Aligned with the development of the National Adaptation Plan that aims to mainstreaming climate change adaptation in the development planning processes to enhance climate resilience and adaptive capacities and, reduce climate vulnerability within all relevant sectors, Amman has been undertaking multiple projects to address climate risk in Amman to promote climate change adaptation and emphasized the need to institutionalize responsive and forward-looking climate adaptation practices to contribute to achieving a pro-active, climate risk-resilient city, that assure an increased resilience of its communities and institutions, natural ecosystems, water and agricultural resources in the path towards sustainable and climate-resilient development.

4.1 CLIMATE CHANGE AND DISASTER RISKS

Like other cities around the globe, Amman is already experiencing the impacts of a changing climate. The country is facing irregular patterns of rainfall swinging between the extremes of drought to excessive rain over a short period of time, rising temperatures in summer and lower temperatures in winter, and a significant increase in extreme weather events. Heavy rain events are leading to flooding in lower-lying areas of the city, hazardous blizzards have closed schools, and heat waves and water shortages have directly impacted the health of the population and operation of businesses. These adverse impacts of climate change disproportionately affect the poor and most vulnerable in Amman, including children. According to the United Nations Children's Fund (UNICEF), Jordan ranks 94 in the world in terms of children's exposure and vulnerability to climate and environmental shocks.³¹

The Amman Climate Action Plan integrates the results of the Resilience Strategy 2017 and the Green City Action Plan 2021. In fact, as mentioned in section 2.2 on Methodological approach, the formulation of the GCAP fully integrates the results of the Amman Resilience Strategy. Taken together, these two documents chart a path forward for Amman toward

a more prosperous, resilient and low-carbon future. With this commitment the city is resolving to prevent the worst climate impacts for its inhabitants, thereby building a more sustainable and resilient future for Amman and the country. In order to better situate the climate risk profile of Amman, the updated CAP starts with the national level situation before zooming in on the capital city.

4.1.1 ALIGNMENT BETWEEN NATIONAL AND GOVERNORATE LEVELS

The Jordan National Natural Disaster Risk Reduction (DRR) Strategy 2019-2022³² mentions that climate change-related disasters (flash floods, land-slides, rock falls and droughts) are becoming more frequent events that cause losses of lives and costs millions of economic losses every year in different parts of the country. A multi-stakeholder exercise was carried out in 2016 to prioritize the potential risks that threatened the country, and the results showed that, apart from seismic risks that topped the list, the next five risks in descending order were all climate-related (flash floods, landslides, extreme temperature, drought, and snow storms).³³

National statistics collected since 2027 show that floods had caused 120 deaths between 1927 and 2018, with flooding events occurring every year since 2007.³⁴ The Natural DRR Strategy also acknowledged the confluence of multiple variables such as climate change, environmental degradation, economic inequality, population growth, regional political unrest and migration act to weaken the resilience of communities. The country ranked 75 out of 182 countries in the Notre Dame Global Adaptation Initiative (ND-GAIN) index³⁵ for climate vulnerability in 2019, sliding from 63 in 2015. Since the 1960s, annual maximum temperatures have increased by 0.3–1.8 °C, and minimum temperatures have risen by 0.4–2.8 °C across climate regions.

The annual precipitation has declined by 5–20 percent, depending on the region. Future climate modelling (Table 5) shows (a) further decreases in total precipitation; (b) increasing variability in the location, timing, and quantity of rainfall; (c) warmer average temperatures of up to 2.9 °C by 2050; (d) increased drought occurrence, length, and severity; and (e) more frequent extreme events. Climate change impacts will vary across the country.³⁶

Parameters	RCP2.6		RCP4.5		RCP8.5	
	2050	2100	2050	2100	2050	2100
Temperature	+1.7 °C	+1.7 °C	+1.2 to 1.5 °C	+1.5 to 2.1 °C	+1.7 to 2.9 °C	+3.2 to 5.9 °C
Precipitation	NA	NA	-4 to -15%	-7 to -25%	-7 to -15%	-13 to -22%
Drought	+5 days	+5 days	NA	+30 to 40 days	NA	+>40 days
Floods	No Significant Change	No Significant Change	No Significant Change	No Significant Change	+4 days with precipitation >20 mm	+8 days with precipitation >20 mm
Heat Waves	45 days per year	45 days per year	NA	NA	75 days per year	200 days per year

Table. 5: Climate change impacts under different scenarios.

Source: World Bank (2020) *Water in the Balance: The Economic Impact of Climate Change and Water Scarcity in the Middle East*.

Incidents of flooding are common in Jordan and can be very damaging as many are flash floods. Flooding often follows heavy rainfall events during the winter. Floods in Jordan claim lives, and destroy agricultural land and infrastructure. Rainfall in Jordan varies greatly from one year to another. The dominance of arid conditions and irregular rainfall distribution are the main limiting factors affecting agricultural production. The UN reports that the frequency of drought over 10 years is 2.43 and that the trend for drought is increasing.³⁷

Key Natural Hazard Statistics for 1980-2020

Number of People Affected

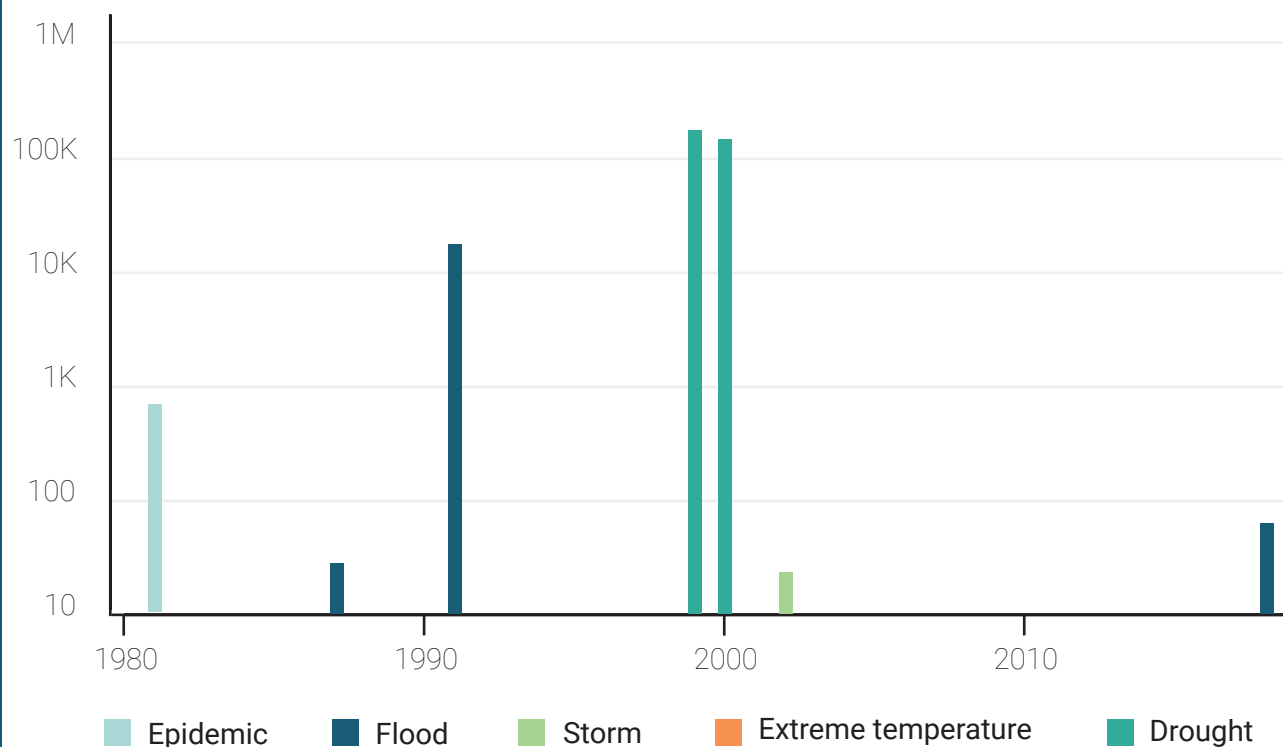


Fig. 6: People affected by shocks in Jordan: 1980-2020.

(Source: <https://climateknowledgeportal.worldbank.org/country/jordan/vulnerability> accessed 30 January 2023)

Jordan uses DesInventar for reporting to the UNDRR on achievements under Sendai Framework for DRR. Table 6 summarises extent of loss and damage caused by disasters at the Governorate level between 1981 and 2000. It reveals that Amman is one of the most impacted governorates in Jordan. In fact, Amman recorded the most events in this period.

Governorate	Datacards	Deaths	Injured	Missing	Houses Destroyed	Houses Damaged	Indirectly Affected	Losses (USD million)	Damages in roads (km)
Ajloun	3	8	99	23	2	-	67	775	5
Al Aqabah	39	8	311	1	1	98	1067	775	21
Al Balqa	83	36	813	-	3	59	111168	17,789	2
Al Karak	72	1	207	-	16	10	1106	14,928	13
Al Mafraq	52	23	186	12	8	5	21	17,492	-
Amman	106	53	431	12	2	26	110979	775	5
At Tafilah	44	6	67	10	3	18	349	775	20
Az Zarqa	38	29	141	-	-	6	51	775	-
Irbid	97	23	504	2	69	328	111166	21,422	6
Jarash	19	6	14	-	1	7	8	775	-
Ma'an	105	18	147	4	1	31	115	775	18
Madaba	30	29	34	4	-	9	15	775	-
TOTAL	717	240	2969	68	106	597	336112	77,831	90

Table. 6: Overview of impacts of hazard events in Jordan by Governorate.

Source: <https://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=jor&continue=y> – accessed 30 January 2023

4.1.2 CLIMATE TREND AND PROJECTIONS OF AMMAN

The climate hazard assessment for Amman, based on 21st Century Climate Change Projections of Precipitation and Temperature in Jordan (Fayez Abdullah, 2020³⁸) reveals noteworthy trends in temperature and precipitation over the past five decades. The analysis of temperature trends from 1960 to 2010 indicates a significant increase in the mean annual temperature. Specifically, there is a slight upward trend in mean maximum annual temperature, while the mean minimum annual temperature experiences a more pronounced increase.

Looking ahead, the study employs climate models to project future scenarios for the period 2015-2099. Two greenhouse gas emissions scenarios, A2 and B2 scenarios, developed by the Intergovernmental Panel on Climate Change (IPCC) as part of the Special Report on Emissions Scenarios (SRES) were considered. The A2 scenario envisions a future marked by high population growth, fragmented development, and increased reliance on fossil fuels, resulting in elevated energy consumption. In contrast, the B2 scenario portrays a world with moderate population growth, greater emphasis on sustainability, and a shift towards renewable energy sources, reflecting a more integrated global community. These scenarios help explore diverse socio-economic pathways and their potential impacts on climate change by providing plausible narratives for future development and emissions trends. Under both A2 and B2 scenarios, the monthly mean maximum temperatures for 2050-2065 and 2080-2099 show a consistent rise. Scenario A2 suggests a warmer climate change trajectory compared to B2, with

potential temperature increases ranging from less than 0.5°C to about 2°C in the earlier period and 1.5°C to 3.75°C in the latter. The maximum temperature tends to increase at a higher rate than the minimum temperature, particularly under the B2 scenario.

In terms of precipitation, the time series analysis reveals a slight decreasing trend in annual precipitation between 1960 and 2010. Future projections for 2050-2065 and 2080-2099 under A2 and B2 scenarios indicate a reduction in mean monthly precipitation for all months, except October, which may see a potential increase. Scenario A2 predicts a 14% reduction in annual rainfall, while B2 indicates an 11% decrease. These findings emphasize the importance of comprehensive climate action planning for Amman, considering the anticipated challenges posed by rising temperatures and changing precipitation patterns. Amman will further assess such research and studies to build an evidence based assessment of climate risks at local level to enable informed decision making.

4.1.3 MULTI-HAZARD PROFILE OF AMMAN

Figure 5 shows the profile of multi-hazard events reported for Amman between 1981 and 2020. Floods and flash floods represent 29% of reported extreme events followed by snowstorm (19%), drought (13%) and frost (12%). The spatial spread of the disaster events in Figure 8 shows that the areas within GAM jurisdiction are the most affected. In winter, heavy rains can cause serious flooding and landslides. Landslides and erosion problems are concentrated on the steep slopes of mountains and wadis in Amman, especially on Mounts: Amman, Akhdar, Ashrafiyah, Nuzha, Weibdeh and Hussein and the Amman-Irbid main road. The 2019 flash flood remains vivid for the inhabitants of Amman. It caused significant material losses to property, infrastructure and inventory that have been estimated to at least JD 9,115,326.³⁹ This event has triggered GAM to strengthen its protocols for emergency operations by the GAM emergency centre, and for coordinating the activity of the different district managers and all of the sectors of the GAM municipal administration.⁴⁰

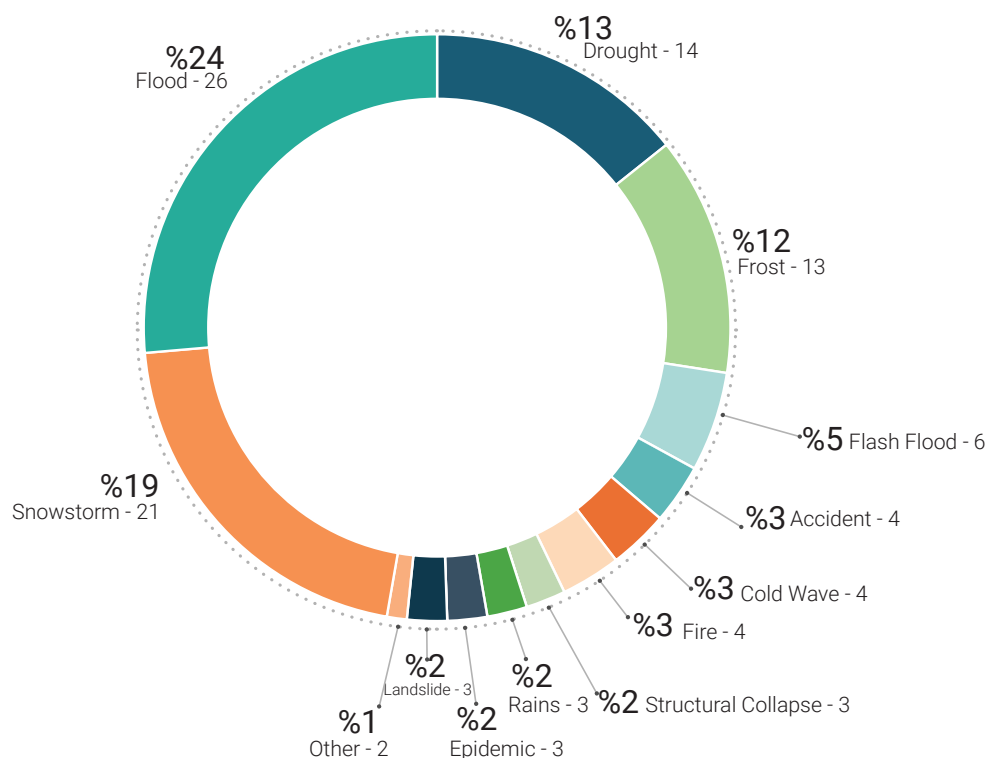


Fig. 7: Multi-hazard profile of DataCards issued for Amman: 1981-2020.

(Source: <https://www.desinventar.net/DesInventar/profiletab.jsp?countrycode=jor&continue=y> – accessed 30 January 2023)

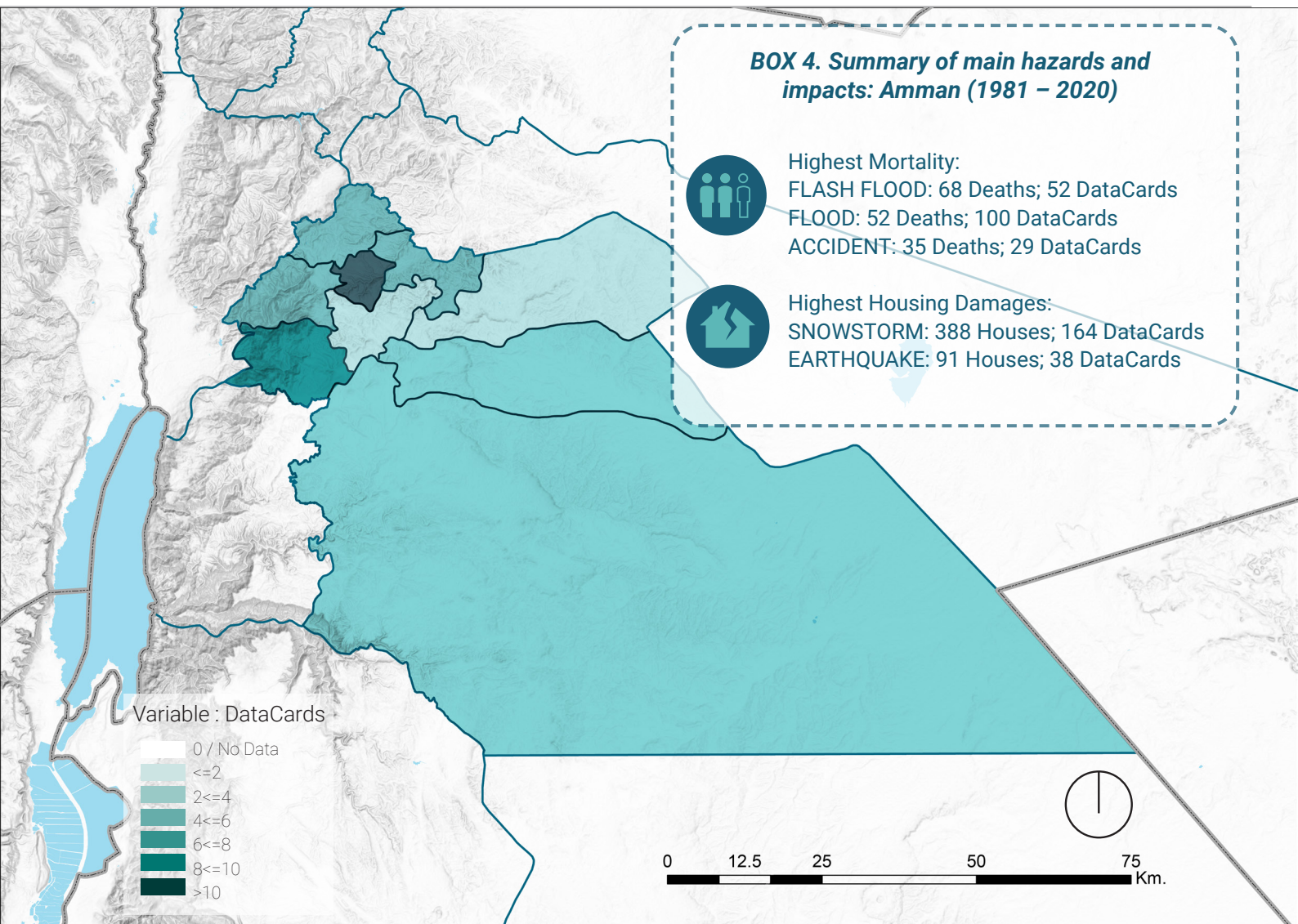


Fig. 8: Distribution of Data Cards within the Governorate of Amman.

(Source: <https://www.desinventar.net/DesInventar/profiletab.jsp> - accessed 30 January 2023)



Picture source: UN-Habitat

4.2 CLIMATE RISK ANALYSIS

The City of Amman fully subscribes to the philosophy that the best defence against future shocks is to transform systems now, to build resilience by addressing climate change and to reduce the vulnerability, exposure and inequality that drive disasters. This philosophy is underpinned by a thorough understanding of the risks of shocks that emerge at the intersection of hazards, and exposure and susceptibility to these hazards, within the broader socioeconomic processes taking place in the City. The City's capacity to carry out geospatially-based climate risks analysis is evolving and several development partners have recently contributed to increasing the knowledge of climate risks within the City boundary. Amman Climate Action Plan 2019 highlights the historical changes and future projections (world bank 2019) for the country as described in the earlier section. As mentioned earlier, the process of updating the Climate Action Plan has not produced new climate risks analysis. Rather, it has curated existing information as described in section 2.2. Currently more detailed analysis of the climate hazards facing Amman are being developed in the Vulnerability Assessment for GAM, through the support of UNDP, and the 4NC as indicated in Table 1.

A qualitative description of four significant climate hazards that affect Amman is given in Table 7, while Table 8 gives a short-term assessment of exposure (population and sectors), likelihood of hazards, events and impacts.

Climate-Related Hazards



Extreme heat

Heatwaves are increasing in intensity and duration and this trend is predicted to continue. This has led to an increase in energy requirements for air-conditioning units. It also has an effect on water requirements in the city. There is no agriculture within the Municipality boundaries, but the heat affects market supplies.



Drought

This is extremely serious, particularly with the rapidly rising population due to the influx of refugees from surrounding countries. Security of water supply is a risk for the city. Water is not always available and is pumped only at limited times during the week, so households need to store water in tanks and wells, and pay for water to be delivered if their store of water finishes. There is no agriculture within the Municipality boundaries, but the heat affects market supplies.



Urban flooding

In recent years flash floods have become a serious problem, making roads dangerous and affecting an increasing number of residential and commercial areas. There are concerns that it could also affect water supply and sanitation.



Snow and ice

Heavy snow can impact transport, hence impacting services, and preventing people from attending work and or schools. They can also have serious consequences for the sick and elderly, who are not able to get needed healthcare. Heavy snow can affect trees as many have been lost over the years due to storm, and not replaced.

Table. 7: Climate hazards impacting Amman.

Source: GAM report to C40

The Fourth National Communication (NC4) is carrying out a multi-hazard risk assessment for all Governorates in Jordan, and the analysis is being carried out at the sub-district geographical level. The CORDEX is being used for dynamic downscaling at the level of 28 meteorological stations and using data sets for the period 1950 to 2020. The hazards that are being investigated are floods, droughts and heat waves. At the time of writing the updated CAP, the multi-hazard analysis was ongoing.

Climate-Related Hazards				
	Extreme heat	Drought	Urban flooding	Snow and Ice
Vulnerable population groups most exposed	• Children and youth • Low-income households • Outdoor workers	• Low-income households	• Marginalized/ minority communities	• Women and girls • Elderly • Marginalized/ minority communities • Low-income households • Outdoor workers
Sectors most exposed	• Agriculture • Forestry • Administrative and support service activities • Conservation • Financial and insurance activities • Professional, scientific and technical activities	• Agriculture • Forestry • Manufacturing • Conservation • Real estate activities • Human health and social work activities	• Sewerage, waste management and remediation activities • Administrative and support service activities Public administration and defence Wholesale and retail trade; repair of motor vehicles and motorcycles • Transportation and storage	• Agriculture • Forestry • Electricity, gas, steam and air conditioning supply • Administrative and support service activities • Public administration and defence • Wholesale and retail trade; repair of motor vehicles and motorcycles • Transportation and storage
Proportion of population exposed to hazard	%70-80	%40-50	%20-30	%50-60
Current probability of hazard	High	High	Medium High	Medium High
Current magnitude of impact of hazard	Medium	High	Medium High	Medium
Expected future change in hazard intensity	Increasing	Increasing	Increasing	No change
Expected future change in hazard frequency	Increasing	Increasing	Increasing	No change
Timeframe of expected future changes	Short-term (by 2025)	Short-term (by 2025)	Short-term (by 2025)	Short-term (by 2025)

Table. 8: Climate hazards impacting Amman

4.2.1 A FOCUS ON FLOODING

The flood analysis project was carried out in order to assess the areas at most risk from flooding hazard and assess the ways in which this hazard could be mitigated. The area of Amman which is most prone to flooding is the Downtown area, which is a low-lying area, and the historic center of the city. It is now a busy shopping area with many small shops, as well as residences and the Roman Amphitheatre; an important archaeological site. The targeted study area is shown in Figure 7. It serves as a catchment area for a large part of the built-up area of Amman. There is a rainwater culvert, Saqf alSail, running through the study area. Water flows through this culvert from West to East in the general direction of the Jordan River Valley.

