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List of acronyms

AAC	Aqaba-Amman National Desalination and Carrier Project
BAU	Business As Usual
BUR	Biennial Update Report
CBAM	Carbon Border Adjustment Mechanism
CBJ	Central Bank of Jordan
CCD	Climate Change Directorate
CCDR	Country Climate and Development Report
CO2	Carbon Dioxide
CPS	Current Policy Scenario
CSA	Climate-Smart Agriculture
EE	Energy Efficiency
EPM	World Bank Electricity Planning Model
EU	European Union
EV	Electric Vehicles
FDI	Foreign Direct Investment
GAM	Greater Amman Municipality
GDP	Gross Domestic Product
GgCO2e	Grams of Carbon Dioxide Equivalent
GHG	Greenhouse Gas
GoJ	Government of Jordan
HEV	Hybrid Electric Vehicles
IPP	Independent Power Producer
JOD	Jordanian Dinar
JREEEF	Jordan Renewable Energy and Energy Efficiency Fund
KG	Kilograms
LTS	Long-Term Strategy
MCM	Million Cubic Meters
MENA	Middle East and North Africa
MFMod	World Bank Macro-Fiscal Model
MIGA	Multilateral Investment Guarantee Agency
MRV	Monitoring, Reporting, Verification
MW	Megawatt
NAP	National Adaptation Plan
NCCP	National Climate Change Policy
NCCC	National Committee on Climate Change
NDC	Nationally Determined Contribution
PEFA	Public Expenditure and Financial Accountability
PIM	Public Investment Management
PM	Particulate Matter
PPP	Public-Private Partnership
PV	Photovoltaics
ND-Gain	Notre Dame Global Adaptation Initiative
RCP	Representative Concentration Pathway
RE	Renewable Energy
SDGs	Sustainable Development Goals
SME	Small and Medium Enterprise
tCO2e	Tons of carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
WIB	Water in the Balance

Introduction and report structure

The Jordan Country Climate and Development Report (CCDR) assesses the interplay between the country's development goals and climate change. The CCDR was prepared between July 2021 and September 2022, building on the extensive body of relevant knowledge in Jordan. Additional analytical work was also carried out, including background notes.[1]

Report preparation also included inputs and feedback collected through engagements with the Government and civil society, private sector, and international partner stakeholders from September 2021 to September 2022.

The report consists of five chapters. The first chapter reviews the country's current development priorities and objectives (Section 1.1), the risks and opportunities from climate change and natural hazards (Section 1.2), and the risks and opportunities for investment in a low-carbon growth path (Section 1.3). This part lays out initial conditions and provides cross-country benchmarking, including emissions per capita and other metrics.

The second chapter reviews existing country climate commitments through international agreements, e.g., the Nationally Determined Contribution (NDC); domestic legislation, and sub-national commitments (Section 2.1). The chapter reviews country commitments and the set of policies and institutional arrangements required to achieve these commitments, covering resilience and risk management (Section 2.2) and mitigation (Section 2.3). Beyond climate policies, Section 2.4 assesses the capacity to manage the economic transition in response to climate change.

The third chapter explores climate-related interventions and identifies priorities for the next five years based on their synergy with development goals, economic and social costs and benefits, the availability of different financing modalities, and the actions' time scales. The section summarizes deep-dive findings into two areas in which sector transformation is an imperative in the context of climate change: (a) the water/food security/energy nexus and (b) low-carbon urban development and its linkages with the transport and energy sectors.

The fourth chapter uses a macroeconomic modelling exercise to assess the impact on growth, macroeconomic and fiscal stability of selected climate impacts and adaption and mitigation investments within a medium- to long-term (2050) time horizon. This chapter also summarizes the findings of deep dives in two cross-sectoral dimensions: (a) unlocking financing for investments in climate-responsive, green solutions and (b) creating opportunities for inclusive, climate-responsive jobs.

The final chapter summarizes the CCDR's findings regarding synergies and trade-offs between Jordan's climate commitments and its development goals and priorities in the next five years to inform decision-making.

[1] Background paper 1: Deep Dive 1 Water-Food-Energy Nexus Technical Background Paper
Background paper 2: Pathways for Decarbonizing Growing Cities across the Urban-Transport-Energy Nexus in Jordan
Background paper 3: Amman Urban Growth Scenarios
Background paper 4: Jordan Urban Climate Risk Analysis
Background paper 5: Deep Dive 3: Unlocking Financing for Climate Action in Jordan
Background paper 6: Employment Effects of Climate Change in Jordan: How Can Climate Action Bring Opportunity to Jordan's Workers?
Background paper 7: Trade and Climate Change Dynamics: The Impact of Climate Change on the Competitiveness of Jordan's Export Sectors
Background paper 8: Jordan Trade and Climate Change Diagnostics: A Background Paper to the Jordan CCDR
Background paper 9: Climate Change Risks and Opportunities for the Private Sector in Jordan
Background paper 10: Climate Change Risks and Opportunities for the Financial Sector in Jordan
Background paper 11: The Macro-Fiscal Model for Climate Change (MFMod-CC) in Jordan

Executive summary

Putting climate at the center of Jordan's development model

Jordan's development trajectory has been altered by external shocks that have tested the country's resilience over the past 15 years and will continue to shape its path to economic recovery. The global financial crisis in 2008, followed by the regional conflicts that erupted in 2011, disrupting trade routes to key trade partners and leading to the influx of 1.3 million Syrian refugees, have had a profound and lasting socio-economic impact. The doubling of the population from 5 million to 11 million over the past two decades has increased pressure on service delivery and on Jordan's already very limited natural resource base, including extremely scarce water and land resources. The national poverty rate for Jordan was estimated at 15.7 percent in 2017–2018 with many more households near the poverty line and indications of increased poverty since 2019. Given the COVID-19 pandemic, the war in Ukraine, and the country's geopolitical location, Jordan's path to economic recovery is shaped by uncertainty and risk. GDP growth is projected to remain around 2.3 percent until 2024, while the debt to GDP ratio is projected to rise to 117.9 by 2024 from 113.7 percent in 2021. The high unemployment rate (22.6 percent in the second quarter of 2022) and the need to create jobs for the large cohorts of young Jordanians entering the labor market every year, are also key factors shaping the country's development path.

Natural resource poor and import-dependent, Jordan is particularly vulnerable to external shocks underscoring the country's need to ensure water, energy, and food security as part of its development model. Jordan is facing an existential water crisis. As one of the most water scarce countries in the world with only 97 m^3 per capita per year, available water is well below the absolute water scarcity threshold of 500 m^3 per year. Climate change will decrease water availability even further for agriculture, cities, firms, and social systems (30 percent less water per capita by 2040) while increasing water demand. Climate change is also increasing the frequency and intensity of droughts in Jordan, and multi-year droughts that parallel the current one will become the new normal, where municipal water supply nears humanitarian thresholds and food insecurity is further exacerbated by lack of irrigation water. Food imports represented nearly 20 percent of total imports in 2019, leading to an import bill of approximately US$4.5 billion (over 10 percent of GDP). Jordan also continues to import over 90 percent of its energy. Such vulnerabilities, underscored by strained fiscal space, place improving water, energy and food security at the core of Jordan's development needs. There are also substantial co-benefits from climate action with regards to energy, water and food security.

Jordan is a small GHG emitter globally and compared to peer countries; however significant development and adaptation co-benefits are associated with climate mitigation actions in the urban, transport and energy sectors. Jordanian cities present significant opportunities for climate action. With 91 percent of the population living in urban areas, cities greatly contribute to GHG emissions. Jordan's urbanization rate is high relative to peer countries, and the urban population is expected to increase by 15 percent by 2030. Jordan's cities have not fully leveraged the benefits of agglomeration, productivity gains, firm entry and jobs, and better services associated with urbanization. Inefficient urbanization increases pressure on infrastructure, service delivery costs, job access, and leads to loss of agricultural land, while also adding to a higher carbon footprint. The transport sector is catching up with the energy sector as the country's top GHG emitter and transport-related inefficiencies are equivalent to at least 6 percent of GDP.

While delays in confronting climate realities will further exacerbate Jordan's development challenges, climate-responsive development can bridge inequalities, protect livelihoods and promote social cohesion. Climate change is a challenge and an opportunity in a country facing increasing pressures on poverty, debt, income distribution, and demand for jobs. The challenge stems from the disproportionate impacts of projected climate change on specific economic sectors where energy and water are major inputs (such as agriculture and tourism), vulnerable labor segments (informal and youth), and household groups – creating pressing adaptation needs in a strained macroeconomic and fiscal context. On the other hand, Jordan's notable human capital, innovation, and entrepreneurship strengths are real assets that can be leveraged to position the country as a leader in a growing regional climate service economy.

To meet Jordan's development and climate goals, carefully prioritized and sustained action is needed, considering significant domestic constraints. Maintaining the status quo would likely further harm people, the economy, and the country's natural capital. The Country Climate and Development Report (CCDR) explores pathways to help Jordan meet its development goals while promoting resilient and low-carbon growth. Jordan

has taken strides in climate action with commendable integration of climate goals (manifested in Jordan's ambitious NDCs) into the country's development plans. The 10-year Vision for Economic Modernization Vision launched in June 2022 considers sustainable practices and green investment as an integral part of Jordan's future economic growth and improving quality of life. The Jordan CCDR aims to support these efforts by offering an analytical assessment of policy and investment pathways that can unleash the country's economic potential and improve Jordanians' living standards in a changing climate. More specifically, the CCDR reviews how climate action can help the country meet its development objectives—increased investment, higher growth and productivity, job creation, poverty reduction, and more efficient use of scarce natural resources.

Strengthening policy implementation and financing adaptation needs are key challenges

An early mover in the MENA region with regards to submitting its Nationally Determined Contribution (NDC) in 2015, Jordan has been consolidating the strategic framework for implementing its climate commitments, laying solid foundations for a transition to more climate-responsive development. The legal framework for climate action has been strengthened, notably with the Climate Change Bylaw enacted in 2019, which established the National Climate Change Committee (NCCC). Sector policies have gradually mainstreamed climate change considerations. Regarding adaptation needs, Jordan submitted its National Adaption Plan (NAP) in 2021, reiterating the urgency of implementing adaptation measures.

Despite being a small GHG emitter, Jordan has set ambitious national, sub-national, and sectoral climate commitments; while the country is on track to meet its updated NDC commitments by 2030, total GHG emissions are estimated to continue to increase toward 2050. The electricity sector is on a low-carbon trajectory, with an increasing share of renewables significantly higher than the NDC target of 31 percent. Jordan's current National Energy Strategy focuses on energy security with an ambitious goal of reaching a share of 50 percent renewables in the electricity mix by 2030[2]. Achieving this goal requires significant investment in stronger regional interconnections, smart grid infrastructure and pumped hydro storage, and a reduction in energy consumption by 9 percent through energy efficiency by 2030. GHG emissions from the transport sector have been rapidly increasing, becoming the largest source of emissions. Jordan has recently launched the preparation of the Long-Term Strategy for Low-Carbon and Climate Resilient Development (2050) as part of the Paris Agreement, which should also create a robust social dialogue toward defining and implementing a 'Whole-of-Economy' vision for a climate-responsive Jordan.

Meeting Jordan's NDC commitments largely depends on securing as-yet-unidentified financing. Jordan has made significant progress in mobilizing resources to meet the financing estimate of US$5.7 billion in its 2015 NDCs; however, donor dependency for climate action is high, as evidenced by the conditionality of the GHG target and framing of the NDCs. At the sub-national level, the Greater Amman Municipality (GAM) is a regional leader in climate change with an ambitious goal of reaching net-zero carbon emissions by 2050; however, a financing strategy to meet GAM's ambitious plans is yet to be developed.

A greater focus on implementing existing strategies and citizen engagement is needed. Despite Jordan's increasing focus on climate change and progress in preparing climate strategies, implementation remains slow as the government perceives development and climate action as competing priorities in a challenging fiscal and socioeconomic environment, and as capacity needs to be built in line agencies. Greater engagement with citizens and the private sector will also be key to achieve Jordan's climate targets, to secure support for needed reforms, change behaviors and practices, and to leverage the necessary financing.

The financial sector could significantly contribute to addressing the financing gap for the transition to a resilient and low-carbon economy. This should be encouraged and accompanied by supportive policies and incentives and training of key financial sector institutions, including the Central Bank of Jordan (CBJ). The successful implementation of the CBJ's Strategy for Greening the Financial Sector can be a major step in increasing the climate responsiveness of the financial sector in Jordan. This includes enhancing climate risk management, given the large size of Jordan's financial sector (181 percent of GDP) and the impact of climate change on financial risks, which could spill over into the real economy.

[2] In 2021, the RE share of the electricity generation mix increased to 26 percent, up from 20 percent in 2020.

Preserving debt sustainability is a challenge to financing Jordan's climate-smart development. Reforms, non-financial incentives, leveraging private investment and Jordan's extensive experience in innovative financing would help. Project-based financing, combined with de-risking instruments and grants, has played a key role in accelerating utility-scale solar and wind power production in Jordan. The country has implemented various credit lines and refinancing schemes to support clean technologies in the industrial and MSME sectors. Jordan is planning to mobilize project-based financing, private finance and green finance to support investment in desalination and non-revenue water reduction. Non-financial measures, such as extra floor space for builders constructing green buildings have also enabled investments. A combination of climate-related policy reforms and innovative financing packages from public and private financing sources, complemented by climate-specific financing sources, will be required considering the country's macroeconomic and fiscal situation.

Pathways towards adaptation, resilience, and low-carbon growth

Jordan's trajectory in meeting its climate and development goals will be largely determined by policy and investment choices in five strategic sectors - water, energy, agriculture, transport and urban development. The transformation of those sectors towards a resilient and low carbon path would need to be closely coordinated along two nexuses to maximize co-benefits and to reduce potentially negative socio-economic impacts: the water-energy-food security nexus, in a context of extreme water scarcity and pressing adaptation needs, and the urban-transport-energy nexus, which is at the core of the shift towards a low-carbon growth path.

The water-energy-food security nexus: Adapting to increasing water scarcity and higher temperatures

Water efficiency and conservation are a priority across all sectors to minimize the financial burden of investments in water supply. Climate change will exacerbate water scarcity while simultaneously increasing water demand. Opportunities to augment Jordan's water supply are few and costly including to: (i) desalinate water and transfer it a long distance at considerable expense (current plans include the Aqaba-Amman National Carrier Project or AAC); or (ii) purchase water from other countries which may be less expensive but introduces sovereignty and political concerns. As Jordan advances the AAC Project as a significant supply-side investment, the country also needs aggressive action on water efficiency (more than 50 percent of water in the system is lost to leakage or commercial losses). Advancing supply augmentation or demand control measures alone will not close the increasing supply-demand gap, they must be combined to achieve water security and adapt to climate change. The financial sustainability of the water sector is also a persistent challenge. Achieving cost recovery is an important goal for the water sector, requiring a broad suite of demand control actions to achieve it. The Water Sector Financial Sustainability Roadmap (FSR), prepared through a consultative process by the Government of Jordan, outlines a set of policy and investment measures that will close the sector's operational deficit by 2029 and reduce debt accumulation. Efficiency gains outlined in the FSR include systematically reducing non-revenue water from 53 percent to 25 percent by 2040, energy efficiency and energy load shifting improvements and a tariff reform program. A large part of the water sector's fiscal deficit is due to the water supply being highly energy-intensive and inefficient. Adopting the FSR policy and investment measures would reduce water sector debt by billions of JOD by 2040, helping to return the sector to operational cost recovery before the AAC comes online.

To address the adverse effects of increasing water scarcity, a combination of policy measures and investments is needed to adapt to declining water availability without over-pressurizing the energy sector or derailing mitigation ambitions. Building on the FSR, those investments include (a) improving the efficiency of water use in urban areas, energy efficiency investments, and an economically efficient tariff structure that recognizes the time of use, (b) investing in in-network storage to enable a shift in peak energy demand of the water sector, (c) investing in pumped hydro storage, (d) introducing 'smart' net metering/billing policies that encourage the use of solar energy by accounting for the time of consumption, (e) adopting policies that accelerate the deployment of smart grid infrastructure, and (f) cooperating regionally on energy and water.

As water productivity improvements plateau, without major shifts, extreme water scarcity will constrain growth in the agri-food sector, impacting food security, rural employment, and vulnerable groups. In Jordan, as in many countries, the agriculture sector is the largest consumer of water resources, using 51 percent of the water consumed. Jordan's agri-food sector is also a major source of rural employment and income for the most vulnerable groups, including refugees. Irrigated agricultural water productivity has improved steadily, though it will be difficult to achieve further improvements without cropping and technological shifts such as controlled environment agriculture.

Fortunately, viable avenues to increase water efficiency and reduce fresh water use in agriculture while maintaining agricultural livelihoods exist off-farm and on-farm, through a combination of complementary policies and investments. Those include investments in (a) rehabilitating the King Abdullah Canal (KAC) to reduce conveyance losses, and (b) enhancing treated wastewater (TWW) infrastructure to increase the volume of reclaimed water and its use in the Jordan Valley. Substituting fresh water with treated wastewater in agriculture is a promising intervention to reduce overall fresh water use in agriculture, and (c) using enhanced remote sensing to reduce illegal groundwater abstractions. Finally, substantial gains can be expected from shifting crop selection towards less water-intensive crops and more climate-resilient crops and improving the water-use efficiency of the existing crop mix, including scaling up the use of cover for vegetable production, and upgrading irrigation methods and technology where necessary.

The above package of priority policies and investments are expected to generate significant benefits by 2030, including increased financial sustainability of the water and energy sectors (e.g., reducing the need for additional electricity generation), and significantly reduced agricultural demand for fresh water. Importantly, the shift to energy and water efficiency measures and new agricultural technologies are also expected to generate new, higher-skilled jobs.

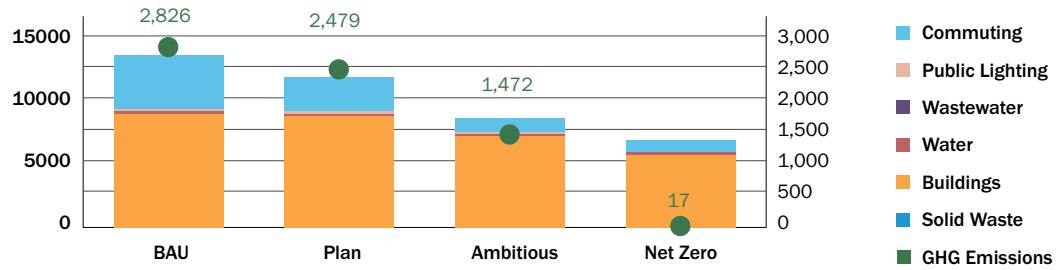
The urban-transport-energy nexus: resilient and low carbon urban services

Given the urban concentration of Jordan's population, decoupling growth from emissions requires spatially integrated solutions across the urban, transport, and energy sectors. 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 scenarios considered include (a) a business-as-usual scenario, (b) the municipality's current development plan, (c) a more ambitious scenario within the municipality's current targets, and (d) an ambitious net-zero scenario. The analysis suggests that Amman can substantially reduce energy consumption and GHG emissions through integrated and complementary policy levers, and by controlling urban sprawl. Modelling results (Figure ES1) demonstrate numerous benefits, from reduced energy consumption and GHG emissions, by 27 percent and 41 percent by 2050 respectively, through more aggressive measures beyond GAM's current plans; reduced exposure to flood risks; reduced urban expansion through better planning and improved connectivity; and reduced infrastructure investment costs by 25 percent by 2050 under the ambitious scenario. Reaching net zero emissions, however, will require doubling capital investments for renewable energy and related infrastructure.

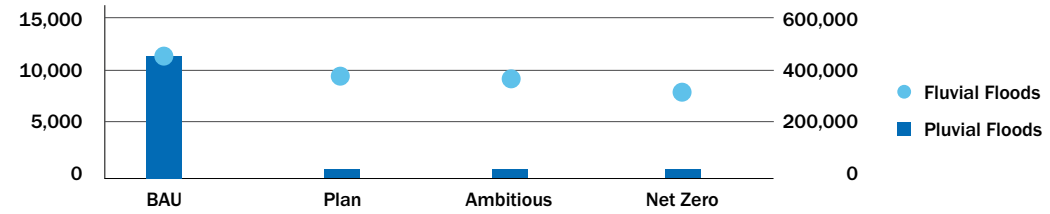
A combination of policy measures and financing opportunities have been identified to begin the long-term transformation of urban areas in Jordan, starting with Amman, into inclusive, green, resilient cities. Those include (a) integrating green urban and transport planning to deploy transit-oriented development and facilitate public transport reform, (b) integrating priority investment opportunities in green infrastructure and services, particularly public spaces and nature-based solutions, to mitigate floods and heat islands, (c) prioritizing urgent "no regret" infrastructure in Amman and municipalities, including recycling and sorting facilities, upcycling hubs, sanitary landfills, and collection and transfer systems, (d) accelerating energy efficiency (EE) across sectors, including investments in electricity demand-side management enabled by a smart grid, supported with advanced metering infrastructure, (e) adopting Electric Vehicle (EV) goals and an action plan to signal a national commitment to this market transformation, (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, and (h) launching housing sector reforms in conjunction with land-use planning and zoning improvement and stronger enforcement of building regulations.

Figure ES1. Insights from integrated spatial scenarios for Greater Amman for 2050

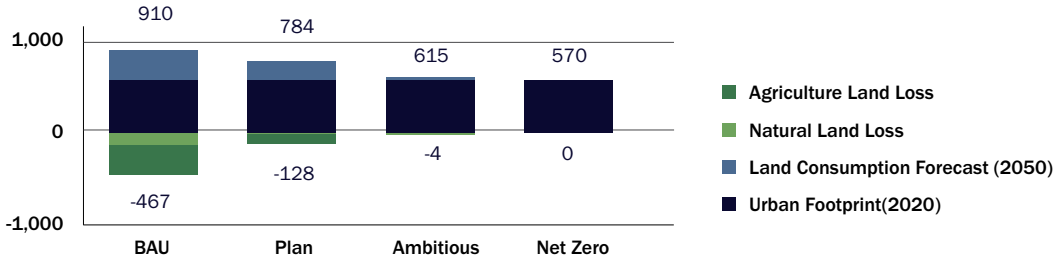
GHG emissions ($kgCO_2eq$/capita/annum) and energy use (MJ/capita/annum)



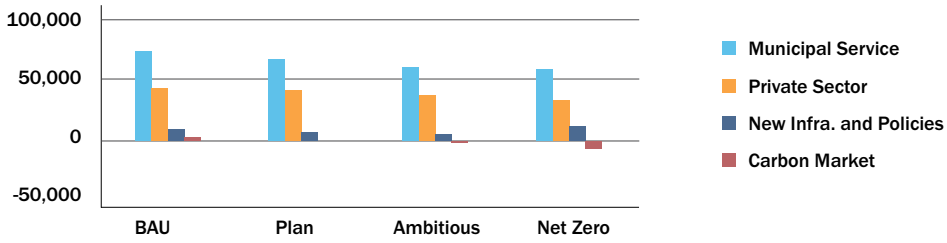
Population exposed to fluvial and pluvial flooding (people) by 2050



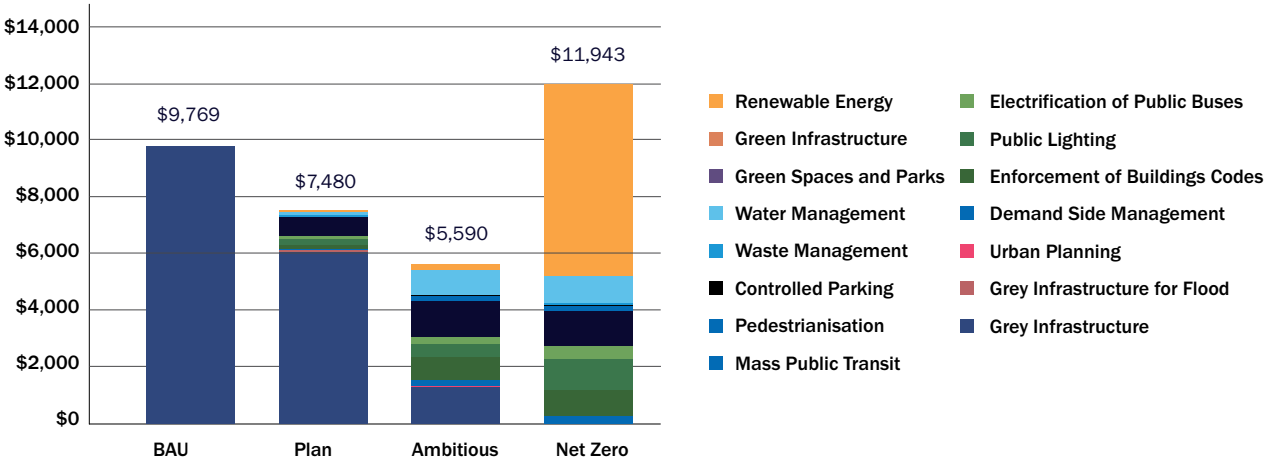
Urban land consumption and natural land loss (km2) by 2050



Municipal and private expenditure (US$ mil.) by 2050



Total capital expenditure for new infrastructure, local policies (US$ mil.) by 2050



The macroeconomic perspective, financing climate action and an inclusive transition for workers

The macroeconomic perspective

Four scenarios have been explored to examine the macroeconomic costs of climate change damages and the costs and benefits of identified investments to promote resilience and low-carbon growth: Scenario I models climate change damages linked to increased temperatures and extreme weather effects (floods); Scenario II explores the impacts of increasingly severe water scarcity on the economy; Scenario III explores the impact of selected water scarcity adaptation measures aiming at addressing the damages from increased water scarcity on the economy; and Scenario IV explores the impacts of investments of approximately US$9.5 billion—the identified additional priority investments from 2022 to 2030 across the two strategic nexuses —on the baseline.