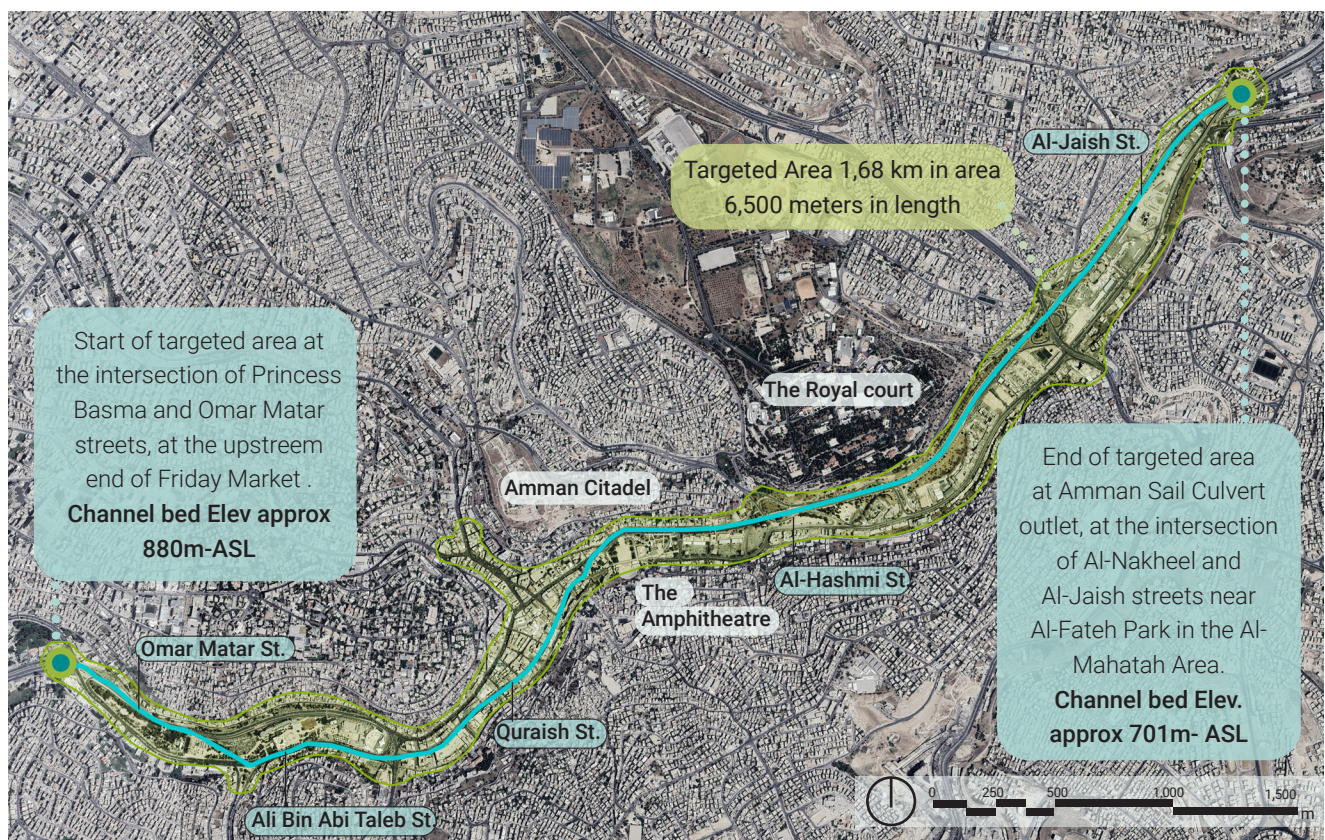


Fig. 9: Extent of the targeted area in Downtown Amman.

(Source: UN-Habitat (2021) *Developing a Preliminary Design for Flood Mitigation and Performing a Flood Risk Assessment and Flood Hazard Mapping for Downtown Amman*)

The Downtown area has experienced several severe floods in recent years, causing loss of life and damage to property. As mentioned above, the most recent severe flooding event occurred in February 2019. During this flooding event, rainfall data were collected at a series of weather stations within the catchment area for Saqf alSail. This data has been used to assess the risk of future flooding. The flooding hazard is caused by the intensity of the rainstorms and the difficulty of accommodating the rainwater in the existing culvert. A further issue is that there is a sewer line running through a section of the culvert, which further reduces the capacity of the culvert. In order to assess the level of the flooding risk throughout the area, the different components of this hazard have been considered, namely (i) the depth and speed of the water, and (ii) the amount of debris that can be carried. The level of the flooding is defined in the following Table 9. Maps were developed for floodwater depth and velocity distribution for the studied design for storms of 2, 5, 10, 25, 50 and 100 years return periods, and these distribution maps were then used to generate hazard maps. For illustrative purposes, the map for the 2 year flooding hazard is shown in Figure 10.

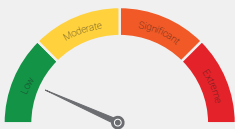
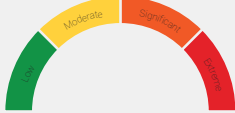
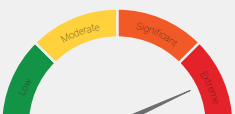
$d \times (v + 0.5)$	Degree of flood hazard	Description
<0.75		Caution (Flood zone with shallow flowing water or deep standing water)
1.25-0.75		Dangerous for some (i.e. children) (Danger: Flood zone with deep or fast flowing water)
2.5-1.2		Dangerous for most people (Danger: flood zone with deep fast flowing water)
>2.5		Dangerous for all (Extreme danger: flood zone with deep fast flowing water)

Table. 9: Hazard to People as a Function of Velocity and Depth

Source: UN-Habitat (2021) *Developing a Preliminary Design for Flood Mitigation and Performing a Flood Risk Assessment and Flood Hazard Mapping for Downtown Amman*

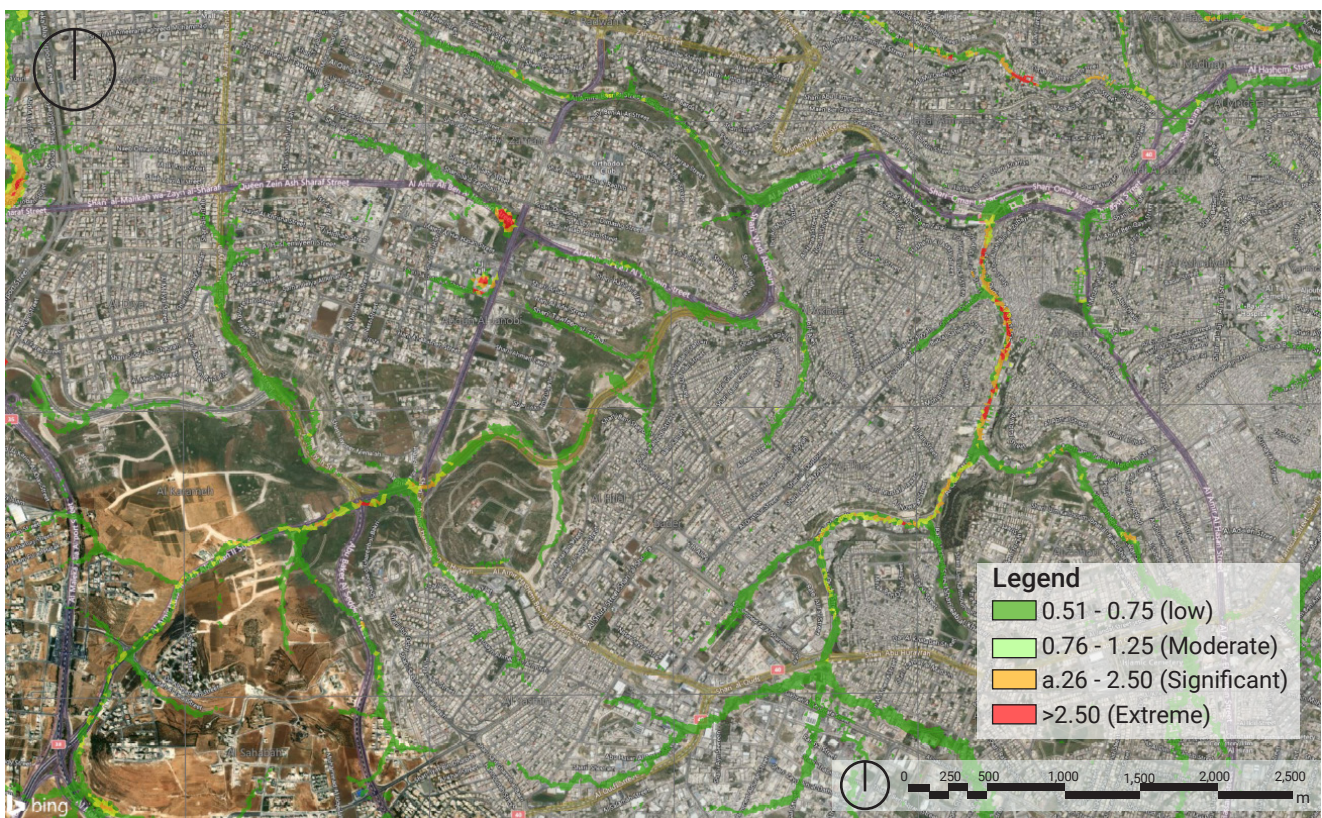


Fig. 10: Hazard map for the 2 year flooding event.

(Source: UN-Habitat (2021) *Developing a Preliminary Design for Flood Mitigation and Performing a Flood Risk Assessment and Flood Hazard Mapping for Downtown Amman*)

GAM has collaborated with UN-Habitat on the Flash Flood Resilience project and identified about 120 sites for enhancing resilience in Amman. The area of Amman which is most prone to flooding is the Downtown area - low-lying but the historic center of the city.

4.2.2 THE IMPACT OF CLIMATE CHANGE IN THE CITY

Amman grapples with various climate hazards, including flash floods, earthquakes, droughts, heatwaves, frost days, and snowstorms. While flash floods historically caused significant loss of life, the expanding urban footprint, including the obstruction of natural watercourses, has heightened the risk of flash flooding. Snowstorms, on the other hand, have resulted in substantial economic losses, accentuated by the surge in built-up areas.

The city is confronted with rising average temperatures and heatwaves under all future climate scenarios and also faces reduced precipitation and an elevated risk of severe drought. Even though Amman initiated a Disaster Risk Management Plan in 2009 and a Resilience Strategy in 2016, it is necessary to have comprehensive and updated disaster risk reduction (DRR) and climate adaptation strategies leading to a dearth of resilience data for different sectors and alignments. Population density increases disaster risk, with congested escape routes, dense infrastructure and poverty increasing vulnerability to hazards. Heatwaves pose significant public health risks and can also impact the stability of road and rail infrastructure. The Jordan Building Code mandates seismic-proof construction standards, yet the rapid urbanization has resulted in informal settlements with shelters not meeting formal permitting processes, particularly for refugees.

Amman relies heavily on energy imports, constituting 93% of its energy consumption. The demand for energy is growing and the supply chain, passing through politically unstable regions, is susceptible to natural and climate-related disasters. The anticipated increase in energy demand, driven by rising summer temperatures and frequent heatwaves will intensify the urban heat island effect and a strain in energy supplies. Furthermore, the city anticipates an influx of migrants and refugees, straining existing systems and leading to reduced access to essential services such as water and sanitation for vulnerable groups.

As described in the Table 7 on broader impacts of the climate risks and Table 8 on vulnerable population, sectors and probability of a diverse array of climate-related hazards including extreme heat, drought,

urban flooding, and snow and ice significantly impacting Amman and its vulnerable communities. Building upon this, given below is an exploration of how these hazards affect various vulnerable groups and the sectors pivotal to the city's social, economic, and environmental framework.



The Impact of Heat

High temperatures and extreme heat events are a challenge in the south-eastern parts of the city. The impacts of heat events affect various sectors, posing multifaceted challenges to the city's social, economic, and environmental fabric. From vulnerable populations such as children, outdoor workers, and low-income households facing heightened health risks and economic burdens, to key sectors like agriculture, forestry, and conservation grappling with ecosystem degradation and productivity losses. Additionally, industries such as financial services, insurance, and professional activities encounter operational disruptions, increased costs, and infrastructure vulnerabilities amidst rising temperatures. Addressing these challenges necessitates comprehensive strategies that prioritise resilience, adaptation, and equity, ensuring the well-being of Amman's residents and the sustainability of its systems in the face of escalating heat events.

KEY SECTORS	HOW THE SECTOR IS IMPACTED & WHERE
Vulnerable Population Groups	
Children and youth	Heightened health risks such as heat-related illnesses due to their exposure towards heat especially in the south-eastern parts of the city. They may experience impaired learning and academic performance, aggravated by discomfort and reduced concentration during extreme temperatures especially in the heat prone areas of the city.
Low-income households	Marginalised communities face disproportionate risks due to inadequate access to cooling facilities. The economic conditions and building material obstruct these households to afford cooling actions/appliances. This amplifies the risk of heat-related illnesses and discomfort.
Outdoor workers	Outdoor workers, including construction labourers, agricultural workers, and street vendors, face heightened vulnerability due to limited access to shade, rest breaks, and adequate hydration facilities. Increased likelihood of heat-related illnesses such as heat exhaustion and heatstroke among workers. Physical exertion under hot conditions aggravates dehydration and heat stress, impacting productivity and performance.
Sectors	
Agriculture	Extreme heat affects the crop yields, water resources, and the livelihoods of farmers. Elevated temperatures increase water demand for irrigation while accelerating evapo-transmission rates, leading to water scarcity and reduced soil moisture levels. Prolonged heat waves can also disrupt plant growth cycles, decrease crop quality, and increase susceptibility to pests and diseases.
Forestry	Extreme rise in temperatures can lead to increased evaporation, soil moisture depletion, and drought stress in trees, making them more susceptible to pests, diseases, and wildfires. Such wildfires pose significant threats to biodiversity, ecosystem services, and forest-dependent livelihoods.
Administrative and support service activities	Increased strain in the delivery of administrative services and logistical operations. Operational services are hindered and heat-related health issues, such as heat stress and fatigue, may lead to absenteeism and decreased workforce productivity.
Conservation	Heat events pose a challenge to the preservation of natural habitats, biodiversity, and cultural heritage sites. Increased stress on ecosystems, leading to reduced water availability, soil degradation, and loss of vegetation cover leading to disruption of ecological services and risk to native plant and animal species. Heat-related disturbances can also cause the degradation of cultural heritage structures.
Financial and insurance activities	Increased financial pressure in the city to tend to the aftereffects of the heat wave. Various economic risks and operational challenges are experienced. Increase in extreme events will lead to delays in transactions, communications, and data processing for affected sectors. Heat-related damage to property and assets, such as buildings and vehicles, can lead to insurance claims and financial losses for both individuals and businesses.
Professional, scientific and technical activities	High temperatures can decrease productivity and lead to absenteeism. Operational disruptions, such as power outages or equipment failures caused by extreme heat can affect technical services.



The Impact of Drought

From agricultural struggles to economic strains, the impacts of prolonged water scarcity ripple through the city of Amman. Reduced precipitation and water scarcity directly affect vital sectors such as agriculture, manufacturing, healthcare and real estate, exacerbating vulnerabilities and disrupting livelihoods.

KEY SECTORS	HOW THE SECTOR IS IMPACTED & WHERE
Vulnerable Population Groups	
Low-income households	Limited access to clean water affects basic needs like drinking and sanitation and food shortages. Displacement may occur as families seek resources elsewhere, impacting the social dynamics. Education is disrupted, especially for girls, and gender disparities widen as women bear the brunt of increased household burdens.
Sectors	
Agriculture	Reduced rainfall and water scarcity lead to decreased crop yields, soil degradation, and livestock losses. Farmers face challenges in irrigation, with shrinking water sources affecting cultivation. Crop failures result in decreased agricultural productivity, threatening food security and livelihoods. Consequently, many farmers experience economic hardships, with implications for rural communities and national food supply chains.
Forestry	Decreased precipitation and water scarcity contribute to soil moisture reduction, hindering tree growth and regeneration. Forest biodiversity declines as drought-sensitive species struggle to survive. GAM's community garden and urban forestry related actions will face additional stress due to lack of water for survival of plants/trees.
Manufacturing	Disruption in industrial processes reliant on water for cooling, cleaning, and manufacturing. This leads to decreased production efficiency and increased operating costs. Increased operational challenges and economic pressures in the manufacturing sector.
Conservation	Conservation efforts to protect and restore ecosystems are hindered as resources become scarce, and conservation areas struggle to maintain adequate water supplies for wildlife and vegetation
Real estate activities	Water scarcity can lead to increased competition for properties with reliable water sources, driving up prices in certain areas while devaluing others. Construction industries reliant on water may experience delays or increased expenses, impacting real estate development projects. Reduced water availability affects landscaping and green spaces in the real estate properties.
Human health and social work activities	Reduced water availability leads to shortages of clean water, affecting sanitation and hygiene practices, which can increase the risk of waterborne diseases and malnutrition. Drought-induced economic hardships may strain healthcare systems and social support networks, making it challenging for individuals to access essential services and support. Increased demand for assistance and support causes a strain in the healthcare and social services sectors leading to unequal distribution of services



The Impact of Urban Flooding

Floods in Amman impact various sectors and communities across the city - from marginalised neighbourhoods to crucial sectors such as public administration, transportation and retail, the consequences of flood waters impact widely. Heavy rains are usually centred around the central and eastern areas of the city. Infrastructure damage, economic losses, health risks, and social disparities are among the various effects that floods bring to Amman especially in the Downtown area. As per the study conducted in partnership with UN-Habitat on flood mapping, the targeted area is a low land area, (it is the main valley) where the floods generated from almost all the urban area of Amman contributes to its flooding problem. The area is known as "Sail area", and is endangered every year during the winter season by floods which cause loss of life and damage to the property. Figure 1 presents the area of concern. Floodwaters overwhelm inadequate drainage systems and infrastructure, and the marginalised communities often bear the brunt, facing vulnerability and limited access to resources. City has identified 120 sites for flood control in Amman by UN-Habitat's Flash Flood Resilience project.

KEY SECTORS	HOW THE SECTOR IS IMPACTED & WHERE
Vulnerable Population Groups	
Marginalized/ minority communities	Marginalised or minority communities are disproportionately impacted due to inadequate infrastructure, unsafe housing conditions, limited access to resources, heightened health risks, increased displacement and homelessness. The migrant communities staying in refugee camps and likewise are prone to the major impacts of floods leading to displacement of families. The high-intensity rainfall impacts low-lying areas of the city with flooding/flash floods generally for a few hours.
Sectors	
Sewerage, waste management and remediation activities	Heavy rainfall overwhelms the city's sewerage systems, leading to sewage backups and contamination of water sources. This increases health risks and requires extensive remediation efforts to clean up polluted areas. Additionally, floods carry debris and waste, increasing solid waste management challenges. Cleanup operations become more complex and costly, straining resources and disrupting regular waste collection services.
Administrative and support service activities	Businesses in the admin and support service sector, including offices, consultancy firms, and service providers, may face major hindrances due to damaged infrastructure, power outages, and transportation difficulties. Floodwaters can enter into office buildings, leading to property damage, loss of equipment, and stoppage of operations. Employees may struggle to access workplaces, affecting productivity and service delivery.
Public administration and defence	Increased strain in resources and personnel within the public administration and defence sector, requiring additional workforces and funding for emergency response and recovery activities. Critical infrastructure such as communication networks, transportation routes, and emergency response systems may also be affected, hampering the ability of government agencies to coordinate disaster response efforts effectively.
Wholesale and retail trade; repair of motor vehicles and motorcycles	As per flood mapping report of UN Habitat, the Downtown area includes the main commercial center and part of an old housing zone as well as the old archaeological site of the Roman Amphitheater. Land values in this part of the City are the highest in Jordan. The area is a densely populated dense urban area that has an approximate area of 1.68 square kilometers and is approximately 6,500 meters in length. It extends from the intersection of Princess Basma and Omar Matar streets at the upstream end of Friday market in Ras Al-Ain area, and runs downstream along the path of Omar Matar, Ali Bin Abi-Taleb, Koraysh, Al-Hashimi and Al-Jaish streets. Businesses within this sector including shops, markets and auto repair shops may suffer damage to inventory, equipment and infrastructure due to floodwaters. This can lead to financial losses, disruptions in operations and temporary closures. Delivery of goods and services will be affected causing a delay in the supply chain.
Transportation and storage	Infrastructure such as roads, bridges and warehouses may be damaged or obstructed due to flooding especially flash floods, disrupting supply chains and distribution networks. This can lead to delays in the transportation of goods and materials, affecting businesses' ability to meet customer demands and causing financial losses. Flooded storage facilities may also result in inventory damage or loss.



The Impact of Snow and Ice

Frost and snow has been extreme in certain parts of Amman especially in the western and northern parts of the city. From impacting the safety of outdoor workers and the livelihoods of low-income households, extreme cold events such as snowstorms cause challenges among vulnerable groups and in various sectors. Disruption in transportation networks causes difficulties in access to essential services. Marginalised communities, including migrant populations and those residing in refugee camps are among the most vulnerable. Sectors such as agriculture, forestry, and public administration grapple with operational disruptions and resource constraints, while the wholesale and retail trade sectors encounter supply chain interruptions.

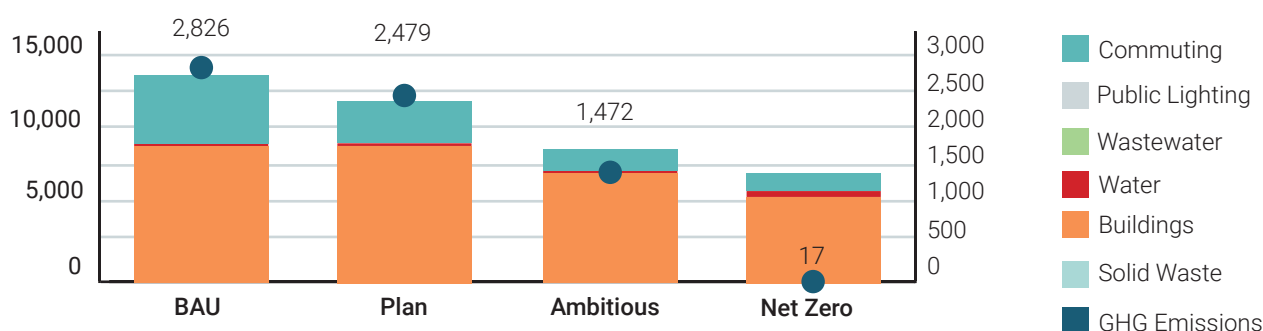
KEY SECTORS	HOW THE SECTOR IS IMPACTED & WHERE
Vulnerable Population Groups (Especially in the western and northern parts of the city)	
Women and girls	Safety concerns for women residing in the western and northern areas arise due to hazardous road conditions, while hindrances to education and work disproportionately affect women and children. Health risks increase, especially for vulnerable populations, and the care burden intensifies as women often take up caregiving responsibilities. Limited access to services also impacts these vulnerable sects.
Elderly	Safety risks increase as icy conditions make mobility difficult and increases the likelihood of slips and falls. This can lead to injuries, particularly among the elderly. Access to essential services such as healthcare and groceries may be affected thereby increasing health concerns and getting essential supplies. Lack of heat insulation may cause hypothermia among some of the elderly. Social isolations during such weather conditions may also affect their mental health.
Marginalized/ minority communities	Extreme cold temperatures can worsen existing health conditions and increase the risk of hypothermia, especially for those living in inadequately heated homes. These communities often face overcrowded and inadequate living conditions, exacerbating the effects of extreme weather events. Migrants, especially the ones living in refugee camps face high risk of their shelter collapsing during extreme weather events. Access to humanitarian aid might become difficult due to hindrances in connectivity and transportation.
Low-income households	Lack of adequate insulation and heating in their homes, makes the residents vulnerable to cold temperatures and increases the risk of health issues such as respiratory illnesses and hypothermia. Limited financial resources may also restrict their ability to purchase warm clothing or afford heating equipment. Additionally, disruptions to transportation and work due to snowstorms can result in lost wages for low-income earners, creating economic hardships. Access to essential services like healthcare and groceries may also be compromised during snowstorms.
Outdoor workers	Construction workers, street vendors, and agricultural labourers, face safety risks due to slippery surfaces and reduced visibility, increasing the likelihood of accidents and injuries. Extreme weather conditions may also cause issues in work schedules and lead to income loss for daily wage earners. Exposure to cold temperatures can result in health issues such as frostbite and hypothermia, especially for those without proper protective clothing or access to shelter homes.