Adopting adaptation measures to cope with water scarcity lessens its impact on GDP but may come at a high economic cost depending on numerous factors including financing model for adaptation investments. Scenario I which models the impacts of heat and flooding under three separate climate change scenarios resulted in negative impacts on economic activity as real GDP decreased by -0.2 by 2050 in the most extreme climate scenario (RCP 8.5). Water scarcity under Scenario II resulted in GDP decreases of up to 6.6 percent by 2050 compared to the baseline depending on assumptions made with regards to capital and labor mobility. Scenario III modeled low- and high-cost adaptation strategies to eliminate a 200 million cubic meters (MCM) additional shortfall in water supply by 2050. Real GDP could decrease from -2.2 to -4.5 percent in 2050 compared to the baseline, depending on the adaptation scenario. Based on the assumptions in the model of full public sector financing for water-related adaptation measures, the ensuing government financing needs result in a significant increase in public debt, which could unhinge a strong private investment crowding out effect. With a debt-to-GDP ratio of nearly 100 percent at the beginning of the projection period, interest rates would need to increase to incentivize investors to finance additional spending; however, this could crowd out other private sector investments, lowering potential output and incomes. This calls for implementation of the Water Sector FSR measures to reduce the sector's debt burden on the economy, including pursuing options to minimize the cost of capital (such as grant and concessional financing), to reduce operational costs and to enhance predictable revenue flows through planned tariff reform.

Investments in infrastructure aiming at climate change mitigation and adaption raise overall economic activity over time. However, the share of government financing for the additional investments increases macroeconomic risks. The impact of a US$9.5 billion investment package in key sectors (transport, energy, water, urban and agriculture) until 2030 is assessed without including the climate-related benefits derived from them due to data constraints. These investments provide a sustained increase in real GDP growth of over 1 percent above the baseline by 2050. However, the financing composition of the additional investments (public vs private, and level of grant financing of the public component) are key factor impacting macroeconomic outcomes. Finally, the increased investment, with their private and public components, come at the cost of contracting private and public consumption (as a share of GDP) compared to the baseline.

Unlocking finance for climate responsive development

The CCDR estimates Jordan's incremental investment needs [3] for resilient and low carbon development in key sectors at US$9.5 billion (not including the AAC) for priority actions to be fully implemented by 2030. These financing needs, covering priority actions identified in Chapter 3 under the two strategic nexuses considered, build on the NDC priorities and include projects contributing to adaptation and resilience across the water, agriculture, energy, transport, and urban (including green buildings and waste management) sectors. Figure ES2 summarizes those priority investment packages, including whether they are included in the NAP and/or NDC, and the degree of emphasis placed on them in the new Vision for Economic Modernization Vision. Those packages include a combination of policy reforms and new investments, which are to be considered jointly to achieve the intended adaptation, mitigation and development co-benefits. The CCDR also identifies ways to mobilize the financing needed for those priority investments through a combination of actions, while noting the critical role of concessional financing considering macro-fiscal constraints.

[3] This assessment does not include projects already approved by the government and under development (such as the AAC). The costs include those of priority investments identified in Chapter 3 of this CCDR in the two nexuses covered, for priority activities to be fully implemented by 2030. Refer to Chapter 3 for the list of priority investments that have been included.

Implementation of these recommendations will establish the enabling environment for increasing private sector participation and attracting new funding sources. Notably, private sector investments represent a large share of the prioritized investment needs identified in this CCDR (over 60 percent of the US$9.5 billion incremental financing needs).

Figure ES2. A snapshot of priority investment packages to 2030

Nexus	Packages of Priority Interventions *	Estimated Total costs (US$ million)	Priority in NDC or NAP	Target Sectors and Climate Change Priority (2030-2050)	Economic Modernization Vision (2022–33)
Water-energy-agriculture and food nexus	**Adapting to increasing water scarcity and ensuring fiscal sustainability of the water and energy sectors**	1,363	NAP	Water, Agriculture and Energy - Increasing water productivity; improving resource-use efficiency	
	Reducing fresh water use in agriculture while safeguarding livelihoods	1,860	NAP		
	Boosting system-wide resilience with a focus on drought	685	NAP		
	Optimizing energy use and leveraging mitigation opportunities in the agri-food and water sectors	303	NAP and NDC		
LLow-carbon urban development	**Integrating green urban-transport planning, reforming public transport, and deploying transit-oriented development.**	1,588	NDC	Urban, Waste, Transport and Energy - Increasing the share of RE, reducing GHG emissions from energy and waste and improving resource-use efficiency	
	Investing in green infrastructure for urban rejuvenation, waste management, and circular economy	990	NDC		
	Promoting Energy Efficiency and green public buildings	2,716	NDC		
Total		**9,505**			

Last column: Darker green means stronger emphasis in the Economic Modernization Vision 2022-2033

** This assessment does not include projects already approved by the government and under development (such as the AAC)*

The first area for action to mobilize green finance is improving government practices with regards to public investment management and leveraging private investments. Jordan could explore opportunities to:

a. Fully operationalize existing instruments for public investment management to leverage financing for climate action: this includes, among others,using the Public Investment Management (PIM)/Public Private Partnerships (PPP) policy and legal framework and its implementation tools, such as the National Registry of Investment Projects (NRIP), to develop a robust pipeline of climate-responsive capital investment, piloting innovative government support mechanisms to strengthen the bankability of the PPP projects, and scaling up State-Owned Enterprises' (SOEs) role in financing green infrastructure and climate-responsive projects;

b. Adopt green procurement and performance contracting practices and strengthen national quality infrastructure to encourage greening of the supply chains;

c. Integrate climate criteria into private sector development programs and strategies, such as FDI-related strategic plans, export development (e.g., new National Export Strategy), access to finance initiatives, innovation policy and entrepreneurship (e.g., amending the National Entrepreneurship Policy) to drive existing and new firms and industries to adapt their business models and technologies. It is also crucial to fully operationalize the climate finance governance system to strengthen coordination across government, the private sector, the financial sector, and the general public.

The second area for action is improving fiscal discipline, budgeting and transparency. This includes ensuring the traceability of climate action strategies and plans to the medium-term fiscal framework and strengthening the management of financial and non-financial assets and liabilities to reduce emissions, promote adaptation, and build resilience. Transparently identifying climate-related actions, defining related policies and investments needs and tracking of expenditures to ensure attribution is essential for scaling-up financing for climate action. This will enable both financing from traditional and from climate finance sources.

Finally, the third area for action is strengthening the financial sector to mobilize private investment. Access to finance is still a significant challenge for MSMEs, while Jordan's banking sector has witnessed a persistently high liquidity in the last decade and more. While broader efforts to increase access to finance are needed, enhancing access to green financing will require strong low-carbon policies and national commitments to incentivize the financing sector and the private sector. Several steps can be taken in that area.

a. Implementing the CBJ's Strategy for Greening the Financial Sector, active consultations between the private and financial sectors to align their vision for greening the financial sector, and adopting a national green taxonomy to add consistency to how financial institutions classify economic activities and respective borrowers or loans;

b. Implementing targeted awareness-raising measures for the private sector, using climate action and green financing to incentivize SMEs to join the formal economy, and fostering green entrepreneurship, including facilitating local service providers and start-ups with technology and service solutions; and

c. Accelerating the development of disaster risk finance and insurance products.

While policy reforms and improved public investment management are an integral and essential part of the solution to finance climate action in Jordan, additional sources of climate finance will also need to be identified. While all the above actions will ensure more efficient use of existing resources, help leverage financing from the private and the financial sectors, as well as provide stronger incentives for demand-side investments in climate-responsive solutions, this report recognizes that Jordan would still need to mobilize additional financing for the prioritized investments. As shown by the modeling exercise carried out for this CCDR, access to concessional financing is a critical determinant of long-term economic outcomes; in the absence of such financing, the achievement of priority climate actions may be at risk. This is particularly the case for critical investments that are less likely to attract private financing due to their public goods nature or to lower returns on investments. Jordan is currently working on a climate investment plan (forthcoming) which provides an opportunity to refine the financing strategy for priority adaptation and mitigation actions.

An inclusive transition for workers

Climate impacts will impinge on workers' livelihoods, ranging from reduced incomes to complete displacement from jobs. However, Jordan's highly segmented labor market impedes workers' capacity to move between segments to find better or alternative jobs. There are various channels through which public policies and programs can help narrow the gaps that characterize Jordan's segmented labor market; by reducing the differences in job characteristics between segments, workers can transition more easily. Climate actions to reduce GHG emissions and improve water efficiency and conservation can be growth- and jobs-generating if accompanied by supportive labor policies. The education sector has a major role to play in facilitating the transition to a resilient and low carbon development path in Jordan, by ensuring that new entrants in the labor market are equipped with the skills required by the growing green industry and services sectors and by contributing to changing awareness and behaviors related to climate action.

Climate actions can create new growth opportunities through emerging green industries and environmental services. Many jobs can be adapted and created through climate actions in renewable energy, but more so in the construction and agri-food sectors. Benchmarking with other countries also reveal significant scope to improve the performance of the tourism sector both in terms of job creation and reducing GHG emissions. Decentralized renewable energy,[4] solar water heating, and biogas capture and reuse in wastewater treatment plants, water, and energy efficiency investments emerge as cost-effective approaches to climate change. Similarly, rainwater harvesting,[5] and water-efficient agriculture can also reduce GHG emissions and create jobs. The higher skill level required for such jobs could attract Jordanian workers. Climate actions can prioritize vulnerable groups through targeted interventions based on a deeper understanding of their short- and long-term adaptation needs. Finally, Jordan's social protection system can be leveraged to mitigate negative impacts on the most vulnerable.

[4] As solar PV is economically feasible and profitable at a small scale, energy can be supplied in a decentralized way based on investments from households and businesses with the private sector doing the manufacturing, installation, and operation and maintenance. If the cost of energy storage continues to fall, it may eventually be economically feasible for consumer/producers to disconnect from the grid.

[5] See FAO (2016) for discussion.

Conclusion

In Jordan, natural resource scarcity and import dependence mean pronounced climate change impacts are inevitable and adapting to climate change is a pressing development priority. However, there are options to mitigate the risks identified in this report and use climate action as a platform to reimagine Jordan's economy, cities and labor force. Coping with water scarcity will make Jordan's economy more resilient. Investing in human capital, innovation, and empowering the private sector and entrepreneurship will break labor market barriers; using climate change as a means for inclusion instead of being a disproportionate force of inequality will strengthen Jordan's social cohesion. For example, initiating a systematic process of climate consultations could democratize climate actions and bring sensitive issues such as pricing reforms closer to the public arena, aiding transparency.

Jordan will need to use a combination of avenues to leverage financing for priority climate action. Selected policy reforms to improve the management of public investment in key sectors, attract and leverage private sector financing, incentivize end-users and change behaviors, and ensure greater engagement of the financial sector will all be essential for the achievement of Jordan's climate priorities. Equally important will be the identification of additional financing for priority investments, without which the country's climate commitments may remain out of reach.

Building on its extensive experience in climate action, Jordan also has a lot to offer regionally and globally. With its well-educated population, climate action appetite, and experience in driving the climate agenda, especially on renewable energy, Jordan is well-position to take a leading role in innovative regional climate dialogue and initiatives.

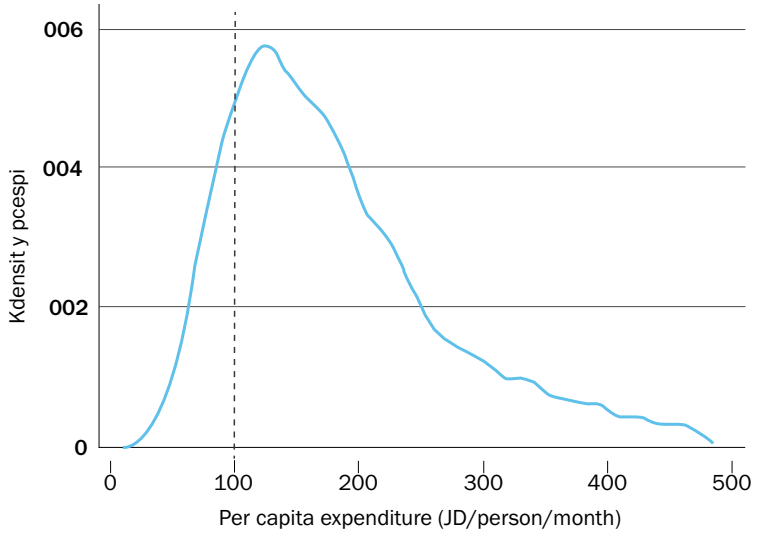
1. Putting climate at the center of Jordan's development model

Jordan is a small upper-middle income country with scarce natural resources and is particularly exposed to regional and global shocks. Over the past two decades, Jordan's population has doubled from around 5 million to 11 million, increasing pressure on service delivery and on its fragile natural resource base, including scarce water and land resources. Jordan has also faced a series of external shocks which have altered its development trajectory. Headwinds started with the global financial crisis in 2008, followed by the regional conflicts that erupted in 2011, disrupting trade routes to key trade partners and leading to the influx of 1.3 million Syrian refugees. Growth slowed to 2 percent on average over 2016–2019, impacted by the decade-long Syrian crisis and high energy, transport, and labor costs. Given the protracted COVID-19 pandemic, the war in Ukraine, and climate change, Jordan's path to economic recovery is uncertain. Implementing Jordan's climate commitments could mitigate risks and produce development co-benefits.

1.1. Jordan's development priorities and objectives

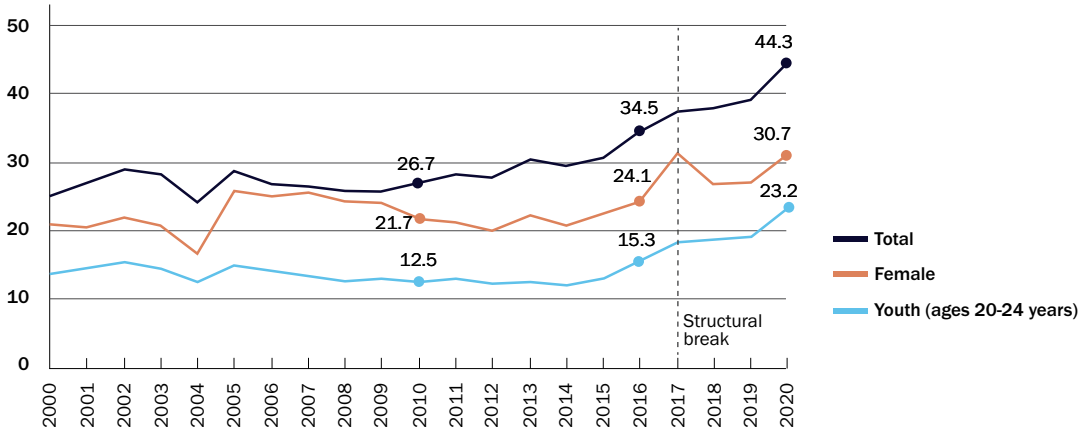
Two years into the COVID-19 pandemic, future economic prospects remain uncertain. Jordan faces increasing poverty, poorly distributed income, and inclusion pressure. The COVID-19 pandemic severely impacted small and medium enterprises (SMEs), which provide 52 percent of private-sector employment. In 2021, Jordan's real GDP grew by 2.2 percent, reflecting a good recovery after a 1.6 percent contraction in 2020. The economic rebound in 2022 may aid household recovery but may be slow and uneven. GDP growth is projected to remain around 2.3 percent until 2024. The working-age population is expected to increase from 4.4 million in 2020 to 6 million in 2030 (NES 2011–2020). The World Bank's Jobs Diagnostic (2019) indicates that Jordan's economy needs at least 6 percent growth to reduce unemployment. Foreign direct investment (FDI) flows notably declined from 6.1 percent to 1.5 percent of GDP from 2010 to 2019, foregoing a potential source of productivity gains and external economic funding. Jordan faces binding fiscal constraints with considerable contingencies in key sectors. Debts and liabilities in the energy and water sectors amounted to 20 percent and 7 percent of GDP at the end of 2019, respectively. At the end of 2021, Jordan's public and publicly guaranteed debt reached 113.7 percent of GDP. The national poverty rate for Jordan was estimated at 15.7 percent in 2017–2018 (MOSD, MOPIC, UNICEF 2019). Many households live near poverty, and even a small shock to income or increase in prices can tip them into poverty (Figure 1), particularly under rising unemployment (Figure 2). Food security is also of concern.

Figure 1. Household per capita consumption distribution in Jordan, 2017–2018, relative to the national poverty line



Source: 2017–18 HEIS and World Bank calculation

Figure 2. Unemployment rates in Jordan in percentages



Sources: Department of Statistics, WB staff estimates. Note: The Department of Statistics adopted a new methodology for the labor force survey during Q1-2017 based on recommendations from the International Labor Organization.

Slow job creation has worsened labor market outcomes (Figure 2). The labor market is extremely segmented across three main dimensions: public-private, informal-formal, and local-migrant, with gender inequality being a cross-cutting concern. Under 14.2 percent of Jordanian women are in the labor force, one of the lowest rates in the world (Lugo et al., 2020). Fifty-seven percent of workers in Jordan are informal, i.e., not registered with social security (LFS, 2019), most working in small and microenterprises and many living in poor and near-poor households (MOSD, MOPIC, UNICEF 2019). Ninety-five percent of working refugees are informally employed (LFS, 2019) and among the country's poorest individuals. Most poorly remunerated, low productivity, unskilled jobs are filled by non-Jordanians willing to accept less attractive employment terms. This pattern is strongest in the agriculture and construction sectors. Among Jordanians, 75 percent of the poorest decile work in the services sector, particularly in wholesale and retail trade.

The economic impact of the COVID-19 pandemic has intensified poverty and labor market trends. The labor market's deterioration is the most significant threat to household welfare. Unemployment rose significantly during the pandemic, reaching 25 percent at its highest point in Q1–2021. Women and youth, who already had structurally high labor participation unemployment rates, have been hit hardest. Youth unemployment jumped to unprecedented levels during the pandemic—50 percent in Q4-2020 among 15–24 and is still above pre-pandemic levels at 46.1 percent. Most of the jobs that are being created are low-skilled, low-wage jobs.

Jordan's Vision 2025, launched in 2015, articulates the country's development goals. It argues for a shift to a new development model to address the formidable challenge of providing decent job opportunities for its young population.[6] Jordan's Vision 2025 recognizes that Jordan must transition to a high-productivity economic model led by the private sector that can generate high-quality jobs. Vision 2025 also notes the unsustainable level of social spending—8.4 percent of GDP in 2013—including subsidies in several sectors – energy, water, food, education, health - arguing for a greater focus on jobs and incomes to address issues of poverty and inclusion. It focuses on attracting private investments, increasing exports, and addressing fiscal imbalances. Several priority clusters were identified (Box 1.1), many impacting or likely to be impacted by climate change, e.g., construction, transport, logistics, tourism, and financial services.

Ensuring energy, water, and food security features at the core of Jordan's Vision 2025. Jordan is one of the world's most water-scarce countries, which constrains growth. Jordan imports over 90 percent of its energy. Over the past decade, Jordan has pursued energy security, including by exploring domestic fossil fuel resources and expanding renewable energy. Most arid and semi-arid areas suffer from land degradation due

[6] More than half of the population is under the age of 24.

Box 1.1. Jordan vision 2025

In May 2015, the GoJ launched Vision 2025, a ten-year strategy that called for transforming Jordan's socioeconomic development model to achieve growth and prosperity based on competitiveness and providing more employment opportunities. The strategy is based on the principles of (a) promoting the rule of law and equal opportunities, (b) increasing participatory policymaking, and (c) achieving fiscal sustainability and strengthening institutions. Jordan aims to achieve sustained economic growth by improving infrastructure, enhancing education and health, and strengthening the role of the private sector and civil institutions.

Jordan's Vision 2025 identifies priority export markets beyond the current regional crisis, aiming to become a regional trade hub. It also identifies priority clusters to drive growth and create jobs, building on existing strengths and identifying opportunities in new clusters based on emerging trends. The clusters identified as having high potential are construction and engineering, transport and logistics, tourism and events, health care, and services in life sciences, business, education, and finance. Depending on the progress achieved, the Vision offers two scenarios: the targeted scenario offers a 7.5 percent real growth rate by 2026, while the baseline scenario offers a 4.8 percent growth rate.

to overgrazing, erosion, poor irrigation practices, and urban encroachment. Desertification is a significant risk. Food imports represented nearly 20 percent of total imports in 2019.

The geographic pattern of Jordan's economic development is resource intensive. The population is nine-tenths urban, with many in the capital Amman. The population's geographic concentration in the Northern parts of the country, far from the port of Aqaba, translates into high transportation costs and GHG emissions for imports and exports. Freight transport relies on roadways and suffers from inefficiencies. Rapid urban population growth has increased the demand for water and the water sector's energy intensity. Urban sprawl and poor public transportation are drivers of high energy use.

Jordan's progress toward achieving the Sustainable Development Goals (SDGs) has been mixed and below its ambitions. Despite Jordan's success in integrating SDGs into national strategies and frameworks, progress has been slow due to limited policy implementation and regional shocks. With regards to SDG performance, in 2021 Jordan ranked 72 out of 165 countries and scored 70.1, compared to the regional average of 67.1.[7] Gains were made in clean water (SDG 6), affordable and clean energy (SDG 7), and industry, infrastructure, and innovation (SDG 9). Four further SDGs were evaluated as moderately improving and eight as stagnating (Figure 3).

Figure 3. Jordan's performance on the SDGs: Sustainable Development Report 2021

[7] Sustainable Development Report 2021

Several years after launching Vision 2025, progress towards the country's development goals has been uneven. The key development challenges identified in 2015—stronger growth, more and better jobs, fiscal sustainability, and more sustainable pathways for water, energy, and food security—remain partially unaddressed. Reduced economic opportunity due to the COVID-19 pandemic and the continued impact of the Syrian crisis has led to a tense social context. The Government's Economic Priorities Program 2021-23, under implementation, recognized those challenges and was designed to accelerate the economic recovery following the COVID-19 pandemic.

A new 10-year Vision for Economic Modernization was launched in June 2022. This vision is based on two strategic pillars: (a) accelerating growth through unleashing Jordan's full economic potential and (b) improving the quality of life for all citizens, with sustainability as a cornerstone of this vision. The first pillar focuses on qualitative leaps in economic growth and job creation, with the continuous growth of the net income of individuals, and the second pillar on tangibly improving the quality of life. The vision encompasses eight interlinked objectives that recognize the importance of a green and sustainable development path (Table 1).

Table 1. Strategic objectives of economic growth drivers, 2022-2033

High Value Industries	Develop Jordan into a regional industrial hub through high growth exports with high quality and value products
Future Services	Achieve excellence in services sectors to enhance national development and increase exports of services on regional and global levels
Destination Jordan	Position Jordan as a prime tourism and film production destination
Smart Jordan	Develop and prepare local talents to meet the needs of future skills, required resources and institutions to accelerate economic growth and enhance quality of life
Sustainable Resources	Optimise the use of natural resources to ensure sustainability, unleash inclusive sectoral growth and enhance quality of life
Invest Jordan	Stimulate domestic and foreign investments through an attractive and efficient investment and doing business ecosystem
Green Jordan	Support sustainable practices as a pillar of Jordan's future economic growth and enhance quality of life
Vibrant Jordan	Improve quality of life for Jordanians through developing and adopting higher life standards that revolve around the citizen and the environment

1.2. Risks and development opportunities from climate change and natural hazards

Jordan is increasingly vulnerable to climate change, with impacts already evident. The country ranked 75 out of 182 countries in the ND-GAIN index for climate vulnerability in 2019, sliding from 63 in 2015. 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.[8] Jordan received a vulnerability score of 0.375 on par with peer countries (Figure 4), driven by high sub-scores on freshwater withdrawal, urban concentration, and energy import dependency. 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.[9] Future climate modeling (Table 2) 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.[10] Climate change impacts will vary across the country. For example, the northern region and King's Highway are projected to experience the largest precipitation declines.

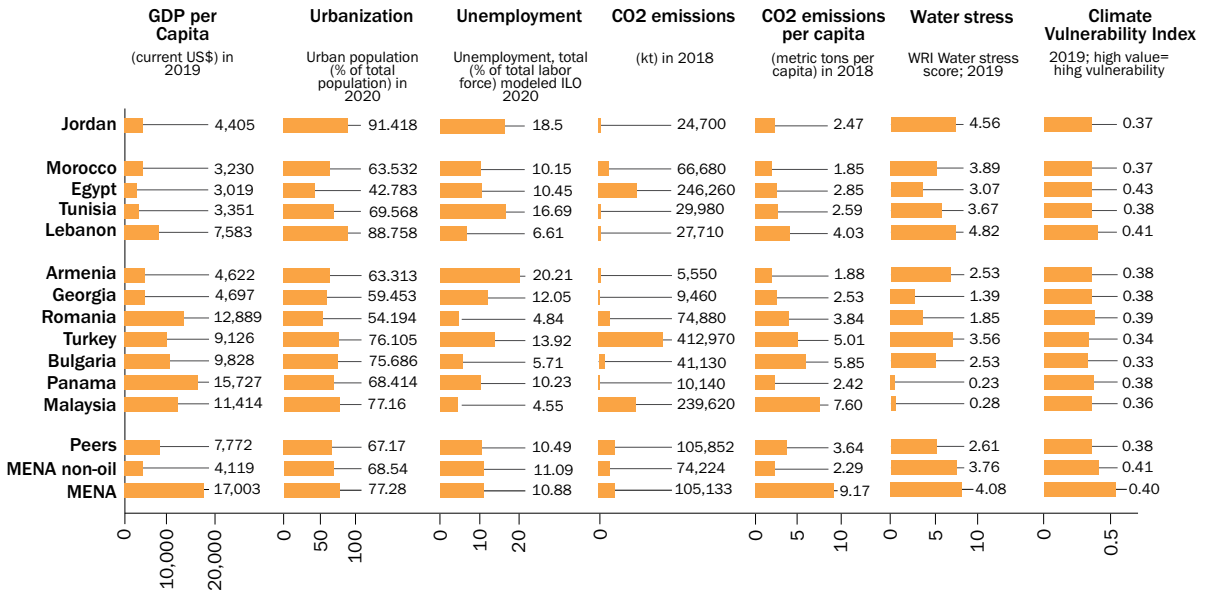
[8] ND-Gain Note Dame Global Adaption Initiative

[9] Harris et al., "Updated High-Resolution Grids of Monthly Climatic Observations – the CRU TS3.10 Dataset," International Journal of Climatology 34, no. 3 (2014): 623–42, https://doi.org/10.1002/joc.3711

[10] United Nations Economic and Social Commission for Western Asia (ESCWA) et al., "Arab Climate Change Assessment Report – Main Report" (Beirut: United Nations Publication E/ESCWA/SDPD/2017/RICCAR/Report, 2017), https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/riccar-main-report-2017-english_0.pdf;
United Nations Development Programme (UNDP), "Jordan's Third National Communication on Climate Change"; IPCC, "Fifth Assessment Report — IPCC," n.d., https://www.ipcc.ch/assessment-report/ar5/.

Climate change will exacerbate Jordan's development challenges by impacting people, natural resources, and the economy, creating pressing adaptation needs across sectors. Prolonged and more intense heat waves and reduced water availability and quality will affect the population's health. Higher temperatures will make outdoor work such as construction and agriculture a health risk. They will reduce worker productivity, meaning lower earnings for many workers and companies, compounding existing growth and job challenges. Only 12 percent of the rural and 21 percent of the urban populations have air conditioning access.[11] Extreme weather events will impact infrastructure, agriculture, water availability, and labor productivity[12]. Prolonged dry seasons will affect low-income rural communities in poverty pockets such as the western and southern parts of the Badia desert. Finally, climate change will affect Jordan's competitiveness, generating new risks and opportunities for the private sector.

Figure 4. Key economic and climate indicators: Jordan versus selected peers



Source: World Development Indicators, World Resources Institute, ND-GAIN Country Index

Table 2. Climate change impacts under different scenarios[13]

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 >20mm	+8 days with precipitation >20mm
Heat Waves	45 days per year	45 days per year	NA	NA	75 days per year	200 days per year

Source: Water in the Balance: The Economic Impacts of Climate Change and Water Scarcity in the Middle East. World Bank, 2020

[11] Department of Statistics, 2015 population census

[12] The agriculture and construction sectors are major employers for vulnerable groups such as refugees and women. These sectors are particularly sensitive to extreme weather events.

[13] Roadmap for Jordan LTS 2050 – Annex 3

Climate change will decrease water availability while increasing water demand for agriculture, cities and social systems, and will negatively affect Jordan's agriculture sector and food security. Jordan is facing an existential water crisis. Population growth and increasing demand from economic development have reduced the amount of water per person. With only 97 m^3 per capita per year, available water is well below the absolute water scarcity threshold of 500 m^3 per year. By 2025, water demand is estimated to exceed available water resources by over 26 percent.[14] The World Bank's 'Water in the Balance' report estimates that a 20 percent reduction in water availability (a plausible scenario reflecting scientific consensus) could decrease GDP by up to 6.8 percent. Around half of Jordan's available water is used for domestic and industrial water supply and half for agriculture. Higher evapotranspiration levels due to climate change are expected to increase Jordanian irrigated agriculture water demand by 5 to 20 percent by the 2070s. Higher temperatures may impact crop growing phases, increasing yield loss[15] and impact severely Jordan's rainfed crops, including barley and wheat (Figure 5).[16] The projected output declines for some agricultural products - such as grain and fodder for livestock - brings higher food security risks.

Jordan's three largest cities, Amman, Irbid, and Zarqa, which play an outsized role in the economy, will all experience increased hazard exposure under future climates. All three cities will become drier yet will experience more extreme precipitation events, which can worsen flooding. The built-up area exposed to pluvial flood hazards has increased and will continue increasing under all climate scenarios, disproportionately affecting low-income households. Air pollution is also a serious concern in all three cities. The average particulate matter 2.5 (PM2.5) concentration has increased to levels well above the WHO guideline threshold for health outcomes, set at 10 micrograms per cubic meter of air, standing at 43, 32, and 21 micrograms per cubic meter of air in Zarqa, Amman, and Irbid, respectively. Climate change will also heighten urban heat further. Zarqa has already seen a 3°C rise in surface temperature over the past eight years. Jordanian cities must invest in climate change adaptation measures while limiting GHG emissions.

Climate change represents a serious threat to the growing tourism industry. Tourism is the largest export sector in Jordan, accounting for more than 30 percent of goods and services' trade before the pandemic. Climate change impacts tourist locations, tourism seasonality and influences operating costs. Changes, including water availability, biodiversity loss, diminished landscape aesthetics, altered agricultural production, increased natural hazards, coastal erosion and inundation and damage to infrastructure will impact tourism to varying degrees.[17] The water footprint of the tourism sector can be high in dry climates, reaching up to 15 percent of domestic water consumption in Mediterranean countries such as Spain, Greece and Malta. Jordan's trade structure is highly vulnerable to the impacts of climate change, and climate change may negatively affect the country's trade balance. Jordan imports over 92 percent of its energy and around 70 percent of its staple food needs, with the food import bill expected to increase with climate change.[18] [19] The five largest export sectors—textiles, chemicals, fertilizers, pharmaceuticals, and rare minerals, with an export value of US$5.28 billion—accounted for 60 percent of total export volume in 2019. They are either highly energy-and water-intensive or sensitive to energy and water tariffs. Firms expect to be impacted by climate change, with increased scarcity and costs of water and energy inputs being the key threats; however, many SMEs are unprepared for those changes.

[14] Ministry of Water and Irrigation. National Water Strategy: 2016–2025.

[15] Jawad Taleb Al-Bakri et al., "Impact of Climate and Land Use Changes on Water and Food Security in Jordan: Implications for Transcending 'The Tragedy of the Commons,'" Sustainability 5, no. 2 (February 2013): 724–48, https://doi.org/10.3390/su5020724; Rodomiro Ortiz, "Crop Genetic Engineering Under Global Climate Change," Annals of Arid Zone 47 (September 1, 2008): 343–54.

[16] Ortiz, "Crop Genetic Engineering Under Global Climate Change."

[17] The MOE National Climate Change Policy

[18] IRENA 2021, The Hashemite Kingdom of Jordan: Renewables Readiness Assessment

[19] Carnegie Endowment: The Cost of Food Security in Jordan

Figure 5. Climate change impacts on crop yields in Jordan, under 3 °C and 5 °C increase scenarios

a. Impacts of a +3°C increase in temperature due to climate change on crop yields in the middle east

Country	Rice	Wheat	Coarse grains	Oil crops	Sugar crops	Fibers	Vegetables and fruits	Other crops
Iran, Islamic Rep.	-0.4	+18.8	-15.7	4.2	8.9	-1.2	2.8	5.6
Iraq	-5.1	-24.8	-24.0	11.2	9.0	-5.7	3.6	-2.8
Jordan	0.0	-15.6	-9.3	12.1	0.0	0.0	2.1	1.2
Lebanon	0.0	-11.8	-10.6	12.0	8.7	0.0	2.9	7.7
Syrian Arab Republic	0.0	-12.1	-12.0	12.0	8.6	-3.0	2.5	4.4
Turkey	4.6	-13.8	-11.6	11.6	8.5	-1.7	2.9	2.1
RME	-1.7	-17.3	-10.0	11.2	9.7	-2.8	4.5	3.4

Note: RME= Rest of the Middle Est

b. Impacts of a +5°C increase in temperature due to climate change on crop yields in the middle east

Country	Rice	Wheat	Coarse grains	Oil crops	Sugar crops	Fibers	Vegetables and fruits	Other crops
Iran, Islamic Rep.	-0.4	+18.8	-15.7	4.2	8.9	-1.2	2.8	5.6
Iraq	-5.1	-24.8	-24.0	11.2	9.0	-5.7	3.6	-2.8
Jordan	0.0	-15.6	-9.3	12.1	0.0	0.0	2.1	1.2
Lebanon	0.0	-11.8	-10.6	12.0	8.7	0.0	2.9	7.7
Syrian Arab Republic	0.0	-12.1	-12.0	12.0	8.6	-3.0	2.5	4.4
Turkey	4.6	-13.8	-11.6	11.6	8.5	-1.7	2.9	2.1
RME	-1.7	-17.3	-10.0	11.2	9.7	-2.8	4.5	3.4

Note: RME= Rest of the Middle Est

Given the large size of Jordan's financial sector—181 percent of GDP—the impact of climate change on financial risks could have strong spillover effects on the real economy. Banks have significant sovereign exposures—25 percent of total assets—and are major investors in GOJ securities; if climate change adds to an already high public debt level, this could lead to financial risks to banks. The construction, real estate, and industrial sectors account for 38 percent of Jordan banks' total credit portfolio (Figure 6). Conversely, while the low share of loans in the agriculture sector would indicate low exposure to risks related to the impact of climate change on agriculture, the lack of access to finance impedes the agri-food sector's adaptation to climate change and its ability to mitigate risks through investments in climate-smart agriculture (CSA).

Figure 6. Sectoral distribution of the bank loan portfolio in Jordan and a qualitative assessment of exposure to climate change risks

Sector	Risk	Portfolio share	Potential impacts
 **Construction and real estate**		**26%**	• Transition: energy efficiency standards and regulations; additional capital injections for refurbishment. • Physical: natural hazards affect lifetime of buildings; reduced asset value.
 **Public services and utilities**		**15%**	• Transition: low-carbon policies; large investments for adaptation; need to significantly adjust the energy mix; pressure on financial sustainability of public water/energy service providers.
 **General trade**		**15%**	• Transition: change in consumer preferences; change in trade regulations (e.g., EU CBAM);. • Physical: disruption of supply chains due to increased extreme events.

Sector	Risk	Portfolio share	Potential impacts
Industry		12%	• Transition: impact of low-carbon policies (industry is the third biggest emitter in Jordan); change in consumer preferences; significant increase in inputs' prices (water, energy). • Physical: disruption of supply chains due to increased extreme events.
Tourism, Hotels, and Restaurants		2%	• Transition: changing tourist preferences; increased demand for eco-tourism; low-carbon policies; links to other sectors (e.g., transport: land, air). • Physical: negative impact on key tourism assets; changing suitability of locations; seasonality.
Agriculture		1%	• Transition: low-carbon policies; consumer preferences; environmental regulations. • Physical: decreased water availability; decreased productivity.
Transportation services		1%	• Transition: low-carbon policies (large emitter); capital injections for flee upgrading; electrification.
Mining		1%	• Transition: low-carbon policies; environmental standards; stranded assets. • Physical: suitability of locations; erosion.
Other (consumer loans)		24%	• Limited impact.

Source: WB staff assessments and CBJ

Climate change policies and actions are becoming increasingly integral to preserve the state-citizen contract, which not only includes acknowledging the urgency of climate change, but also underscoring the changes required for Jordan's economy and society. From a climate change mitigation perspective, citizen views and behaviors have emerged as a central concern for those involved in building sustainable, low-carbon futures to avert public resistance and the need to gain social acceptance of policies, the desire to change behaviors, and efforts to understand citizens' actions to drive solutions in more bottom-up ways through community or grassroot innovations. From the standpoint of climate change adaptation, there is increasing recognition of the value of promoting equity and participation in decision-making and efforts to incorporate bottom-up and place-based approaches.

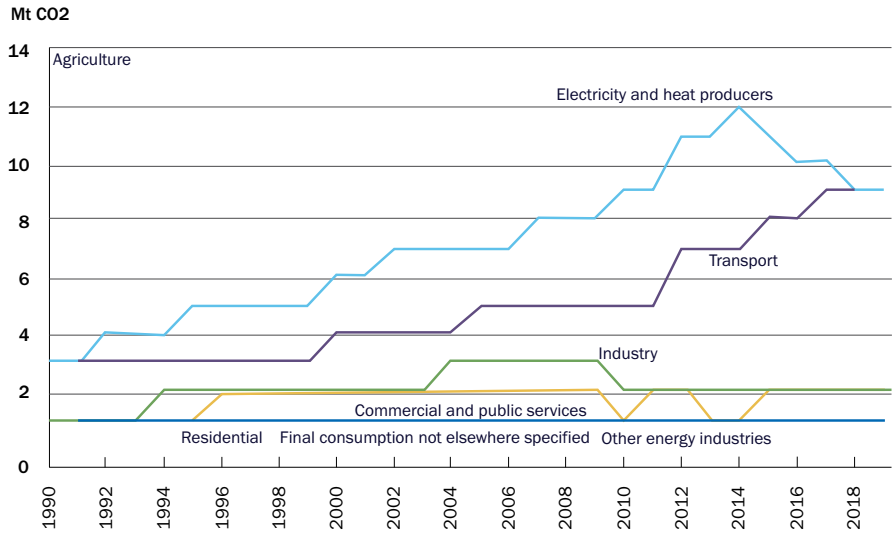
1.3. Risks and opportunities for a low-carbon growth path

Jordan is a very small GHG emitter globally compared to peer countries (Figure 4). In 2018, Jordan's total GHG emissions—35.81 metric tons of carbon dioxide equivalent—represented 0.06 percent of the global total, compared to 0.19 percent for Morocco and 0.67 percent for Egypt. Emissions per capita are low and decreasing and stood at 3.6. tons/capita in 2018[20] which is comparable with other non-oil producing countries in MENA, such as Egypt and Morocco. Energy consumed by unit of GDP has decreased in the past two decades and is comparable with other upper-middle-income countries. While Jordan is a small GHG emitter globally, significant development and adaptation co-benefits are associated with investments in climate change mitigation in the urban, transport, and energy sectors.

The transport sector is catching up with the energy sector as the country's top emitter. As of 2018, the energy sector was the main source of GHG emissions (65.5 percent), followed by waste (15.6 percent), industrial processes (5.6 percent), and agriculture (3.3 percent). Regarding final energy use, the transport sector accounts for almost half of final energy consumption, and at the current growth rate, it could surpass power generation as the top emitter (Figure 7).

[20] World Bank Open Data; CAIT Data Explorer

Figure 7. Cardon dioxide emissions by sector In Jordan (1990–2019)[21]



Reducing emissions from the energy sector in Jordan would require addressing inefficiencies in the transport sector while providing development and mitigation co-benefits. Transport-related inefficiencies are equivalent to at least 6 percent of Jordan's annual GDP. According to the GAM, traffic congestion losses in Amman amount to JOD 1.5 billion annually, approximately 5 percent of the total GDP. Other costs include losses due to traffic fatalities and injuries, amounting to approximately 1 percent of Jordan's GDP in recent years (JOD 296 million in 2020); noise pollution, with costs ranging between JOD 54 and JOD 160 million in 2014; and pollutant emissions. Public transport inefficiencies increase household expenditures and hinder women and youth from joining the workforce. Finally, the road network in Jordan has not yet fully incorporated climate risks into its technical design and maintenance, resulting in unsafe road conditions and accidents during extreme weather events.

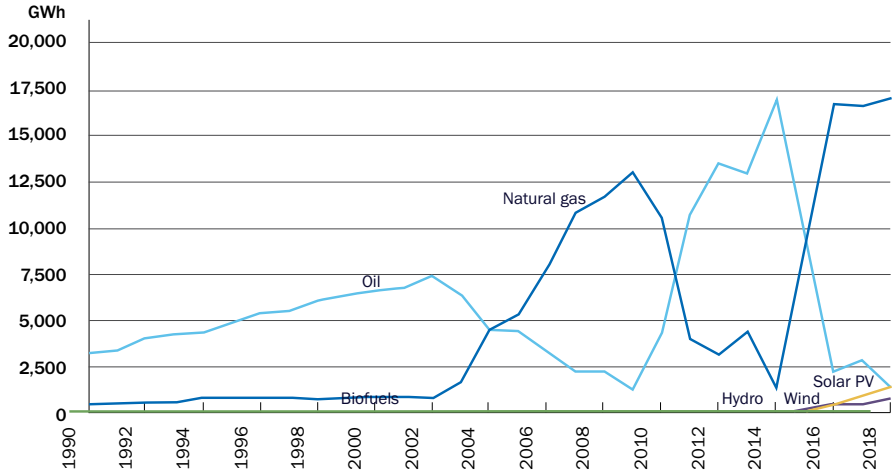
Energy sector emissions have decreased thanks to renewable energy (RE) and energy efficiency (EE) initiatives; however, overall energy demand is likely to rise with climate change and population growth. Jordan imports over 92 percent of its energy for transport and electricity generation. In 2020, nearly 80 percent of its electricity was generated from natural gas. Jordan was one of the early movers in the MENA region on wind and solar energy IPPs. Since 2015, the share of renewable energy has steadily grown (Figure 8). In addition, with oil being replaced with natural gas, emissions have steadily declined. However, this rapid decline in GHG emissions is expected to slow down with the commissioning of the oil-shale power plant. The islanded nature of the Jordanian grid and its relatively small size[22] render system operations challenging with large shares of utility-scale renewables[23]. Currently, the total installed capacity of transmission and distribution connected RE projects in Jordan accounts for 37 percent of the total installed capacity in the system. Extensive RE and EE initiatives across the public and private sectors and for end-users have been implemented. However, since 2018, the economic slowdown has resulted in negative growth, oversupply, and financial unsustainability in the energy sector.

[21] Source: IEA

[22] Peak load of approximately 4010 MW in 2022

[23] 2063.3 MW installed capacity in 2020 including extensive net metering and wheeling schemes that exceeded 600MW of distribution connected self-generation in 2020

Figure 8. Electricity generation by source, Jordan 1990–2018[24]



Cities present significant opportunities for climate action – both for adaptation and mitigation, with development co-benefits. With 91 percent of the population living in urban areas, cities greatly contribute to GHG emissions (Figure 9). Jordan's urbanization rate is high relative to peer countries, and the urban population is expected to increase by 15 percent by 2030. Jordan's cities have not fully leveraged the benefits of agglomeration, productivity gains, firm entry and jobs, and better services associated with urbanization. Inefficient urbanization increases pressure on infrastructure, service delivery costs, job access, and leads to loss of agricultural land, while also adding to a higher carbon footprint.

Based on the latest data, as of 2016, 56 percent of total industry GHG emissions from industrial processes and product use came from cement production (Figure 10), meaning a large share of Jordan's industrial emissions is generated by a relatively small industrial segment. An industrial decarbonization strategy, especially targeting high emitters clustered around Amman such as the cement, glass, and steel industry, will be crucial to mitigating a significant source of emissions. Benchmarking with more advanced economies shows room for improvement (Figure 11).

Jordan's agriculture sector was the fourth largest GHG emitting sector in 2017, emitting 4.8 percent of the country's GHG emissions (FAOSTAT).There are opportunities in the livestock and land use sectors to improve emission efficiency, reduce emissions and increase carbon sequestration in rangelands. A large share of agri-food system GHG emissions could be mitigated by reducing the high level of loss and waste in supply chains, such as the estimated 45 percent in Jordan's vegetables and fruit sector.[25]

Jordan must carefully manage climate-related trade risks given its significant share of emission-intensive exports. A significant share of Jordan's key export sectors is highly emission-intensive industries. Multiple countries are planning to introduce environmental regulations linked to trade, such as carbon border adjustment mechanisms (CBAM). While immediate consequences for Jordan are likely to be moderate, indirect and medium-term effects could be significant. The EU CBAM, scheduled to be introduced in late 2022, could become a barrier to exporting chemicals.

Jordan faces the challenge of financing a climate-responsive, inclusive, and sustainable recovery during a tight fiscal situation featuring declining private investment. Jordan's existing international commitments focus on electricity and transport-related emissions, but a broader set of climate actions is needed to sustain Jordan's economy and safeguard the resources on which current and future generations depend.

[24] Source: IEA (https://www.iea.org/data-and-statistics/data-browser?country=JORDAN&fuel=Electricity%20and%20heat&indicator=ElecGenByFuel)

[25] FAO Capacity Building for Food Loss Reduction in the Near East.

Figure 9. Spatial distribution of GHG emissions and urban clusters[26]

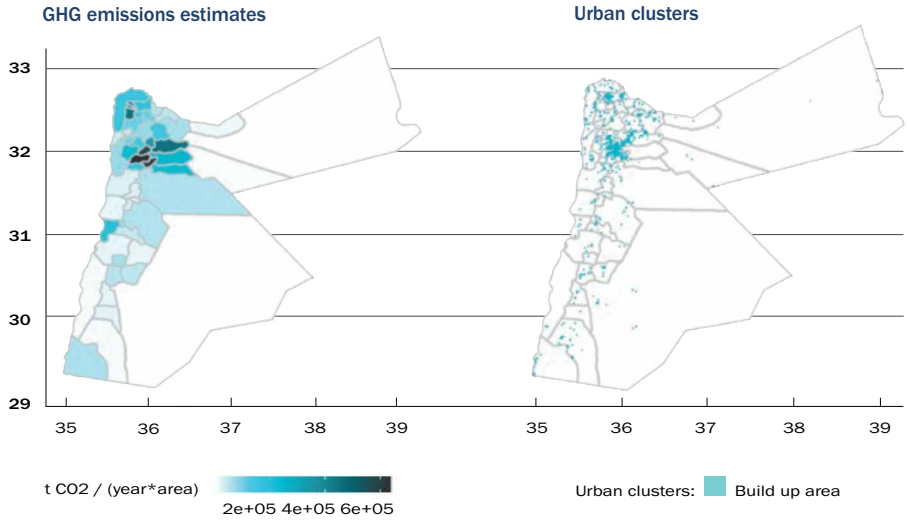


Figure 10. GHG net emissions (2016)

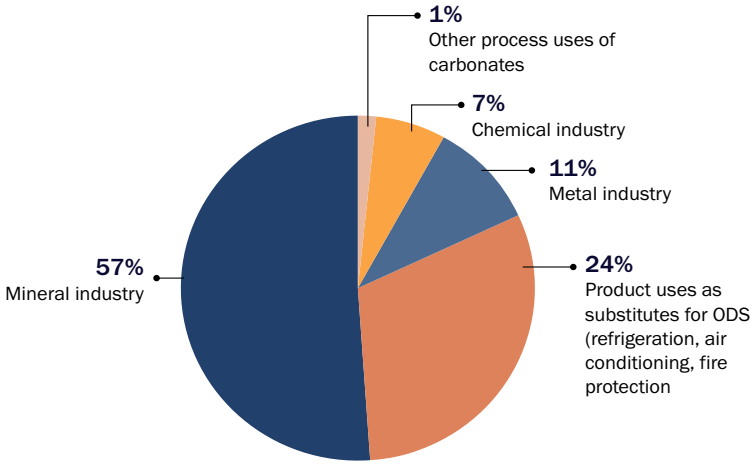
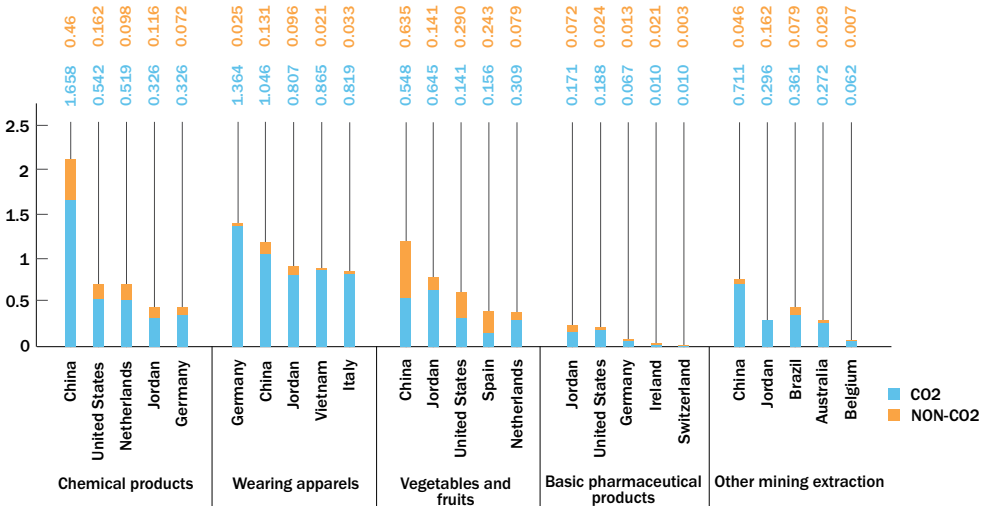


Figure 11. Country comparison in GHG intensity of key export sectors in 2014 (KG/US$)



[26] Source: Emissions estimates were developed with data from Emissions Database for Global Atmospheric Research. Area units are 0.1 x 0.1 degree. Build up area was retrieved from WorldPop, 2020.

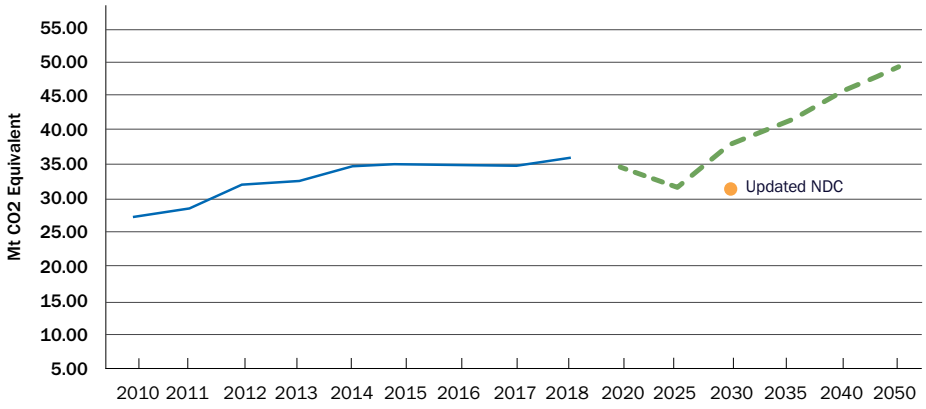
2. Strengthening policies and capacities to meet Jordan's climate commitments

2.1. Climate change adaptation and mitigation commitments

Despite its relatively low emissions levels, Jordan was an early mover in international climate commitments. Jordan was among the first group of developing countries to ratify the UNFCCC. Jordan ratified its Nationally Determined Contributions (NDCs) in November 2015 and developed an NDC Action Plan in 2019. Its National Climate Change Policy (NCCP) of 2013–2020 was the first comprehensive climate policy in the MENA region.