Conservation	Conservation efforts to protect and restore ecosystems are hindered as resources become scarce, and conservation areas struggle to maintain adequate water supplies for wildlife and vegetation
Sectors (Especially western and northern parts of the city)	
Agriculture	Drop in temperature and accumulation of snow can damage crops leading to yield losses and reduced quality. Heavy snowfall can damage irrigation infrastructure and storage facilities, further affecting agricultural productivity. Transportation hindrances can cause obstacles to distribution of products to the markets.
Forestry	Heavy snowfall can lead to breakage of tree branches or risk of the entire tree falling. This can cause safety hazards to the passersby or any worker. Extreme cold and accumulation of ice affects the growth of green cover in the city.
Electricity, gas, steam and air conditioning supply	Heavy snowfall and freezing temperatures can lead to power outages and disruptions in gas supply due to damage to infrastructure such as power lines, transformers, and pipelines. Snow and ice can impair the operation of steam and air conditioning systems, reducing their efficiency and capacity to provide heating and cooling services to residential, commercial, and industrial buildings.
Administrative and support service activities	Increased vulnerabilities may cause strain in the administrative services and support being provided. Severe weather conditions can disrupt daily operations leading to office closures. Snow and ice can also pose safety hazards for employees working in outdoor or field-based roles, such as maintenance workers or security personnel.
Public administration and defence	Severe weather conditions can disrupt government operations, leading to office closures and delays in the delivery of essential public services. Transportation blockages may hinder the mobility of government officials and emergency response teams.
Wholesale and retail trade; repair of motor vehicles and motorcycles	Severe weather conditions can hamper transportation networks, making it difficult for suppliers to deliver goods to wholesalers and retailers. This can lead to shortages of essential products and disrupt supply chains, affecting businesses' ability to meet customer demand. Additionally, icy roads and reduced visibility can pose safety hazards for delivery drivers and commuters, further delaying the movement of goods and services. Extreme cold weather may result in damage to vehicles and infrastructure, leading to increased demand for repair services.
Transportation and storage	Severe weather conditions can lead to road closures, reduced visibility, and hazardous driving conditions. This can result in delays in the delivery of goods, affecting supply chains and leading to shortages of essential products. icy roads and freezing temperatures can damage vehicles and infrastructure, increasing maintenance costs and causing logistical challenges. Snow and ice make it difficult to access storage services thereby making it difficult to store items and distribute them effectively.

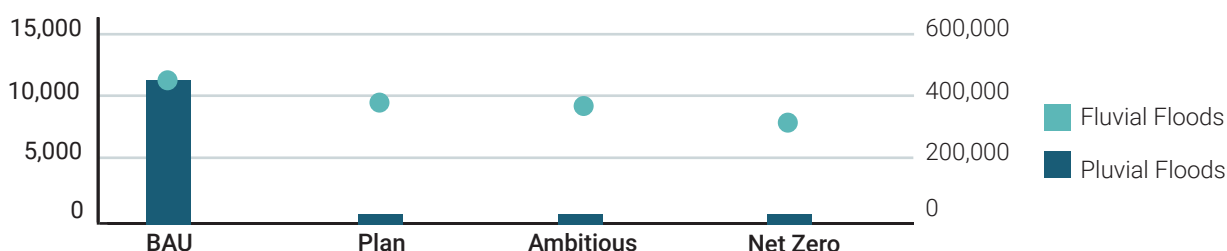
4.3 THE INTEGRATION OF ADAPTATION AND MITIGATION IS KEY TO BUILDING RESILIENCE

Given the urban concentration of Jordan's population, particularly in cities such as Amman, decoupling growth from emissions requires spatially integrated solutions across the urban, transport, and energy sectors. As part of a World Bank study, an urban growth scenario analysis was carried out for Amman, considering the concentration of population in the municipality, its share of GDP, and its ambitions in terms of climate action. The spatially-dependent macro-economic modelling produces both mitigation and adaptation co-benefits as shown in Figure 11.

GHG emissions (kgCO2 eq/capita/ annum) and energy use (MJ/ capita/annum)



Population exposed to fluvial and pluvial flooding (people) by 2050



Urban land consumption and natural land loss (km2) by 2050

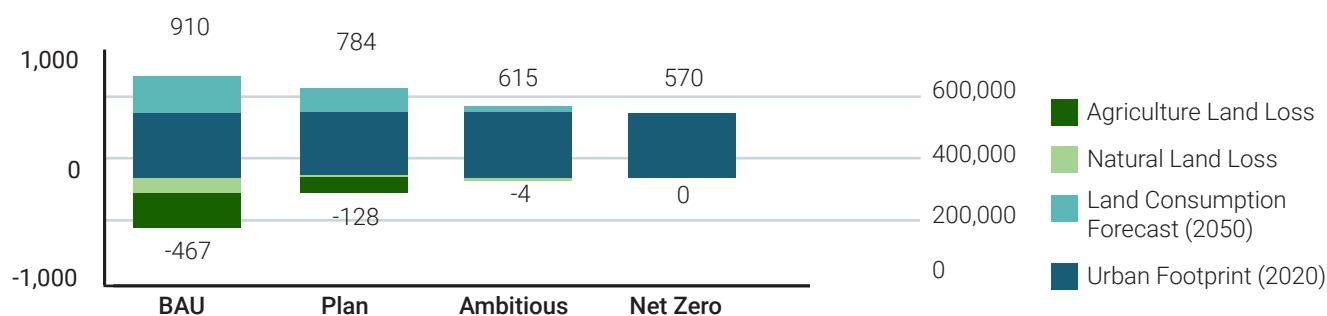


Fig. 11: Adaptation and mitigation co-benefits of sustainable urban development in Amman.
(Source: Jordan Country Climate and Development Report, 2022)

Since Amman is generally known to be water scarce, while simultaneously experiencing extreme flooding events, the GCAP also provides strategies for exploring benefits of natural resources, while also minimizing the city's dependence on this scarce natural resource. Modelling results demonstrate numerous benefits in investing in green infrastructure, from reduced energy consumption and GHG emissions, and reduced exposure to flood risks and heat islands by integrating priority investment opportunities in green infrastructure and services, particularly public spaces and nature-based solutions, and reduced urban expansion through better land-use planning and improved connectivity.

4.4 ADAPTATION AND DISASTER RISK REDUCTION STRATEGIES AND ACTIONS

Amman has identified several strategies and actions to address identified priority hazards and impacts. These strategies and actions are intended to build overall resilience, adapt to climate change and its impacts, and reduce disaster risk. The climate adaptation and DRR strategies and actions are given in Table 10. These are drawn from the GCAP (2021), recommendations arising from UN-Habitat's Flood Risk Mapping project and the GAM Strategy 2022-2026, and references are provided to link the strategies to their sources. The actions are differentiated as short-term (ST), medium-term (MT) and long-term (LT), and their contributions to the SDGs are indicated. Where available, sub-actions are identified. It should be noted that there are only a few long term actions developed for Amman. At the National level, the National Adaptation Plan ⁴¹ lists targets only for the short term – i.e. up to 2030. It is expected that longer term actions will be further developed in the LTS (Long Term Strategy for Sustainable Low Carbon Development in Jordan), due to be completed in 2024.

For this Climate Action Plan, the main focus to-date is on flood risk analysis and management, and as such most of the strategies and the actions pertain to building city reliance to flood hazards. Going forward, the city will expand its focus to other climate hazards - this will be a key outcome of the detailed analysis of the climate hazards in Amman, being developed in the Vulnerability Assessment for GAM, through the support of UNDP, and the 4NC as indicated in Table 1.



Picture source: UN-Habitat

Strategies	Actions	Source of Funding	Timeframe	SDGs
Strategy 1 : To reduce flood risk in critical areas by %50 by 2040	Incorporating sustainable urban drainage systems (SuDS) principles into publicly-owned buildings* Sub-actions: - Review and update green building guidelines used in Jordan, particularly portions related to efficient water management - Compile a database of various WSUD and SuDS technologies and solutions that can be utilised - Identify measures to be incorporated in the Jordan Building Code in coordination with national ministries, thus becoming mandatory for new projects - Develop designs and specifications and perform environmental impact analysis	Municipal budget; international financial institutions Estimated Cost (9.4m – 13.71m)	ST - MT	SDG3; SDG5; SDG9; SDG10; SDG11; SDG13; SDG17
	Integration of water-sensitive urban design (WSUD) and SuDS* Sub-actions: - Identification of 100 sites where different types of landscaped and vegetated areas could be implemented and in combination these would reduce the amount of floodwater reaching the Downtown area** - Compile a database of various WSUD and SuDS technologies and solutions that can be utilised	Municipal budget; international financial institutions Estimated Cost (24k-36k)	ST - MT	
	Addressing urban floods through the Flood Risk Assessment and Hazard Mapping Study** Sub-actions: - Identification of 120 suitable sites for pilot projects - Implementation of the Al-Zohour green triangle pilot flood control system at approximately 3 kilometres southwest of downtown Amman	Municipal budget; co- financed by Japang government; international financial institutions Estimated Cost Undetermined	ST	
	Regular maintenance of the culverts to ensure that the rainwater could flow freely without obstruction, and the use of new flow interceptors to allow easier access for the water, and to allow water from tributaries to enter Saqf alSail directly**	Municipal budget Estimated Cost Undetermined	ST	
	Construction of a culvert parallel to the main existing culvert, and the addition of an additional bypassing culvert and a bypassing tunnel in the West of Amman to collect rainwater upstream and deflect it away from the Downtown area**	Municipal budget Estimated Cost Undetermined	LT	
	Update the Downtown Amman Masterplan database for evaluating proposed long-term solutions** Sub-action: Undertake additional surveys	Municipal budget Estimated Cost Undetermined	LT	
Strategy 2 : Early Warning System for Flooding	Capture and Retain Heavy Rains in Jordan (CapTain Rain) (with the support of German Federal Ministry of Education and Research) Sub-actions: - Undertake feasibility study to revise and improve current methods of flood prediction and prevention in Jordan - Analysis of socio-ecological drivers of flash floods in Wadi systems, and the compounding effects of climate change and land use change - Carry out vulnerability risks assessments to inform flood management - Carry out river engineering interventions to allow a better simulation and prognosis of flash flood events	Municipal budget, studies co-funded by the German Ministry of Education and research Estimated Cost Undetermined	ST - MT	SDG3; SDG5; SDG9; SDG10; SDG11; SDG13; SDG17
Strategy 3 : Reduce water network losses by %70 by 2040	Upgrade water supply and distribution network Sub-action: Carry out feasibility study (€ 930,000) and develop a phased approach to carrying out civil engineering works in order to minimise mobility, accessibility and pollution issues in Amman	Municipal budget; Jordan government; international financial institutions Estimated Cost Undetermined	ST	SDG3; SDG5; SDG6; SDG9; SDG10; SDG11; SDG13; SDG17

Strategies	Actions	Source of Funding	Timeframe	SDGs
Strategy 4 : Improve water efficiency in buildings by %25 by 2030	Develop an integrated green infrastructure strategy Sub-actions: - Review and update Jordan Building Code in coordination with national ministries in order to strengthen the adoption of best available technologies - Develop monetary and non-monetary incentives to promote water efficiency in buildings - Carry out awareness campaigns to convey the multiple sustainable development benefits of water efficiency	Municipal budget; international financial institutions Estimated Cost (€260,000 – €400,000)	ST	SDG3; SDG5; SDG6; SDG7; SDG10; SDG11; SDG13; SDG17
Strategy 5: Safeguard water supply	Aqaba-Amman Water Desalination and Conveyance National Project ⁴²	Municipal budget; Jordan government Estimated Cost (USD 2.2 billion)	MT - LT	SDG3; SDG5; SDG6; SDG7; SDG9; SDG10; SDG11; SDG13; SDG17
Strategy 6: Reduce or maintain the urban heat island effect and carbon emissions in Amman through blue and green infrastructure and improve the quality of green spaces	Implement nature-based solutions for Ruseiffa natural lagoon and develop a sustainable recreation area Sub-actions: - Perform extensive site surveys along the Wadis on the upstream direction to identify plants/ industries/ businesses contributing by discharge to the water reaching the pond. Aerial and satellite images can be used as supplementary sources - Setup a real-time stream flow gage monitoring programme to quantify discharge from the different streams - Identify and stop any illegal discharges to the pond area from the neighbouring industries and households - Design and construct water drainage infrastructure (e.g. micro-tunnelling) connecting the pond area to the Zarqa River, from which water can flow naturally	Municipal budget; Donor agency; Land Value Capture Estimated Cost (€ 5,200,000 - Phase 1; €5,800,000 - € 8,120,000 - Phase 2; Total € 11,000,000 - €13,320,000)	ST - MT	SDG3; SDG5; SDG9; SDG10; SDG11; SDG13; SDG17
	Invest in expanding green spaces Sub-actions: - Record green assets and identify ownership, primary uses and potential viability, using geographic information systems (GIS) where appropriate, to deliver multifunctional benefits - Assess the possibility of transformation of non-agricultural urban/peri-urban land into agricultural land to fit with existing land use classification and consider land acquisition by the municipality - Assess, incentivise and enforce roof top use for green usage - Develop a stakeholder engagement plan for the project, involving government representatives of GAM, Ministry of Environment, and Ministry of Agriculture, Ministry of Health, Ministry of Transport, and Ministry of Public Works, local groups, and social and environmental NGOs. Identify local issues, challenges, risks and community needs using data audit and consultation	Municipal budget; Donor agency; Land Value Capture Estimated Cost (€ 350,000 - € 530,000)		
	Develop an integrated green infrastructure strategy Sub-actions: - Identify existing status and features of the GAM area and how it could be improved - Additional sub-actions are the same as for previous action	Municipal budget; Donor agency; international financial institutions Estimated Cost (€ 260,000 – € 400,000)		

Strategies	Actions	Source of Funding	Timeframe	SDGs
infrastructure* and Improve the quality of green spaces	Finalise and implement the Amman Strategic Master Plan 2060 Sub-actions: - Review relevant existing plans in GAM - Assess mobility, transport, and walkability around Amman - Review existing street plans - Prepare priority lists of crowded areas - Assess and review existing land use classification. The possibility of change should be explored based on green infrastructure strategies and plans - Provide stability and sustainable land use classifications - Explore and provide new directions of the Master Plan into east and southeast Amman - Promote application and incentivise implementation of green building codes - Incorporate the above into the Amman Strategic Master Plan 2060 and finalise and implement the plan	Municipal budget; Donor agency; international financial institutions Estimated Cost (€ 4-3 million)		
	Implement a Climate Change Community Engagement Plan Develop Engagement Plan in close collaboration with local communities based on prior analysis of vulnerable communities and groups of stakeholders in the city	Municipal budget Estimated Cost (€ 100,000 - €120,000)		
	Cooling of existing parking lots - Conduct feasibility study to identify suitable locations for implementation - Identify preferred methods of green infrastructure - Set out financing and appropriate team structure	Municipal budget; Donor agency; international financial institutions		
	Make dense urban areas greener by planting micro-forests to help offset the negative effects of climate change, such as flash floods, while creating other positive impacts, such as improving air quality and providing shade; 3 areas are already implemented as part of Urban Lungs Project ⁴³ (see Box 6 below)	Municipal budget; Donor agency; international financial institutions Estimated Cost (€ 5,300,000- €8,000,000)		
Strategy 7 : Improve urban food security**	Use of storm water retention systems for urban agriculture purposes, and application of good agricultural practices for dry and drought-resistant agriculture on land owned by GAM ⁴⁴ Sub-actions: - Carry out design of retention systems - Identify and develop operational manual for good agricultural practices best suited for the local climatic conditions - Train local communities in use of water systems and good agricultural practices	Municipal budget; Donor agency; international financial institutions Estimated Cost Undetermined	ST - MT	SDG2; SDG3; SDG5; SDG10; SDG11; SDG13; SDG17
	Establish a community-based urban garden in order to improve urban climate resilience and enhance food security, and provide capacity-building for GAM on community gardening, nature-based solutions and composting Sub-action: Carry out physical design in collaboration with local communities	Municipal budget; Donor agency; international financial institutions Estimated Cost (USD 166,000)		
Strategy 8 : Track change in communicable diseases through online system	The target by Ministry of Health, in their Strategic Plan (2025-2023) is that %25 of private sector hospitals and %75 of government hospitals should be reporting information for communicable diseases by 2025 Sub-action: %60 of personnel trained in use of JERIS (Jordan Electronic Reporting Information System) by 2025	Jordan Government Estimated Cost (JD 105,000).	ST	SDG3; SDG5; SDG10; SDG13; SDG17

Table. 10: List of Strategies and Actions for Climate Adaptation and DRR.

Notes: *GCAP, 2021; **UN-Habitat, 2021 ; § GAM Strategy 2022-2026

In addition to GHG emissions reductions, the implementation of adaptation strategies and actions will provide a number of co-benefits as summarised in Table 14, in addition to GHG emissions reductions. The Aas included in Amman GCAP that contains an assessment of co-benefits for actions developed by sector.



Social co-benefits	Economic co-benefits	Institutional co-benefits
• Improve health • Improve safety and/or security • Enhance the public realm • Access to basic services • Social equity	• Revenue generating activities/ net savings of costs (e.g. water saving) • Promotes economic inclusion • Avoided damages	• Improve institutional capacity or efficiency • Enhances the legislative environment

Amman is considering following strategies to set the co-benefit targets for adaptation:

- Early Warning System for Flooding to inform all the vulnerable communities by 2030
- Increase Blue and Green infrastructure by 2030 to reduce the impact of urban heat island effect, reduce emissions and improve air quality in Amman
- Reduce flood risk in critical areas by 50% by 2040
- Reduce water network losses by 70% by 2040
- Improve access to water and wastewater networks to 100% of Amani's by 2040
- Improve water efficiency in buildings by 25% by 2030

Amman's Green City Action Plan 2021, provides more details of the co-benefits, especially in the section 5. Green City Actions for Amman were assessed in terms of social, economical and institutional co-benefits criteria for the sectors like Integrated water resources management, Comprehensive and reflective land-use planning and Responsive and forward-looking climate adaptation practices.

5. CLIMATE CHANGE MITIGATION

5.1 AMMAN EMISSIONS INVENTORY

A city-wide GHG inventory enables cities to measure their overall emissions and understand what level of emissions different activities within the city contribute to the overall amount. This helps cities to better target actions that can reduce emissions. The total GHG emission for the City of Amman was 9.271 MtCO₂e in 2019 giving a per capita emission of 2.4 tCO₂e per inhabitant. Emissions from Stationary sources (residential and commercial), Transport and Waste Management contributed of 48.9%, 40.0% and 9.9% total emissions, respectively. The largest sub-sectors of emissions were electricity in buildings, and on-road transport. Details of the 2019 GHG Inventory are given in Annex 1. The large attribution of the city's GHG emissions to buildings corresponds to the decrease in vegetation and the increase in built-up area.⁴⁵

GAM's Emissions, by Sector

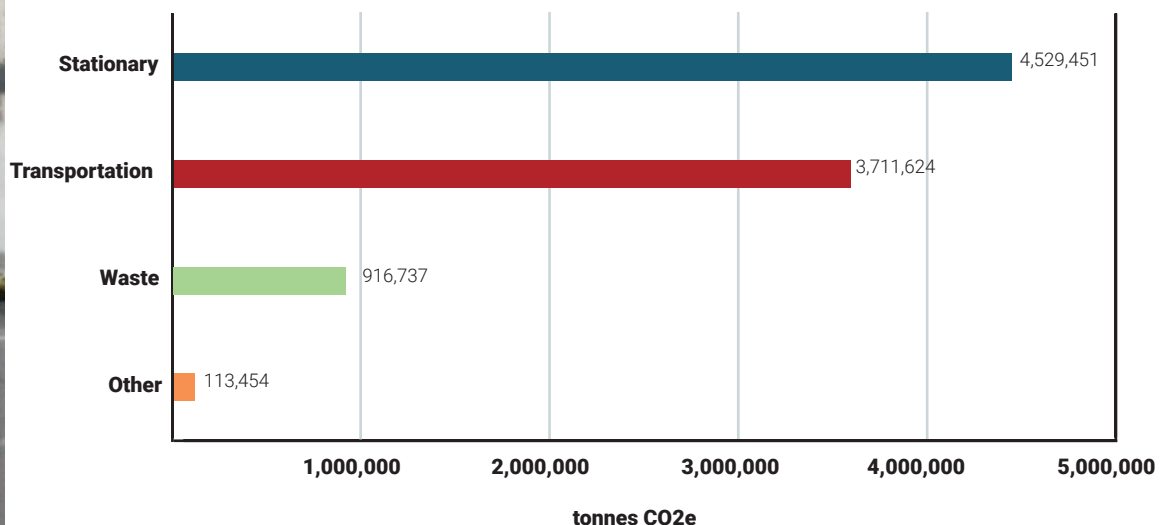


Fig. 12: Emission of Amman by Sector.
(Source: CIRIS 2019)

tCO ₂ e	BASIC + Other Scope 3	Scope 1	Scope 2	Scope 3
	Stationary	1,183,176	2,921,746	424,530
	Transportation	1,974,246	799	1,736,579
	Waste	834,637		82,100
	IPPU			
	AFOLU	-28,022		
	Other Scope 3			141,476
	Total	9,271,266		

Fig. 13: Emissions profile of Amman, 2019.

(Source: CIRIS 2019)

The sectoral profile of emissions provides valuable information to guide the selection of mitigation strategies and actions.

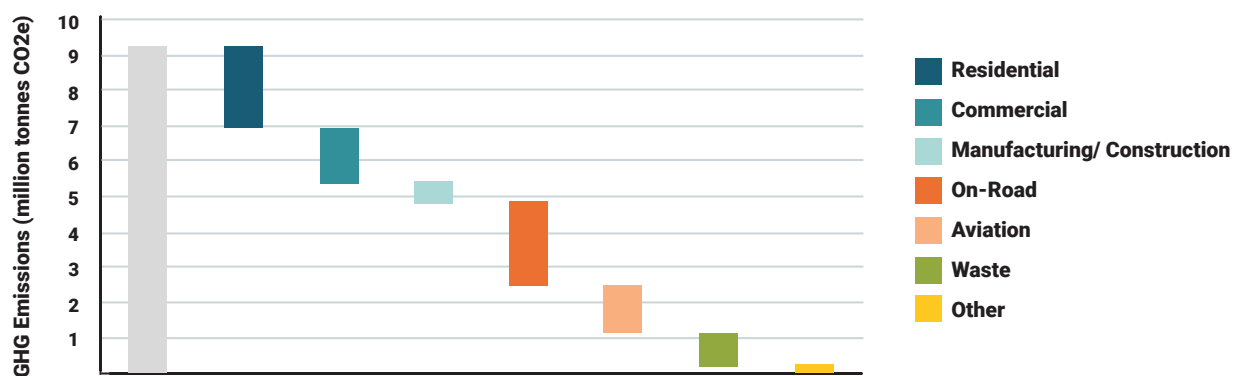


Fig. 14: Sectoral emissions waterfall, 2019.

(Source: CIRIS 2019)

The breakdown of the 2019 GHG emissions shows that there is a relatively strong contribution of Scope 3 emissions (2.255 MtCO₂e) and its inclusion may have a significant impact on mitigation scenario analysis. Seventy-seven percent of Scope 3 emissions relate to the Transport sector (aviation and road transport taking place outside the city boundary). The mitigation analysis that follows has excluded Scope 3 emissions (out of GPC BASIC) since there is less direct control from the city of Amman, and more complex drivers of activity to forecast.