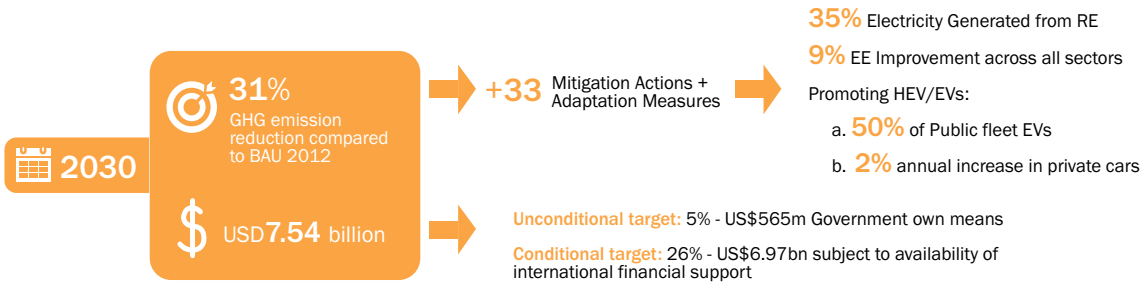
Jordan has established ambitious GHG emission reduction targets relative to peer countries in the MENA region. In October 2021, Jordan increased its commitment to reduce GHG emissions from 14 to 31 percent by 2030, with 26 percent conditional on financing and 5 percent unconditional (Figure 13). The new 31 percent GHG reduction target would imply emissions of 30,291 carbon dioxide equivalent (Gg) compared to 43,989 CO2 eq (Gg) under business-as-usual in 2030, against 2012 baseline figures. The costs associated with this new GHG emissions reduction target amount to US$7.5 billion. Jordan's increased commitments are also reflected in more ambitious sector targets, such as generating 35 percent of electricity from RE by 2030 and a 50 percent share of electric vehicles in the public fleet by 2030.

Figure 12. Carbon dioxide emissions projections to 2050 under current commitments



Source: Jordan NDCs and BUR 2017

Figure 13. Summary of Jordan's updated NDCs



Jordan is on track to meet its updated NDC commitments; however, Jordan's GHG emissions are estimated to continue rising toward 2050. According to the overall GHG Inventory estimates, Jordan contributed 35,810 GgCO2e in 2018, which puts it on the trajectory toward achieving the updated NDC goal. Without any actions, however, GHG emissions will continue to increase by 2050, driven by population growth (Figure 12).

Meeting Jordan's highly ambitious NDC commitments depends on securing as-yet-unidentified financing. Jordan's target reflects a relatively high level of conditionality (26 percent conditional and 5 percent

unconditional) compared to some regional peers (Morocco 18.3 percent unconditional and 45.5 percent conditional; Lebanon 20 percent unconditional and 31 percent conditional) but is more ambitious relative to peers such as Egypt.

At the sub-national level, the GAM is a regional leader in climate change with an ambitious goal of reaching net-zero carbon emissions by 2050. GAM, home to more than 40 percent of Jordanians, conducted two GHG emissions inventories for 2014 and 2016. Since then, they have adopted the Amman Climate Plan – A vision for Amman 2050 to achieve net-zero emissions and the Green City Action Plan (2021), a first in the region, supported by several related initiatives such as the Resilience Strategy, Smart City Roadmap, and a Financial Reform Plan. Amman is also a member of C40, a network of the world's megacities committed to addressing climate change.

2.2. Existing policies for mitigation and adaptation

Jordan has been consolidating the strategic framework for implementing its climate commitments. Jordan adopted a National Green Growth Strategy in 2016 and developed the National Plan for Green Growth (2017–2025) to encourage investment in six priority areas: energy, water, transport, agriculture, tourism, and waste management. Jordan has also adopted a large body of general and sector-specific climate policies and strategies at national and sub-national levels (Table 3).

The legal framework for climate action has also been strengthened. In 2019, the country enacted Climate Change Bylaw No. 79 as the legal framework for climate action, focusing on four areas: (a) institutional processes, particularly establishing a National Climate Change Committee; (b) developing the country-wide IT and technical infrastructure for Monitoring, Reporting, Verification (MRV) and National Registry for all Climate mitigation actions; (c) developing sectoral strategies for achieving NDC goals by 2030 and towards the 2050 long-term strategy to achieve climate neutrality, and (c) defining innovative financial and climate finance options to accelerate climate action. The Renewable Energy and Energy Efficiency Law of 2012 aims to strengthen the private sector's role.

Table 3. Overview of Jordan's key strategies, policies, and legal documents on climate change

Strategies
National:
• Jordan Economic Modernization Vision 2033
• Jordan Vision 2025 GIEP (former EDP) 2021–2023 Government Priorities 2021–2023
• The National Green Growth Plan (NGGP, 2017) Green Growth National Action Plans (GG-NAPs, 2020) for Energy, Water, Agriculture, Transport, Tourism, and Waste sectors
Sectoral strategies:
• Jordan Energy Strategy (JES) 2020–2030
• National Water Strategy & Master Plan (NSMP) 2016–2025
• Climate-Smart Agriculture Investment Plan (2021) and National Agriculture Strategy (2022–2025)
• Health Sector Strategic Plan 2018–2022
• National Climate Change Health Adaptation Strategy and Action Plan of Jordan (2012)
• National Tourism Sector Strategy 2020–2025
• Jordan Long Term National Transport Strategy and Action Plan
Policy documents
• National Climate Change Policy 2013–2020 (NCCP)
• National Climate Change Adaptation Plan (NAP), 2021
• Climate Change Policy for Resilient Water Sector (2016)
Legal provisions and international commitments
• Jordan's NDCs to the Paris Climate Agreement
• Environment Protection Law No 6. of 2017
• The Climate Change Bylaw 79/2019
• Instructions on climate change expenditure definition, 2021
• Jordan Environment Fund (JEF) Bylaw 18/2018 (updated 2019)
• The Renewable Energy and Energy Efficiency law No. 3 of 2010.
• Jordan Renewable Energy and Energy Efficiency Fund (JREEEF) Bylaw 49/2015
• The General Electricity Law No. 64 of 2003
• Waste Management Framework Law No 16 of 2020.

Source: Jordan Climate PEFA

The electricity sector is on a low-carbon trajectory with an increasing share of renewables. Jordan's current energy strategy aims to achieve 50 percent renewable energy by 2030, significantly higher than the NDC target of 31 percent. Reaching these goals will require significant investment in stronger regional interconnections, smart grid infrastructure and pumped hydro storage, and a 9 percent reduction in energy consumption by 2030. The Clean Energy Transmission Modelling analyzed four specific scenarios: (a) Current Policy Scenario (CPS) by 2050 and compared to CPS (b) Reducing Emissions by 60 percent (NZ60), (c) Reducing Emissions by 80 percent (NZ80), and (d) Reducing Emissions by 100 percent (NZ100). Results are presented in Figures 14 and 15. The analysis indicates that achieving net-zero emissions would require additional investments in the network, energy storage, carbon capture, renewable energy and early retirement of 1.3 GW of CCGT plants starting in 2026. Compared to the current policy scenario, which requires additional investments of US$12 billion by 2050, achieving net zero emissions requires US$24.2 billion. This is excluding the cost of transmission grid reinforcement requirements and the cost of early economic retirement of gas-fired power plants. Unless these additional investments are secured through grants, the annual levelized cost of electricity would increase by 22 percent in 2050 compared to the CPS (from 34.6 USD/MWh to 42.3 MWh). The corresponding grid emissions factor (tCO2/MWh) for the four scenarios is depicted in Figure 15. Under the CPS, the grid emissions factor is on a declining trajectory.

Figure 14. Scenarios for electricity generation mix - medium demand growth

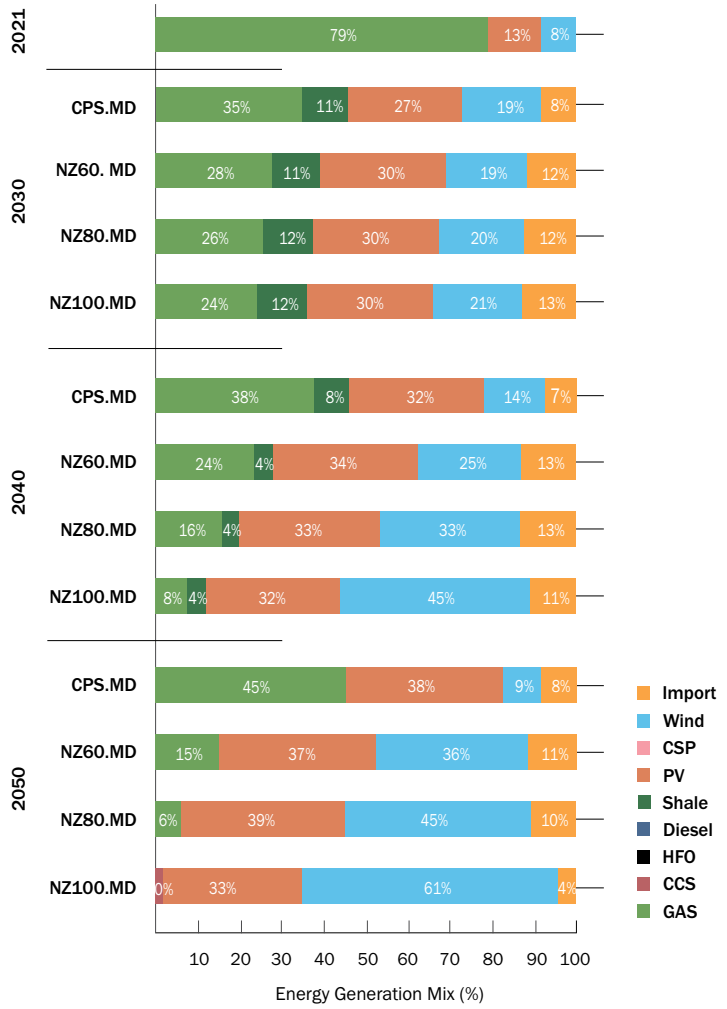
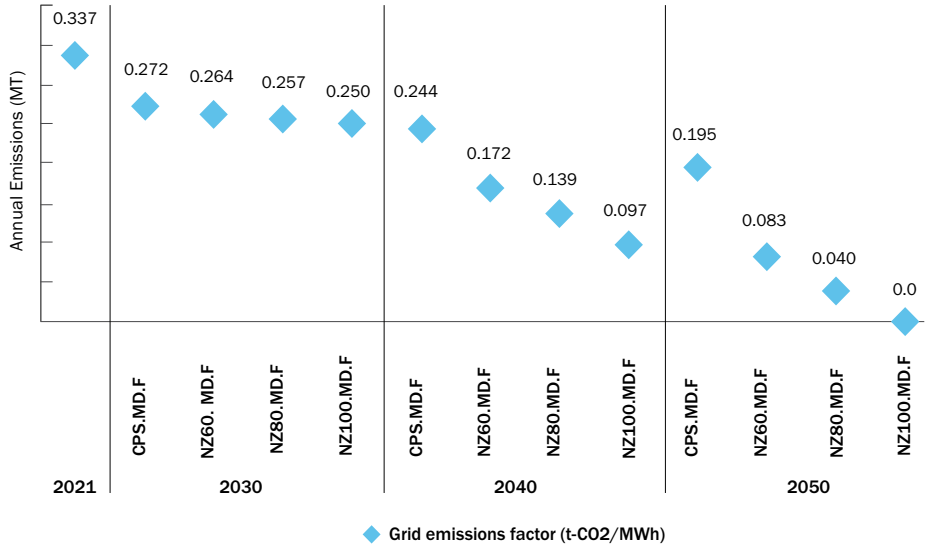


Figure 15. Grid emissions factor - medium demand growth



In 2021, Jordan submitted its National Adaption Plan, which seeks to mainstream climate change adaptation in the development planning processes to enhance climate resilience and adaptive capacities and reduce climate vulnerability within all relevant sectors. The plan identifies the urgency of implementing adaptation measures to address the impacts of climate change, which are already becoming evident in terms of climate variability and extreme weather events.

Jordan continues to strengthen its coordination mechanisms for enhancing disaster preparedness, systematic implementation of strategies, and risk financing. The government established the National Center for Security and Crisis Management (NCSCM) in 2015 and the multi-stakeholder National Disaster Risk Reduction Platform under NCSCM in 2017. A Jordan National Natural Disaster Risk Reduction Strategy 2019–2022 has also been developed and the focus should now turn to implementation, including disaster preparedness, mitigation measures, early warning systems, and disaster risk financing instruments.

Jordan requires a whole-of-economy approach to address complex and interrelated development and climate change challenges. As further discussed under Chapter 3, reaching Jordan's development goals in the context of climate change will primarily depend on coordinated action to accelerate the transformation of key sectors (energy, water, agriculture, transport and urban development). Accordingly, the Government of Jordan, with World Bank support, is preparing its Long-Term Low-Carbon and Climate Resilient Strategy 2050 (LTS). This strategy will incorporate the analysis in this CCDR and build on a stakeholder consultation process to develop pathways to achieve a net zero emissions target, and climate-resilient economic and social development. This process also aligns with Jordan's fourth National Communication submission to the UNFCCC.

2.3. Government budgets, existing investments, and institutional arrangements

The Ministry of Environment (MoE), established in 2003, coordinates the implementation of national commitments toward the UNFCCC. The Climate Change Directorate (CCD) was created at the MoE in 2014, following approval of the National Climate Change Strategy, to address climate change issues and establish appropriate policies. The CCD's role has increased to include coordinating with sector ministries, agencies, and development partners. As of 2022, climate change work led by the CCD has been recognized through a dedicated budget line. In light of this achievement, the CCD's mission would now benefit from additional specialized in-house technical expertise on climate change.

The CCD is leading Jordan's National Committee on Climate Change (NCCC) in implementing legal instruments, policies, and strategies related to climate change. The NCCC which was established under the 2019 Climate Change By-law consists of 16 high-level members from relevant public authorities. The NCCC recognizes representatives of key entities representing governmental sectors, sub-national agencies, civil society, research institutions, universities, and the private sector. These representatives can be called upon to form technical committees on specialized topics.

Systematic and proactive public engagement on climate change issues remains limited, however. Based on feedback from sessions with civil society organizations and youth groups during the CCDR's preparation, some institutional challenges include limited coordination between national and subnational level entities responsible for climate change. There is a lack of a strategic approach for consistent information sharing and public education on climate change, and public engagement for planning, implementing, and monitoring climate-change commitments.

Donor dependency for climate action is high, as evidenced by the conditionality of the GHG target and framing of the NDCs. For the 2000 to 2019 period, Jordan attracted significant climate financing. OECD DAC statistics indicate that Jordan received over US$5 billion towards climate change-related activities during that period. Of this, over US$3 billion was for mitigation actions (63 percent) and nearly US$2 billion for adaptation (37 percent). This funding was concentrated on water supply, sanitation and energy, and banking and financing activities.

Jordan has made significant progress in mobilizing resources to meet the financing estimate of US$5.7 billion in its 2015 NDCs. The Second Biennial Update Report (2nd BUR) to the UNFCCC estimates that Jordan had mobilized nearly US$3.7 billion by 2020 (Figure 16). This includes investments in water and wastewater treatment plants, solid waste, and green transport solutions, although they remain relatively limited compared to large utility-scale wind and solar power plants with associated infrastructure like Jordan's Green Corridor. Jordan's Monitoring, Reporting, and Verification (MRV) system was launched in 2021 and will improve climate finance tracking.

Despite Jordan's progress in preparing climate strategies and plans, implementation remains slow. There is a growing gap between climate action financing needs and available resources. Fiscal constraints affect the policy and regulatory environment, particularly incentives for investments in climate-responsive solutions. Many commitments remain aspirational and lack financing sources. Inter-agency coordination to align policies and incentives is a common challenge. There has been limited progress in developing locally appropriate and innovative non-fiscal, non-financial incentives for climate action. Jordan's budget documentation provides insight into expected performance in climate-related sectors, but budget programs are not directly linked to the national climate change framework. GoJ must therefore align its budget with its commitments to the Paris Agreement climate goals.

Jordan could more purposefully mainstream climate concerns in public investments. In 2020, the Government allocated under 30 percent of Jordan's capital projects' budget towards the six 'green growth' sectors: tourism, energy, agriculture, water, transport, and buildings. Most projects in those sectors do not fulfill the climate-responsive eligibility criteria established by the national government (Figure 18),[27] though most projects could be redesigned to meet those criteria. For example, once the Ministry of Public Works and Housing (MoPWH) adopts green public buildings standards, nearly 96 percent of the budget could promote adaptation and mitigation.

[27] The nine eligibility criteria cover potential mitigation, adaptation and, resilience benefits from a capital expenditure project, (e.g., increasing efficiency or adopting renewable energy). If the project fulfills any one or more of the criteria, it is tagged as a 'climate responsive CapEx'.

Figure 16. Progress toward the 2015 NDC financing requirement, in million US$ [28]

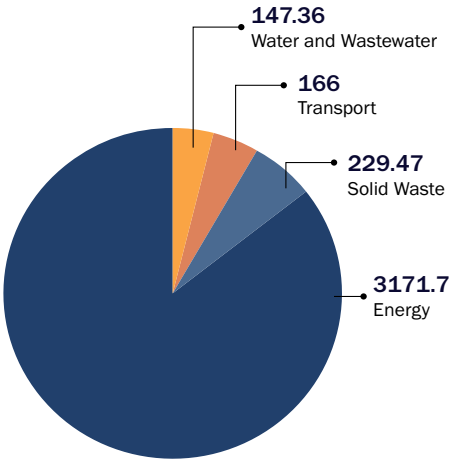
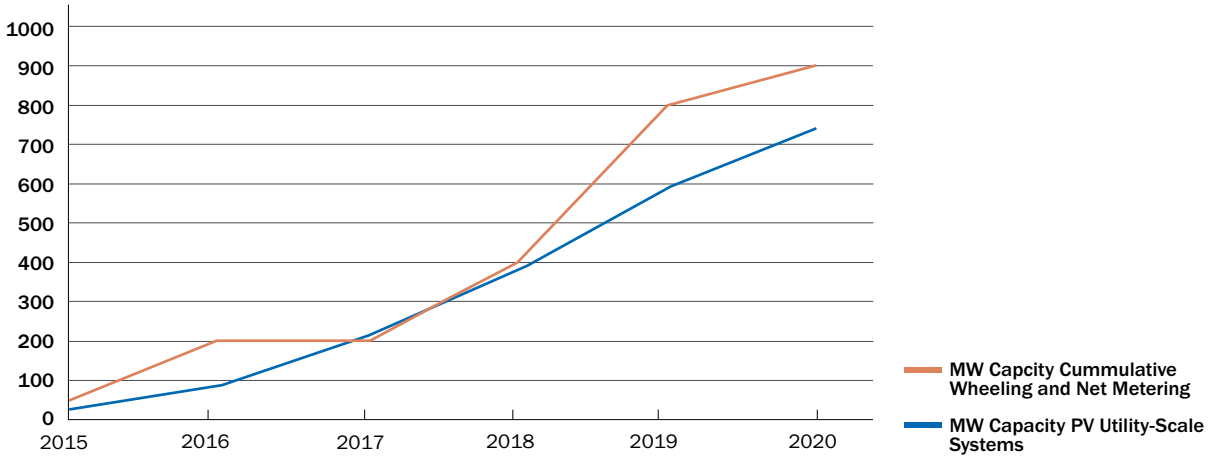


Figure 17. Cumulative capacity of renewable energy projects[29]

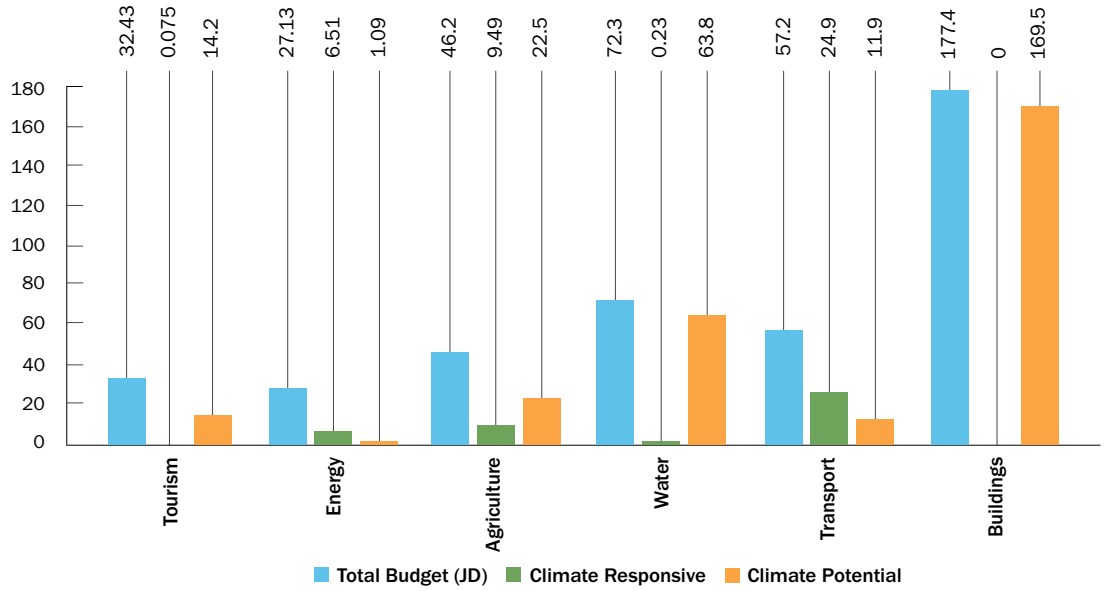


By 2021, the government introduced climate-responsive eligibility criteria in the Public Investment Management (PIM) and Public-Private Partnership (PPP) framework. Jordan's PIM and PPP processes are governed by the 2018 PIM-PPP Governance Framework and the 2019 PIM-PPP Policy, which requires public projects to consider climate change early at the project concept note stage. Eligible projects will be flagged in the National Registry of Investment Projects (NRIP) and MRV system, with relevant projects entered into the National GHG Registry. This is expected to inform the budget's prioritization process and build a pipeline for upstream identification of climate financing needs.

[28] Source: Jordan. Second Biennial update Report (2nd BUR).

[29] Government of Jordan Capital Projects 2019-2021

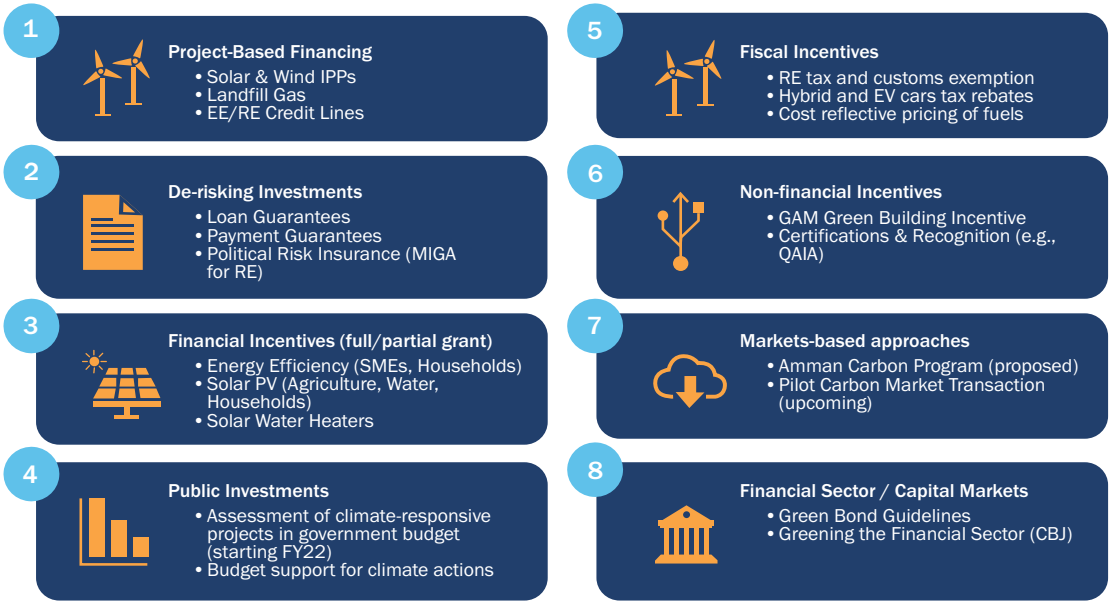
Figure 18. Government of Jordan capital projects in green growth sectors 2020, in JOD million[30]



2.4. Financing and institutions for climate action

Jordan was an early mover on climate change in the MENA region and has gained extensive experience in innovative climate action financing. The US$3.5 billion in climate financing from 2015 to 2020 has primarily come through project-based financing, supported by derisking instruments, fiscal incentives, and public investments. Figure 19 presents a high-level summary of the financing approaches used in Jordan.[31]

Figure 19. Experience with financing approaches in Jordan



[30] Government of Jordan Capital Projects 2019-2021

[31] WB, Transformative Climate Finance, 2020.

Project-based financing, coupled with derisking instruments and grants, has played a key role in accelerating utility-scale solar and wind power production in Jordan. This success is proving challenging to replicate across sectors as the astounding growth in renewable energy was created through a convergence of influencing factors. Figure 20 captures the policy and incentives that led to investment in utility-scale and self-generation renewable energy in Jordan. It is useful to note that the level of cross-subsidy increased high enough to create a quasi 'price signal,' which coupled with effective fiscal policy incentives (particularly exemptions on import of RE equipment) helped generate strong private sector interest in renewables. MIGA has provided political risk insurance guarantees for solar projects under the first Renewable Energy Round, whose success led to subsequent rounds attracting more investors at lower tariffs.

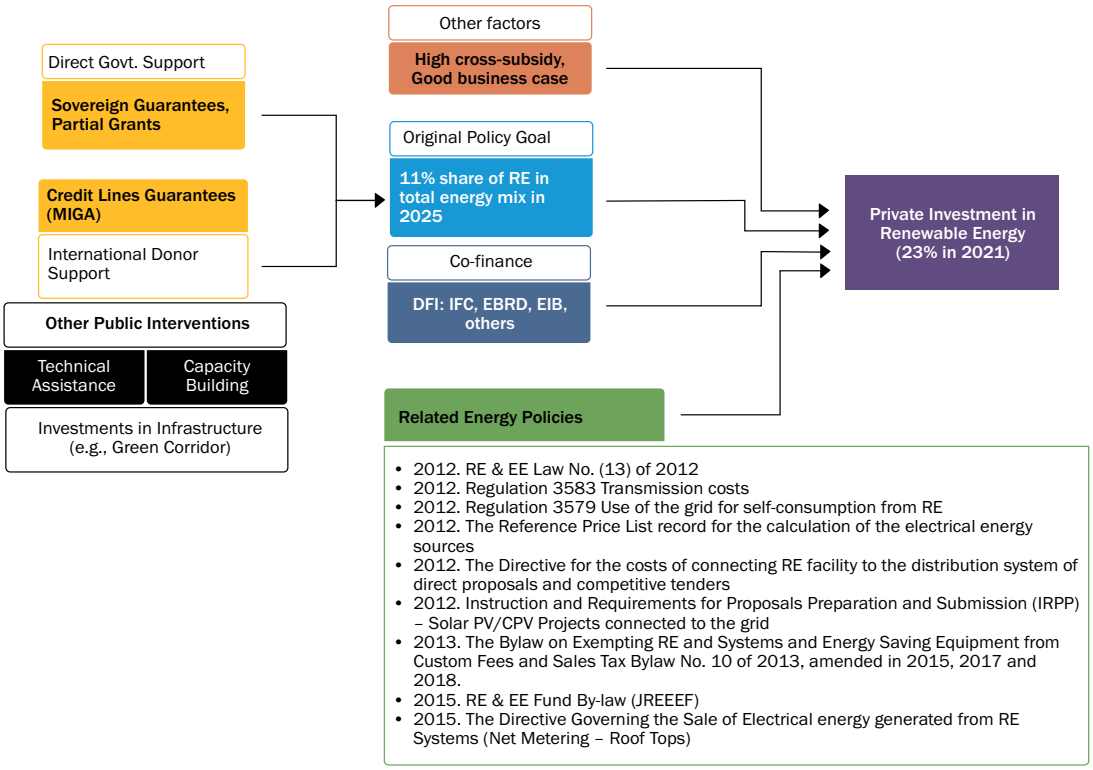
Jordan has implemented various financing programs to support clean technologies in the industrial and MSME sectors, particularly credit lines and refinancing schemes. In addition to targeted financing programs supported by AFD and EBRD, CBJ offers a low interest refinancing program supporting renewable energy. This program of JOD 1.2 billion[32] has financed around 500 projects, including renewable energy solutions for hospitals, manufacturing, and food storage facilities, for a total amount of around JOD 230 million. The Jordan Renewable Energy and Energy Efficiency Fund (JREEEF), the Jordan Loan Guarantee Corporation (JLGC), and several commercial banks signed an agreement in 2016 to finance renewable energy projects for SMEs and households, wherein JLGC guarantees up to 70 percent of the value of loans issued by the banks. The uptake is limited, with only six loans taken out by 2020, attributed to a lack of interest from SMEs, banks lacking credible market references for borrowers, and an inability to verify project assumptions or risks.

Several grant schemes provide full or partial financing for clean technologies across sectors. GAM-certified green buildings are also awarded non-financial measures, e.g., extra floor space. The Solar Grant program, 'Fils-Al-Reef' (FAR), has provided free solar photovoltaic (PV) systems to low-income households since 2019 under the National Aid Fund (NAF), on the condition that their electricity usage does not exceed 300 KWh/ month. With co-financing from development partners, partial grant programs support clean technologies for residential, water, agriculture, MSME, tourism, education, and other priority sectors. The electricity sector has a high level of cross-subsidy, with the burden borne by the productive sector. High costs and scarcity drive the business case for large industries undertaking investments in energy and water. Similar efforts have been successful in micro water harvesting, and rangeland conservation at the community scale, with extensive technical assistance and civil society involvement through the Adaptation Fund, Global Environment Facility, and UN agencies.

Carbon pricing has been extensively explored in the Jordanian context, though Jordan has limited experience with carbon markets. There are only four registered Clean Development Mechanism (CDM) projects and one registered Voluntary market project in Jordan (those include fuel switch projects replacing heavy fuel oil with natural gas, at the Aqaba Thermal Power Station and Samra power plant and landfill gas recovery and utilization for power generation at the Ruseifeh and Ghabawi landfills). Government and civil society stakeholders noted the challenges facing energy and water subsidies and the tax policy and fiscal constraints as barriers to introducing a carbon tax or any similar charges in the coming years. Based on stakeholder feedback, this CCDR is not assessing carbon pricing; this question will, however, be further discussed during the upcoming development of the LTS 2050. As Jordan has implemented a MRV system and GHG Registry, the forthcoming Paris Agreement Article 6 strategy, should create a stronger governance framework to support carbon market participation.

[32] The loan ceiling for renewable energy is 4 million JD, with the 10-year maximum loan term and grace period up to 24 months. The funds are provided to commercial banks at 1 percent interest rate for projects inside Amman, and 0.50 percent for projects outside Amman. Banks can relend these funds with 3–4 percent interest rate for projects inside Amman, and 2.5–3.5 percent for projects outside Amman, which is significantly below market interest rates in Jordan.

Figure 20. Investment map in utility-scale and self-generation renewable energy in Jordan



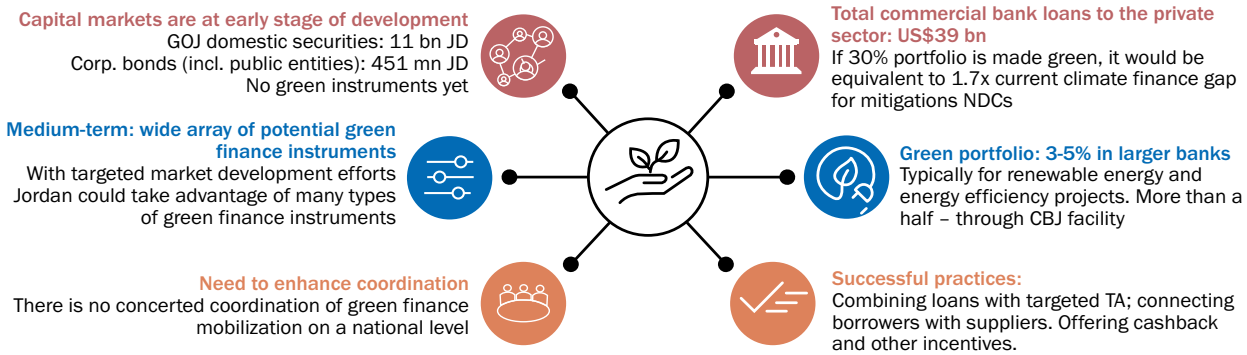
Fiscal incentives such as tax breaks are successful but at significant cost to the government, and green loans account for under 2 percent of commercial banks' portfolios in Jordan. Recent experience in the transport sector has highlighted the importance of a thorough analysis of government costs and a full understanding of the interaction between fiscal and sectoral policy goals to avoid declining government revenue. In terms of green loans, there is neither a well-developed definition nor accurate data on green loan portfolios in Jordan's banking sector. Banks consider 'green loans' as those that support implementing renewable energy or energy efficiency solutions. IFC estimates that around 30 percent of bank balance sheets in emerging markets should be green by 2030 to meet global climate goals.

Commercial banks acknowledge that the financial sector lacks the climate investment capacity to contribute to climate finance mobilization and mainstream climate considerations into risk management frameworks. Addressing capacity and information gaps is expected to be among the key milestones of the CBJ's Strategy for Greening the Financial Sector. Larger firms do not identify access to finance as a major issue in implementing climate-smart business practices. However, access to finance is still a broader issue for SMEs, while Jordan's banking sector has witnessed a persistently high liquidity in the last decade and more. The appetite and capacity of the financial sector for green financing therefore needs further assessment. All interviewed banks expressed the need to combine their financing with targeted technical assistance to their client firms, particularly SMEs.

Capital markets in Jordan are nascent; broader regulatory work is needed to advance Jordan's capital markets in general. The outstanding domestic treasury bills and bonds at the end of October 2021 amounted to JOD 10,955 million or 34.2 percent of the estimated GDP. The corporate bond market is very small at present. According to MOF, corporate bonds—including public entities—accounted for JD 451 million (1.4 percent of GDP) as of October 2021. The Amman Stock Exchange (ASE) had a market capitalization of JOD 12.9 billion (or 41.5 percent of GDP) in 2020. Market capitalization has been declining since 2007; for example, market capitalization was over 60 percent of GDP in 2017. The annual turnover has been relatively low and declining in 2017–2020, from 25.74 percent in 2017 to 17 percent in 2020. The institutional investor base is underdeveloped, except for a large public pension fund.

The Green Bond Guidelines issued in 2021 provide a high-level framework to stimulate dialogue with private sector stakeholders.[33] There are currently no green bonds or other green capital market instruments issued in Jordan (Figure 21). If present, these could diversify a currently highly concentrated investor base, as banks hold over 80 percent of GOJ domestic securities. However, in the short- to medium-term, the aim is to achieve Jordan's climate change objectives through non-debt-creating channels to the maximum extent possible.

Figure 21. High-level summary of the financial sector and capital market stance in the green finance area



[33] Subsequently, IFC is working on its first Green Bond in Jordan.

3. Pathways towards adaptation, resilience, and low-carbon growth

Jordan's trajectory in meeting its climate and development goals will be determined largely by the policy and investment choices the country makes in five strategic sectors - water, energy, agriculture, transport and urban development. The transformation of those sectors towards a resilient and low carbon path would need to be closely coordinated along two nexuses to maximize co-benefits and to reduce potentially negative socio-economic impacts: the water-energy-food security nexus, in a context of extreme water scarcity, and the urban-transport-energy nexus, which is at the core of the shift towards a low-carbon growth path. In the water-energy- food security nexus, adaptation considerations are intrinsically linked to mitigation considerations, primarily through energy use in the water and agriculture sectors. In the urban transport-energy nexus, mitigation considerations are closely linked to adaptation and considerations of other co-benefits for Jordan and its people. This chapter discusses policy and investment synergies and trade-offs in those two critical nexuses to inform prioritization over the next five years.

3.1. Integrated solutions for the water-energy-food security nexus

3.1.1. The water, energy, and food security nexus

The expected increased water scarcity in Jordan makes water efficiency and conservation a paramount strategic priority across all sectors, but significant challenges remain:

- **While the share of agricultural water use is less than in past decades, the sector's water consumption remains suboptimal.** Agriculture is the largest consumer of water resources in Jordan, consistent with other countries. It accounts for 51 percent of total water usage: 33 percent surface water, 39 percent groundwater, and 28 percent treated wastewater (MWI, 2016). Agriculture's productivity per cubic meter of water is about US$1.6, while the corresponding figures are orders of magnitude higher in other sectors.[3435] The cost of producing new water through desalination is projected to be over US$3 per cubic meter,[36] while the average provision cost of municipal water in Jordan was US$2 per cubic meter in 2020.[37]
- **Non-revenue water (NRW)—water supplied to networks but not billed to end users due to commercial or physical losses—accounts for approximately 50 percent of municipal water in Jordan, a high figure.39 Jordan's water supply is also highly energy-intensive and inefficient.** Water losses are high due to leaks in the water distribution system infrastructure and poor commercial performance, including under-registration.40 Progress in reducing NRW has been challenging due to Jordan's topography, the limited natural endowment of water resources, and the lack of a holistic, systematic approach by utilities. As many consumers are geographically distant from water sources, some deep underground, increasing energy is required for withdrawal. Up to 90 percent of Amman's drinking water comes from 125–325 kilometers away.41 Other problems include inefficient, outdated pumps and the need to pump continuously to meet pressure requirements, given the low water availability.

The concurrent effects of climate change on the water, energy, and agriculture sector and their strong linkages require integrated solutions. The mutual dependencies between sectors (Figure 22) require cross-sectoral solutions in four priority areas of intervention:

a. **Ensuring the financial sustainability of the water and energy sectors,** shifting the current unsustainable trajectory towards financially sustainable pathways that can cope with increasing water scarcity through immediate interventions;

[34] World Bank 2018. Beyond Scarcity: Water Security in the Middle East and North Africa.

[35] and the cost of producing new water through desalination is projected to be more than US$3 per cubic meter

[36] World Bank 2018. Beyond Scarcity: Water Security in the Middle East and North Africa.

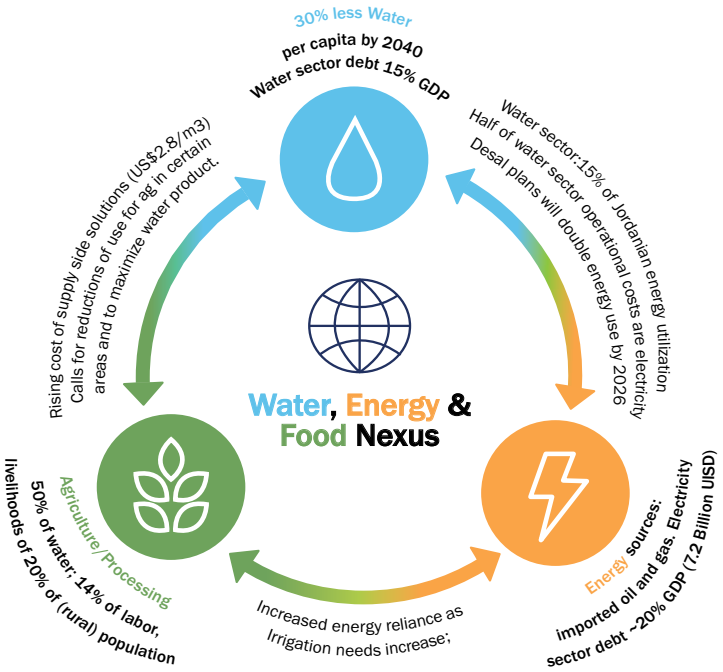
[37] World Bank Calculation

b. Improving the efficiency of water use and reducing fresh water use in the agriculture sector while safeguarding livelihoods and addressing structural issues through combined policy and investment packages to achieve a water-use trend reversal in the short medium-term;

c. Boosting system-wide resilience with a focus on drought, adapting to progressively more frequent and long-lasting drought events in the short and medium-term;

d. Leveraging mitigation opportunities in the agri-food and water sectors in the medium- and longer-term.

Figure 22. The water-energy-food security nexus in Jordan



3.1.2. Challenges and opportunities

The water sector is facing severe financial sustainability challenges. Opportunities to augment water supply are limited and increasingly costly. By the end of 2019, the water sector deficit was JOD 310 million (1 percent of GDP) and sector debt was 2,524 MJD (7% of GDP). This deficit and the debt accumulation are partly due to rising energy costs and significant capital investments needed to (a) augment the bulk water supply, (b) improve the urban water supply networks to meet the needs of a growing population, and (c) significantly expand modern wastewater treatment facilities. Opportunities to augment water supply include: i) desalinating water and transferring it a long distance at considerable expense (current plans include the Aqaba-Amman National Carrier Project or AAC); or (ii) purchasing water from other countries which may be less expensive but introduces sovereignty and political concerns.

Augmenting water supply with desalinated water will likely place more financial burden on the water sector, although additional water supply is needed to close the supply-demand gap in Jordan and to respond to adaptation needs. Efficiency measures alone will not close the supply-demand gap, and options for national projects for supply augmentation are limited. The anticipated deficit and debt in 2040 with and without efficiency measures and the AAC are shown in Figures 29 and 30.[38] Energy represents around 50 percent of

[38] The cost of capital scenarios was based off the cost of the Disi pipeline and conveyance, which delivers 100MCM per year. An annual lease payment of 196 MJD/a is equal to 3x the cost of the Disi pipeline, as the AAC is expected to deliver 300 MCM per year once operational. An annual lease payment of 121 MJD/a was developed to reflect a lower cost of capital scenario and is equal to 1.85x the cost of the Disi pipeline.

AAC's anticipated operating costs, depending on the final design/financial structuring of the project and the cost of energy. [39] Figures 23 and 24 show that efficiency measures would reduce debt accumulation

Efficiency measures and investments in tangible, near-term renewable energy projects could significantly improve water sector debt. The Water Sector Financial Sustainability Roadmap (FSR) [40], prepared through a consultative process, outlines a set of policy and investment measures (loss reduction investments, energy efficiency investments, agricultural water management investments and tariff reform) that will close the sector operational deficit by 2029 and reduce debt accumulation. Investing in these adaptation measures would reduce water sector debt by billions of JOD by 2040, helping to return the sector to operational cost recovery before the AAC comes online.

Figure 23. Debt (MJD) in 2040 with/without efficiency gains

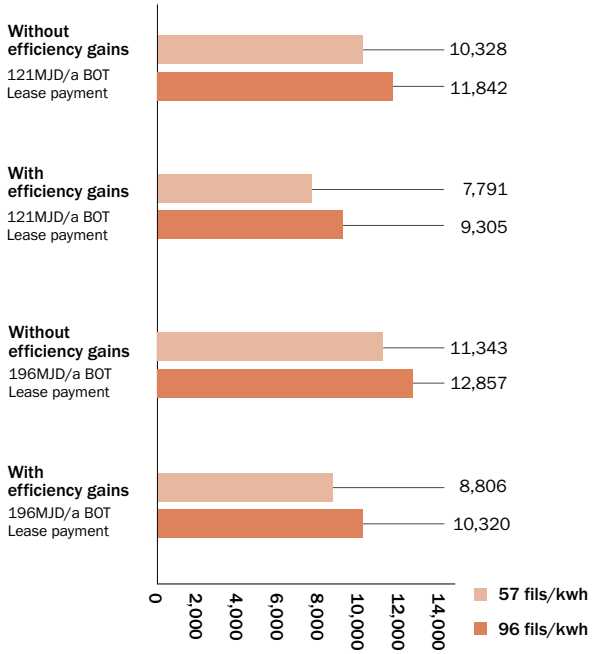
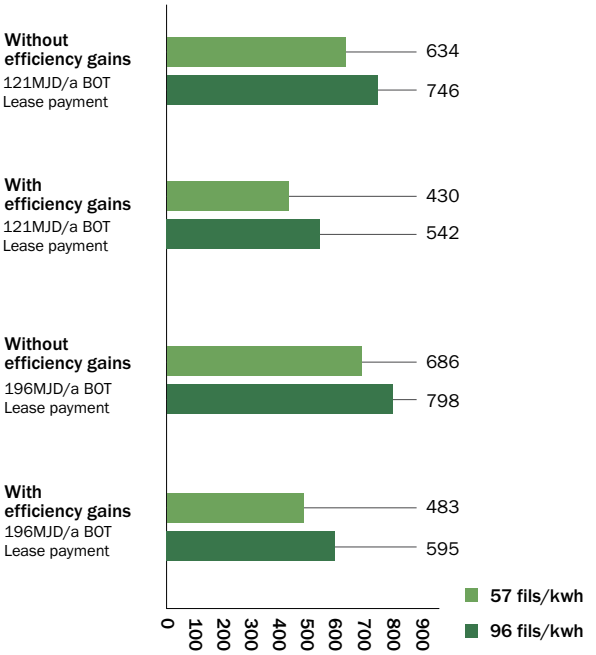


Figure 24. Deficit (MJD) in 2040 with/without efficiency gains



Jordan's agri-food sector shapes the economy outside of Jordan's main urban centers. It is a major source of rural employment and income for smallholders and vulnerable groups, including refugees. Approximately 48 percent of employed Syrians work in the agricultural sector. Twenty-six percent of the country's utilized agricultural area is owned by smallholders (<5 ha), most of whom are heavily impacted by the effects of climate change.[41] Jordan also imports around 70 percent of its staple food needs, exposing it to price fluctuations.[42]

Agriculture must reduce the absolute quantity of fresh water it consumes. The sector benefits from large implicit subsidies through water pricing, with a marginal cost of water to the agricultural user below US$0.2 per cubic meter compared to an average cost of water provision of US$2. The government maintains an imperfect system of water quotas that fail to adequately incentivize better water use, efficient crops and practices, and uptake of treated wastewater. However, as discussed below, opportunities exist to reduce agricultural fresh water use while maintaining agricultural livelihoods.

[39] Two energy costs scenarios were developed to reflect potential energy costs for treating and pumping water once the AAC is operational. The first energy cost scenario is 96 fils/kWh, which is the cost recovery tariff for the energy sector while the second energy cost scenario is 57 fils/kWh.

[40] Water Sector Financial Sustainability Roadmap, 2022

[41] Jordan National Agriculture Census 2017

[42] https://carnegieendowment.org/sada/84424

Irrigated agricultural water productivity has steadily improved through water-saving technologies and policies. Further improvements in water productivity will become increasingly difficult to achieve and require cropping and technological shifts. Measures including shifting the crop mix from grains towards horticulture, high adoption rates of advanced irrigation techniques in large- and medium-scale farms, and substituting fresh with treated wastewater (TWW) have improved water productivity. At the aggregate level, Jordan's agricultural water value is approximately US$1.6 per cubic meter, above many other countries in the region but well below Israel with under US$ 2.5 per cubic meter. Irrigated agriculture water value has constantly risen in Jordan, from US$ 0.87 per cubic meter (2003–2007) to US$ 1.96 per cubic meter by 2017. Recent data indicate a slowdown in the rising value of agricultural water, suggesting more advanced technologies such as hydroponics and a shift towards water-efficient crops will be required. Implementing a set of agricultural water savings and reallocation options in agriculture could lead to a possible overall increase in water use efficiency from 81 to 86 percent. Increasing treated wastewater reuse by 31 MCM, building on the existing blended 144 MCM reused each year, would facilitate reallocating fresh water to higher value uses in municipal and industrial supply.

Unauthorized groundwater abstraction makes up a large proportion of irrigation water use. A remote-sensing analysis in Jordan identified that unauthorized groundwater abstraction accounted for around 30 percent of recorded groundwater abstraction, equaling around 106 MCM[43]. Groundwater abstraction for agriculture is substantial in the highlands, partly due to a high number of illegal wells and the limited metering of private abstractions. Groundwater over-abstraction is also prevalent in the Jordan Valley, where it is used to meet the gap between supply and demand, particularly during drought years. The actual abstraction in various aquifer systems is estimated between two and three times the officially stated safe yields.

The water and agriculture sectors are large energy consumers, using around 16 percent of all energy in 2020. The water sector is the largest single energy consumer in Jordan, with half of water utilities' operational costs for electricity. As a result of Jordan's hydrogeology and topography, significant energy is required for pumping water to urban and agricultural areas. The accumulated arrears of the water sector to the energy sector (concentrated in NEPCO) have reached more than JD350 million by the end of 2020.

Climate change will significantly increase the energy demand of the water and agriculture sector. This demand increase will put further pressure on the energy sector's fiscal sustainability and load management. Additional massive capital investments in the energy sector will be required to meet increasing water demand, e.g., energy storage, regional integration, grid reinforcement, etc., which may increase the fiscal burden of the energy sector. While renewable energy could technically reduce electricity costs, Jordan's small and islanded grid makes it increasingly difficult to buildout wind and solar RE projects without occasionally curtailing these capacities to reliably manage the grid. The cash-flow challenges of Jordan's water sector may deteriorate and be transferred to the energy sector. In addition, higher energy demand from desalination projects could provide further challenges for load and demand management.

3.1.3. Pathways to adapt to water scarcity

Priority 1: Ensuring fiscal sustainability of the water and energy sectors

Adapting to water scarcity will involve efficiency and conservation measures and harnessing new water sources such as treated wastewater, desalinated brackish water, and seawater. Options to augment the water supply in Jordan are costly and energy intensive. Desalination from open water sources requires significant energy. Transporting water from sources to population centers must overcome significant elevation (>1000 m) and distances (>400 km), leading to enormous energy needs for pumping. While desalination from brackish water would reduce the energy costs of pumping, it would still be costly. Further options to augment the water supply face similar challenges. Expanding the substitution of freshwater with treated wastewater for use in agriculture implies upgrading treatment facilities and transporting water from centralized and decentralized wastewater treatment plans, often located close to the population center to agriculture production areas as well as lifting of re-allocated freshwater resources from the King Abdullah Canal up to 1000 m of elevation.

[43] GIZ Assessment of Ground Water Abstraction in Jordan during Years 2017, 2018 and 2019

Water sector measures needed to adapt to declining water availability will be even more energy-intensive. In 2020 the average energy density of each cubic meter of water produced was 6.0 kilowatt-hours per cubic meter. Many consumers are geographically distant from water sources requiring significant energy for water pumping. Geographical limitations, energy intensive extraction, and lack of maintenance investments have led to energy consumption levels well above international benchmarks; energy consumption for water supply in Egypt, India, and Brazil is under 2 kWh/m^3. The water sector's energy consumption is expected to increase due to decreasing groundwater levels, increasing salinity in existing supply wells, and the need to augment existing supplies with seawater desalination at Aqaba.

The energy policy for the water sector was developed in 2016 with two main objectives: increasing energy efficiency and using renewable energy for better cost recovery. In 2022 the water sector's energy policy is being updated to improve energy performance, including energy management practices. However, the degree of freedom for the water sector to define its energy policy is constrained by GOJ's overall energy policy. Cabinet Resolution no (2714) dated 9/1/2019 limits the water sector to developing renewable energy projects with a maximum of 1-megawatt-hour peak capacity. The cabinet resolution was issued due to general grid integration concerns of renewable energy and is planned to be in place until the Ministry of Energy and Mineral Resources has studied the grid's ability to absorb additional renewable power.[44,45]

Achieving cost recovery is an important goal for the water sector, and a broad suite of operational efficiency and demand management measures is required to achieve it. As set out in the FSR, tariff increases are a key policy tool in achieving cost recovery.

A combination of policy measures and investments is needed to adapt to declining water availability without putting undue pressure on the energy sector or derailing mitigation ambitions:

a. **Energy efficiency in the water and agriculture sectors:** Investments in pump replacement and energy management systems;[46]

b. **Investing in in-network storage to enable a shift in peak energy demand of the water sector;**

c. **Adopting an economically efficient time of use electricity tariff** incentivizes consumers to consume during the day when ample renewable energy exists. This and investment in storage within the water distribution network could significantly reduce energy utilization during peak energy load hours and reduce costs.

d. **Pumped hydro storage:** The energy and water sectors would benefit from utilizing pumped storage in water reservoirs to provide supplemental variable power supply for the grid or to contribute to water pumping requirements in the water sector;[47]

e. **Introduce "smart" net metering/billing policies that encourage using solar energy by accounting for the time of consumption.**

f. **Adopt policies that accelerate the deployment of smart grid infrastructure,** including smart meters, energy accounting practices, and energy storage, to reduce grid losses and improve reliable integration of variable renewable generation in the distribution grids.

g. **Regional cooperation on energy and water:** Jordan has significant photovoltaic power potential on large tracts of land. Regional cooperation or trade agreements focusing on exporting energy and importing water may provide additional water.