GAM's Emissions, by Scope

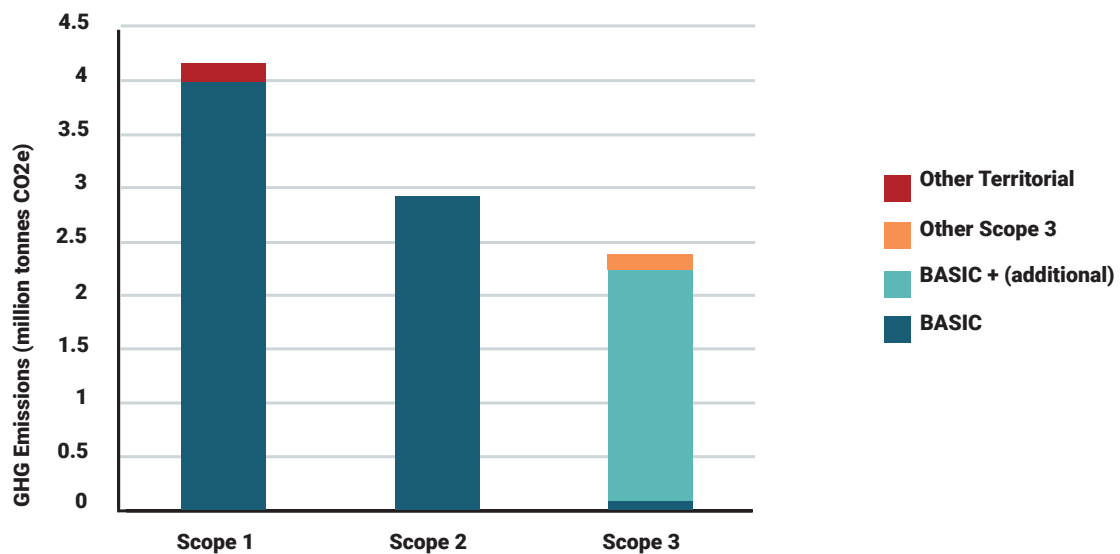


Fig. 15: Emission of Amman by Scope, 2019.
(Source: CIRIS 2019)

5.2 LOW-CARBON DEVELOPMENT STRATEGIES

In the absence of any mitigation strategies and actions, the growth in population and economic activity will result in an increase in baseline emissions from 7,392,996 tCO₂e (GPC BASIC emissions in 2019) to 9,546,333 tCO₂e (2030) to 12,415,571 tCO₂e (2040) to 16,383,451 tCO₂e (2050). The per capita emissions will increase from 1.916 tCO₂e/inhabitant in 2019 to 1.963 tCO₂e/inhabitant in 2030 to 2.284 tCO₂e/inhabitant in 2050. In order to arrive at GAM's ambitious yet achievable target of net-zero emissions by 2050, the actions and strategies have been developed to meet the interim targets of emission reduction of 14% by 2030 and 30% by 2040 (compared to the base year 2019-level emissions).

The CCDR (2022) has modelled a combination of policy measures and financing opportunities to transform Amman into an inclusive, green, resilient city.⁴⁶

These include:

- Integrating green urban and transport planning to deploy transit-oriented development and facilitate public transport reform,
- Integrating priority investment opportunities in green infrastructure and services, particularly public spaces and nature-based solutions, to mitigate floods and heat islands,
- Prioritizing urgent "no regret" infrastructure in Amman and municipalities, including recycling and sorting facilities, upcycling hubs, sanitary landfills, and collection and transfer systems,
- Accelerating energy efficiency (EE) across sectors, including investments in electricity demand-side management,

- e. Adopting Electric Vehicle (EV) goals,
- f. Promoting a modal shift towards cleaner and greener freight transport,
- g. Enhancing financial sustainability and modernizing the management of the road sector, and municipal public land and assets,
- h. Launching housing sector reforms in conjunction with land-use planning and zoning improvement and stronger enforcement of building regulations.

These mitigation strategies are also similar to those contained in the GCAP that provides ten strategic objectives up to 2030 as summarised in Table 11.⁴⁷

S01	Increase renewable energy supply by 25% by 2035 to improve energy diversity, independence and resilience	
S02	Reduce the rate of energy demand by 15% by 2030 by improving the energy efficiency of building and electrical systems	
S03	Increase the modal share of public transportation by 30% by 2030 by institutionalising and normalizing public transport	
S04	Develop a public realm strategy that supports pedestrian travel	
S05	Incorporate smart systems in transport planning	
S06	Improve resource management by increasing the efficiency of solid waste management regimes	
S07	Integrate circular principles into waste management	
S08	Reduce the amount of waste sent to landfill by 12% by 2030	
S09	Upgrade waste management infrastructure	

Table. 11: Mitigation strategies in the GCAP, 2021.

In order to achieve the strategic objectives, GCAP prioritizes climate actions as listed in Table 12.

Sector	Mitigation Actions	Cost (Euro)
Energy and buildings	- Invest in large grid-scale solar projects - Integrate LED systems into municipal street lighting - Finance smart meters and batteries to promote grid stabilisation - Pilot green building retrofit for GAM owned building and other existing buildings - Establish green school buildings - Develop solar-powered bus stands - Expand the existing Landfill Gas Recovery System	26 – 65 million 18.5 million 22 million - Not available - Not available 280,000 – 780,000 - Not available
Accessible, diverse and low-carbon mobility systems	- Expand integrated bus network and low-emission bus fleet - Conduct pilot project to promote active mobility - Install Intelligent Transport Systems - Introduce car free days in city centre to promote city centre events and active mobility - Provide free bus service to and from the pilot pedestrian area on specified days - Develop an integrated sustainable transport strategy (including cycling tracks) - Implement an on-street parking system	40 million 5.9 – 8.3 million 3.3 – 6.6. million 70,000 – 80,000 200,000 - 450,000 60,000 – 120,000 4 – 5 million
Resource efficient and holistic waste management systems	- Waste prevention and recycling strategy - Improve Al-Shaer waste transfer station - Expand road sweeper operations to improve the public realm - Construct an additional landfill cell - Partner with large-scale commercial sectors to collect organic waste and explore opportunities on composting. - Establish a WEEE (Waste Electrical and Electronic Equipment) waste transfer facility - Construct a clean material recovery facility and establish recycling programme	40,000 – 90,000 6.5 million 6.2 million 7.8 million 0.838 – 1.26 million 400,000 – 410,000 7 – 12.5 million

Table. 12: . Sectoral mitigation actions contained in GCAP, 2021.

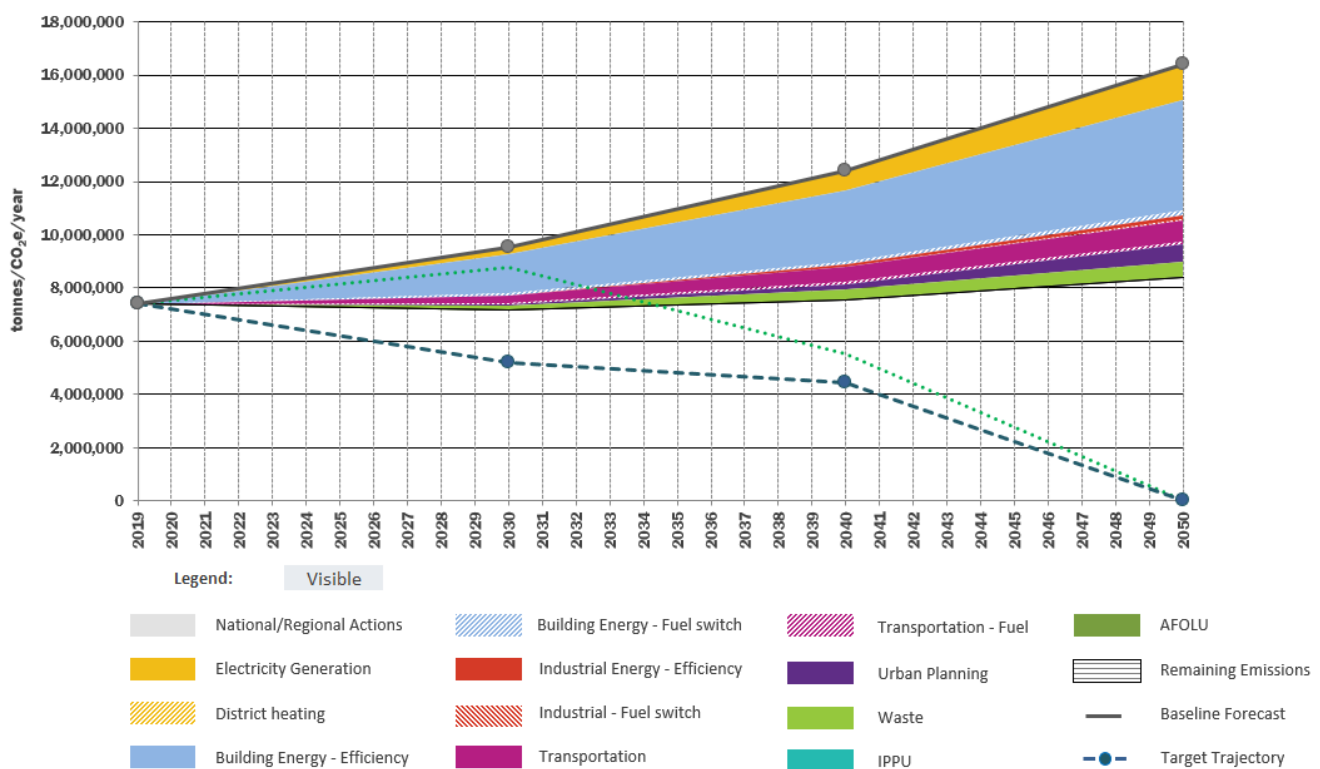
Source: Green City Action Plan, 2021

For the updated CAP, two sets of mitigation strategies and actions have been modelled using C40's PATHWAYS Tool. The first set comprises the existing and planned strategies and actions, and together they produce the Existing & Planned Scenario. An Ambitious Scenario comprised of strategies and actions that produce higher levels of GHG emissions reductions has also been modelled. The strategies and actions, including targets to 2050 that comprise the Existing & Planned Scenario and the Ambitious Scenario are summarised in Annex 2. For all practical purposes, these are similar to those mentioned above, and where available and applicable, sub-actions are also provided.

5.2.1 EXISTING AND PLANNED SCENARIO

The City of Amman has embarked on sustainable development for over a decade as witnessed by the numerous strategies and plans that have been developed, and culminating in the formulation of the second Climate Action Plan as a synthetic document.

In this context, a number of planned activities across several sectors will produce just over 25% of emissions reductions below the baseline scenario in 2030 (Figure 15). Since Amman is considered to be in the category of 'late peak' cities, this level of emission reductions is sufficient to meet the target in 2030 (8,770,024 tCO₂e allowable emissions). However, considering Existing and Planned mitigation strategies and actions alone falls short of achieving the ambitious target of 32.4% emissions reductions relative to the baseline that the city has set itself with an achievement gap of 699,618 tCO₂e in 2030. The achievement gap is obviously much larger for the year 2050 (8,403,422 tCO₂e).



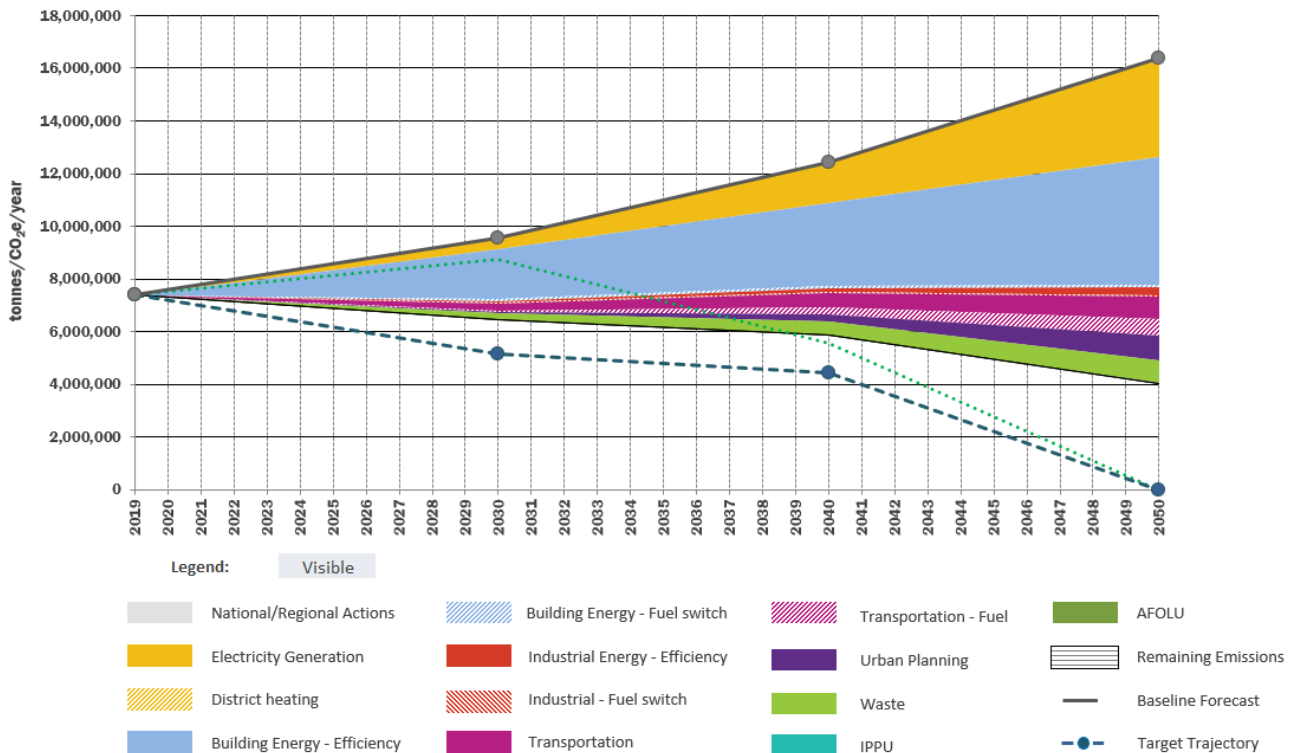
Metric	2019	2030	2040	2050	Unit
Baseline Forecast	7,393,137	9,546,514	12,415,805	16,383,755	tonnes CO ₂ e/year
Target	NA	%32.4	%52.7	%100.0	% below baseline level
Allowable Emissions	NA	6,453,291	5,872,747	0	tonnes CO ₂ e/year
Achieved w/ Actions	NA	7,152,909	7,566,301	8,403,422	tonnes CO ₂ e/year
Achievement Gap	NA	699,618	1,693,554	8,403,422	tonnes CO ₂ e/year
Achievement in %Reduction	NA	%25.1	%39.1	%48.7	% below baseline level
Intensity Achieved w/ Actions	NA	1.47	1.28	1.17	tonnes CO ₂ e/capita/year

Fig. 16: Emissions reductions from Existing and Planned strategies and actions.

(Source: PATHWAYS modelling, 2023)

5.2.2 AMBITIOUS SCENARIO

By increasing the level of ambition across all sectors, except for grid electricity in 2030 that is not within the control of the city, Amman target emission reductions in 2030 (32.4%) and 2040 (52.7%) are achieved. However, it is noted the reductions of just over 5.87 MtCO₂e in 2040 fall short of the baseline Trajectory value (5,541,356 tCO₂e).



Metric	2019	2030	2040	2050	Unit
Baseline Forecast	7,392,996	9,546,333	12,415,571	16,383,451	tonnes CO ₂ e/year
Target	NA	%32.4	%52.7	%100.0	% below baseline level
Allowable Emissions	NA	6,453,169	5,872,637	0	tonnes CO ₂ e/year
Achieved w/ Actions	NA	6,453,169	5,872,636	4,041,251	tonnes CO ₂ e/year
Achievement Gap	NA	0	0	4,041,251	tonnes CO ₂ e/year
Achievement in %Reduction	NA	%32.4	%52.7	%75.3	% below baseline level
Intensity Achieved w/ Actions	NA	1.33	0.99	0.56	tonnes CO ₂ e/capita/year

Fig. 17: Emissions reductions from Ambitious strategies and actions.

(Source: PATHWAYS modelling, 2023)

Also, residual emissions in 2050 amount to just over 4 MtCO₂e. The sectoral contribution to the residual emissions is illustrated in Figure 17, showing the road transportation, the use of energy in buildings (residential and commercial), industrial activities and solid waste management are mainly responsible for the residual emissions. Using Amman's Target Trajectory as reference, it can be seen that additional efforts will be required beyond 2041 for reaching net-zero emissions in 2050. Ways to bridge the residual emissions in 2050 are given in section 6.2.

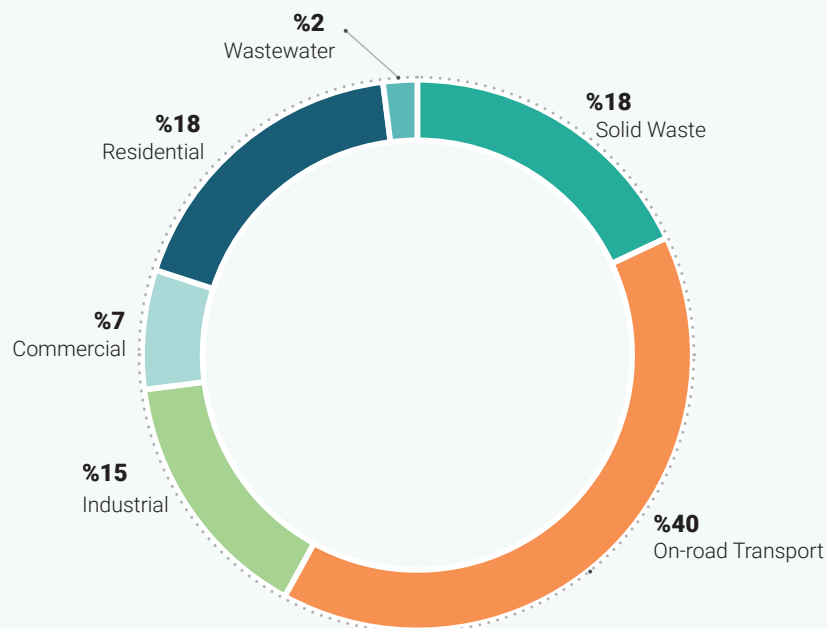


Fig. 18: Sectoral contribution to residual emissions in 2050.

(Source: elaboration based on data obtained from PATHWAYS modelling, 2023)



5.2.3 MITIGATION CO-BENEFITS

In addition to producing the global environmental benefit of GHG emissions reductions, the implementation of mitigation strategies and actions will provide a number of sustainable development benefits as summarised in Table 13.

Social benefits	Environmental benefits ⁴⁸	Economic benefits
Green jobs creation (SDG5; SDG8)	Reduced air pollution (less non-GHG emissions and particulate matters) (SDG15)	Investments in green economy enhances the local economy (SDG8)
Improved health due to reduced air and land pollution (SDG3; SDG15)	Reduced land pollution due to environmentally sound disposal of waste (less littering) (SDG12; SDG15)	Increased indirect economic spill over effects due to enhanced local economy (SDG8)
Increased well-being of inhabitants due to increased liveability and conviviality (e.g. less pollution, improved public lighting, more open and green spaces, less congestions etc..) (SDG3; SDG5; SDG10;SDG11; SDG15)	Protection of ground water from contamination (SDG14)	Macroeconomic benefits of reduced energy bill on imported fossil fuels (SDG8; SDG12)
		Reduced costs for municipality (shared investment costs with partners, less maintenance, lower energy operational costs) (SDG8; SDG12)

Table. 13: Sustainable development co-benefits of climate mitigation.

The GCAP contains an assessment of co-benefits for actions developed by sector. Multi-criteria analysis is used to rate projects using the indicators shown in Table 14. However, it did not lead to the development of targets for co-benefits, which is something that still needs to be addressed for the city. Amman's Green City Action Plan 2021, provides more details of the co-benefits, especially in the section 5.Green City Actions for Amman where they are assessed in terms of social, economical and institutional co-benefits criteria as mentioned above.



Social co-benefits	Economic co-benefits	Institutional co-benefits
- Improve health - Improve safety and/or security - Enhance the public realm - Access to basic services - Social equity	- Revenue generating activities/ net savings of costs - Promotes economic inclusion - Avoided damages	- Improve institutional capacity or efficiency - Enhances the legislative environment

Table. 14: Co-Benefit Assessment Indicators used in GCAP.



6. LOOKING TO THE FUTURE

Picture source: UN-Habitat

6.1 NEXT GENERATION RISK ANALYSIS

As a learning organization, the Greater Amman Municipality recognises that there is room for improvements in its approach to carrying out risks analysis. Importantly, there is need to have a systemic approach to the analysis of climate-induced risks for better evidence-based sustainability planning. The need for a systemic approach also reveals the shifting perceptions on risks as emerging at the intersection of both climate and non-climate drivers within a broader socio-ecological complex, including regional geopolitics. The Climate Action Plan has anticipated the need for improvements in the City risks analysis through the following:

Extended Risk Framework

An emerging element of urban risk analysis relates to the confluence of multiple climate drivers and the consequential intersection with non-climate drivers,⁴⁹ such as land use changes and levels of poverty among others. Due to interactions and feedback mechanisms between climate drivers and socioeconomic needs (such as provision of water, food, energy, mobility, amongst others), the IPCC Sixth Assessment Report

(AR6)⁵⁰ has warned that multiple climate impact drivers – i.e. concurrent climate events - may potentially produce dangerous hazard combinations. For example, multiple climate-related drivers may affect multiple regions at the same time, or in a sequence of events that could amplify their overall impacts, potentially leading to failures of a country's basic societal functions. Single and concurrent events can be further amplified by non-climate hazards such as inappropriate land use planning. Hence, future climate risks analysis for the City of Amman will have to contend with such multi-hazard analysis, coupled with socio-economic impacts. Future risk analysis will have to increase the coverage of climate hazards, as well as investigating the risks posed by concurrent hazards.

Multi-criteria vulnerability assessments

Vulnerability assessments will also have to include socioeconomic indicators through the use of GIS-based multi-criteria analysis. Such analysis are crucial to provide information on differential impacts accruing to women and men (gendered approach),

and to vulnerable communities, including children, elderly and persons living with disabilities. The multi-hazard risk analysis that is being carried out under the Fourth National Communication (see Section 4.2.2) is making use of GIS-based multi-criteria analysis.

Water-Agriculture Nexus

Climate risks analysis to date have focused on climate hazards taking place within the boundaries of the City or Governorate. Since the City of Amman is a net importer of potable water and food from outside its boundary, it is exposed to all climate events that negatively affect the agriculture-water nexus. Jordan is the one of the most water-scarce countries in the world.⁵¹⁻⁵² The annual per capita water availability has declined from 3,600 m³/person/year in 1946 to less than 100 m³/person/year in 2017 - far below the threshold of 500 m³/person/year which indicates severe water scarcity.⁵³ The water scarcity in Jordan is further exacerbated by the huge influx of Syrian refugees⁵⁴ and the fluctuation of the precipitation trends resulting from the adverse impacts of climate change and the increase of drought frequencies and severity that impose unprecedented strain on the fragile natural water resources. This has severe implications on the availability of safe drinking water and Jordan's long-term ability to supply water for agriculture and will amplify the drop of groundwater level in the main aquifers, which is currently dropping at an average rate of 2 m/year.⁵⁵

As climate hazards become more severe in Jordan, negative impacts on the agriculture-water nexus will cascade within the city boundary in the form of food insecurity, and increased water scarcity and stress, which will disproportionately affect vulnerable communities living in Amman.

Pathways approach to resilience planning

In the future, scenario planning will have to be carried out to better understand the socioeconomic impacts (e.g. losses and damages) that can be expected to accrue from the impacts of multi-hazard events in the City of Amman.