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[44] https://edama.jo/wp-content/uploads/2019/01/The-Cabinet-Resolution-on-Suspending-Approvals-for-Renewable-Energy-Projects.pdf

[45] IRENA 2021 Renewables Readiness Assessment: The Hashemite Kingdom of Jordan

[46] Potential energy-efficiency investments are costed at US$250 million, reducing the energy requirements of the water sector by 350 gigawatt hours per year (from 2866 GWhr in 2020). An energy management system is estimated at US$1.5m, reducing energy demand by 53 gigawatt hours per year.

[47] NEPCO is currently pursuing the detailed feasibility study of establishing a pumped hydro storage facility (~450 MW capacity) at the Mujib Dam site

Priority 2: Reducing fresh water use in agriculture while safeguarding livelihoods

Water conservation is a strategic adaptation priority in the agriculture and domestic water supply sectors to help reduce the growing water-availability gap. Despite the national efforts to improve water conservation in recent years, for example, by increasing water productivity and treated wastewater (TWW) reuse and reducing non-revenue water, the country is yet to develop its full water savings potential to close the water demand gap and reduce the need for costly water supply augmentation projects. Improvements in water use efficiency across the economy may reduce the economic impact of water scarcity in Jordan by up to 40 percent (World Bank, 2020).

Preparing Jordan for some of the inevitable consequences of water scarcity means recognizing water's productive value. Although there is widespread recognition that water is scarce in Jordan, its economic value is rarely recognized. Efforts to value water can take many forms, from economic instruments to administrative tools, communication, and law enforcement campaigns. For domestic users, valuing water usually means rationalizing water tariffs, improving billing and collection, and enforcing illegal use. Water tariffs must be increased carefully to ensure the poorest and most vulnerable populations retain access to water. At the agricultural level, monitoring use, modernizing irrigation systems, increasing on-farm water productivity, and reducing losses in food-supply chains could be beneficial. Strong legal frameworks will be essential to ensure equitable resource allocation while providing the opportunity for efficiency gains (World Bank, 2018).

Viable avenues to reduce freshwater use in agriculture while maintaining agricultural livelihoods exist, both off-farm and on-farm through a combination of policies and investments:

a. Rehabilitating the King Abdullah Canal (KAC) to increase the availability of fresh water in agriculture by reducing conveyance losses, potentially increasing water availability for irrigation from 50 MCM to 64 MCM.

b. Enhancing the treated wastewater (WW) infrastructure to scale up the volume of reclaimed water and its use in the Jordan Valley.

c. Using enhanced remote sensing to tackle the formidable challenge of illegal groundwater abstractions.

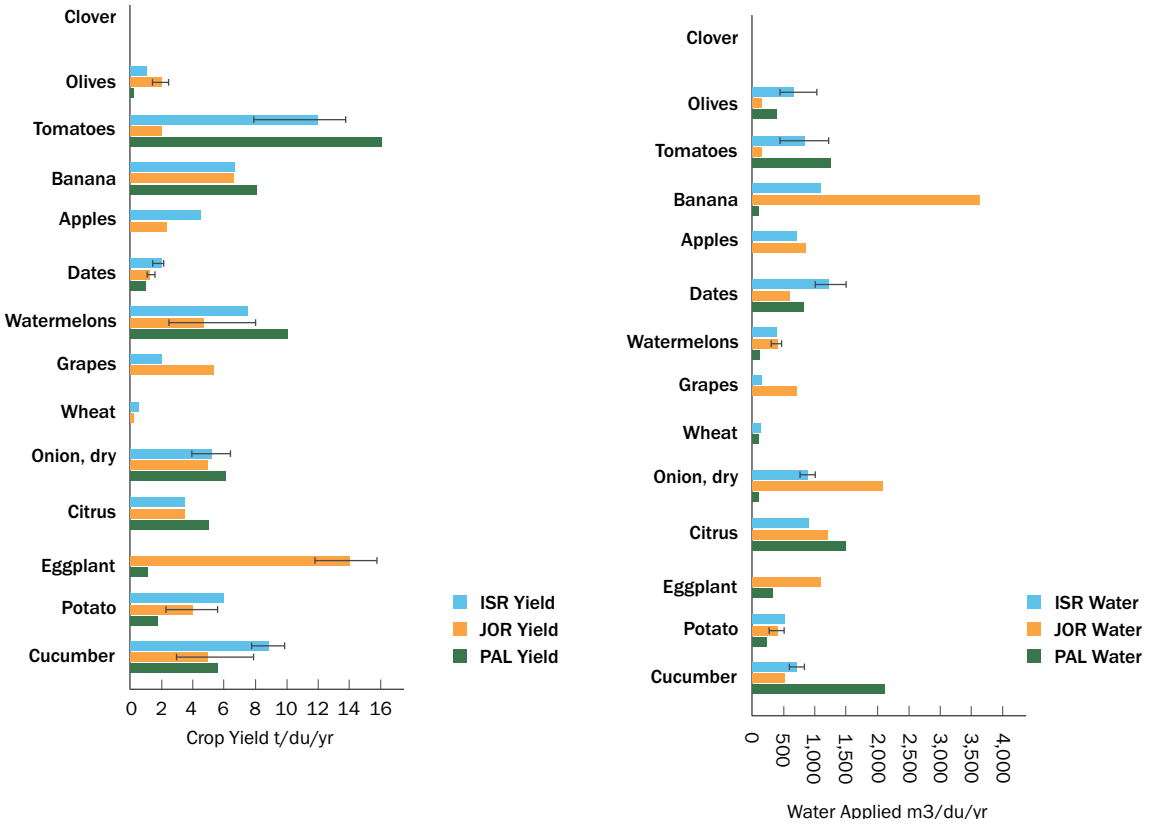
d. Substituting freshwater with treated wastewater in agriculture is a most promising intervention to reduce overall fresh water use in agriculture. The existing crop mix in Jordan would allow for a considerable expansion of treated wastewater use in agriculture of 31 MCM per year with the benefit of freshwater reallocation to municipal supply water, with an expected IRR of 27 percent. TWW used in agriculture must comply with the highest food safety and environmental standards. Soil salinization risks must be managed prudently and the distribution system to farms requires separate delivery systems, one for freshwater and another for TWW and brackish water.

e. Shifting crop selection towards less water-intensive crops, while preserving priority value chains and crops with large export potential. A shift in crop selection would imply moving towards livestock, vegetables, and certain stone fruits (dates, olives) with higher water values.

f. Improving the water-use efficiency of Jordan's existing crop mix. If Jordan would realize water productivity levels similar to Israel, it could maintain its agricultural output while reducing agricultural water consumption between 50–168 MCM/year or around 10–30 percent (Figure 25).[48]

[48] Richter et al. (2017) Opportunities for saving and reallocating agricultural water to alleviate water scarcity

Figure 25. Crop yield and water application comparison for Israel, Jordan, and Palestine



Priority 3: Boosting system-wide resilience with a focus on drought

Jordan would benefit from shifting toward a multi-sectoral drought risk management framework and strengthening drought monitoring, prediction, response systems, risk mitigation measures, and key stakeholder dialogue and communications. The specific measures the government might consider follow the pillars of drought risk management: (a) improving the Drought Monitor, forecast, and early warning system as the anchor point for tracking and predicting the location and intensity of droughts to inform decision-making and trigger preparedness and contingency responses, (b) Drought Resilience and Impact Assessment that identifies who and what is at risk along with protocols for assessing impacts, and (c) Mitigation and Response Planning and Measures which includes pre-drought actions to reduce risks, an Operational Response Plan with well-defined measures for when a drought hits, and a social safety net program to protect the most vulnerable. Finally, strengthening the country's approach to disaster risk financing strategies, including insurance and risk-layering strategies, could also be a beneficial adaption strategy.

Improving the water storage system and controlling abstractions can enable water managers to better capture surface water runoff for use during dry years. Given the high variability in precipitation, reservoir and groundwater storage is instrumental in capturing runoff from seasons with a high level of precipitation for use in dryer years. Though Jordan has a portfolio of dams on major rivers and wadis and active water user associations, in some cases, sedimentation limits the active storage in the reservoir. Limited infrastructure maintenance may also impact structural integrity. Dam rehabilitation is needed to reduce the risks of failure and improve the storage system's performance.

Developing rainwater harvesting systems and reducing groundwater overdraft will increase climate resilience. Rainwater harvesting systems (RWH) are effective interventions for adapting to increasing water variability. In Jordan, piloted rainwater harvesting systems have shown to be cost-effective solutions—yet a national RWH strategy must inform the scale-up and further development of these interventions. Groundwater, if managed well, can also provide a supplemental water source during droughts. Jordan should reduce the unsustainable use of groundwater to ensure this water source can sustainably support water needs during the increasingly frequent drought periods.

Finally, the scale-up of CSA technologies offers further opportunities to build resilience to climate change in rainfed systems. These include rainfed olive and barley production, practices such as contouring, terracing, and using appropriate plows, polymers, and organic matter that can improve crop infiltration and soil storage capacity. For agropastoral goat and sheep production, land degradation can also be offset by integrated land restoration programs. Selective breeding of the local Awasi sheep can increase productivity and expand markets. Meeting CSA technologies' potential requires strengthening extension services and improving farmers' adaptive capacity. Plans to refine agriculture risk insurance instruments should be explored to enable farmers to manage production risks better.

Priority 4: Leveraging mitigation opportunities in the agri-food and water sectors

Considering renewable energy in agriculture in Jordan, particularly through solar water pumping, could reduce GHG emissions and energy costs. A large share of farmers in Jordan uses fossil-fuel-powered generators or grid electricity for water pumping and other agricultural activities. In 2010, only 1,000 kW of solar PV was installed in rural areas, used for lighting, water pumping, and other social services.[49] Replacing fossil-fuel- or grid-powered pumps with solar water pumps could reduce energy use and emissions. Jordan could provide financial support to agriculture-focused RE programs through the JREEF funding facility at MEMR.

Deploying solar water pumps poses a risk for sustainable water use in Jordan without supported and enforced policy frameworks to reduce potential over-pumping. Solar water pumps reduce irrigation costs and increase farmers' access to cheap groundwater, which risks over-pumping. Promising solutions include increased groundwater monitoring, combined schemes with water-saving technologies, metering, low-power water pumps, and social learning interventions. An equally effective intervention is buying back solar electricity from farmers connected to the grid (feed-in tariff). The additional revenue stream from solar energy creates an incentive for efficient farm irrigation, reducing the risk of over-pumping. This intervention will require investments in smart grid technologies and grid resilience solutions, enabling the grid to reliably and safely absorb decentralized renewable energy.

Further opportunities for mitigation in the agriculture sector should be explored. These include the generation of soil carbon sequestration through improved land management and restoration. For example, the Badia's restoration can improve natural ecosystem resilience as landscapes inhabited by local and native rangeland species are better adapted to extreme climate variance and provide micro-ecosystems benefitting soil health and moisture.

Reducing food loss and waste can contribute to better use of scarce water and land resources. Over 45 percent of Jordan's vegetables and fruits are wasted or lost.[50] Basel et al. (2019) found that 34 percent of the total wheat supply in Jordan from local production and imports is lost or wasted, costing the country about US$105 million annually.[51] Food waste disposal accounted for around 7 percent of emissions in 2019. Therefore, reducing food waste and loss can generate mitigation benefits and optimize scarce resources.

3.1.4. Recommendations

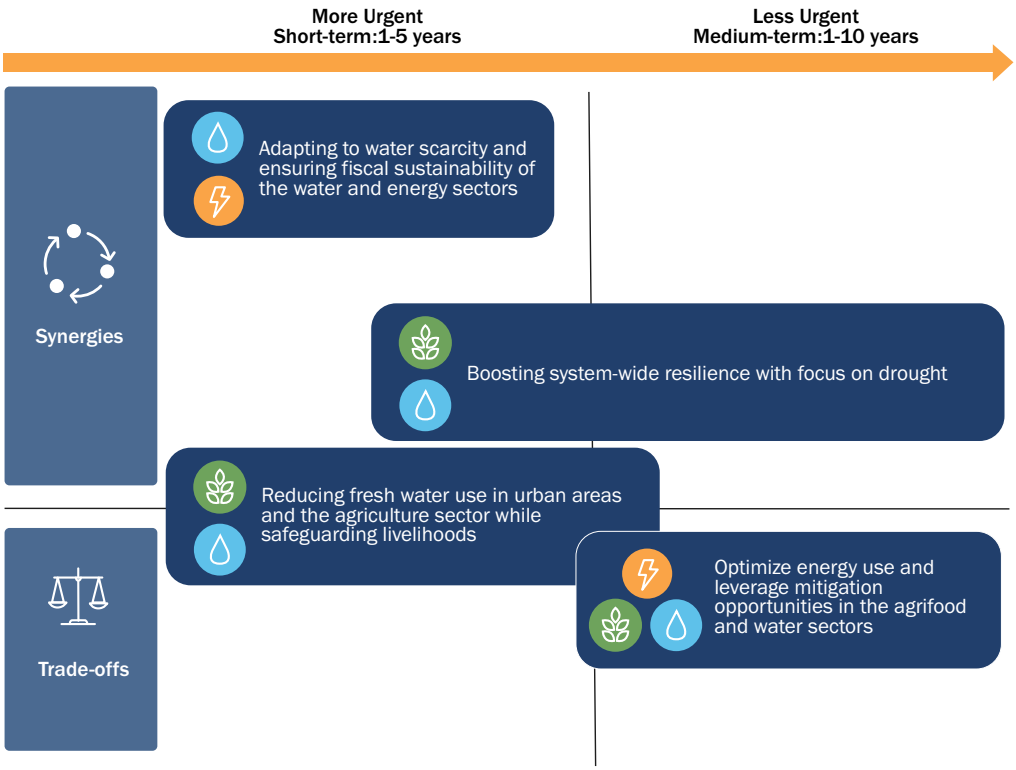
The four priority areas above have been selected based on urgency, impact—at the sector level, on jobs, vulnerable groups, and growth—political feasibility and readiness. All proposed interventions listed below are considered to have a high potential impact, adequate readiness, and be politically feasible within the time horizon of 2030. Figure 26 places the interventions on a spectrum between urgency over the short term (5 years) versus the medium term (5–10 years). It indicates whether they are expected to generate synergies or trade-offs with other development objectives.

[49] Jordan Third Annual Communication on Climate Change

[50] FAO Capacity Building for Food Loss Reduction in the Near East

[51] https://link.springer.com/article/10.1007/s12571-019-009627#:~:text=Our%20results%20show%20that%2034,of%20losses%20in%20natural%20resources.

Figure 26. Setting priorities for the nexus



Three of the four intervention areas are considered priority areas of focus in the next five years, while the fourth could be implemented over a five to ten-year time frame:

a. *Priority 1:* The fiscal imbalances across the nexus are rapidly worsening, particularly as large-scale adaptation investments are proposed for development. Fortunately, fiscal efficiency measures at the water-energy nexus have positive returns across all dimensions, with strong synergies between climate and development objectives.

b. *Priority 2:* Reducing fresh water use in urban and agricultural settings is equally urgent, given the worsening water scarcity trends departing from an already extreme situation. However, in addition to synergies to be realized through efficiency interventions, important trade-offs between water allocations to different uses will need to be made, including considerations of distributional impacts and how vulnerable populations would be affected.

c. *Priority 3:* Building drought resilience through cross-sectoral systems is becoming important in the short term but will become more so as time progresses, and slow-onset drought trends intensify.

d. *Priority 4:* Emissions reductions across the nexus are not immediately urgent considering other more pressing priorities and may require significant trade-offs. Current exploratory efforts should be reinforced to establish proof of concept for emission-saving opportunities in the medium term.

The package of priority policies and investments identified in the four priority areas is expected to yield many economic benefits in the next five years. The estimated financing needs associated with these priority interventions is US$4.2 billion until 2030. An important share of those investments corresponds to demand-side interventions, and an estimated 50 percent would need to come from the private sector, including agricultural producers. Those investments lead to many benefits, further described under Chapter 4, Section 4.2.

3.2. Integrated solutions for low-carbon and resilient urbanization

3.2.1. The urban-transport-energy nexus

Jordan's economy, population, and GHG emissions are spatially concentrated in Amman agglomeration and several other major cities. Between 1990 and 2015, Amman's agglomeration built-up area and population grew by 71 percent and 114 percent, respectively.[52] The Greater Amman Municipality (GAM) is responsible for 55 percent of employment. Jordan's transportation and logistics sector is also vital to the economy and contributes over 8 percent of the country's GDP. GHG emissions are also spatially concentrated around urban centers like Amman and Irbid (see Figure 9). There are significant opportunities for Jordan's cities to deploy mitigation strategies, build resilience, and support adaptation measures to reduce climate-induced risks.

A sustained focus is required on adopting policies that (a) promote energy transition, including energy efficiency and renewable energy in urban areas; (b) decouple growth from emissions and facilitate low-carbon pathways; (c) enable spatially-integrated solutions across the urban, transport, and energy sectors; and (d) support these actions through smart governance and sustainable financing models. A prominent example is the opportunity to complement the recent Bus Rapid Transit (BRT) investments in Amman with land-use policies that allow for more efficient and resilient uses of urban land. This integration will allow for a modal shift towards low-carbon public non-motorized forms of green transport. It will help control urban sprawl, a significant contributor to GHG emissions[53] and costly infrastructure expenses.

Access to smarter financing for climate investments will be critical. Several opportunities could be explored. Unlocking land-based financing through better urban and transport planning, shifting towards transit-oriented development (TOD) models, optimizing service delivery and costs, and enhancing municipal asset (land and buildings) management are much-needed climate-smart investments. Scaling climate-responsive solutions requires mobilizing the private sector in energy efficiency and renewable energy, solid waste management, and sustainable road-sector financing at the national and city level. Furthermore, to avoid being locked into an unsustainable growth path, the following mitigation actions need to be urgently pursued:

a. **Curb potent methane gas emissions from waste.** Methane is the most powerful driver of climate change among short-lived substances.

b. **Manage the rise in GHG emissions from sectors such as transport,** especially with the rise in private vehicle use, and from urban sprawl and fragmentation which are significant contributors to GHG emissions.

c. **Address sectors responsible for a major share of energy use and GHG emissions by investing in complementary combinations of policy levers,** such as energy efficiency in buildings, transport, and industry.

3.2.2. Challenges and opportunities

Current land-use planning and building regulations in cities in Jordan produce low-density urban forms that are costly to service, making investing in high-efficiency public transit options harder. As a result, most Jordanians rely on cars, increasing congestion and worsening air pollution and CO2 emissions. The number of private vehicles almost doubled between 2008 and 2018, reaching over a million. This situation results in high pressure on the transport infrastructure and negative impacts on accessibility, the environment, public health, and the economy.

The major cities in Jordan have seen a large influx of refugees into urban communities, putting significant pressure on service delivery, municipal finance, and planning, affecting cities' resilience. As of end-2021, 65 percent of registered Syrian refugees reside in the three largest cities of Jordan.[54] The influx of refugees since 2013 and the increase in Jordan's population in urban areas have strained municipal finance, service delivery, and growth patterns in the major urban centers. The Syrian refugees remain highly vulnerable.

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[52] These figures are based on 'Degree of Urbanization,' endorsed by the UN Statistical Commission in 2020. Under this methodology, a city or urban center is composed of contiguous grid cells of 1 km2, having density of at least 1,500 inhabitants/km2, and total population of at least 50,000. More details on the methodology can be found on the European Commission's Joint Research Center website.

[53] The IPCC AR6 WGIII report suggests that integrated spatial planning to achieve compact and resource-efficient urban growth could reduce GHG emissions between 23-26% by 2050 compared to the business-as-usual scenario. Reductions could be achieved through co-location of higher residential and job densities, mixed land use, and transit-oriented development.

[54] Amman (30%), Irbid (20%), and Zarqa (15%). Another 25% of registered Syrian refugees reside in Mafraq, a city 80 km north of Amman, along the Syrian border.

Social inclusion remains a major challenge. It is estimated that 16-25 percent of Amman's urban population live in vulnerable settlements with overcrowding, lack of services, and widespread violation of both zoning and building regulations. Neither public transport vehicles nor transit infrastructure are adapted universal accessibility standards or consider gender mobility differences even as 13 percent of Jordanians have a disability, and 84 percent of these people live in urban areas. It takes the urban poor in Amman twice as long to commute to work compared to residents from affluent neighborhoods due to distance between poor neighborhoods and workplaces, making it both more costly and unsafe for women and girls, especially when public transport is scarce.

Despite major progress in promoting more uptake of renewable energy (RE) and energy efficiency (EE) measures in Jordan, penetration of RE and EE in end-use remains limited. Notably, Amman's renewable energy use for heating/cooling applications has been limited and based mostly on solar water heaters, while the transport sector relies almost exclusively on imported fossil fuels.[55]

Solid waste is responsible for a large and rapidly growing share of GHG emissions. The waste sector's GHG emissions account for 10.6 percent of total emissions, 98.6 percent resulting from methane gas from managed landfills.[56] The increased waste generated has strained collection and disposal capacities, with only an estimated 5 percent to 10 percent of the total municipal waste produced annually recovered or recycled. A shift towards circular economy approaches could help address current challenges, including financial constraints,[57] a shortage of proper equipment, fleet, and trained labor, limited technical knowledge and funds for capital investments in sanitary waste disposal, and a lack of public awareness on waste handling.

An industrial decarbonization strategy targeting high emitters, such as the cement, glass, and steel industries clustered around Amman, will be crucial to mitigating a significant source of emissions while improving the efficient use of resources needed for urban growth and economic profitability. Companies reduce their energy, water, and material consumption by investing in decarbonization projects, which reduce their operating expenses. The industry's decreased natural gas, electricity, and water consumption also mean efficient use of finite resources needed for healthy urban growth. A combination of decarbonization technologies (e.g., trigeneration, waste heat recovery, heat integration, variable frequency drives, alternative fuels, waste to energy, sustainable water practices, renewable energy) could bring industry emissions down competitively. Regulatory frameworks and operational/business models are needed to drive the transition towards a circular economy by increasing reuse, repair, and remanufacturing.

Given the high levels of urbanization in Jordan, inter-urban transport connectivity is vital for moving people and goods, aiding Jordan's economic development. Transport in Jordan relies heavily on the roads sector. The trucking sector is highly fragmented and aging, with the average truck age reaching 19.25 years in 2020, making the transport of goods inefficient, costly, and environmentally damaging. Despite Jordan's strong reliance on roads for the flow of people and goods, the sector suffers from chronic underfunding (0.5 percent of GDP compared to an average of 1-3 percent in developing countries) for road asset management. It also leads to faster deterioration of roads, more frequent major rehabilitation, and a greater risk of destruction due to flash floods and landslides.

Climate change is poised to intensify shocks and chronic stress to major urban areas, putting highly concentrated lives, livelihoods, infrastructure, and assets at risk. Climate change will increase the demand for climate-resilient and adaptive city planning, infrastructure, and urban services. For example, (a) air pollution is severe in the largest Jordanian cities, where the concentration of the PM2.5 particles is higher than the WHO standard of 10 µg/m3, constituting a significant health risk for a large number of the urban population; (b) urban heat in Jordanian cities, especially the increasing summer daytime surface temperature above 40 degrees Celsius, will pose increasingly significant impact in urban health and productivity; (c) pluvial flooding risk is projected to be higher under climate scenarios. In Amman, over 50 percent of the at-risk households are low-income with a lower capacity to cope with flood hazards.

[55] As of early 2022, the total number of vehicles in Jordan was 1.8 million, out of which 31,816 were electric cars (around 1.8% EV penetration).

[56] Waste sector- national green growth action plan

[57] SWM fees only cover about 29 percent of MSWM costs as estimated by municipalities.

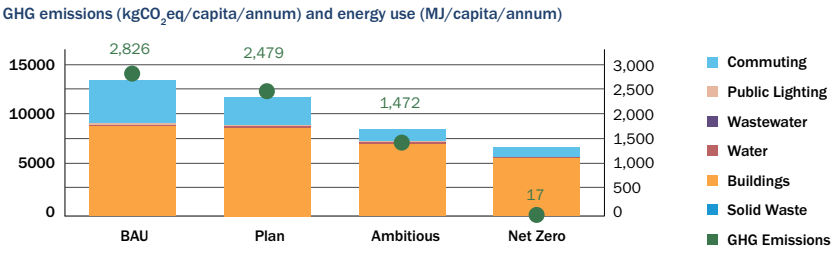
3.2.3. Pathways to low carbon and resilient urban growth

An urban growth scenarios analysis suggests Amman can significantly reduce energy consumption and GHG emissions through integrated and complementary policy levers and by controlling urban sprawl. The following four scenarios were modeled, two based on Amman's current plans. The model suggests that adopting more aggressive measures under GAM's current plans (ambitious scenario) can reduce GHG emissions by 41 percent. Figure 27 presents a summary of key findings:

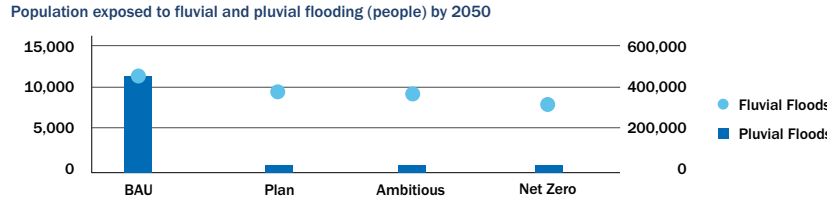
- **Business as usual scenario 2050.** A baseline scenario that does not promote green policies and interventions and urban expansion is projected based on historical growth.
- **Planned scenario 2050.** The scenario is based on geospatial information provided by GAM and simulates the interventions and policies determined in various action plans, including Amman Climate Action Plan for 2050. The main policy levers are built-up area expansion, green building codes, energy efficiency measures, and mobility systems.
- **Ambitious scenario 2050.** The ambitious scenario builds on the planned scenario by adopting more aggressive measures within the urban, energy, and transport sectors. The scenarios also include additional interventions based on Jordan's NDCs.
- **Net zero scenario 2050.** This scenario simulates what it would take to reach net zero carbon emissions by 2050. Building on the ambitious scenario, it includes additional GAM-proposed green projects with community benefits, maximizing infill development and minimizing urban expansion and spatial growth.

Figure 27. Insights from integrated spatial scenarios for Greater Amman for 2050

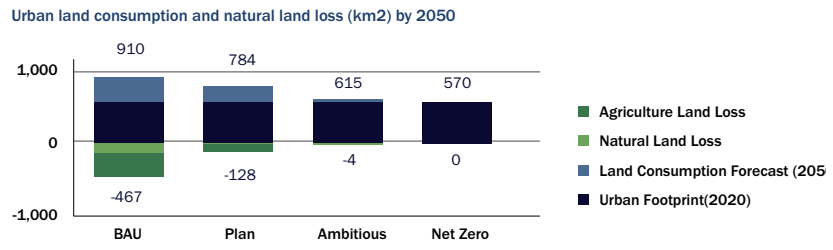
Amman can reduce its energy consumption and GHG emissions by 27 percent and 41 percent, respectively, through more aggressive measures beyond GAM's current plans. Reaching net zero carbon emissions by 2050 requires additional measures.



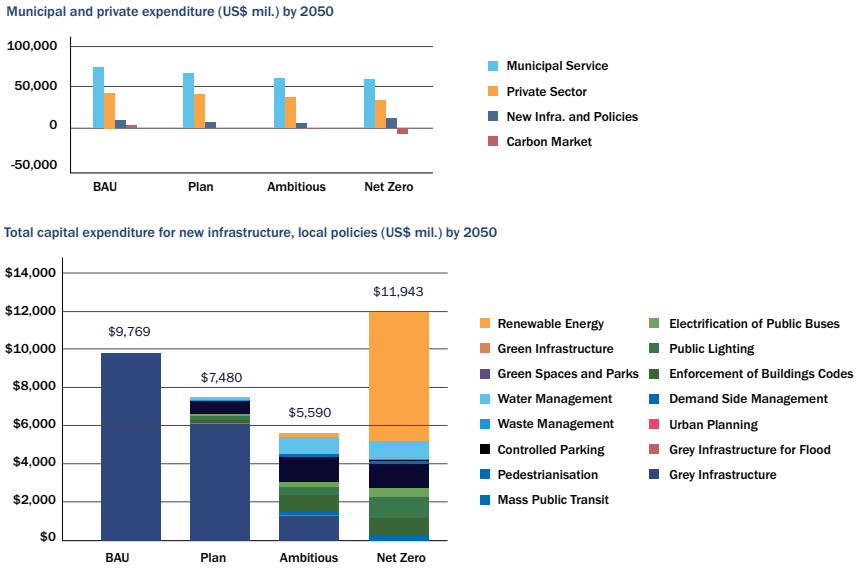
Current plans are estimated to have significantly reduced exposure to flood risks. Mitigation investments may yield further adaptation benefits, potentially reducing exposure by up to 15 percent.



A more spatially efficient urban form can be achieved through better planning, connectivity, and controlled expansion. The ambitious scenario anticipates a 22 percent reduction in urban expansion against current plans.



Amman can realize cost-efficiencies and other co-benefits to achieve synergies by investing in complementary combinations of policy levers. A shift from grey to green infrastructure and smarter and complementary policies across the urban, transport, and energy sectors may reduce total infrastructure investment costs by 25 percent by 2050 under the ambitious scenario. Reaching net zero emissions will require doubling capital investments (compared with the ambitious scenario) for renewable energy and related infrastructure.



3.2.4. Recommendations

A combination of policy measures and financing opportunities have been identified to begin the long-term transformation of urban areas in Jordan, starting with Amman, into inclusive, green, resilient cities. Implementing these recommendations is estimated to cost approximately US$5.3 billion until 2030, potentially attracting US$ 3.7 billion by encouraging consumer and private sector participation:

a. **Integrate green urban-transport planning to deploy transit-oriented development and facilitate public transport reform.** Policy measures and investments in the public transport system and active mobility include expanding the BRT in Amman, connecting Amman to nearby secondary cities, and integrating public transport with walkability and non-motorized transportation infrastructure; facilitating market responsive land use planning and building regulations that encourage compact walkable cities and reduce sprawl and fragmentation; investing in urban planning capacity and leveraging digitization and spatial data platforms to support integrated and compact spatial planning, evidence-based policies and service delivery efficiencies.

b. **Define priority investment opportunities in green infrastructure and services,** particularly public spaces and nature-based solutions, to mitigate floods and heat islands. This includes improved water recycling from stormwater harvesting for non-potable uses. This will also reduce financial losses from disaster risks. The cost of temporary relocation and productivity loss due to a three-day flooding event in Amman alone could cost US$25 million, which is avoidable through these investments.

c. **Prioritize urgent "no regret" infrastructure in Amman and municipalities,** including recycling and sorting facilities, upcycling hubs, sanitary landfills, and collection and transfer systems. Other efforts should include developing a comprehensive system-wide solid waste management master plan for Amman, and reforms to promote upstream waste minimization for municipal waste, i.e., reduce, recycle, and recovery strategy. Efforts should also include institutional governance and financial sustainability reforms and developing models for private sector participation.

d. **Accelerate energy efficiency (EE) across sectors,** including investments in electricity demand-side management enabled by a smart grid, supported with advanced metering infrastructure (AMI). This will unlock growth and innovation potential by establishing the energy service market for innovative business models. Actions include promoting green building standards, investing in public buildings' energy efficiency, and ensuring deeper penetration of green building codes for private and public buildings. Actions can also include retrofitting public buildings and strengthening enforcement of building codes, including thermal

codes, actively exploring energy service company (ESCO) business models, and leveraging land-based financing. The electrification of major energy systems in buildings, e.g., heating, should be promoted so local RE resources can be utilized, reducing the reliance on imported fossil fuels.

e. **Adopt Electric Vehicle (EV) goals and action plan to signal a national commitment to this market transformation.** The goal could relate to a gradual increase in EVs or phasing out vehicles with internal combustion engines. The corresponding targets for charging infrastructure, e.g., the planning of EV charging infrastructure, should synergize with overall urban spatial planning. The action plan should include enhanced pricing policies that encourage day-time charge to maximize RE usage, regulatory support for expanding EV charging infrastructure, and incentives for vehicle owners to adopt EVs.

f. **Enhance financial sustainability and modernize the management of the road sector, and municipal public land and assets.** This encompasses: (a) enabling public-private partnerships for the construction and maintenance of climate-resilient roads; (b) implementing a road asset management system and performance-based maintenance contracts; (c) improving subnational financial performance through better debt and revenue management and rationalizing O&M costs; (d) adopting long-term planning; (e) enabling land value capture and unlocking land-based financing options; (f) enhancing municipal companies' governance and performance, and (g) enhance overall city creditworthiness.

g. **Promote a modal shift towards cleaner and greener freight transport.** This can start with fleet renewal and consolidation in the short term and shift to railways in the medium term for a cleaner and greener solution for freight movement,[58] especially along Highway 15.

h. **Launch housing sector reforms in conjunction with land-use planning and zoning improvement and stronger enforcement of building regulations.** These actions will enable the implementation of a residential green buildings program. This will also reduce unpermitted and unsafe housing units, disproportionately affecting the poor and vulnerable households; encourage infill and affordable housing development, and minimize sprawl and fragmentation.

The economic benefits of priority policies and investments identified in the four priority areas in the next five to ten years are summarized below. An important share of those investments corresponds to demand-side interventions. This is further discussed in the next chapter.

a. **Improved access to jobs and economic opportunities in Western Amman, where 86 percent of businesses and 78 percent of shopping centers in GAM will be located within 2km of a BRT station.** Other benefits would include enhanced livability of Western Amman due to reduced congestion and better air quality by removing 14,500 cars off the road along the corridor daily. Improved road and non-motorized transport networks will reduce traffic congestion and emissions. Reduced travel time would lead to an aggregate saving of 603.8 million hours per year. Improved road safety is expected to result in an average reduction of 116 fatalities from road traffic accidents per annum. Finally, benefits include better access to urban services for vulnerable groups such as Syrian refugees and improved climate resilience, e.g., reducing vulnerability to flooding.

b. **If by 2030,[59] Jordan's EV fleet reaches a share of 8.3 percent of the country's total vehicles,[60] average annual CO2 emissions are expected to be 241,000 tons lower.[61]** Even at this low level of EV adoption by 2030, these savings are equivalent to 0.7 percent of Jordan's national CO2 equivalent emissions in 2018. Using World Bank shadow prices for carbon, from 2022 to 2030, Jordan could save an estimated US$70 million through lower carbon emissions from the vehicular fleet.[62]

[58] The carbon footprint of railways is estimated to be over 4 times lower than road sector for the movement of freight.

[59] Based on the Scoping Model developed under the forthcoming World Bank Economics of Electric Mobility Flagship Report, the adoption of electric vehicles in Jordan could yield significant environmental gains.

[60] Based on a target that 30% of new car and bus sales are EVs by 2030 and 72% of new 2-wheeler sales are EVs by 2030. This global target has been set by many countries.

[61] Savings are estimated over the lifecycle of the EVs purchased from now till 2030.

[62] Estimated in NPV using a discount rate of 12 percent.

c. Managing the drivers of urban sprawl and fragmentation can result in agglomeration economies and city productivity and limit agricultural land encroachment. Other benefits include reduced emissions related to transit due to better urban configuration and improved city walkability, reduced urban heat and air pollution from an increase in open green spaces inside the city boundaries, and reduced use of cars. Building resilient infrastructure to diverse climate change impacts will reduce financial losses from increased natural disaster risks.

d. A debt management program for GAM will ensure that debt service remains within sustainable limits. Improved revenue performance will increase operating surplus, freeing up more borrowing capacity. Improved forecasting, budgeting, accounting, and reporting will increase investor/lender confidence in GAM's ability to undertake and manage long-term financial commitments. These improvements will enable GAM to achieve and maintain investment-grade ratings for its municipal debt obligations. Clear long-term financial planning will increase investor/lender confidence, while citizen and stakeholder involvement will ensure public support for municipal investment priorities.

4. Macroeconomic perspective, financing for climate-responsive development and jobs

This chapter examines the impacts of climate change and combatting actions across Jordan's economy, building on the risks and opportunities (Chapters 1 and 2) and the priorities identified (Chapter 3). It focuses on the country's key development goals from a macroeconomic perspective (Section 4.1) and then explores leveraging financing for climate-responsive development (Section 4.2). Finally, it discusses opportunities for creating inclusive, climate-responsive jobs and skills (Section 4.3). The recommendations presented in Chapter 3 focus on priority actions for the next five to ten years in the context of Jordan's NDCs, to maximize synergies between climate commitments and development goals and to avoid being locked into unsustainable development pathways. In the long run, 2030-2050 and beyond, decision-making would need to be informed by plausible long-run scenarios in priority dimensions. These scenarios should be regularly updated and refined with new data and information emergence.

4.1. Macroeconomic perspective

Four scenarios that capture the interplay between climate change impacts and Jordan's macro-fiscal picture were examined. Under Scenario 1, the impacts of increased heat due to climate change on agriculture yields and labor productivity are included in the benchmark growth and macroeconomic baseline. Scenario 2 explores the impacts of increasingly severe water scarcity on the economy. Scenario 3 explores the impact of selected adaptation measures to address water scarcity damages on the economy. The fourth scenario is presented under Section 4.2. It explores the impacts of a package of investments of approximately US$9.5 billion—the identified additional priority investments from 2022 to 2030, excluding investments related to desalination and conveyance under the AAC—on the baseline. Appendix presents a detailed description of the model used, data sources, assumptions, and results. The set of scenarios presents the key underlying assumptions and channels through which impacts are reflected in the model, followed by simulation results and interpretation. The macroeconomic modelling in this chapter uses MFMoD[63] to analyze several climate-related scenarios on economic growth and macroeconomic outcomes and account for sectoral dynamics in a climate-aware macrostructural setup. The scenarios explored for this CCDR focus on damages across three climate scenarios: RCP2.6, RCP4.5, and RCP8.5.

Scenarios are cast in long-term growth and macroeconomic baseline as a benchmark for comparison (Table 4). The baseline incorporates key features of the Jordanian economy up to 2050. It incorporates historical data and extrapolates current economic trends through a slow adjustment path. The sectoral composition shifts gradually towards Services, while Industry and Agriculture slightly reduce their contributions to the overall economy, reflecting their gradually slowing productivity. Short- to medium-term macroeconomic projections reflect the headline macroeconomic framework consistent with the IMF's 3rd Review completed in October 2021, running up to 2026. Commodity price projections are taken from the World Bank's Prospects Group until 2035. External demand aggregates are sourced from the latest World Bank's Macro Poverty Outlook up to 2024. Model dynamics determine the longer-run projections.

[63] MFMOD is a macrostructural standalone model frequently used by the Jordan team for economic monitoring products and medium-term growth and macroeconomic forecasts. The model is dynamic and features intertemporal consumption utility optimization and firm expenditure minimization; sticky prices and wages; distinguishes consumer and producer prices; detailed fiscal and external balances; sectoral VA; international linkages through trade, commodities, remittances, and tourism; and is based on time series with annual data. The model contains several factors that disturb equilibrium including tax wages, investment adjustment costs, and short-run prices and wages stickiness. Key features include focus on price level, inflation, exchange rates and role of monetary policy (using interest rate as policy instrument); costly debt accumulation, and exogenous TFP. Appendix 1 contains a technical presentation of how MFMOD integrates climate related damages features into the model.

Table 4. Jordan: baseline benchmark for long-term growth

	Supply side (%annual growth rates)			Sectoral decomposition (% of GDP at market prices)			
	TFP	Capital stock	Potential GDP	Agriculture	Industry	Services	Net taxes
Historical trends							
1980-2020	0.68	3.64	3.89	5.44	24.97	61.32	8.27
2010-2020	-0.52	2.84	2.65	4.60	24.77	57.68	12.95
Baseline							
Adjusted baseline							
2050	0.32	3.09	2.64	3.90	19.00	67.60	9.50

Note: "adjusted baseline" takes the Jordan CE team's assumption on the sectoral shares in 2050

4.1.1. Scenario 1: Assessing the impact of heat and flooding

This scenario focuses on internalizing the impact of heat and flooding under different climate scenarios into the economy's growth and macroeconomic baseline. It excludes the effects of water scarcity, which have been examined separately. This scenario simulates the economic effects of those damages under RCP2.6, RCP4.5, and RCP8.5. Key assumptions used in this scenario are found in Appendix.

Scenario 1 results signal only modest negative impacts on economic activity in general. Based on the damages considered and assumptions made, the size of shocks suggests that significant output losses are not to be expected. The impacts of the modeled climate change damages on real GDP growth are mild and suggest the damages do not pose a major risk for Jordan. In RCP 2.6, the GDP growth rate impact of -0.1 percent over the baseline reflects the mild effects on labor productivity caused by heat damage. RCP 4.5 and 8.5 confirm mild effects, more specifically, no deviation from the baseline in GDP growth in RCP 4.5 and a decrease of –0.2 in RCP 8.5. In RCP 4.5 and 8.5, the agriculture impact is somewhat strong. The RCP 4.5 effect of a slight productivity bump towards the end of the forecast horizon is due to increasing agriculture yields, which are also increasing in RCP 8.5 but at a slower pace. The diverging yield increases in the two scenarios reflect non-linear effects on agriculture productivity.[64] Despite these results, the overall impact on GDP growth is countered by the negative effects of heat affecting labor productivity, consistent with the characteristics of RCP 4.5 and 8.5. This contrasting result suggests that over time, with limited climate change action, the negative impact of damages on labor productivity could potentially dominate the positive impacts on the agriculture sector, leading to intervention trade-offs in different sectors. However, the impacts of heat on labor productivity are proxied by the figures from Tunisia, as damage estimates for Jordan do not yet exist. In addition, this scenario does not include damages from increased water scarcity.

Scenario 1, including the agriculture modeling, assumes neither a further reduction in water availability with climate change nor accounts for increasing water stress. There is an established biophysical relationship between heat stress and water availability. Water stress increases heat stress because water availability through rainfall or irrigation provides an evaporative cooling effect, and air moisture reduces physiological heat stress. The interplay between rising temperatures and water stress will impact agriculture and labor productivity. These effects, when appropriately quantified for Jordan, can be integrated into future macro-structural economic modeling scenarios.

In terms of macroeconomic internal and external balances, the simulation results yield very marginal impacts on external balances and fiscal aggregates, including public debt, once again reflecting the limited impact of the modeled climate change damages on the economy. The internal dynamics of all variables indicate relatively well-performing transmission channels in the model, as the direction of the changes is reasonable over time.

[64] In agriculture yields calculated by IMPACT- FAO, only one-third of livestock/crops experience damages while two-thirds produce stronger yields over time, and stronger in RCP 4.5, indicating that the damages/benefits are not proportional or linear.

4.1.2. Scenario 2: Impacts of increasingly severe water scarcity

Results highlight the importance of water for Jordan's long-term economic growth and the nature of trade-offs for its development path. This scenario studies the impacts of different levels of increasing water scarcity in Jordan on real long-term growth under different labor and capital mobility assumptions. Key assumptions are detailed in Appendix. The 'Water in the Balance' report (WiB, 2020) examined the impact on the economy of a 5, 10, and 20 percent increase in water scarcity in Jordan.[65] The WiB report found the real GDP growth rate would decline by -0.5 to -6.8 percent by 2040, depending on the extent of water scarcity modeled against the baseline and contingent on the specific modeling assumptions. For this scenario, MFMoD is calibrated to adjust to WiB assumptions.

Increased water scarcity is projected to have the largest negative impact on Jordan's economic prospects compared to other potential climatic effects under full labor and capital immobility assumption. Table 5 below reflects the impacts on real GDP growth deviations of the 20 percent increase in water scarcity, the largest shock considered in WiB. The results related to all other WiB scenarios are reported in Appendix.

Table 5. Jordan – WiB impact of a 20 percent increase in water scarcity on the economy

	Baseline				20% water scarcity + Primary sectoral effects			20% water scarcity + Primary sectoral effects+ some labor and capital immobility			20% water scarcity + 100% capital and labor immobility		
	2020	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
					Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*		
Average Growth (%)													
Real GDP	1,0	1,3	1,5	1,7	-0,3	-0,7	-1,1	-1,1	-2,8	-4,5	-1,7	-4,1	-6,6
Real GDP per capita	-0,7	1,1	1,0	1,3	-0,3	-0,7	-1,1	-1,1	-2,8	-4,5	-1,7	-4,1	-6,6

Ensuring labor and capital mobility is essential to attenuate the drastic impacts of water scarcity in Jordan, highlighting the importance of addressing structural issues to adapt to climate change. A fundamental assumption in the modeling is that capital and labor are immobile. Given this assumption, all sectors are severely impacted. Increased water scarcity changes the shadow price of water by 550 percent in the case of the 20 percent scarcity increase. This increase would raise the cost of doing business and reduce firms' profits and returns to labor in sectors that depend on water as an input. In other scenarios where capital and labor are allowed to reallocate, the overall impact is materially attenuated, as new investments and labor flow into sectors less impacted. This analysis shows the importance of labor and capital mobility in enabling the Jordanian economy to adapt to the impacts of climate change. Regarding labor mobility, it highlights the importance of addressing continuing structural issues in the labor market to mitigate potential negative effects of climate change on the economy and jobs, a point further discussed in Section 4.3 below. Finally, the sub-scenarios explored point to more significant impacts on GDP when increased water scarcity is considered, confirming the importance of adaptation options for Jordan's long-term growth.

4.1.3. Scenario 3: Selected water scarcity adaptation measures

Four sub-scenarios cover combinations of selected water supply investments and water efficiency interventions to resolve an additional water gap between demand and supply in the amount of 200 MCM by 2050 (Table 6). The modelling assessed their economy-wide impact on real growth, investment productivity, internal and external macroeconomic balances related to the investment costs, and the benefits of resolving the aggregate 200 MCM gap. A significantly more disaggregated model would capture the full economic benefits of having water available to meet water demand in Jordan, including health, industrial growth, and agricultural productivity. Water demand in Jordan significantly exceeds the supply available through current natural endowments and purchases. This sub-scenario focuses only on the additional anticipated water supply-demand gap arising from climate change, adopting a value of 200 MCM, which corresponds to the 20 percent increase in the water scarcity scenario in the WiB report[66].

[65] A 20 percent increase in water scarcity is a conservative estimate, compared to the scientific consensus of a 30 percent increase in water scarcity by 2040

[66] Key assumptions used in this scenario are found in Annex 1.

The ranges of adaptation costs in Table 6 reflect the uncertainty of the future cost of capital and energy, to which modeling results are sensitive. Capital expenditure (CAPEX) ranges of desalination/conveyance are based on the current information about the AAC project, which is based on the cost structure of the Disi pipeline PPP and a scenario where the future cost of capital is reduced. Operating expense (OPEX) ranges reflect the uncertainty of future energy prices, considering high and low energy price scenarios. Possible ways to minimize the cost of capital include increasing the grant component, accessing concessional loans from international financial institutions, blending with climate and refugee financing, and accessing guarantees or phasing implementation of the project to defer costs.

Table 6. Selected water scarcity adaptation scenarios[67]

	Low cost - Desalination and conveyance	High cost - Desalination and conveyance
Low cost - NRW Reductions	**Desalination low:** JOD 100.1 m per 100 MCM, CAPEX 40.2%, OPEX 59.8% NRW low: JOD 54.9 m per 100 MCM, 97.5% CAPEX, 2.5% OPEX	**Desalination High:** JOD 182.7 m per 100 MCM, CAPEX 36.8%, OPEX 63.2% NRW low: JOD 54.9 m per 100 MCM, 97.5% CAPEX, 2.5% OPEX
High cost – NRW Reductions	**Desalination low:** JOD 100.1 m per 100 MCM, CAPEX 40.2%, OPEX 59.8% NRW High: JOD 97 m per 100 MCM, 97.5% CAPEX, 2.5% OPEX	**Desalination High:** JOD 182.7 m per 100 MCM, CAPEX 36.8%, OPEX 63.2% NRW High: JOD 97 m per 100 MCM, 97.5% CAPEX, 2.5% OPEX

Note: CAPEX = capital expenditure; OPEX = operating expenses; NRW = non-revenue water; MCM = million cubic meters;

Results show that eliminating the 200 MCM additional shortfall in water supply by 2050 may come at a high economic cost. The possible effects on real growth and macroeconomic dynamics (Table 7) reflect a range of estimated effects, exposed to the high uncertainty endemic to macroeconomic projections exercises. Although these economic costs may seem lower than those reported in Scenario 2, they are not comparable; in these sub-scenarios, labor and capital resources are mobile and reallocated by firms over time to respond to scarcity conditions. The ensuing government financing needs could result in a significant increase in debt (Table 7), which could unhinge a sizeable private investment crowding out effect. With a debt-to-GDP ratio of nearly 100 percent at the beginning of the projection period, interest rates would need to increase to incentivize investors to finance the additional spending, which could crowd out some private sector investment and lower potential output and incomes. Overall, real GDP could thus be negatively impacted by a -2.2 to -4.5 percent growth rate by 2050 (Table 7). Lower incomes would reduce domestic demand, amplifying the effects of financing a portion of the government borrowing from earnings. The increase in foreign capital flows to finance the debt would cause the current account deficit to widen, putting downward pressure on the currency, resulting in lower and more expensive imports.

Table 7. Impact of selected adaptation measures on the economy, Jordan

	Baseline				Low-cost Desal + Low-cost NRW scenario			High-cost Desal + Low-cost NRW scenario			Low-cost Desal + High-cost NRW scenario			High-cost Desal + High-cost NRW scenario		
	2020	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
					Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*		
Average Growth (%)																
Real GDP	2,0	2,7	3,1	3,4	-0,1	-0,6	-2,2	-0,1	-1,0	-3,6	-0,1	-0,7	-2,9	-0,1	-1,1	-4,5
Real GDP per capita	-1,4	2,2	2,0	2,5	-0,1	-0,6	-2,2	-0,1	-1,0	-3,6	-0,1	-0,7	-2,9	-0,1	-1,1	-4,5
Fiscal Aggregates (% of GDP)																
Fiscal revenue	22,7	23,5	24,3	22,8	0,0	0,1	0,2	0,0	0,1	0,4	0,0	0,1	0,3	0,0	0,2	0,5
Fiscal expenditure	29,9	30,4	30,4	27,2	0,8	1,9	3,4	1,2	3,0	6,2	1,0	2,6	5,0	1,4	3,7	8,6

[67] For desalination and conveyance, most costs are OPEX, driven by additional electricity costs; the difference in the high and low figures is largely due to the electricity price for the AAC. AAC CAPEX costs equate to the total cost of the AAC, allocated evenly from 2027 to 2040 to derive the annual figure. For all results that include the AAC, figures are based on information shared among the development partner community. The final CAPEX/OPEX costs will be determined only at financial close.

	Baseline				Low-cost Desal + Low-cost NRW scenario			High-cost Desal + Low-cost NRW scenario			Low-cost Desal + High-cost NRW scenario			High-cost Desal + High-cost NRW scenario		
	2020	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
- o/w Interest payments	4,2	3,9	3,9	3,4	0,5	2,0	4,1	0,8	3,2	7,7	0,7	2,7	6,2	0,9	4,0	11,0
Budget deficit	-7,3	-5,3	-5,7	-4,4	-0,8	-1,8	-3,2	-1,1	-2,8	-5,8	-1,0	-2,4	-4,7	-1,4	-3,5	-8,1
Public debt	109,0	114,2	111,7	96,9	3,7	13,4	27,7	5,4	20,4	46,4	5,0	17,9	39,1	6,6	25,2	61,6
- o/w External Public Debt	45,4	36,8	32,4	26,5	0,9	3,4	7,0	1,4	5,1	11,6	1,3	4,5	9,8	1,7	6,4	15,5

The economic costs projected in these sub-scenarios call for options to alleviate the government financing needs and promote more efficient use of water resources. Since water losses and increasing the water supply are significant and highly costly, tariff reform could reduce price distortions. The shadow price of water is around 450 percent (WiB report). Implicitly this puts the demand elasticity of water at 20/450 = 0.04, where 20 percent is the estimated increased water scarcity. Even at that very low elasticity, a price signal on a scarce resource such as water could help manage demand and efficiently allocate scarce water resources between uses. A more comprehensive analysis of water demand elasticity would need to distinguish water for agriculture, urban, and industrial consumption to support the design of water tariff reform. Water tariff reform, however, requires further time-pressing empirical analysis in Jordan in key dimensions. There are significant social, humanitarian, and political dimensions to be considered, alongside the time needed to prepare and implement a water tariff reform. In addition, a complementary financial analysis of the water sector shows sustained NRW reductions positively impact water sector debt by achieving operational cost recovery and would help improve fiscal sustainability.[68] Along with these dimensions, impacts on economic growth and macroeconomic balances could be enriched with more granular information on water consumption, production, and pricing for different uses, i.e., agriculture, urban consumption, and industrial. Such information could also inform a distributional impact analysis of water tariff reform on households.