6.2 MINDING THE MITIGATION GAP IN 2050

It should be noted that carbon sequestration activities were not modelled for Amman as this is treated exogenously in the PATHWAYS tool. In future mitigation analysis, the sectoral scope should be increased as indicated in Table 18 below. Whereas emissions from Industrial Processes and Product Use (IPPU) are expected to be relatively small (because of the small share in national GHG emissions), sequestration from urban forestry and other carbon sequestration actions could play an important role in achieving net-zero emissions.

Notwithstanding the above methodological issues, the Ambitious scenario is aligned with the Deadline 2020 trajectory targets up to 2040. In order to bridge the mitigation gap – i.e. residual emissions - to 2050, an Extended scenario has been developed. The approach used has been to identify a selected number of mitigation strategies based on the sectoral scope shown in Figure 17 that can be adopted to support the city's ambition to reach net-zero carbon by 2050. The objective of the Extended scenario is not to be prescriptive but rather to provide broad orientations for consideration. The bundle of strategies that are analysed lower 2050 emissions to 92.7% below the baseline scenario, and leaves residual emissions of 1,191,998 tCO₂e – i.e. 7.3% of the 2050 BAU emissions (Table 15). It is pointed out that Jordan is currently in the process of developing the national Long Term Strategy (LTS), which when completed will provide more clarity and guidance for updating the Ambitious and Extended scenarios for the City of Amman. In order to achieve net-zero emissions by 2050, GAM will be using the strategies and actions mentioned for the ambitious and Extended scenario while building on its commitments as mentioned in Amman's Resilience Strategy, Climate Action Plan 2019 and Green City Action Plan 2021.

Metric	2019	2030	2040	2050	Unit
Baseline Forecast	7,392,996	9,546,333	12,415,571	16,383,451	tonnes CO ₂ e/year
Target	NA	%32.4	%52.7	%100.0	% below baseline level
Allowable Emissions	NA	6,453,169	5,872,637	0	tonnes CO ₂ e/year
Achieved w/ Actions	NA	6,359,420	5,177,449	1,191,998	tonnes CO ₂ e/year
Achievement Gap	NA	-93,748	-695,187	1,191,998	tonnes CO ₂ e/year
Achievement in %Reduction	NA	%33.4	%58.3	%92.7	% below baseline level
Intensity Achieved w/ Actions	NA	1.31	0.87	0.17	tonnes CO ₂ e/capita/year

Table. 15: Co-Benefit Assessment Indicators used in GCAP.

Source: PATHWAYS modelling

Since the mitigation strategies for the Extended scenario are underpinned by actions with more aggressive targets, and given that several of these strategies require national-level policy and political support, barriers analysis has been carried out for the proposed strategies.

6.2.1 STRATEGIES FOR EXTENDED SCENARIO

The Ambitious Scenario leaves a residual GAP of just over 4 MtCO₂e in 2050. Consequently, an Extended Scenario has been developed based on the five strategies given in Table 16. For coherence in action, the strategies build on the Ambitious scenario and the result is shown in Figure 18. The Extended strategies are for all practical purposes prospective, and they provide a list of targets for different actions in order to bridge the emissions gap in 2050. So the approach used here does not preclude alternative mitigation strategies and actions to be developed in future analysis. This is important to note since Jordan is in the process of developing a national long-term mitigation strategy, the results of which may provide new mitigation pathways for consideration.

Although the main concern is to bridge the mitigation gap in 2050, the 2040 targets were also increased in some cases in order to make the mitigation transition between 2040 and 2050 less onerous. This is the reason for the increased emission reductions of 695,187 tCO₂e in 2040 relative to the Ambitious scenario as shown in Table 15.



Table. 16: Summary of strategies informing the Extended scenario

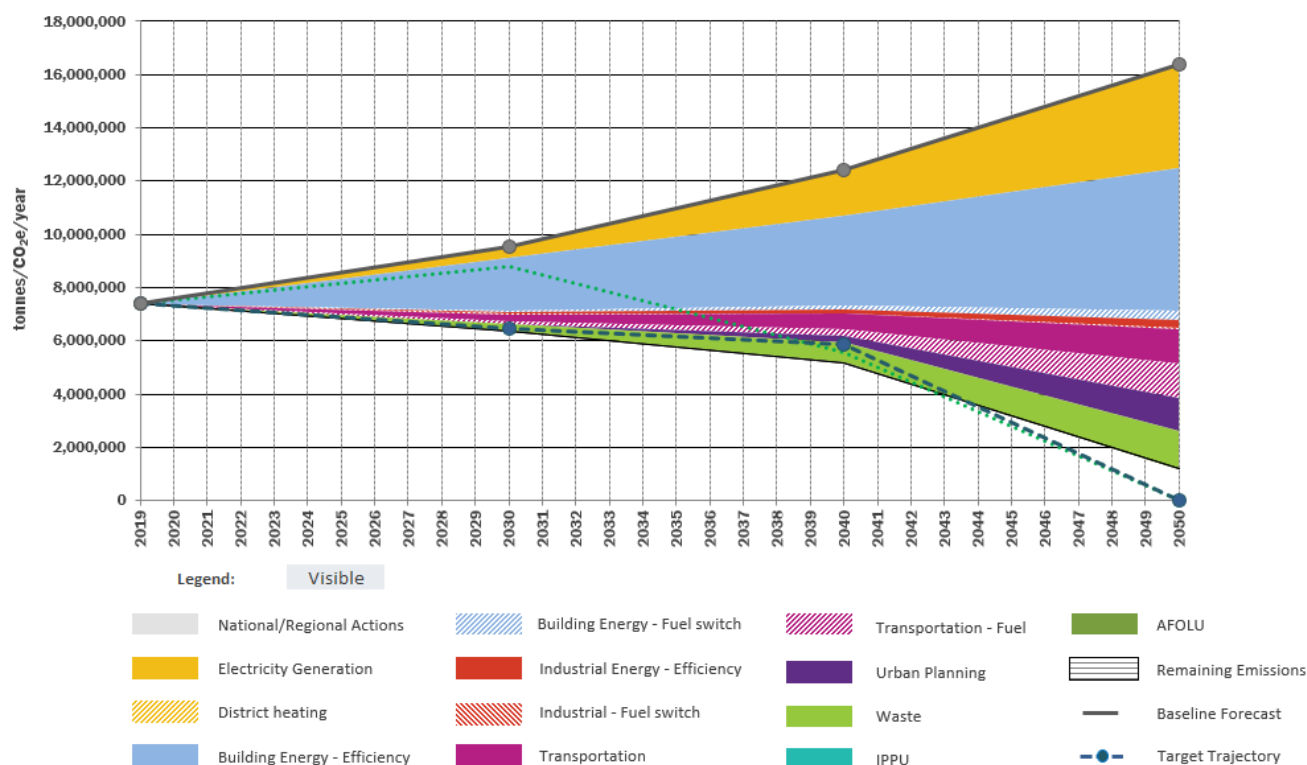


Fig. 19: Extended scenario for the City of Amman.
(Source: PATHWAYS modelling)

6.2.2 BARRIERS ANALYSIS

The mitigation strategies and actions underpinning the Extended scenario will face a number of barriers that have to be addressed or overcome for eventual implementation. Each extended strategy is therefore accompanied by a barrier description table that identifies and discusses the implementation barriers faced. For illustrative purposes, the barriers analysis for the first strategy is shown in Table 17 while the barriers analysis for the remaining strategies is listed in Annex 3. Each Extended strategy is discussed in relation to the corresponding Ambitious strategy, and barriers analysis is carried out the following barriers: legal & institutional; financial; political & social; practical & technological.

Extended Strategy Name	Strategy #1: Complete decarbonisation of the electricity grid by 2050
Strategy description / Assumptions	In the Ambitious scenario, the electricity mix has 50% and 90% renewables in 2040 and 2050, respectively. This is aligned with the ambition of the Climate Change Policy 2022-2050 for reaching net-zero carbon. Given that there is significant increased demand for electricity in 2050 arising from electrification of land transportation and in buildings (cooling, heating and cooking) in the Extended scenario, the national grid is fully decarbonised (i.e. 100% renewables) in 2050. Correspondingly, the share of renewables in the electricity mix in 2040 is increased to 55%. This strategy also demands the complete elimination of shale oil that is expected to be produced locally as opposed to natural gas that is mainly imported. The generation of electricity is outside the control and mandate of GAM.
Barrier	Description of Barrier
Legal & Institutional	- The generation, distribution and sales of electricity are not within the mandate of GAM as per Law No. 18 (2021). Hence, the city has no control over the national grid or over the enforcement of the Renewable Energy & Energy Efficiency Law, Law No. 13 (2012) (http://jreeef.memr.gov.jo/EBV4.0/Root_Storage/EN/EB_List_Page/Law_No(13)_Of_2012_Renewable_Energy_&_Energy_Efficiency_Law.pdf – accessed 13 March 2023). - The revised NDC (2021) (https://unfccc.int/sites/default/files/NDC/2022-06/UPDATED%20SUBMISSION%20OF%20JORDANS.pdf – accessed 13 March 2023) targets to increase the share of renewables to 35% by 2030, which is higher than the share of 31% contained in the National Energy Strategy 2020-2030 (https://www.memr.gov.jo/EBV4.0/Root_Storage/EN/EB_Info_Page/StrategyEN2020.pdf - accessed 13 March 2023). - Nevertheless, the updated NDC is explicit that the level of ambition reported would be achievable only if considerable support would be provided to the government in the form of capacity building, technology transfer and financing. - The target presented by the city in the extended scenario is much more ambitious than what exists in national strategic documents, and it is aligned with the forthcoming Climate Change Policy 2022 – 2050 wherein net-zero carbon is sought by 2050.
Financial	Not applicable since investments are not expected from GAM regarding decarbonisation of the national grid.
Political & social	The Government of Jordan has invested in the exploration of locally-available oil shale as a measure to increase the energy security of the country. Several concessions agreements have already been signed to implement projects of oil shale mining by using various technologies of surface retorting or thermal injections for oil production (https://www.memr.gov.jo/EBV4.0/Root_Storage/EN/EB_Info_Page/StrategyEN2020.pdf - accessed 13 March 2023). According to the extended strategy, a political decision will have to be made to phase out oil shale by 2050.
Practical & technological	- The extended strategy favours large-scale adoption of solar PV. The National Energy Strategy 2020-2030 mentions the low performance of this technology arising from the accumulation of dust and dust storms despite the fact that solar radiation is excellent. Hence, a solution to the problem of dust will have to be found (which will increase capital and operational expenses). - The biggest barrier to the adoption of renewable power as the majority power source is the challenge of maintaining sufficient storage to address daily variation in renewable energies such as solar and wind. There is an inherent mismatch between solar energy production and power demand, implying the need for energy storage infrastructure. Jordan Energy Strategy (2020-2030) concludes the importance of introducing storage projects into the power system (batteries, water dams)⁵⁶. Given that the use of pumped hydro is likely to be limited in Jordan, given its water scarcity and topography, battery storage has to be contemplated. - Although feasibility studies are yet to be carried out, it is anticipated that the large-scale deployment of variable renewable energies in the national grid will require large investments in utility scale energy storage.

Table. 17: Barriers description table - Strategy #1.

6.3 IMPLEMENTATION ISSUES TO BE ADDRESSED

In the years to come, Amman will focus on removing bottlenecks in order to accelerate progress on climate actions within the broader ambit of sustainable development. It will mainstream climate change horizontally into policies and strategies, programmes and partnerships, and municipal operations, covering energy, building, housing, waste management, land use planning and transport, among others. In order to support the process of scaling-up climate actions, the implementation issues listed in Table 18 will need to be addressed decisively.

Issue	Observations
Data and information for integrated policy decision-making	- CIRIS is used for GHG inventory, and institutional and human capacity needs to be reinforced so that up-to-date annual inventories are carried out; the sectoral scope of the CIRIS inventory should be increased to cover/ improve coverage of sectors such as Industrial Processes and Product Uses (IPPU) and Agriculture, Forestry and Other Land Uses (AFOLU). - GAM has no capacity for carrying out mitigation scenario analysis using the PATHWAYS tool. In addition to building human capacity, an improved coordination mechanism needs to be established for data collection regarding mitigation strategies and actions, especially regarding data that are generated by external organisations. - Adequate data related to economic and infrastructural impact of climate change, as well as the number of related deaths, needs to be monitored and collected in order to measure the impact such effects may have on different urban areas and community groups and to tailor solutions accordingly.* - Lack of access to risk information, across ministries, across municipalities as well as by private sector and the general population.** - A recent study by UNDRR has noted a fundamental weakness concerning the lack of clarity of what constitutes disaster events.⁵⁷
Gender and child rights	As far as climate action is concerned, Amman is yet to integrate gender and child rights into its policies, strategies and climate change initiatives in line with the CCP 2022 – 2050.*
Enforcement capacity of GAM (building licensing and permits process)	The enforcement of building energy codes and policies set at the national level to promote green buildings should be strengthened.*
Land use planning	GAM should improve its land use regulations and practices to accommodate the development of green spaces, which are vital for minimizing Urban Heat Islands (UHIs). Integrated land use planning will also serve to support multi-functional tools like green infrastructure and sustainable urban drainage systems that provide multiple sustainable development dividends.*
Quantification of adaptation and mitigation co-benefits	The present CAP has identified a number of sustainable development co-benefits that will accrue from implementing proposed adaptation and mitigation strategies. GAM will need to carry out a quantitative analysis of co-benefits with clear goals and objectives in future CAP updates.
Monitoring & Evaluation	There is need to reinforce the monitoring and evaluation (M&E) of policies, strategies, and plans addressing climate change in order to enhance effectiveness and efficiency of implementation.

Integration of policies, strategies and action plans

GAM has produced a number of studies and report that are complementary and overlapping. There is need to better integrate the sustainable development policies, strategies and action plans into a unitary whole. The GAM Strategy that condenses the 4-year planning and budgeting requirements of the municipality should serve the purpose of integration.

Table. 18: List of implementation issues to be addressed.

*Voluntary Local Review, 2022; ** Jordan National Natural DRR Strategy, 2019.

7. IMPLEMENTATION, MONITORING & EVALUATION



Picture source: UN Habitat

7.1 IMPLEMENTATION

The City of Amman is implementing the Climate Action Plan through the GAM Strategy 2022 – 2026 that is updated on a regular basis. It is emphasized that the GAM Strategy is gender-responsive and it integrates the principle of equity, especially given that the impacts of decarbonisation and the impacts of climate change and climate variability have disproportionate impacts accruing to vulnerable communities. Both the CAP 2023 and the GAM Strategy are aligned with the CAP 2019 and the GCAP 2021. The GCAP sets Strategic Objectives supporting low-carbon and climate-resilient development up to 2040, and contains an implementation plan that is integrated in the GAM Strategy that is reviewed and updated every four years.

Amman Climate Action Planning is driven from and aligned with the national policies and commitments. This is evidenced in the contribution of GAM to the NDCs and the MRV (measurement-reporting-verification) system under the authority of the Ministry of Environment.

GAM is planning on carrying out a Climate Public Expenditure Review (CPER) consistent with the one being prepared at the national level. This will be beneficial for Amman to showcase Amman effort on fulfilling its commitments concerning Climate Change.

As it is already the case for the GAM Strategy, the sector level adaptation and mitigation strategies and actions are under the responsibility of respective technical divisions and departments in GAM (Table 19). There are strategies that require collaboration with external stakeholders (mainly public institutions like ministries); there are also those that are outside the control of GAM and are implemented by external parties as described in Table 19. The Directorate of the Executive Director of Follow-up at the Office of the Mayor of Amman has the responsibility to coordinate and liaise with external stakeholders regarding the implementation of strategies that are not under the purview of GAM.

Strategy in CAP	Responsible Party
ADAPTATION (with reference to strategies listed in Table 10 and organigram shown in Figure 5)	
Strategy 1	The GAM Planning Directorate, GAM Roads Directorate and the GAM Engineering Directorate (updating the Downtown Amman Masterplan database) are responsible for implementing this strategy.
Strategy 2	Strategy implemented by the GAM Roads Directorate
Strategy 3	The GAM Engineering Directorate (in collaboration with the Ministry of Water and Irrigation) is responsible for implementing this strategy.
Strategy 4	The GAM Planning Directorate is responsible for implementing this strategy.
Strategy 5	This strategy is not under the purview of GAM and is the responsibility of the Ministry of Water and Irrigation and Miyahuna.
Strategy 6	• GAM Planning Directorate (Amman Strategic Master Plan 2060); • GAM Public Facilities; GAM Agriculture and Forestry Directorate; GAM Sustainable Development and Amman Resilience Unit (nature-based solutions / green infrastructure); • GAM Communication Directorate and GAM Sustainable Development and Amman Resilience Unit (Community Engagement Plan); there will be collaboration with the GAM Environmental and Solid Waste Directorate that carries out Environmental Studies and Awareness, and the GAM Information and Communication Directorate; • GAM Roads Directorate (cooling of parking lots). • GAM Project Sustainability Unit (Urban Lungs Project)

Strategy 7	Responsible entities for this strategy are GAM Agriculture and Forestry Directorate; GAM Engineering Directorate; GAM Project Sustainability Unit
Strategy 8	This health sector is not under the purview of GAM. This strategy is implemented by the Ministry of Health.
MITIGATION (with reference to strategies listed in Annex 2 and organigram shown in Figure 5)	
EG1 & EG2	- The generation, supply and sales of utility-scale electricity is not under the purview of GAM. The national strategy to decarbonise the grid is the responsibility of the Ministry of Energy and Mineral Resources (MEMR). The technical codes and financial schemes for promoting grid-connected rooftop PV are also the responsibility of MEMR; - EG2 will also involve GAM Licensing Directorate and GAM Sustainable Development and Amman Resilience Unit.
BEE1 – BEE15	- Jordanian National Building Council (JNBC) for all aspects of energy efficiency in buildings related to enforcement of energy codes; for building energy codes, there will be collaboration with the GAM Licences Directorate and the GAM Districts and City Services Directorate that are mandated to issue building and occupancy licences, and the Jordan Engineering Association; - Jordan Standardization and Metrological Organization (JSMO) for all actions requiring the development of minimum energy performance standards (MEPS) for energy efficiency equipment and materials, and for carrying out market surveillance of the quality standards of same; - GAM (through the Licences Directorate and the Districts and City Services Directorate) will provide non-monetary incentives for the adoption of building energy codes (please see Table 25 also); - The GAM Districts and City Services Directorate is responsible for energy efficiency measures in GAM-controlled operations like public lighting and buildings owned and managed by GAM.
T1 – T4	- GAM Public Transport and Construction of Transport Infrastructure Directorate is responsible for all actions related to mode shift towards public transport; mode shift towards no carbon options like biking and walking; and adoption of public electric vehicles and new transport modes such as cable carts. There will be collaboration with other GAM directorates (e.g. Roads Directorate and Planning Directorate) and the Ministry of Transport; - Ministry of Transport for supporting actions related to the adoption of private electric vehicles (passenger cars and goods vehicles).
SW1 – SW5	The GAM Environmental and Solid Waste Directorate and the GAM Environmental Studies and Projects Directorate are responsible for the implementation of all solid waste management strategies and actions.
WW1 – WW3	The collection and treatment of sewer waste (wastewater) is not under the control of GAM. Miyahuna is responsible for the strategies regarding wastewater management.
IEE1 – IEE2	The implementation of industrial energy efficiency strategies are not under the control of GAM. These strategies will be under the responsibility of MEMR in collaboration with the Ministry of Industry, Trade and Supply, and the Amman Chamber of Industry.
UP1	The GAM Planning Directorate, the Licences Directorate and the Districts Directorate have the responsibility for implementing transit-oriented development through integrated urban planning and control of building and occupancy licences.

Table. 19: Responsibility matrix for the implementation of CAP.

7.1.1 INCLUSIVITY IN ACTIONS

As part of GAM's mandate, there are social programs directed to both refugees and host communities, including providing the needed public infrastructure for social activities, as well as training and capacity building programs directed to youth, women and children. The following are few examples that testify to GAM's inclusive approach in services delivery:

1. In addition to being an adaptation action, UN-Habitat's community garden project (Strategy 7 – Improve urban food security in Table 10) is designed to enhance social cohesion and help local communities, particularly in East Amman, to be inclusive of refugees. The garden is being designed through a participatory approach and is providing vocational training to the participants;
2. The Jordan Renewable Energy and Energy Efficiency Fund (JREEEF), operating under the aegis of MEMR, has been established to provide financial support (partial or full grants) for the implementation of renewable energy solutions and energy conservation measures. One of the aims of the fund is to help poor families. For instance, a previous project has provided full funding for installation of 400 solar water heaters for poor families in Jordan (including Amman). The fund has also helped students through the implementation of energy efficiency and renewable energy measures in public schools. JREEEF is also supporting the installation of solar PV in organizations that provide special care to orphans, people with special needs and the elderly, in order to contribute to reducing their energy bills;
3. The Bus Rapid Transit (BRT) Phase 1 is currently in soft operation and will be opened officially when the Amman –Zarqa BRT infrastructure is completed. This system combined with its proposed expansion, BRT Phase 2, will form one large network, which will be enhanced by a proposed network of feeder buses. The BRT network will offer a cost-effective solution to city traffic. Commuters travelling into the city will be able to transfer from regular buses run by Amman Vision to the BRT at no additional cost. The system will serve to improve the quality and reliability of travel by public transport, and it will reduce travel times, including waiting times, to make public transportation more convenient for passengers. Improvements to the sidewalks

along the BRT routes, and the provision of at-grade crossings, where possible, will make the stops easily accessible, and the buses themselves will be accessible by wheelchair and will be able to accommodate disabled and elderly passengers.

The improved reliability and shorter travel times by bus will provide an important improvement for poor people and particularly women, who rely on safe, comfortable and cheap public transport to commute (work, school, grocery shopping, health care etc..). The shorter waiting times at stops and provision of seating at stops will make it more suitable for the elderly, people with disabilities and women with children, and will also ease safety concerns for women travelling alone. Replacing trips by older public transport vehicles and private cars by trips with modern buses running on cleaner fuel will also improve the living conditions (air quality) in Amman by reducing vehicle emissions that affect human health, particularly for the elderly and the vulnerable (people with underlying health conditions);

4. There are about 3,000 people working as waste-pickers in the informal solid waste sector in Amman, and 22% of waste-pickers in Jordan are Syrian refugees.⁵⁸ GAM is engaging with the waste-pickers to provide them with temporary permits for this work. The contracts will not affect their income and will allow them to work in co-operation with GAM and the private sector. GAM is also raising awareness among the waste-pickers, concerning best solid waste management practices (e.g. occupational safety and health, and recycling).
5. In 2020, GAM carried out a solid waste management campaign "Keeping Our City Clean" in collaboration with EBRD and the EU.⁵⁹ The aim of this EU-funded campaign was to spread awareness among school students of the importance of responsible waste management in keeping the city clean. A main aim was to highlight the importance of both re-use and recycling, to reduce the amount of solid waste going to landfill, and how this can produce environmental and health benefits. The campaign was targeted at 20 government schools and reached over 2,000 students, both Jordanian and Syrian refugees.

Box 6: Urban Micro-Lungs

The Urban Micro-Lungs (UML) initiative is a green infrastructure intervention executed by the project Improving Living Conditions in disadvantaged areas in Amman (ILCA), funded by the German Federal Ministry for Economic Development and Cooperation (BMZ) and implemented by GIZ in partnership with the Jordanian Ministry of Environment and Greater Amman Municipality. The initiative is implemented with the technical expertise of Tayyun Research Studio and aimed at establishing three urban micro-forests in the densely populated area of East Amman.

The UML initiative aimed to bring back nature into the city through a unique planting technique called the Miyawaki Method that utilises meticulous soil engineering to provide the ideal conditions for plant growth. It is used to create a self-sustaining native forest that develops up to ten times faster than conventional methods. These micro-forests provide various environmental benefits by improving air quality, providing shade, and reducing water runoff. The careful selection of plant species, based on the habitat of the area, also ensures that they are drought-tolerant and require little maintenance.

The project utilised a participatory approach involving community members of all ages in the transformation process of the selected areas. The surrounding communities are enabled to enjoy the improved aesthetics and witness the positive health outcomes resulting from the newly established forests

7.2 MONITORING AND EVALUATION

As this document is aligned with the GAM Strategy and the GCAP, it is to be noted that both documents are accompanied by monitoring and evaluation frameworks. In addition, the GCAP provides a list of parameters and indicators that form part of a sector-level (air quality, water quality [including waste water], soil quality, green space, biodiversity & ecosystems, resilience to natural disasters and climate change adaptation, transport, buildings, energy, water availability, solid waste and land use) MRV system. These indicators are connected to mitigation (Table 21 - Annex 2) and adaptation (Table 10) strategies, as well as the co-benefits given in Table 13.

A transparent process has been established for monitoring, evaluating and reporting on the implementation of the GCAP. Supported by two excel-based tools, the aims of this approach are to:

- Track implementation progress of GCAP actions through a Project Management Plan (PMP);
- Identify whether each implemented action is having the desired results and impacts, linking back to state and pressure indicators through the Impact Monitoring Plan (IMP);
- Facilitate learning about what is and what is not working, both in terms of the actions and the management and delivery structures in place within GAM; and
- Determine what adjustments need to be made during the GCAP implementation to maximise the potential positive impacts.

Also, GAM carries out its annual GHG inventory using CIRIS, and this will be the main tool that will be used for tracking progress regarding GHG emission reductions. The annual GHG inventory is carried out under the oversight of the Sustainable Development Unit. As is already the case for the GAM Strategy, the monitoring and evaluation of sector level adaptation and mitigation strategies and actions will be under the responsibility of respective technical divisions and departments (Table 19).

The GAM Urban Observatory, which operates under the GAM Audit & Development of Institutional Performance Directorate, collects data for several indicators. The Inclusive Planning Indicators in the CAP framework that are collected annually by the Urban Observatory are listed in Table 26 (Annex 4).

The scope (e.g. level of resilience from climate risks, mitigation by sector, co-benefit or enabler) of each indicator is given in the right-most column.

The GEF-funded, UNDP-implemented project “Sustainable Urbanization and Resource Efficiency” has provided technical assistance to GAM to measure city performance using WCCD indicators (100 indicators: economy, education, energy, environment, finance, fire and emergency response, governance, health, recreation, safety, shelter, solid waste, telecommunication and innovation, transportation, urban planning, wastewater, water), and the database will be transferred to the GAM Urban Observatory in 2023. The Climate Action Plan is a live document and will be updated every 5 years to assess the comprehensive progress of actions for net-zero emissions by 2050 and achieving other climate goals. GAM is also making efforts to mainstream the climate actions by incorporating them into city’s planning and strategic documents. The GAM Strategic Plan 2022-26 has also integrated the earlier action plans and suggested actions.



Picture source: UN-Habitat

7.3 BARRIERS & CONDITIONALITIES FOR ACHIEVING THE CLIMATE GOALS:

Amman is committed to implement climate actions with a collaborative approach. In order to achieve the climate goals and net zero future, Amman will need to overcome several key barriers and resolve conditional requirements especially synergies on targets and enabling policies, institutional coordination and financial support between national and city level governments for accelerating implementation of climate actions. The detailed strategy level barrier analysis has been conducted to understand the potential hurdles and to find solutions in advance. Some of the key barriers that are important to keep in mind while implementing the actions are explained below.

Legal & Institutional Barriers:

The existing legal framework poses significant challenges to the effective implementation of the outlined climate action strategies in Amman. Specifically, the absence of a comprehensive solid waste management law and national strategy hinders the organization of stakeholder roles, creates overlapping responsibilities, and impedes private sector engagement. Additionally, the lack of control over the national grid and limited influence over the Renewable Energy & Energy Efficiency Law restrict Amman's capacity to independently drive the complete decarbonization of the electricity grid. A crucial need for legal reforms to facilitate circular waste economy business models and govern the transition to renewable energy sources is evident.

Financial Barriers:

Financial constraints emerge as a common obstacle across the different strategies. In the waste management sector, the high cost associated with establishing circular waste economy infrastructure, such as Material Recovery Facilities (MRF) and landfill expansion, poses a challenge. Similarly, financing barriers in the adoption of electric vehicles (EVs) and the development of an EV charging infrastructure affect the transition to low-carbon urban mobility. The upfront capital investment required for enhancing building energy codes in residential and commercial structures stands as a significant financial barrier, especially considering the potential economic burden on vulnerable communities. Securing sustained finance for multi-year adaptation projects like reducing the impact of urban flooding, losses from water supply networks might be challenging with competing priorities. The need for incentivisation models, innovative funding models, public-private partnerships, and international support to address these financial constraints is evident.

Political & Social Barriers:

Political challenges arise from contradictions in strategic documents related to solid waste management and mobility planning. The need for harmonization and congruence at all levels becomes crucial for effective climate action. Additionally, the lack of a national electric mobility strategy and action plan presents a political barrier to the accelerated shift to electric vehicles. Socially, waste-pickers operating in the informal waste economy require consideration, necessitating the establishment of waste-pickers' cooperatives. Overcoming social and cultural barriers to mode shift in urban mobility and public resistance to building energy code enforcement also feature as critical challenges. Ensuring equity and justice in the application of building energy codes to prevent negative financial impacts on vulnerable communities is a social imperative.

Practical & Technological Barriers:

Practical barriers include the need for technological advancements and the establishment of alternative waste management technologies. Implementation hurdles in waste management, such as the lack of mandatory Landfill Gas (LFG) capture systems, hinder progress. The feasibility of large-scale adoption of solar PV and addressing the challenges of dust accumulation in Jordan's context present practical and technological challenges. In the context of urban planning for transit-oriented development, the need for a shift in thinking and the adoption of new urban planning paradigms are practical barriers. Additionally, the lack of energy storage infrastructure for renewable energy sources poses a significant practical challenge, requiring investment in utility-scale energy storage solutions.

Overcoming Barriers for Amman's Climate Action Strategies:

Amman is a wilful and determined city to not let these barriers come in the way of a successful climate action plan and implementation. It has been seen through various initiatives, strategies and the administrative willingness that the city is motivated to work on the initiatives which would help Amman be a sustainable city in the future and fulfil all the NDCs and targets. To overcome the barriers hindering the implementation of the strategies, a comprehensive and collaborative approach is essential.

Each strategy faces specific challenges, and addressing them requires coordinated efforts from governmental, private, and civil society stakeholders. For adoption of policies targeting decarbonisation of grid and waste management, advocacy and public awareness among the citizens is a crucial part. In maximizing the circular solid waste economy, Amman must establish a robust legal framework, with the review and alignment with the National Strategy, and foster circular waste economy models. Public-private partnerships should be encouraged, social inclusion promoted, and waste management technologies should be initiated. Integrated urban planning must be prioritised to take measures for the city to be resilient to disaster. National electric mobility strategy can be developed with a focus on EV infrastructure and local manufacturing. For transit-oriented development, recognizing past planning limitations, strengthening institutional capacities, sustaining political will, and prioritizing capacity-building are essential. To navigate legal and institutional challenges, the city can collaborate with relevant bodies and collaborate with national authorities. Employ innovative financing models, and focus on market transformation for financially viable solutions may be explored. City will also explore possibilities to integrate an internal risk management system for climate actions, minimizing the negative impacts while progressing towards achieving goals of the climate action plan. As stated in the Amman Resilience Strategy, 2017, the city will ensure equity and inclusivity by involving civil society, vulnerable communities and youth groups in various climate actions.



8. ANNEXES

ANNEX 1 – DETAILED GHG INVENTORY, 2019

GHG Emissions Sources (by Sector)		Total GHGs (metric tonnes CO ₂ e)					
		Scope 1	Scope 2	Scope 3	BASIC	BASIC+	BASIC +S3
Stationary Energy	Energy use (all emissions except 1.4.4)	1,183,176	2,921,746	424,530	4,104,922	4,529,451	4,529,451
	Energy Generation Supplied to the grid (1.4.4)	185,615					
Transportation	(All emissions)	1,974,246	799	1,736,579	1,975,045	3,711,624	3,711,624
Waste	Waste generated in the city (III.X.1 and III.X.2)	834,637		82,100	916,737	916,737	916,737
	Waste generated outside city (III.X.3)	196,872					
IPPU	(all IV emissions)						
AFOLU	(all V emissions)	-28,022				-28,022	-28,022
Other Scope 3	(all VI emissions)			1414,476			1414,476
Total		4,346,480	2,922,544	2,243,209	6,996,704	9,129,790	9,271,266

GPC ref No.	GHG Emissions Source (by Sector and Sub- Sector)	Total GHGs (metric tonnes CO ₂ e)			
		Scope 1	Scope 2	Scope 3	Total
I	Stationary Energy				
I.1	Residential buildings	585,634	1,505,083	218,689	2,309,405
I.2	Commercial and institutional buildings and facilities	363,633	1,038,791	150,936	1,553,360
I.3	Manufacturing industries and construction	233,909	285,389	41,467	560,765
I.4.1/2/3	Energy industries	NO	No	No	
I.4.4	Energy generation supplied to the grid	185,615			
I.5	Agriculture, forestry and fishing activities	NO	No	No	
I.6	Non- Specified sources	NO	92,482	13,438	105,920
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	NO			
I.8	Fugitive emissions from oil and natural gas systems	NO			
SUB-Total	(city including frameeork only)	1,183,176	2,921,746	424,530	4,529,451
II	Transportation				
II.1	On-road transportation	1,974,246	799	388,072	2,363,116
II.2	Railways	NO	No	No	
II.3	Waterborne navigation	NO	No	No	
II.4	Aviation	NO	No	1,348,508	1,348,508
II.5	Off-road transportaion	NO	No	No	
SUB-Total	(city including frameeork only)	1,974,246	799	1,736,579	3,711,624
III	Waste				
III.1.1/2	Solid waste generated in the city	784,281		722	785,053
III.2.1/2	Biological waste generated in the city	No		No	
III.3.1/2	Incinerated and burned waste generated in the city	513		108	620
III.4.1/2	Wastewater generated in the city	49,844		81,220	131,064
III.1.3	Solid waste generated outside the city	196,827			
III.2.3	Biological waste generated outside the city	No			
III.3.3	Incinerated and burned waste generated outside the city	No			
III.4.3	Wastewater generated outside the city	No			
SUB-Total	(city including frameeork only)	834,637		82.100	916,737

IV	Industrial processes and product uses				
IV.1	Emissions from industrial processes occurring in the city boundary	NE			
IV.2	Emissions from product use occurring within the city boundary	NE			
SUB-Total	(city including framework only)	1,183,176	2,921,746	424,530	4,529,451
V	Agriculture, Forestry and other Landuse				
V.1	Emissions from livestock	NE			
V.2	Emissions from land	-28,022			-28.022
V.3	Emissions from aggregate sources and non-CO2 emission sources on land	NO			
SUB-Total	(city including framework only)	-28.022			-28.022
VI	Other scope 3				
VI.1	Other scope 3			141,476	141,476
Total	(city including framework only)	3,964,038	2,922,544	2,384,685	9,271,266

Table. 20: City GHG inventory, 2019.

ANNEX 2 – MITIGATION STRATEGIES AND ACTIONS

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
Electricity Generation (EG)		
EG1 – Decarbonisation of grid electricity	Action 1: Increasing the share of renewable energies to %31 of the electricity mix in ;2030 %37 in 2050 in line with mitigation scenario in the NC4	Action 1: Increasing the share of renewable energies to %31 in the electricity mix in %50 ;2030 in %90 ;2040 in 2050 in line with the CCP 2050 - 2022
	Sub-actions: • Formalise the project team with members from JEPCo and clarify the project lead (GAM/JEPCo). • Project team will develop the scope of work and action plan to determine the scale of the intended project/s and geographic focus areas. • Draft detailed budgets and cash flow implementation plans for this capital-intensive project. A Built-Operate Transfer (BoT) or Purchase Power Agreement (PPA) model is envisaged, with details documented as the foundation for the tender scheme • Develop Public-Private Partnerships for catalysing investments	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
EG2 – Increasing distributed generation with solar PV	Action 1: Reducing self-generation from fossil fuel to %12 in %8 ;2030 in %4 ;2040 in 2050	Action 1: Reducing self-generation from fossil fuel to %8 in %5 ;2030 in %0 ;2040 in 2050
	Sub-actions: - Carry out survey to better understand the underlying causes that drive self-generation - Strengthen national grid to improve reliability of supply in order to contribute towards reducing the need for self-generation	
	Action 2: For residential buildings, the share with rooftop PV is: (2040) %10 ;(2030) %5 and (2050) %15. The average installed capacity is fixed at 3 kW.	Action 2: For residential buildings, the share with rooftop PV is: (2040) %15 ;(2030) %8 and (2050) %25. The average installed capacity increases to 3.5 kW (2030) to 4 kW (2040) to 4.5 kW (2050).
	Action 3: For commercial buildings, the share with rooftop PV is: %15 ;(2030) %10 (2040) and (2050) %20. The average installed capacity is fixed at 5 kW.	Action 3: For commercial buildings, the share with rooftop PV is: (2040) %25 ;(2030) %15 and (2050) %35. The average installed capacity is: 5 kW (2030); 5.5 kW (2040); 6 kW (2050).
	Sub-actions: - Review and update tariffs for grid-connected solar PV rooftop installations - Develop and implement incentive system for the adoption of rooftop solar PV generation as part of green building design - Adoption of smart meters	
Buildings (Energy Efficiency) (BEE)		
BEE1 – Increasing the use of lighting control technology for commercial and institutional buildings	Action 1 - All new commercial and institutional buildings will be inspected by technical staff from the SBU (Sustainable Building Unit), newly established under the umbrella of JNBC (Jordanian National Building Council). The staff will validate the implementation of the code of EE lights, according to amended Buildings law number 2018/24. In this way it is expected that the percent of commercial and institutional buildings using lighting control systems will increase from %20 in the base year to %70 by 2030 and %100 by 2040	No additional action
	Sub-actions: - Carry out survey to understand the choice of lighting technologies in commercial and institutional buildings - Integrate the type of lighting control within MEPS for lighting technologies	
BEE2 – Increasing the efficiency of equipment for commercial and institutional buildings	Action 1: JSMO (Jordan Standardization and Metrological Organization) has a mandate to build, implement and update systems compatible with international practices in the field of EE equipment.	No additional action
	Action 2: In the base year %70 of new office computers were star rated this should be increased to %100 by 2040.	No additional action
	Action 3: In the base year %50 of new refrigerators were classed as highly efficient, this should be increased to %80 by 2040 and %100 by 2040.	No additional action
	Action 4: In the base year %40 of new equipment for hotel laundry was considered to be highly efficient, this should be increased to %60 by 2030 and %100 by 2040	No additional action
	Sub-actions: - Develop and enforce MEPS for electrical and electronic equipment - Design incentive schemes to promote the adoption of efficient equipment	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
BEE3 - Improve the efficiency of space heating systems for commercial buildings	Action 1: JNBC will enforce the implementation of EE code for electric heating systems. The target is to increase the percentage of new electric heating systems using efficient electric heat pumps from %40 in the base year to %80 in 2030 and %100 by 2040.	No additional action
	Action 2: JSMO will ensure the availability of efficient heating systems using natural gas (Gas boilers). The target is to increase the percentage of new natural gas heating systems using efficient gas boilers from %20 in the base year to %70 by 2030 and %100 by 2040	No additional action
	Sub-actions: • Same as for BEE2	
BEE4 – Improve the efficiency of cooling systems for commercial buildings	Action 1: JNBC will enforce the implementation of EE code for cooling systems, and the JSMO will ensure the availability of efficient cooling systems in the local markets. In the base year %30 of new buildings were using low efficiency cooling systems and %70 were using mid efficiency cooling systems. By %94 2030 of new buildings will use high efficiency cooling systems and by 2040 this will be %100	No additional action
	Sub-actions: • Same as for BEE2	
BEE5 – Improve the efficiency of water heating systems for commercial buildings	Action 1: JNBC will enforce the implementation of EE code for efficient water heating systems, and the JSMO will ensure the use of the EE solar water heaters and EE gas boilers. In the base year %70 of new electric water heaters were inefficient. This will be reduced to %30 by 2030 and %0 by 2040. In the base year %60 of new water heating systems using natural gas were inefficient, this will be reduced to %20 by 2030 and %0 by 2040	No additional action
	Sub-actions: • Same as for BEE2	
BEE6 – Reduce the number of low flow fixtures in new buildings	Action 1: JNBC will enforce the implementation of water efficient code. JSMO will ensure the availability of the efficient water fixtures systems in the local markets. The percent will be reduced from %80 in the base year to %0 by 2030	No additional action
	Sub-actions: • Same as for BEE2 but for low flow fixtures	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
BEE7 – Improve the insulation of new commercial buildings	Action 1: SBU will enforce the implementation of the thermal insulation code. The target will be implemented in a non-mandatory manner using the concept of net-zero carbon buildings. There will be an incentive scheme to the building developers. This is expected to raise the percent of efficient commercial buildings from %10 in the base year to %70 by 2030 and %100 by 2040. Sub-actions: • Develop and enforce MEPS for building insulation; a ratcheting system must be used by the JNBC to increase the ambition of the minimum energy performance of buildings based on best available technologies periodically • Develop and enforce standards for building insulation materials • Develop energy label for the energy performance of buildings • Design incentive schemes to promote building insulation by applying energy label • Increase awareness in green building design	No additional action
BEE8 – Convert all commercial cooking to electric cookers	Action 1: Jordan standardization and metrological organization (JSMO) fulfils its mandate to build, implement and update systems compatible with international practices in the fields of Energy efficient equipment. In the base year %80 of cooking is carried out on LPG stoves. The percent of cooking being switched to electric stoves will be %20 by %50 ,2030 by 2040 and %100 by 2050 Sub-actions: • Carry out survey to assess the technology needs and choices made in commercial cooking • Review and update MEPS for electric cookers for commercial applications • Design incentive schemes to promote switch towards electric cookers	No additional action
BEE9 – Increasing the use of lighting control technology residential buildings	Action 1: All new residential buildings will be inspected by technical staff from the SBU. The staff will validate the implementation of the code of EE lighting control systems, according to amended Buildings law number 2018/24. It is expected that the percent of new residential buildings using lighting control systems will increase more slowly than for commercial buildings as expertise is developed, from %5 in the base year to %30 by %60 ,2030 by 2040 and %100 by 2050 Sub-actions: • Same as for BEE1	No additional action
BEE10 – Increasing the efficiency of equipment for residential buildings	Action 1: JSMO has a mandate to build, implement and update systems compatible with international practices in the field of EE equipment. The efficiency of appliances is expected to increase to %60 mid efficiency and %40 high efficiency in 2030 to reach %100 efficiency by 2040.	No additional action

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
BEE11 - Improve the efficiency of space heating systems for residential buildings	Action 1: JNBC will enforce the implementation of EE code for electric heating systems. The target is to increase the percentage of new electric heating systems using efficient electric heat pumps from %70 in the base year to %80 in %90 ,2030 by 2040 and %100 by 2050.	No additional action
	Action 2: JSMO will ensure the availability of efficient heating systems using natural gas (Gas boilers). The target is to increase the percentage of new natural gas heating systems using efficient gas boilers from %20 in the base year to %50 by %70 ,2030 by 2040 and %100 by 2050	No additional action
	Sub-actions: • Same as for BEE2	
BEE12 – Improve the efficiency of cooling systems for residential buildings	Action 1: JNBC will enforce the implementation of EE code for cooling systems, and the JSMO will ensure the availability of efficient cooling systems in the local markets. In the base year %20 of new buildings were using high efficiency cooling systems. By %80 2030 of new buildings will use high efficiency cooling systems and by 2040 this will be %100	No additional action
	Sub-actions: • Same as for BEE1	
BEE13 – Improve the efficiency of water heating systems for residential buildings	Action 1: JNBC will enforce the implementation of EE code for efficient water heating systems, and the JSMO will ensure the use of the EE solar water heaters and EE gas boilers. In the base year %70 of new electric water heaters were inefficient. This will be reduced to %30 by 2030 and %0 by 2040. In the base year %60 of new water heating systems using natural gas were inefficient, this will be reduced to %20 by 2030 and %0 by 2040	No additional action
	Action 2: The target is to increase the percentage of new electric cooling systems using electric solar water heaters from %20 in the base year to %90 in 2030 and %100 by 2040	No additional action
	Action 3: The target is to increase the percentage of new LPG cooling systems using LPG high efficiency boilers from %10 in the base year to %70 in 2030 and %100 by 2040.	No additional action
	Action 4: The target is to increase the percentage of new natural gas cooling systems using natural gas high efficiency boilers from %10 in the base year to %90 in 2030 and %100 by 2040.	No additional action
	Sub-actions: • Same as for BEE2	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
BEE14 – Reduce the number of low flow fixtures in new residential buildings	Action 1: JNBC will enforce the implementation of water efficient code. Meanwhile JSMO will ensure the availability of the efficient water fixtures systems in the local markets. The percent will be reduced from %90 in the base year to %100 by 2030.	No additional action
	Sub-actions: • Same as for BEE6	
BEE15 – Introduce better insulation of new residential buildings	Action 1: SBU will enforce the implementation of the thermal insulation code. The target will be implemented in a non-mandatory manner using the concept of net-zero carbon buildings. There will be an incentive scheme to the building developers. This is expected to raise the percent of efficient residential buildings to %90 by 2030 and %100 by 2040.	No additional action
	Sub-actions: • Same as for BEE7	
Transportation (T)		
T1 – Promote shift from Private Car and Taxi to Public Transport	Action 1: There is an increasing mode shift towards public modes of transport as follows: - Minibus: %3 ;(2040) %2 ;(2030) %1 (2040) - Bus: %6 ;(2040) %5 ;(2030) %4 (2040) - BRT: %9 ;(2040) %8 ;(2030) %5 (2040)	Action 1: Ambition is increased in 2050 only for Bus (%8) and BRT (%12) mode shifts. The BRT Phase 2 with additional lines in the West of the city giving better connection to areas to the West and South.
	No action related to aerial tram	Action 2: Aerial tram providing a last km solution for the Downtown area by 2050 and strong demand management measures to be implemented by 2050 (as detailed in TMMP (Transport Mobility Master Plan) GAM, 2008 will help to encourage mode shift to Public Transport to allow shift of %23 by 2050 with implementation of all the projects. Taxi trips and bus trips through the Downtown are expected to be replaced by aerial tram rides giving a mode shift of %2 and %1 respectively by 2040 and %3 and %2 respectively by 2050
	Sub-actions: • Review and update the TMMP based on integrated sustainable urban transport approaches • Promote car-free days in the city centre to promote active mobility and promote mode shift • Adopt Intelligent Transport System for better management of public transport fleet • Implement a SMART on-street parking system • Implement Phase 1 and Phase 2 BRT system with integrated feeder buses	
T2 – Promote shift from Private Car to Walking	No shift takes place	Action 1 – Improvements to the pedestrian realm and the provision of neighbourhood services will encourage a shift to walking of %2 by %4 ,2030 by 2040 and %6 by 2050
	Sub-actions: • GAM to develop a set of policies and regulations to enforce improving the sidewalk condition in Amman, based on clear design guidelines and specifications • Develop a geospatial documentation system (e.g. through GIS) for the sidewalk condition in Amman, including sidewalk, sidewalk imperfections, geometric vertical and horizontal (mis-) alignments, drainage issues, etc. • Identify areas under municipal ownership that can undergo retrofitting for continuity along the BRT catchment area. • Develop design drawings for typical sidewalk upgrades and renovation interventions • Implement pilots in the specified areas on a phased basis • Provide free bus rides from pedestrian pilot areas on selected days	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
T3 – Switch to electric cars/taxis	Action 1: The uptake of electric cars is dependent on the market choices, which could be influenced by promotion of this type of cars and information on the types of savings that could be made in fuel consumption. It is expected that electric cars will become more acceptable if initial difficulties concerning charging infrastructure and replacement batteries can be resolved. Therefore in the ambitious scenario it is assumed that share of electric cars and taxis could increase to %4 in %6 ,2030 in 2040 and %8 in 2050.	Action 1: It is expected that electric cars will become more acceptable if initial difficulties concerning charging infrastructure and replacement batteries can be resolved. Therefore in the ambitious scenario it is assumed that share of electric cars and taxis could increase to %5 in %10 ,2030 in 2040 and %17 in 2050.
	Sub-actions: • Develop financial incentives to support switch towards electric cars / taxis • Design and implement electric vehicle recharging infrastructure, including time-of-day reflective tariffs	
T4 – Switch electric vehicles for public transport	Action 1: For buses, it is assumed that electrification will be at %2 between 2030 and 2050.	Action 1: It is assumed that there will be a further uptake of %2 per 10 year period, giving a share of electric buses of %2 in %4 ,2030 in 2040 and %6 in 2050
	Action 2: For the BRT Phase 1, it is assumed that electrification will be increased to %10 in 2030, thereafter remaining at the same level to 2050.	Different scenarios have been assumed for BRT Phase 2, all diesel; all electric and a mix of diesel and electric. It will be assumed that there will be a mix of diesel and electric buses. the proportion of electric buses will depend on improved technology. Currently electric buses are not considered feasible on all routes, due to the topography of the city. It is assumed that the share of the fleet that are electric will increase to %20 in 2040 with the operation of BRT Phase 2 and increase to %40 by 2050 based on improved technology
	No action proposed	Action 3: Shared taxis will be replaced by minibuses. If the minibuses are purchased by the city, they will be all electric, based on the Mayor's commitment to purchase only electric vehicles
	Sub-actions: • Carry out feasibility studies for the routes identified in the Feeder Study to determine which routes are most suitable for operation by electric buses and which are recommended to be operated by modern diesel buses (in terms of route length, slopes/grades, expected passenger demand, bus stop locations, bus frequency, connectivity with the new BRT system, etc.). Include GAM and the Land Transport Regulatory Commission in the process • Identify costs, procurement procedures, operational needs, implementation logistics, and the operations business modality • Resources mobilisation to access low-cost, patient capital for investments in electric buses	
Solid Waste (SW)		
SW1: Increase the percentage of paper waste that is recycled (currently negligible)	Action 1: There is a %30 target for recycling of waste by 2026 according to National Strategy. It is assumed that recycling will be %30 by %40 ,2030 by 2040 and %50 by 2050	Action 1: If further efforts are made to encourage the recycling of paper it should be possible to achieve %35 in %50 ,2030 by 2040 and %60 by 2050
	Sub-actions: • Formulate an integrated solid waste management strategy and action plan that is aligned with the long-term mitigation strategy of Jordan (to be done in collaboration with all stakeholders) • Design and pilot business models for recycling, including PPPs and integration of solid waste-pickers in the solid waste circular economy • Design and implement solid waste recovery facilities / amenities in most appropriate locations in the city • Improve the Al-Shaer waste transfer station to facilitate waste recovery for circular economy • Design and pilot sorting of solid waste at source to prevent contamination of recyclable waste	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
SW2: Increase the percentage of plastic, metal and textile waste that is recycled (currently negligible)	Action 1: There is a %30 target for recycling of waste by 2026 according to National Strategy. It is assumed that recycling will be %30 by %40 ,2030 by 2040 and %50 by 2050. Note the textile waste will be shredded using a shredder to be provided through a project with EBRD.	Action 1: If further efforts are made to encourage the recycling of these materials it should be possible to increase the percentage recycled from %30 in 2030 to achieve %45 by 2040 and %60 by 2050
	Sub-actions: • Same as for SW1	
SW3: Introduce composting of organic waste: food waste and yard/ wood waste	Action 1: In the National Strategy the percent of composting should be 5 to %10 by 2030. For GAM, it is planned that the percent of organic waste composted will be %5 by ,2030 %10 by 2040 and %15 by 2050.	Action 1: In the ambitious scenario GAM will achieve %5 in %20 ,2030 in 2040 and %30 in 2050 for food waste and %10 in %20 ,2030 in 2040 and %30 in 2050 for yard/ wood waste.
	Sub-actions: • Same as for SW1 • Pilot community composting projects in conjunction with urban agriculture projects • GAM to engage in composting of city green waste to be used in green infrastructure • Partner with large-scale commercial sectors to collect organic waste for composting • Develop national standards for locally produced compost	
SW4: Introduce the use of anaerobic digestion for the treatment of food waste	No action proposed	Action 1: In the ambitious scenario GAM will procure anaerobic digesters, which will enable it to treat food waste by anaerobic digestion: %5 in %10 ,2030 in 2040 and %15 by 2050. Note this is not considered necessary for yard waste.
	Sub-actions: • Same as for SW1 • Pilot small-scale anaerobic digestion technology to demonstrate proof-of-concept • Carry out study to identify alternative uses and enabling conditions for the utilisation of methane produced	
SW5: Increase the landfill gas capture rate	Action 1: The current gas capture rate is %63 and there is expected to be a slight improvement to %64 in %65 ,2030 in 2040 and %66 in 2050.	Action 1: Further improvements can be made to the capping of the landfill that will allow a greater efficiency to be achieved. Support may be available from World Bank. This could achieve %65 by %67 ,2030 by 2040 and %70 by 2050.
	Sub-actions: • Undertake a feasibility study to determine sizing, location and technical requirements for the LFG expansion • Determine preferred approach to financing and procurement • Develop design, specifications and contracts for LFG expansion	
Wastewater (WW)		
WW1: Extend the public sewer network	Action 1: The current public sewer network serves %79 of GAM. This should be extended to serve %82 by %85 ,2030 by 2040 and %88 by 2050.	Action 1: The current public sewer network serves %79 of GAM. This should be extended to serve %85 by %90 ,2030 by 2040 and %100 by 2050.
	Sub-actions: • Carry out feasibility that will inform the planning of the phased extension of the sewer system • Identify best business model for the implementation of the extension	

Mitigation Strategies	Actions (Existing & Planned Scenario, EPS)	Actions (Ambitious Scenario, AS)
WW2: Improve the treatment methods for collected sewage.	Action 1: Currently %4 of sewage is discharged into waterways, with no treatment or only primary treatment. This will be reduced to zero percent by 2030.	No additional action.
	Action 2: The remainder of the solid waste is treated by activated sludge with nitrogen removal. The majority of this is also treated with anaerobic digesters. However %12 of the total sewage is treated by this method but without anaerobic digesters, this will be reduced to %4 in 2030 and 2040 and then phased out completely by 2050.	Action 2: The remainder of the solid waste is treated by activated sludge with nitrogen removal. The majority of this is also treated with anaerobic digesters. However %12 of the total sewage is treated by this method but without anaerobic digesters, this will be reduced to %2 in 2030 and %0 as from 2040.
	Sub-actions: • Upgrade Ain Ghazal treatment plant (requiring design, engineering solutions, site requirements, environmental and social impact assessments) • Develop Al Ghabawi septic tank facility (requiring design, engineering solutions, site requirements, environmental and social impact assessments)	
WW3: Biogas-to-Energy	Action 1: In the baseline %100 of biogas is flared. There is a gradual use of biogas for electricity generation as follows: %75 ;(2040) %50 ;(2030) %25 (2050)	The ambition is increased as follows: %75 ;(2030) %50 (2040) and (2050) %100.
	Sub-actions: • Undertake a feasibility study to determine sizing, location and technical requirements for the biogas-to-energy expansion • Determine preferred approach to financing and procurement • Develop design, specifications and contracts for expansion	
Industrial Energy Efficiency (IEE)		
IEE1 – Improve industrial energy efficiency	Action 1: Increasing industrial energy efficiency by %4 in %8 ;2030 in 2040 and %12 in 2050.	Action 1: Increasing industrial energy efficiency by %8 in %15 ;2030 in 2040 and 20 % in 2050.
	Sub-actions: • Carry out energy audits to identify low hanging fruits for energy efficiency improvements • Develop and enforce standards for industrial equipment • Review and update legal framework for a phased approach adoption of industrial energy efficiency • Develop incentive schemes to accompany the adoption of energy efficiency in industry	
IEE2 – Fuel switch from stationary thermal generation to electrification	No action proposed	Decreasing the share of diesel oil in light industry from %42.4 in 2030 to %40 in 2040 to %35 in 2050. The share of electricity is increased proportionally.
	Sub-actions: • Carry out survey to identify industrial processes that would be most easily electrified • Develop an action plan for the phased electrification of thermal operations • Develop financing schemes to promote modernization of industrial energy switch	
Urban Planning (UP)		
UP1 – Decrease the need for travel through integrated urban planning	Action 1: Increasing the percentage of new households in transit-oriented development from %1 in 2030 to %25 in 2050	Action 1: Increasing the percentage of new households in transit-oriented development from %5 in 2030 to %75 in 2050
	Sub-actions: • Review and update the integrated urban plan to include land use policies and strategies to promote transient-oriented development (TOD) • Review and update the TMMP • Sub-actions related to T1, T2 and T4 (above)	

Table. 21: Summary of strategies and actions for the Existing and Planned scenario and the Ambitious scenario

ANNEX 3 – BARRIERS ANALYSIS FOR EXTENDED SCENARIO

Barriers description table - Strategy #2.

Extended Strategy Name	Strategy #2: Maximizing the potential for circular solid waste economy by 2050
Strategy description / Assumptions	The extended strategy contains the following actions taking place mainly in 2050: 1. Recycling: By 2050, 100% recycling of paper (and plastic) waste compared to 50% in the Ambitious scenario; 2. Organic waste: By 2050, 70% of food waste is composted and 30% of same anaerobically digested compared to 30% and 15%, respectively in the Ambitious scenario. Also, 90% of yard waste is composted in 2050 in the Extended scenario compared to 30% in the ambitious strategy. Textiles wastes are completely shredded and incinerated in the extended strategy compared to 60% in the ambitious strategy; and 3. Landfill gas capture: By 2050, this is increased from 70% in the ambitious strategy to 100% in the extended strategy.
Barrier	Description of Barrier
Legal & Institutional	• The collection, transportation, segregation and disposal of solid waste are under the full authority and control of GAM as per Law No. 18 (2021). • The Al Ghabawi landfill site is the largest landfill in Jordan serving Amman and 10 other major cities. The response strategy for increasing quantities of solid wastes due to rapid urbanization and high influx of refugees has been the expansion of the Al Ghabawi landfill. However, this approach is not deemed to be sustainable for the medium-to-long term disposal of solid waste and sewage sludge. • One of the hurdles the MSW management sector faces is the absence of an effective legal framework. Despite the numerous laws and regulations in the environmental protection context in Jordan, there is an urgent need for a solid waste management law and a national solid waste management strategy which shall organize the roles of the different stakeholders, minimize overlapping responsibilities, and facilitate the engagement of the private sector.⁶⁰ • There is need to Review and update the National Strategy and Action Plan (NSAP) for Municipal Solid Waste 2015-2034 ⁶¹ to integrate non-municipal solid waste and elaborate integrated waste management approaches principles (Ministry of Environment (2020) Waste Sector Green Growth National Action Plan 2021-2025, Amman, The Hashemite Kingdom of Jordan). https://faolex.fao.org/docs/pdf/jor201802E.pdf - accessed 13 March 2023). • A legislative framework is needed for regulating business models for the circular waste economy involving private sector participation. It is expected that the institutional capacity of the Amman Vision Company will be strengthened for managing contractual agreements underpinning the legal framework and innovative business models.
Financial	• GAM is already piloting sorting of waste at source and it is landfill gas for electricity generation (~4.5 MW) at the Al Ghabawi landfill is already being carried out. As far as the setting up of a circular waste economy in Amman, there are other infrastructure projects that are planned such as a Material Recovery Facility (MRF) and the expansion of the Al Ghabawi landfill. • The main constraint is financing. To overcome this barrier, the GAM Strategy 2022-2026 (https://www.ammancity.gov.jo/site_doc/plan062022.pdf - accessed 10 January 2023) plans to establish the enabling conditions for public-private partnerships in the solid waste sector. This will reduce the investment burden of GAM, and increase efficiency of integrated waste management in Amman. Please note overcoming the financing barrier rests on regulatory reforms as mentioned above.

Extended Strategy Name	Strategy #2: Maximizing the potential for circular solid waste economy by 2050
Political & social	<u>Political</u> • Jordan and Amman have several strategic documents for the integrated management of solid waste but there seems to be contradictions between the different documents. Some of the divergences are highlighted below: • The National Municipal Solid Waste Management Strategy (NMSWMS) 2015-34 sets targets for waste sorting at the source, including a diversion of 75% of organic waste and 50% paper waste from landfills (https://www.mola.gov.jo/ebv4.0/root_storage/ar/eb_list_page/(3rd_draft_report).pdf – accessed 14 March 2023), which is very ambitious and that is not reflected in any other public documents be it at the national or sub-national levels (e.g. the Existing & Planned Scenario in the present CAP); • The updated NDC of Jordan mentions only two mitigation actions related to the solid waste sector. The first relates to biogas collection and utilization from 3 landfills (Al-Dulail, Al-Salt and Maddaba), none of which are within GAMs jurisdiction. The second is the composting of pre-segregated bio-waste in four unspecified areas for a total of 200 tonnes per day that is well short of the target set in the NMSWMS (https://unfccc.int/sites/default/files/NDC/2022-06/UPDATED%20SUBMISSION%20OF%20JORDANS.pdf – accessed 13 March 2023); • The Green City Action Plan (2021) prioritizes the construction of an additional cell at the Al Ghabawi landfill. Nevertheless, it also proposes a strategic objective to reduce the amount of landfilled waste by 12% in 2030 through the adoption of circular principles (Greater Amman Municipality & EBRD (2021) Amman Green City Action Plan; https://www.amman.jo/site_doc/AmmanGreen2021.pdf - accessed 10 January 2023); • It is, therefore, necessary to harmonise strategies and action plans for congruence at all levels in order to inform the process of developing a circular waste economy in Jordan and urban centres like Amman. <u>Social</u> • At present, there are waste-pickers who operate in the informal waste economy. Any attempt to formalise the circular waste economy will have to accommodate the waste-pickers from a human rights perspective. • The setting up of a waste-pickers' cooperative has been proposed as a first step towards organizing waste-pickers' activities and to provide a platform for inclusive stakeholder engagements in the process of developing innovative business models for the circular waste economy (LDK Consultants Engineers and Planners SA and Mostaqbal Engineering and Environmental Consultants (2014) Baseline Study on the Existing MSWM System in the Hashemite Kingdom of Jordan; https://www.mola.gov.jo/ebv4.0/root_storage/ar/eb_list_page/(1st_draft_report).pdf – accessed 13 March 2023). • The participation of the local population can be a critical asset in developing the circular waste economy such as contributing to sorting of waste at source and effective use of the MRF. These measures by local citizens can lower costs and increase efficiency. However, a baseline study has found that municipalities in Jordan do not feel concerned with public awareness; nor are they qualified to carry out public awareness effectively (LDK Consultants Engineers and Planners SA and Mostaqbal Engineering and Environmental Consultants (2014) Baseline Study on the Existing MSWM System in the Hashemite Kingdom of Jordan; https://www.mola.gov.jo/ebv4.0/root_storage/ar/eb_list_page/(1st_draft_report).pdf – accessed 13 March 2023). Even if GAM has been noted as an exception, the effectiveness of public outreach regarding waste management has been limited. The following solutions are proposed to overcome barriers: a. Capacity building of GAM staff (e.g. Environmental Studies & Awareness Unit) to engage with multiple stakeholders and to develop outreach campaigns; b. Developing dedicated budget for public awareness; c. Fostering partnerships between the public sector, the private sector, academic institutions and NGOs should be established to ensure effective and successful implementation of public awareness and education programs.

Extended Strategy Name	Strategy #2: Maximizing the potential for circular solid waste economy by 2050
Practical technological &	- The City of Amman should start piloting of alternative technologies for integrated waste management such as recycling, composting, anaerobic digestion and waste-to-energy. The following technological hierarchy should be adopted for the extended strategy (Ministry of Environment (2020) Waste Sector Green Growth National Action Plan 2021-2025, Amman, The Hashemite Kingdom of Jordan; https://faolex.fao.org/docs/pdf/jor201802E.pdf - accessed 13 March 2023): - landfilling is limited to residual (i.e. non-recyclable and non-recoverable) waste; - energy recovery is limited to non-recyclable materials; - recycled waste is used as a major, reliable source of raw material, through the development of non-toxic material cycles; - food waste is recycled as organic material or nutrient material. - Need to make LFG capture system in new cells at the Al Ghabawi landfill mandatory, as well as when planning the refurbishment of non-engineered / open landfills for the treatment of solid waste generated in Amman.
Other (please specify)	Not applicable.

Table. 22: Barriers description table - Strategy #2.

Barriers description table - Strategy #3

Extended Strategy Name	Strategy #3: Accelerated shift from private transportation towards public transportation and no carbon urban mobility combined with 100% EV adoption by 2050
Strategy description / Assumptions	The extended strategy for land transportation combines two principles, namely: (i) mode shift away from private transport towards public transport, and walking and biking (the latter supported by Strategy #4 related to integrated urban planning); and (ii) electrification of the land transport sector. In the Ambitious scenario, private cars and taxis contribute 21% and 5.7% of total travel demand in 2050. In the Extended scenario, the share of private cars and taxis in total travel is reduced to 10% and 3%, respectively. The reduction in car travel is accompanied by mode shifts towards public transport (buses and BRT), and no carbon mobility such as walking and biking. For instance, the share of BRT is 12% (2050) in the Ambitious scenario and it is 25% (2050) in the Extended scenario; the shares of biking and walking are increased from 3% to 10%, and from 6% to 10%, respectively, between the two scenarios in 2050. In the extended strategy, all passenger automobiles (private cars and taxis) are electric in 2050 compared to 17% in the ambitious case. There is also higher penetration of electric transit vehicles in 2050 in the extended strategy compared to the ambitious strategy: BRT – 80% versus 40%; Standard bus – 60% versus 6%; minibus – 25% versus 3%. The mode shift will require significant changes in terms of integrated urban planning, as well as investments in public infrastructure to facilitate accessibility and mobility on foot and biking. These issues are under the full control of GAM. In contrast, policies and policy instruments to favour the adoption of electric vehicles are developed at the national level. In order to realise the extended strategy (#3), the barriers discussed below have to be addressed. It is pointed out that since urban planning has a direct influence on mobility and accessibility, the barriers discussed for Strategy #4 are also relevant for modal shift towards low-carbon / no carbon transportation.

Extended Strategy Name	Strategy #3: Accelerated shift from private transportation towards public transportation and no carbon urban mobility combined with 100% EV adoption by 2050
Barrier	Description of Barrier
Legal & Institutional	<u>Mode shift</u> - A study carried out in Amman has identified past, present and future mobility challenges arising from poor planning. In general, Amman's westward and northward growth has not been accompanied by transportation planning policies coordinated with land use policy.(Fuad Tahboub (2021) Towards Sustainable Urban Mobility in Amman: an overview of the Amman BRT project – impacts and expectations; https://dumas.ccsd.cnrs.fr/dumas-03359402/document - accessed 14 March 2023). The mode shift will result from a combination of integrated urban planning to support low-carbon/no carbon mobility options, and a coherent urban mobility plan to favour public transit systems. The former calls for strengthening the capacity of GAM to carry out integrated urban planning (e.g. Planning Directorate), while the second will require updating the existing Transport Mobility Master Plan 2010(http://www.ammanbrt.jo/contents/Articles/2020/4/20/%D8%A7%D9%84%D9%85%D8%AE%D8%B7%D8%B7%D8%A7%D9%84%D8%B4%D9%85%D9%88%D9%84%D9%8A%D9%84%D9%84%D9%86%D9%82%D9%84%D9%88%D8%A7%D9%84%D8%AD%D8%B1%D9%83%D9%87%D9%81%D9%8A%D9%85%D8%AF%D9%8A%D9%86%D8%A9%D8%B9%D9%85%D8%A7%D9%86160322.pdf – accessed 14 March 2023). - The Transport Mobility Master Plan should be informed using the recommendations contained in the report Mainstreaming Transport and Mobility into Jordan's Urban Policy Thematic Guide (UN-Habitat (2021) Mainstreaming Transport and Mobility into Jordan's Urban Policy Thematic Guide; https://unhabitat.org/sites/default/files/2022/02/transportthematic_guide_en.pdf - accessed 14 March 2023) <u>Electrification</u> - The updated NDC already contains several mitigation actions to 2030 that are supportive of a transition towards the extended strategy. The NDC contains (i) Phase 2 of the BRT project in Amman; (ii) the promotion of hybrid and electric vehicles (50% public fleet will be EVs and it assumes a 2% annual uptake of private car EVs) and (iii) electric bus fleet in Amman. Institutionally, GAM is involved only in the electrification of its own fleet of vehicles and the fleet of public transit vehicles that face technical and financial barriers.
Financial	- The main constraint for GAM is financing for the electrification of its own fleet of vehicles and the electrification of vehicles used in public transportation. One way for reducing the cost burden on GAM is the adoption of new business models involving private operators and/or public-private partnerships. The GAM Strategy 2022-2026 (https://www.ammancity.gov.jo/site_doc/plan062022.pdf - accessed 10 January 2023) plans to better structure individual operators in public transport, and it should avail of this opportunity to create the enabling conditions for the electrification of public transport. - The adoption of public-private partnerships can also help to reduce the investment burden of GAM, especially for large infrastructure projects including electric charging facilities. - The Transport Sector Green Growth National Action Plan 2021-2025 (http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/20022_jordan_transport_v10_rc_web.pdf - accessed 14 March 2023) proposes to Approve and Activate the National Public Transport Fund for investments in public transport infrastructure. Although the administration of the Fund is under the purview of national government, its successful capitalisation will benefit GAM. - The cost associated with charging of EVs can play a barrier for individuals to invest in EVs. To overcome this barrier, the electricity utility may design time-of-use electricity tariffs to lower the cost of EV charging. Alternatively, national government incentives to install rooftop solar PV may be provided to support the adoption of EVs.

Extended Strategy Name	Strategy #3: Accelerated shift from private transportation towards public transportation and no carbon urban mobility combined with 100% EV adoption by 2050
Political & social	<u>Political</u> - As mentioned earlier, the electrification of land transportation is a matter of national policy. One of the main impediments regarding the implementation of the electrification component of the extended strategy is the lack of a national electric mobility strategy and action plan that would provide a template for adoption in municipalities, including GAM (http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/20022_jordan_transport_v10_rc_web.pdf - accessed 14 March 2023). The formulation of this strategy and action plan should be aligned with the climate objective of a net-zero Jordan by 2050. - The electrification of the land transport sector will have to be taken into account in the post-2030 Energy Sector Strategy. <u>Social</u> - The choice of mode of transport is to a significant extent culturally-determined. Social and cultural barriers for modal shift towards public transport, walking and biking can be expected to persist in the absence of educational and awareness, and proof-of-concept initiatives. Sociological research has shown that inhabitants of Amman spend a significant amount of their time and money to acquire a car, and that the trend is for more than one car per family regardless of socioeconomic means. Also, public transport is used mainly by those who are in the lowest socioeconomic group, implying that there is a strong socioeconomic vulnerability and gendered element of transportation that needs to be well understood prior to decision making regarding the most needs-based, socially-relevant alternative modes of transportation (Fuad Tahboub (2021) Towards Sustainable Urban Mobility in Amman: an overview of the Amman BRT project – impacts and expectations; https://dumas.ccsd.cnrs.fr/dumas-03359402/document - accessed 14 March 2023). - The Transport Sector Green Growth National Action Plan has provided examples of public initiatives that may be pursued in order to overcome social and cultural barriers: (i) the implementation of a pedestrian green infrastructure enhancement program in local commercial areas and near public transport; and (ii) the deployment of Intelligent Transportation Systems (ITS) to allow a modal and fare integration of the public and private transport systems in the city of Amman. Other social and cultural determinants such as improved lifestyle, city liveability and quality of life should be emphasized in public outreach campaigns. - There may also be the persistent myths that EVs are for the wealthy (being more expensive) and/or that they are not as reliable as conventional vehicles. For the former, the proposed national e-mobility strategy and action plan will have to provide policy instruments (e.g. economic and financial incentives for EVs / disincentives for conventional vehicles) to make investments in EVs more attractive. For the latter, the deployment of EVs by GAM can be used as proof-of-concept to showcase the reliability of EVs.

Extended Strategy Name	Strategy #3: Accelerated shift from private transportation towards public transportation and no carbon urban mobility combined with 100% EV adoption by 2050
Practical & technological	<u>Mode shift</u> - Not applicable since the technologies are known and available. There is only need for scaling up that face the other barriers. <u>Electrification</u> - The main impediment is the availability of an adequate charging network infrastructure (and affordable pricing) in the city. At the present time, there is virtually no such infrastructure in Amman. The updated Transport Mobility Master Plan will have to include the plan for such an infrastructure in Amman based on the national e-mobility strategy and action plan that needs to be developed. - The City can also support the construction of the charging infrastructure by streamlining the municipal licensing and permits process for building charging stations. - A long-term national strategy that will support the large-scale adoption of EVs is investment in a local industry for the manufacture/assembly and recycling of batteries. Such an effort can be spearheaded by GAM to attract foreign direct investments in the City of Amman
Other (please specify)	Not applicable.

Table. 23: Barriers description table - Strategy #3.

Barriers description table - Strategy #4

Extended Strategy Name	Strategy #4: Integrated urban planning to maximise the potential for transit-oriented development by 2050
Strategy description / Assumptions	In the extended strategy, the proportion of new households in transit-oriented developments will be 100% in 2050 compared to 75% in ambitious strategy. Also, due to integrated urban land use planning and enforcement, the requirement for trips will be significantly reduced by factor 0.75. The implementation of the strategy faces the barriers that are discussed below.
Barrier	Description of Barrier
Legal & Institutional	- Urban planning is fully under the purview of GAM. As discussed for Strategy #3, the City of Amman has witnessed sprawl, especially towards the west and the north, resulting in new settlements in low-density areas that do not have adequate transportation facilities (Fuad Tahboub (2021) Towards Sustainable Urban Mobility in Amman: an overview of the Amman BRT project – impacts and expectations; https://dumas.ccsd.cnrs.fr/dumas-03359402/document - accessed 14 March 2023). This has increased the need for private transportation and the need to undertaking longer trips. - Notwithstanding the fact that the City of Amman has had to confront recurrent refugee crises arising from regional geopolitical instabilities, there are systemic problems related to urban planning. GAM recently prepared a report entitled Amman City's Institutional Performance and COVID-19 Resilience (https://drive.google.com/file/d/1vVImT762BDWDBieJ4auvxMqMQhhk2N-7/view - accessed 15 March 2023), revealing that the city's design fuels low public space provision and weak access to local healthcare services, limiting the self-sufficiency of individual neighbourhoods and negatively affecting quality of life and resilience. Hence, there is an inherent mismatch between people's daily needs (e.g. grocery shopping, school, work, leisure amenities, health centres etc..) and the distant locations where these services are provided. - There is call for the preparation of a new Master Plan. However, despite the adoption of at least two master plans in the interim⁶², the same urban challenges have persisted for more than forty years. This implies that a new master plan is not the ideal solution for said challenges. Rather, Amman's urban challenges may be attributed to weak implementation of previous plans or perhaps even to the inappropriate actions proposed in them altogether (https://www.theigc.org/blogs/prospectus-city-growth-rethinking-planning-amman - accessed 14 March 2023). - The first Strategic Goal of the GAM Strategy 2022-2026 is 'Comprehensive and Sustainable Urban Planning'. The way forward in terms of integrated spatial planning will be to recognise that the current planning system and the planning models the city has adopted in the past did not function properly, and may not be adequate to solve current and future urban challenges, including a shift towards transient-oriented development. GAM will also have to strengthen its human and institutional capacities for implementing integrated urban plans.
Financial	- There are no significant barriers to implementing this extended strategy since it is not capital intensive⁶³. Rather, it calls for investments in human and institutional capacities related to the paradigm or ideology (e.g. Is transit-oriented development an element of the existing planning approach?) that is used to carry out integrated urban planning (https://www.theigc.org/blogs/prospectus-city-growth-rethinking-planning-amman - accessed 14 March 2023), drawing lessons learned of what has not worked in the past, and investing in the implementation and enforcement capacities of GAM. - Data analytics are a key element for informed decision making. The GAM Strategy 2022-2026 (https://www.ammancity.gov.jo/site_doc/plan062022.pdf - accessed 10 January 2023) already plans to put in place a comprehensive urban database that enhances planning capacity and making decisions based on institutional knowledge.

Extended Strategy Name	Strategy #4: Integrated urban planning to maximise the potential for transit-oriented development by 2050
Political & social	<u>Political</u> - This is not a significant barrier since GAM has demonstrated the political will to carry out integrated urban planning. As discussed earlier, the issues relate to the approaches used for transcribing the political will into purposeful action to enhance the quality of life of inhabitants in Amman. <u>Social</u> - The purpose of integrated urban planning to promote transit-oriented development has as its proximate objective to enhance the quality of life of citizens. Since the primary beneficiaries are the inhabitants of the city, it is necessary to first understand their needs and expectations. However, more than 50% of the inhabitants report that they cannot influence public decision making (overview of the Amman BRT project – impacts and expectations; https://dumas.ccsd.cnrs.fr/dumas-03359402/document - accessed 14 March 2023). Hence, there is need for GAM to better integrate local stakeholders in the urban planning process. One good example could be the integration of the views and suggestions of local communities in the process of developing the Amman Spatial Profile (see section 2.3). - Further, the reduction in travel demand arising from transit-oriented urban planning will potentially have negative financial impacts on private and individual operators in the public transport system. If not dealt with adequately, there can be resistance to change on the part of these operators.
Practical & technological	There are no technological barriers per se apart from adopting new ways of thinking about urban planning that integrate transit-oriented development as discussed above.
Other (please specify)	Not applicable.

Table. 24: Barriers description table - Strategy #4.

Barriers description table - Strategy #5

Extended Strategy Name	Strategy #5: Application of most stringent building energy codes in residential and commercial buildings by 2050
Strategy description / Assumptions	The extended strategy is underpinned by the most stringent application of energy codes in existing buildings in the City of Amman. Since the new buildings will be compliant with the most stringent building energy codes in the Ambitions scenario, the extended strategy for new buildings focuses on fuel energy switch. As discussed further, it is envisaged that significant barriers will have to be surmounted in order to achieve targets. <u>New buildings</u> Since the national grid is expected to be fully decarbonized in the Extended scenario (Strategy #1), it is proposed that fuel used for space cooling and heating, and cooking will be 100% electric in the extended scenario. In the Ambitious scenario, space cooling and heating use high efficiency thermal energy sources, and cooking is done with LPG. <u>Existing buildings</u> For the residential sector, the policy lever is to enforce the adoption of Improved 2 and Triple Glazing in 90% of the existing park of buildings in the Extended scenario in 2050 compared to Improved 1 and Double Glazing in 30% of buildings in the Ambitious scenario. For the commercial sector, the ambition is even higher with the adoption of Improved 3 and Triple Glazing in 60% of buildings and Improved 2 and Double Glazing Low-E windows in 40% of buildings in 2050. In the Ambitious scenario, 60% of buildings have Improved 2 and Double Glazing with Low-E, and the remaining buildings adopting less efficient insulation in 2050.
Barrier	Description of Barrier
Legal & Institutional	- The development of building energy codes or minimum energy performance and standards (MEPS) for equipment used in buildings is not under the purview or control of GAM. The Jordan National Building Council is responsible for developing building energy codes, and it is also responsible for enforcing the implementation of the codes. Regarding energy efficient equipment, the mandate for developing and enforcing MEPS and standards and labels rest with the Jordan Standards and Metrology Organisation (JSMO). - A ratcheting process will have to be adopted for making building energy codes and MEPS more stringent in terms of energy efficiency requirements over time to reflect the dynamic nature of energy efficiency markets and best available technologies. - Nevertheless, GAM has a critical role to play in the institutional nexus for enforcing the application of building energy codes through the issuance of building construction and occupancy permits / licences. A mechanism has been established by the UNDP-GEF project entitled "Sustainable Urbanization and Resource Efficiency" whereby the GAM database for building licences and permits has been linked with that of the JNBC so that enforcement of building codes are duly enforced.

Extended Strategy Name	Strategy #5: Application of most stringent building energy codes in residential and commercial buildings by 2050
Financial	- The higher upfront capital investment of building energy codes and MEPS remains a financial barrier for the uptake of energy efficiency in buildings, especially since lifecycle assessments are yet to become entrenched in financial and economic decision making. A recent World Bank study has estimated the total cost of applying green building codes in 948,000 existing and new buildings in Amman to USD 953.7 million (IBRD & World Bank (2022) Amman urban growth scenarios: pathways towards a low-carbon future, World Bank, Washington DC) - There are potentially two ways in which GAM is related to this financial barrier, namely: (i) higher capital investments required for future GAM municipal buildings; and (ii) GAM providing monetary and non-monetary incentives for the adoption of building energy codes. Regarding (i), GAM is well-placed as a public institution to raise low-cost capital ⁶⁴. Further, it is expected that innovative business models such as Energy Services Companies (ESCOs) will be available for sharing the burden of capital and operational costs. As a general rule, the City of Amman should also prospect the use of internationally transferred mitigation outcomes (ITMOs) as per Article 6 of the Paris Agreement in order to partially finance capital investments that would reduce GHG emissions.⁶⁵ Regarding (ii), GAM is already trialing indirect financial incentives to adopt existing building energy codes through increased floor area ratio (FAR). In addition, fiscal incentives in the form of lower real estate and housing taxes can be contemplated, while ensuring the financial sustainability of GAM. - Financial barriers may also have social implications for poor and vulnerable persons / communities that are discussed below.
Political & social	<u>Political</u> - The revised NDC for Jordan does not contain any mitigation action related to energy efficiency in buildings. GAM can play a significant role because of its institutional position in regulating the adoption of building energy codes through the building construction and occupancy licensing and permits process (in collaboration with the JNBC). - GAM has recently demonstrated its leadership in the building sector by being the lead implementing institution for the UNDP-GEF project entitled "Sustainable Urbanization and Resource Efficiency". This project has produced several results that can be scaled up to overcome barriers confronting the extended strategy. Some of the results are (not exhaustive): - Establishing an institutional mechanism with the JNBC for the enforcement of building codes - Demonstration of the socioeconomic and environmental benefits of investing in building energy codes in municipal and private buildings - Developing retrofit guidelines for enhancing the energy efficiency of existing buildings <u>Social</u> - The main issue here relates to the application of equity and fairness so that the implementation of mandatory codes and MEPS has a detrimental financial impact on poor and vulnerable persons / communities. Consequently, financial support must be provided to these targeted persons / communities to ensure that they are not adversely affected by the need for deep decarbonisation. The principle of climate justice needs to be taken into account. - Another related element relates to the stigmatisation of poor and vulnerable communities that typically live in low cost housing that are not well insulated. A co-benefit of the extended strategy, when implemented using the principle of fairness and equity, is to eliminate this stigmatisation. Also, the savings on energy bills will have a relatively higher positive impact of low-income household. This is another reason for not leaving them behind.

Extended Strategy Name	Strategy #5: Application of most stringent building energy codes in residential and commercial buildings by 2050
Practical & technological	There are no technological barriers per se since the market for the thermal insulation of buildings already exists as well as energy efficient appliances that are used inside buildings. The main issue is the transformation of the national market for the best available technologies through a combination of legal (ratcheting process to update codes and MEPS) framework, institutional mechanism for enforcement of codes and MEPS, monetary and non-monetary incentives, and ensuring that poor and vulnerable persons are not adversely affected by more stringent regulatory requirements.
Other (please specify)	Not applicable.

Table. 25: Barriers description table - Strategy #5.

ANNEX 4 – URBAN OBSERVATORY INCLUSIVE PLANNING INDICATORS

Domain	Sub-domain	Indicator	Scope
Health and wellbeing	Physical health	Life expectancy at birth	Co-benefit
		Number of deaths from natural disasters per 100,000 population	Resilience (impacts of climate change and extreme events such as flooding)
		Under 5 infant mortality rate	Co-benefit
	Mental health	Number of mental health practitioners per 100,000 population	Co-benefit
		Suicide rate	Co-benefit
	Health care	Number of in-patient hospital beds per 100,000 population	Co-benefit
	Well-being and safety	Number of road traffic related injuries and fatalities	Mitigation (on-road transportation) / co-benefit
		Emergency response time	Co-benefit
		Homicide rate per 100,000 population	Co-benefit
Planet	Air quality	Mean average exposure to PM2.5 and PM10 concentrations (milligrams per cubic metre)	Co-benefit (mitigation - on-road transportation)
		Mean average exposure to NO2 concentrations (milligrams per cubic metre)	
	Green infrastructure	Percentage of urban area that is greenspace	Climate resilience / co-benefit
		Urban tree canopy - number of trees	

Domain	Sub-domain	Indicator	Scope
Planet	Environmental awareness	Percentage of household waste that is recycled	Mitigation (solid waste) / co-benefit
		Volume of waste generated per person or household	Mitigation (solid waste)
		Volume of waste collected from littering	Co-benefit
		Energy consumption per capita or household	Mitigation (energy use in buildings and transportation)
		Water consumption per capita or household	Climate resilience
	Vulnerability to natural hazards	Number of incidences of natural hazards (e.g., excessive heat, droughts, flooding, landslides, earthquakes, cyclones)	Climate resilience
	Renewable energy	Percentage of total energy coming from renewable sources, as a share of the city's total energy consumption	Mitigation (energy use)
		Percentage of population with electrical service supported by renewable energy	
Education and skills	Education attainment	Number of schools and universities	Enabler
		Percentage of student population completing primary education	
		Percentage of student population completing secondary education	
	Education quality	Ratio of students to teachers	
		Percentage of population that is literate	
		Percentage of population that is numerate	
Economic prosperity	Employment	Unemployment rate	Enabler & co-benefit
		Number of jobs	Enabler
	Economic innovation	Number of new patents	
		Number of start-ups	
	Income and poverty	Median household income	
		Median disposable income	
	Productivity	Average time taken for daily commute	Co-benefit & mitigation (on-road transportation + transit-oriented development)
Essential public services	Energy	Percentage of population with electrical service	Co-benefit
		Number of electrical interruptions per customer per day/week/month/year	
	Housing	Percentage of the population in slums and informal settlements	Mitigation (energy use in buildings)

Domain	Sub-domain	Indicator	Scope
Essential public services	Solid waste	Percentage of population with regular solid waste collection at home	Mitigation (solid waste) & co-benefit
		Percentage of city solid waste regularly collected with adequate final discharge	
	Transportation	Kilometres of bicycle paths and lanes per 100,000 population	Mitigation (on-road transportation) & co-benefit
	Water and sanitation	Percentage of households connected to sewage system	Mitigation (waste water)
		Percentage of population with access to sanitation services	Co-benefit
		Percentage of the city population with safely managed drinking water services	Climate resilience & co-benefit
		Percentage of city wastewater by treatment type (i.e., primary, secondary, tertiary)	Mitigation (waste water)
		Percentage of water loss (unaccounted for water) in water supply system	Climate resilience & mitigation (water supply network)
	Technology and communications	Percentage of population with mobile internet coverage (e.g. 4G)	Climate resilience & co-benefit
		Percentage of people using the internet	
Institutions and governance	Voter participation	Voter turnout for local elections	Enabler
		Number of registered voters	
	Representation	Representation in local government	
		Representation in police force	
		Number of local officials elected per 100,000 population	

Table. 26: Inclusive Planning Indicators collected by the GAM Urban Observatory.

Source: GAM Urban Observatory

9. ENDNOTES

1 Coordination meetings were held fortnightly between November 2022 and February 2023 to track progress and to inform the CAP update process.

2 <https://leap.unep.org/countries/jo/national-legislation/law-municipalities-no41-2015> - accessed 30 January 2023; Greater Amman Municipality (2022) Voluntary Local Review: The City of Amman, Jordan, pg. 23-24.

3 Coordination meetings were held fortnightly between November 2022 and February 2023 to track progress and to inform the CAP update process.

4 Resilient Cities Network (2017) Amman Resilience Strategy.

5 UN-Habitat (2021) Developing a Preliminary Design for Flood Mitigation and Performing a Flood Risk Assessment and Flood Hazard Mapping for Downtown Amman.

6 Greater Amman Municipality & EBRD (2021) Amman Green City Action Plan.

7 World Bank Group (2022) Jordan Country Climate and Development Report.

8 UNEP, year 2005 <https://leap.unep.org/countries/jo/national-legislation/environmental-impact-assessment-regulation-no-37-2005> - accessed 12 June 2023.

9 <https://www.giz.de/en/worldwide/83767.html> (and documents available through the site) – accessed 12 June 2023.

10 Greater Amman Municipality (2022) GAM Strategy 2022-2026.

11 Greater Amman Municipality & EBRD (2021) Amman Green City Action Plan, pp. 30-43.

12 UN-Habitat (2021) Amman Urban Profile, pp. 164-178.

13 Greater Amman Municipality (2022) Voluntary Local Review: The City of Amman, Jordan.

14 UN-Habitat (2022) Amman Urban Profile.

15 Department of Statistics (2022) Population Estimates of the Kingdom by Municipality and Sex for the end of Year 2021.

16 UN-Habitat (2022) Amman Urban Profile.

17 UN-Habitat (2022) Amman Urban profile, pg. 62.

18 According to the World Bank (2020) Greater Than Parts: Metropolitan Case Studies, there were are 1,080,716 Palestinian refugees, 193,361 Syrian refugees, 121,000 Iraqi

refugees and 27,000 Yemeni refugees in Amman in 2020.

19 UN-Habitat (2022) Amman Spatial Profile, pg. 82.

20 Green City Action Plan, 2021.

21 Greater Amman Municipality (2022) Voluntary Local Review: The City of Amman, Jordan.

22 The national government contribution to GAM's budget is minimal and typically comes from the proceeds of the 8% fossil fuel tax; UN-Habitat (2022) Amman Urban Profile, p.168.

23 Greater Amman Municipality (2022) Voluntary Local Review, pg. 23.

24 Great Amman Municipality (2022) GAM Strategy 2022 – 2026, pg. 256.

25 Voluntary Local Review, 2022, pp. 82–89.

26 Voluntary Local Review, 2022, pp. 83-84.

27 <https://ppp.worldbank.org/public-private-partnership/library/ppp-laws-concession-laws-jordan>; accessed 26 February 2023.

28 Voluntary Local Review, 2022, pg. 86.

29 UN-Habitat (2022) Amman Urban Profile, pp. 155-161.

30 <https://library.fes.de/pdf-files/bueros/amman/19445.pdf> - accessed 11 May 2023.

31 UNICEF (2021) Children in Jordan at Risk of the Impacts of the Climate Crisis.

32 Hashemite Kingdom of Jordan (2019) Jordan National Natural Disaster Risk Reduction Strategy 2019-2022.

33 Jordan National Natural Disaster Risk Reduction Strategy 2019-2022, pg. 15.

34 Jordan National Natural Disaster Risk Reduction Strategy 2019-2022, pp. 11-12.

35 The ND-GAIN Index ranks countries using a score that calculates their vulnerability to climate change, other global challenges, and their readiness to improve resilience.

36 Jordan Country Climate and Development Report, 2022, pg. 5.

37 <https://climateknowledgeportal.worldbank.org/country/jordan/vulnerability> - accessed 30 January 2023

38 21st Century Climate Change Projections of Precipitation and Temperature in Jordan

39 Dar (2021) Developing a Preliminary Design for Flood Mitigation Measures and Performing a Flood Risk Assessment and Flood Hazard Mapping for Downtown Amman.

40 Voluntary Local Review, 2022, pg. 77.

41 http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/final_draft_nap-2021.pdf - accessed 12 June 2023

- 42 <https://www.arabnews.com/node/2186541/middle-east> - accessed 29 March 2023.
- 43 <https://www.c40.org/case-studies/amman-urban-micro-lungs-initiative/> - accessed 29 March 2023.
- 44 Voluntary Local Review, 2022, pg. 78.
- 45 UN-Habitat (2021) Amman Spatial Profile.
- 46 World Bank Group (2022) Jordan Country Climate and Development Report, pg. vii.
- 47 It is pointed out that the GCAP did not carry out mitigation scenario analysis.
- 48 Appendix D in the GCAP provides a list of environmental indicators that should be used to monitor the state of the environment in Amman.
- 49 United Nations Office for Disaster Risk Reduction (2022). Global Assessment Report on Disaster Risk Reduction 2022: Our World at Risk: Transforming Governance for a Resilient Future. Geneva.
- 50 Intergovernmental Panel on Climate changeC (2021) Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press. Cambridge.
- 51 Water Scarcity Clock. 2021. Water Scarcity Clock (worldwater.io)
- 52 Water Risk Atlas, 2021. Aqueduct Water Risk Atlas (wri.org)
- 53 Ministry of Water and Irrigation, 2017. Jordan Water Sector-Facts and Figures, Amman, Jordan.
- 54 According to UNHCR statistics, the Governorate of Amman has received most of these refugees entailing significant adverse socioeconomic and environmental impacts. See for example: Hamzah Khawaldah, Nidal Alzboun (2022) Socio-economic and environmental impacts of Syrian Refugees in Jordan: A Jordanians' perspective, Heliyon 8(8): e10005; <https://doi.org/10.1016/j.heliyon.2022.e10005>.
- 55 Ministry of Water and Irrigation, 2018. (National Water Strategy of Jordan 2016-2025, MWI, Amman, Jordan.
- 56 <https://www.jordannews.jo/Section-109/News/Energy-storage-station-near-Wadi-Mujib-dam-Kharabshah-21941> - accessed 10 May 2023.
- 57 UNDRR (2022) Data and Digital Maturity for Disaster Risk Reduction – Informing the Next Generation of Disaster Loss and Damage Databases; <https://www.undrr.org/media/84892/download> - accessed 30 January 2023.
- 58 <https://www.jordannews.jo/Section-106/Features/Gov-t-seeks-to-organize-work-of-waste-pickers-in-Jordan-21424> - accessed 29 March 2023.
- 59 <https://www.ebrd.com/news/2020/ebd-and-eu-raise-awareness-about-waste-management-in-jordanian-schools.html> - accessed 12 June 2023.
- 60 Husam A. Abu Hajar et al. (2020) Assessment of the municipal solid waste management sector development in Jordan towards green growth by sustainability window analysis, Journal of Cleaner Production 258: 120539; <https://doi.org/10.1016/j.jclepro.2020.120539>.
- 61 The NSAP which prioritizesmitigating against environmental degradation throughrehabilitation of dumpsites, adding proper fencing,adding sanitary linings and capping them to reduceharmful emissions, and in some cases to collect biogas.
- 62 The first comprehensive master plan at the metropolitan level was completed in 1988. Apart from spin-off projects, the plan was largely unimplemented. The most recent one was developed in 2008, and it had a more strategic outlook
- 63 The Country Climate and Development Report (2022) conducted by the World Bank has shown that the cost related to urban planning in a net-zero urban scenario by 2050 was USD 6.2 million, representing 0.05% of total costs.
- 64 Examples include low-cost climate finance through say the Green Climate Fund, and concessional multilateral and bilateral public finance.
- 65 This is why the mitigation strategies and actions in the Amman Climate Action Plan should be included as mitigation contributions in Jordan's future NDCs, and for them to be accounted under Jordan's Enhanced Transparency Framework. Such an approach will squarely place the City of Amman in a leadership role for achieving the country's net-zero carbon ambitions, and leveraging international climate finance.