At the same time, despite the estimated high costs in the sub-scenario analyses, there are benefits that a macro-structural model cannot fully capture from investments in water scarcity adaptation. These still need to be assessed. Without investments in adaptation Jordan would face an additional water deficit that would put the country even further below the absolute water scarcity threshold. Investing in adaptation measures could also deliver significant human capital benefits, including health, as Jordan would avoid a significant reduction in already scarce water resources. Additionally, adaptation measures could help increase industrial productivity and employment in agriculture and agro-industry through increased water availability, especially if the investment environment in Jordan becomes increasingly favorable to private sector development.

4.2. Unlocking finance for climate responsive development

4.2.1. Identifying financing needs

Chapter 3 identified additional investment needs that would contribute to achieving Jordan's development goals while enhancing climate resilience and reducing GHG emissions by 2030 (Table 8). These financing needs build on the NDC priorities and include projects contributing to mitigation, adaptation and resilience across the agriculture, energy, transport, urban (including buildings and waste management), and water sectors. This assessment does not include projects already approved by the government and under development (such as the AAC). In total, the investment needs are assessed as US9.5 billion to be secured/committed in the coming years to ensure that the initiatives can be fully implemented by 2030, including US$3.1 billion that end-users and consumers are expected to contribute, particularly toward demand-side projects. Nearly 75 percent of these priority investments, for a total amount of US$7 billion, are included under the NDC or NAP.

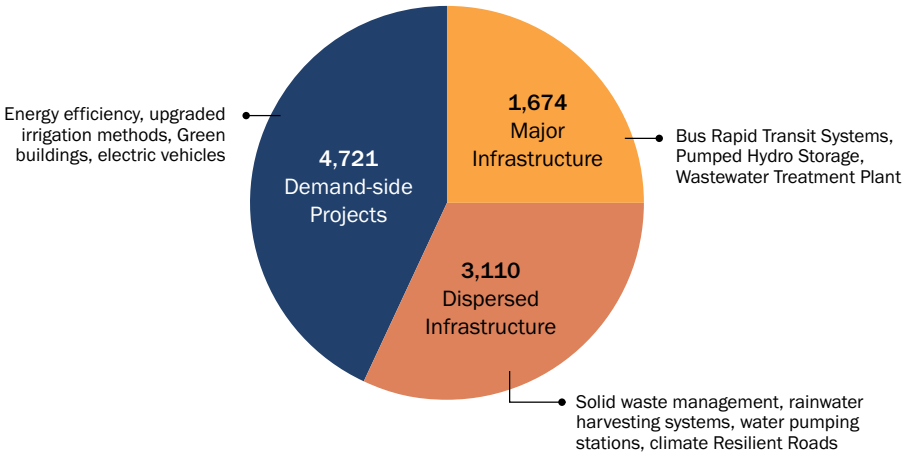
[68] NRW reduction investments which aim to achieve sustained reductions of 2% of NRW per year have a positive net present value (NPV) and internal rate of return (IRR) to 2040.

The financing needs are categorized into three broad areas to reflect the distinctly different approaches and potential sources for these funds (Figure 28). The packages of priority interventions listed in Table 8 include policy measures, incentives and supply- and demand-side investments. The cost estimates for the incentives and investments are drawn from national action plans, cost-benefit analyses, sectoral strategies, and relevant publications of the government and development partners, and complemented with high-level estimates compiled for this CCDR. This section presents a high-level snapshot of the priority investment needs. Detailed investment plans, including financing options and sources, are being prepared as part of an ongoing project[69], including a cost-benefit analysis.

Table 8. Summary of financing needs across packages of priority interventions

	Packages of Priority Interventions	Estimated Total Costs (US$ million)	Priority in NDC or NAP
Water, energy, agriculture, and food nexus	Adapting to increasing water scarcity and ensuring fiscal sustainability of the water and energy sectors	1363	NAP
	Reducing fresh water use in agriculture while safeguarding livelihoods	1860	NAP
	Boosting system-wide resilience with a focus on drought	685	NAP
	Optimizing energy use and leveraging mitigation opportunities in the agrifood and water sectors	303	NAP and NDC
Low-carbon urban development	Integrating green urban-transport planning, reforming public transport, and deploying transit-oriented development.	1,588	NDC
	Investing in green infrastructure for urban rejuvenation, waste management, and circular economy	990	NDC
	Promoting energy efficiency and green public buildings	2,716	NDC
Total		9,505	

Figure 28. Estimated priority financing needs (US$ Million)



- **Major infrastructure: Large, single-site investments that require over US$100 million in financing. These p**rojects require a long lead time averaging over five years from concept to commissioning and a similarly long timeframe from project structuring to financing. These could be implemented as public investments, PPPs, and private-sector-led projects depending on the financial and economic returns, optimal business case, and risk profile. There are several major projects identified as a priority for implementation before 2030:

[69] The Jordan Transparent, Inclusive and Climate Responsive Investments Program for Results (PforR) includes a result area on preparation of plans for priority climate investments.

a. **Bus Rapid Transport (BRT) system** expansion in Amman, including expansion of the BRT to Salt and Zarqa. This is a priority for reducing GHG emissions, improving local air quality, providing much-needed equitable and inclusive public transport options, encouraging the local government to enhance its asset inventory, and exploring land value capture (LVC) instruments to create green infrastructure, using the BRT corridor as a catalyst.

b. **Pumped hydroelectric storage** can serve the dual purpose of harvesting and storing water under variable rainfall and utilizing the reservoir system to manage variable renewable energy supply, generating electricity when the supply is short, and storing the surplus.

c. **Reinforcing power interconnection with Egypt** is crucial to strengthen the reliability of the electricity grid in Jordan, which is a small system with a very high share of variable renewable energy. This interconnection is also a step towards regional power integration, which will conceptually allow for an increased share of RE in the pan-Arab electricity mix. [70]

d. **Enhanced wastewater treatment** enables substituting fresh water, particularly groundwater, with treated water. Urban areas and industrial zones generate a significant amount of wastewater, which is currently a waste.

- **Dispersed infrastructure:** Large, multi-site projects that require over U$20 million in financing. These projects can be phased to be implemented as funds become available. These could also be implemented as PPPs, Performance Based Contracts, and green procurement methods. These could also include co-financing from end-users. Below is a summary of the identified priority investment areas:

    a. **Solid waste and circular economy**, creating opportunities for recycling, improve waste management practices and infrastructure to reduce methane emissions.

    b. **Climate resilient road sector**, improving rehabilitation practices and ongoing operation and management of roads to reduce severe damages and disruptions, particularly due to flash floods, landslides, and extreme heat.

    c. **Urban green rejuvenation** creates multi-use, inclusive green spaces that promote pedestrianization, non-motorized transport, charging infrastructure, and green cover to reduce the urban heat island effect, among other benefits. This is particularly important for low-income neighborhoods and host communities.

    d. **Optimizing energy consumption in the water sector**, improving energy efficiency in pumping stations, strategic integration of renewable energy, and shifting demand to reduce consumption during peak hours.

    e. **Reducing non-revenue water**, improving water networks and metering systems to reduce physical and commercial losses in unbilled water.

- **Demand-side initiatives:** These are demand-side measures to be adopted by the private and residential sectors, especially for optimizing water or energy consumption. These projects are likely to be partially or fully financed by the end-user and could involve public funding as an incentive and the private sector as a service provider. These are likely to be implemented over several years, requiring constant effort to generate interest of the end-user, including through targeted awareness and communications campaigns. These initiatives could also be structured as large-scale programs, for instance, a national green buildings program, a CSA value chain program, or a bulk procurement program for energy/water efficient equipment. Priority investment areas include: (i) demand-side EE improvement and deployment of smart meters across public, industrial, commercial and residential sectors. (ii) Improved water management, through reducing illegal abstraction of water on and off-farm, improved rainwater harvesting, and reducing water losses on the demand-side; (iii) climate smart agriculture solutions, (iv) increasing the share of green buildings, particularly public buildings, through rehabilitation and retrofitting, (v) reducing emissions from vehicles through increased adoption of electric cars and renewal of truck fleets.

[70] Reinforcing Egypt-Jordan interconnection project is identified as a key pan Arab grid interconnection project, as depicted in the World Bank's 2021 Report for the The Value of Trade and Regional Investments in The Pan-Arab Electricity Market:Integrating Power Systems and Building Economies, available at https://openknowledge.worldbank.org/handle/10986/36614

Using MFMoD, Scenario 4 was modeled, focusing on the economic impact of priority investment plans for climate-responsive development across key sectors: transport, energy, water, urban areas, and agriculture. This scenario did not include climate change damage functions or adaptation mitigation plans per se, nor the benefits of such investments. Key assumptions used in this scenario are found in Appendix.

Table 9. Jordan: Indicative additional investment needs related to climate change.

Investments (in US$ million)	Total 2023-2030
Total Investment	$9,505.1
o/w Public Investment (including Grants)	$3,521.5
o/w Grants	$1,901.0
Private Investment	$5,983.6

Those interventions, described in Chapter 3, are expected to yield a broad range of economic benefits over the next 5–10 years, including those summarized below:

Interventions under Water-Energy-Agriculture and Food nexus:

a. Increased financial sustainability of the water and energy sectors to ensure continued service provision, appropriate system maintenance, operational efficiency and to avoid continued debt accumulation. The proposed measures would leverage Jordan's strengths and regional synergies to adapt to increasing water scarcity;

b. Reduced need for additional electricity generation, particularly to cover peak hour requirements and provide green options for variable load energy generation to cover peak demand;

c. Increased energy efficiency in the water sector is expected to save 261.8 GWh/a translating to 35 MJD per year in savings[71];

d. The pumped hydro storage sector is expected to save 277.2 GWh/a translating to 5.5 MJD per year[72] in savings;

e. Strategic integration of renewable energy into the water sector is expected to save 222.9 GWh/a translating to 25.6 MJD per year[73];

f. The energy efficiency domain is a promising area for creating more and better jobs, as further discussed in Section 4.3. The targeted promotion of energy efficiency measures in highly subsidized segments, such as low-income consumers, would help reduce their energy bills;

g. Increasing productivity of agriculture sector interventions is expected to have a significant growth impact. In the highlands, where farmers exclusively use groundwater for irrigation in a significant overdraft, the water savings realized through the proposed efficiency measures (approximately 100 –115 MCM) would be distributed within the irrigated system to fill the existing deficit. The benefit will be increased productivity and reduced over-draft of the critical longer-term groundwater reserves, equating to about US$200–230 million at the current marginal cost of supplying water. In the Jordan valley, an additional 30 MCM of freshwater resources could be diverted from agricultural to other users through substitution with treated wastewater, representing about 10 percent of the proposed volume of the AAC;

h. Shifting towards less water-intensive crops and scaling-up vegetable covers and irrigation technology can also help Jordan to unlock its US$ 1 billion agricultural export potential, including high-value vegetables, with large positive effects on job creation;

i. Scaling-up irrigation technology can additionally lead to job creation for local input suppliers and related services and advisory. These interventions will support rural livelihoods and protect employment, particularly for poor herders and farmers engaged in rainfed agriculture.

[71] World Bank Calculations

[72] World Bank Calculations

[73] World Bank Calculations

Interventions towards low-carbon and resilient urban development:

a. Improved access to jobs and economic opportunities in Western Amman, where 86 percent of business centers and 78 percent of shopping centers in GAM will be located within 2km of a BRT station;

b. If, by 2030, Jordan's EV fleet reaches a share of 8.3 percent of the country's total vehicle fleet, [74],[75] then average annual CO2 emissions are expected to be 241,000 tons lower;

c. Limiting urban sprawl and fragmentation will have significant benefits in terms of limiting encroachment on agricultural lands;

d. A debt management program for GAM will ensure debt service remains within sustainable limits, e.g., 15 percent of operating revenues.

The total amount anticipated as investment needs is approximately US$9.5 billion, spread over eight years (2030 horizon) with different annual implementation schedules, as estimated by the CCDR team. For this scenario, the modeling assumption is that these investments are productive capital investments. There is no explicitly provided benefit in terms of increasing productivity or efficiency in the model. The annualized investment path and financing structure is aggregated from the multi-sectoral major infrastructure investments (single site), dispersed infrastructure Investment (multi-site), and demand-side projects until 2030, with the amounts treated as real 2020 US$. A high-level estimate of investments and financing sources is summarized in Table 8. The public investment includes the government's revenues, funding from bilateral sources, development financing institutions, and global climate-related funding sources. This includes concessional loans but does not include grants, which may be available from public or private sources. Private investment covers financing foreign and domestic investment, including financial institutions.

Investments in infrastructure raise overall economic activity over time. They boost real GDP growth by over 1 percentage point above the baseline as the investments build up the productive capital stock for the economy, adding to the economy's production capacity.[76] The additional investments represent around 23 percent of GDP in 2020 and are spread over eight years. They represent about 2.3 percent of GDP per annum of additional investment. Between 2012 and 2018, Jordan attracted foreign capital of around 5 percent of GDP per year to fill financing needs other than debt, although this trend is now slowing down.

However, the share of government financing for the additional investments increases macroeconomic risks and access to concessional funds is essential. Government financing, including grants, would be about 37 percent of the total, with the remaining 63 percent provided by private investments. While public financing would initially cause a deviation of over 11 percentage points by 2040 of the public debt/GDP ratio, this deviation would slightly decrease to less than 11 percentage points by 2050 as the additional investments complete their cycle and some increase of real GDP growth has materialized. The increased public borrowing causes an increase in borrowing costs (sovereign risk premium), as debt accumulates faster than the economy, which furthermore induces crowding out of private investment. In addition, the government's ability to mobilize domestic savings to finance its share could prove challenging given the sovereign's already large baseline gross financing needs. This difficulty would be somewhat attenuated by the expected 54 percent share of grant in public financing. Realistically, additional investments related to climate change would still need to keep track of investment trends in Jordan to avoid extreme results from the perspective of economy-wide impacts and financing sources. Finally, the increased investment plans, with their private and public components, come at the cost of contracting private and public consumption (as a share of GDP) compared to the baseline.

Mobilizing supplementary flows of private investment, foreign and domestic, would require Jordan to implement reforms to achieve noticeable increases in its attractiveness as a destination for foreign capital compared to the rest of the world. Short of that, capital mobilization could involve prohibitive interest rate levels for Jordan, especially given the already elevated starting and projected debt-to-GDP ratios. The foreign-domestic financing mix for additional investments is furthermore sensitive to recent and ongoing financing

[74] Based on the Scoping Model developed under the forthcoming World Bank Economics of Electric Mobility Flagship Report (Jordan Country Snapshot).

[75] Based on a target that 30% of new car and bus sales are EVs by 2030 and 72% of new 2-wheeler sales are EVs by 2030. This is a global target that has been set by many countries around the globe.

[76] This scenario does not incorporate benefits from the investments through the identified possible climate change interventions. A more complete story would emerge if investments were accompanied by quantified benefits directly linked to resolving and/or alleviating the biophysical damages that motivated them in the first place. Neither adaptation nor mitigation impacts can be formulated yet without quantified benefits.

features. Jordan's climate action plans heavily depend on external funding, as described in Chapter 2.

4.2.2. Recommendations

The following recommendations have been identified to scale up financing for climate-responsive activities in Jordan. Implementing these recommendations will establish the enabling environment for increasing private sector participation and attracting new funding sources. Recommendations are based on consultations with relevant government agencies, surveys, discussions with the private sector, and broader stakeholder engagement.

Improving government practices for efficiency and impact

Utilize PIM/PPP policy and legal framework and its implementation tools such as the National Registry of Investment Projects (NRIP) to develop a robust climate responsive capital investment pipeline and engage development partners and the private sector in mobilizing finance for climate action. Climate actions are rarely large stand-alone projects. Most are a combination of policies and projects, some of which are climate responsive by nature, and most can be designed to be climate responsive. The PIM/PPP policy and legal framework should be enforced to reflect the government climate change strategic priorities and objectives in the selection and prioritization of projects, including by using the MRV framework for project appraisal.

Leverage available government resources to overcome the issue of competing priorities and to attract new sources. National-level Climate and Nature conservation Key Performance Indicators (KPIs) can be defined to incentivize non-debt KPI budget support and debt instruments linked to KPIs that create additional fiscal space for financing. PIM indicators can be utilized to prepare a project portfolio, which can tap into growing demand from development partners and Socially Responsible investors for the issuance of 'use of proceeds' green bonds. The national-level KPIs can also be used to issue Sustainability-linked Bonds (SLBs), designed to promote sustainability while providing general-use liquidity to the issuer. Ecological criteria could be introduced to existing intergovernmental fiscal transfer systems: Ecological Fiscal Transfers (EFTs[77]). EFTs are a type of intergovernmental fiscal transfer that, based on pre-defined KPIs, compensates governorates or municipalities for ecological services and conservation efforts. Implementing EFTs will require strengthening local government's capacity to plan and prepare capital investment, utilize the existing formula for fiscal transfers and enhance it further.

Design and pilot innovative government support mechanisms to strengthen the bankability of PPP projects. Subject to strengthened supervisory framework and improved public investment management, scale up SSIF's and, more broadly, SOEs' role in financing green infrastructure and climate-responsive projects. There is increasing interest and an emerging pipeline of climate-responsive PPPs in Jordan. The development and implementation of these projects have been slow as they face evolving institutional structures and capacities, fiscal constraints, and uncertainties common to projects that introduce new technologies or are not revenue-generating (self-sustaining). Innovative government support mechanisms such as a viability gap and guarantee fund can enhance the affordability and bankability of climate-responsive projects. The Social Security Investment Fund (SSIF) is well-capitalized, and its resources could finance green infrastructure and projects. Also, since SOEs finance nearly one-third of public investment, it is important to strengthen their financial and operational governance to promote climate-responsive investments.

Adopt green procurement and performance contracting practices and strengthen national quality infrastructure to encourage supply chain greening for goods and services. Government agencies spend yearly on new construction, rehabilitation, operation, and maintenance projects. Green procurement enables the utilization of higher quality, greater efficiency, or more durable materials and techniques and could gradually transform the stock of public assets. This would reduce utility bills (water, energy), improve productivity, and encourage the private sector. The government can set the example for Jordan's corporate sector to adopt green supply chain practices and support the SME sector in transforming its business practices. Immediate actions include adopting green procurement practices, new contracting approaches (performance-based contracts, leasing), new financing instruments (land value capture, asset refinance), and strengthening the quality infrastructure for improved product/equipment standards. Each of these helps improve the efficiency

[77] Experiences with EFTs have been captured in other regions. See 'Fiscal Foundations for Decarbonization: Carbon Charges in Brazil' (World Bank 2021) for further information.

of available funding and resources, representing the convergence of mitigation, adaptation, and resilience priorities.

Integrate climate criteria into existing and upcoming private sector development programs and strategies, such as FDI-related strategic plans, export development (e.g., new National Export Strategy), access to finance initiatives, innovation policy and entrepreneurship (e.g., amending the National Entrepreneurship Policy) to drive existing and new firms and industries to adapt their business models and technologies. Climate considerations could also be mainstreamed into the new Financial Inclusion Strategy currently being prepared.

Operationalize the climate finance governance system to strengthen coordination across government, private sector, financial sector, and the general public on climate action. Doing so will enhance the role of the National Climate Change Committee and the goals of the Climate Change By-Law to facilitate effective dialogue and actions. The system would enable stronger coordination between government ministries and the private sector through relevant line ministries.as well as institutions like the Central Bank of Jordan and the Chambers of Commerce. This can address the need for a 'one window/platform' on climate change and a green economy for the private sector.

Improving fiscal discipline, budgeting, and transparency

Ensure traceability of climate action strategies and plans to the medium-term fiscal framework. While Jordan is yet to strengthen its fiscal policy planning capacity further, the main climate change actions articulated in the Green Growth National Action Plan, with the bulk of the climate change actions in priority sectors, are fully costed. These costs are reflected in the annual sector ceilings. Beyond the Green Growth National Action Plan, the climate change strategic framework is costed mainly for capital expenditure, not for all revenue and expenditure policies.

Strengthen the management of financial and non-financial assets and liabilities to reduce emissions, promote adaptation, and build resilience. The GoJ reports on a cash basis IPSAS-compliant accounting framework. Most government financial assets and liabilities are accounted for in the notes to financial statements and debt reports but not in a consolidated annual balance sheet. Records on non-financial assets are decentralized, and existing registries are yet to be valued uniformly and consolidated. Furthermore, SOEs need to report on their climate-related expenditures for the central Government to assess alignment with the country's national climate change priorities.

Strengthening the financial sector to mobilize private investment

Develop and implement the CBJ's Strategy for Greening the Financial Sector, which will help to increase financial sector resilience to climate risks and strengthen the enabling environment for the financial sector to contribute to mobilizing climate finance. The CBJ's Green Finance Strategy for greening the financial sector and broader engagements for developing green capital market tools should become part of national-level climate finance efforts. The CBJ, together with the financial sector participants, should implement a wide array of actions to ensure the financial sector becomes climate-responsive, contributes to green finance mobilization, and addresses climate-related financial risks. The first stepping-stone is to conduct a comprehensive climate-risk assessment for the financial sector in Jordan. The assessment will require strengthening the data collection to quantify physical and transition risks and use these results as input for further steps in greening the financial sector.

Support active consultations between the private and financial sectors to align expectations and vision for greening the financial sector in Jordan. Cross-cutting efforts should be spent on capacity building for the CBJ and financial sector participants to ensure sustainability and successful implementation of the CBJ's strategy. CBJ should more actively engage in a broader national effort in developing national green taxonomy, mobilizing climate finance, expanding the green bonds market with targeted capacity building, and creating the supporting market infrastructure for investors.

The lack of a national classification system of climate-responsive or sustainability-linked activities, i.e., national taxonomy, was highlighted by financial sector stakeholders as a significant gap. A national taxonomy would help level the playing field and add consistency to how financial institutions classify different economic activities and the respective borrowers or loans; it would also help companies identify if their activities or projects qualify for green finance. This taxonomy could draw on international experience and reflect Jordan's local circumstances. The current draft instructions being prepared under the Climate Change Regulation No.

79 (2019) to provide definitions for climate-responsive capital expenditure could be taken as a starting point to be leveraged into a national taxonomy. If there is no willingness to adopt a national taxonomy, CBJ could develop a green/sustainability taxonomy for the financial sector to progress in its mandate of assessing climate-related vulnerabilities and potential systemic risks. Adopting a green taxonomy is crucial to deepen the green finance market, increase green lending, and increase credibility.

Accelerate development of disaster risk finance products. This work would directly support the implementation of the Jordan National Natural Disaster Risk Reduction Strategy. It would require performing a comprehensive diagnostic to identify actions that would help develop or enter into climate and disaster risk financing mechanisms that best fit Jordan's needs. Moreover, the broader insurance market development actions should integrate the objective of developing disaster risk insurance products to protect people, businesses, and the state against financial shocks caused by natural disasters.

Expand the scope of capital market development efforts to include green finance instruments and align it with the national debt management framework. This should include an action plan with short-, medium-, and long-term measures for developing green finance instruments, especially for longer tenors. This will ensure issuance of green or other labeled bonds is an integral part of broader debt management. Targeted development efforts could help capital markets expand and diversify, complementing concessional financing sources. With concerted efforts to advance capital market development, Jordan could take advantage of various green finance instruments, including green loans, green bonds and others.

Strategic partnerships for engaging the private sector

Implement targeted awareness-raising measures for the private sector. For private sector actors to dedicate time and resources to operating in a more climate-friendly way, there has to be a clear business case demonstrating the payoff of these actions, especially since the upfront investment cost may be high. Relevant private sector bodies can develop sector-level cost-benefit analyses with concrete quantitative estimates, provide examples of existing businesses that benefitted from green investments, and provide information on the benefits of specific climate-responsive solutions for firms across sectors.

Identify opportunities for international technology transfers and the development of new financing instruments. Climate action and green financing should incentivize SMEs to join the formal economy. Industry segments can engage with the global community and bilateral trade partners in identifying clean technology solutions, new opportunities for industry-segments technology transfer, knowledge sharing, and development of new financing and risk-sharing instruments. Targeted public-private partnership programs could encourage market linkages and coaching/mentoring connections for greening supply chains between large enterprises and MSMEs. It is important to leverage the applied research sector in enhancing private sector competitiveness through developing and applying innovative climate-smart technologies. The high level of informality, information barriers, and lack of strong management systems are significant constraints in tapping green financing for smaller companies. There are ongoing programs in Jordan focused on supporting SMEs in increasing their management and business capabilities, without which it is difficult to implement effective company-level climate-responsive activities.

Foster green entrepreneurship, including the facilitation of local service providers and local start-ups with technology and service solutions, to build on the existing market opportunities. Given the large numbers of SMEs and their relatively small environmental impact, such green entrepreneur initiatives should be based on providing information rather than resource-intensive support. The exception may be financial support to green knowledge-based start-ups, which may need to draw on specialized investors and technical support from established digital start-ups.

4.3. Creating inclusive, climate-responsive jobs and skills

4.3.1. Jordan's long-standing employment challenges

Without addressing underlying structural issues in the labor market, Jordan would be ill-equipped to mitigate the potentially negative impacts of climate change on workers. A key feature of the Jordanian labor market is its high level of segmentation. Existing labor market segmentation has many contributing factors, including certain restrictive labor policies, government hiring practices, social norms, misalignment between job seekers' skills and expectations, and private employers' demands. Jordan's job segmentation patterns reflect limited dynamism in the private SME sector, where firms struggle to enter, grow, compete and create

jobs. This context makes it difficult to stimulate the labor market and mobility across work status categories and sectors. Data from the Jordan Strategy Forum also indicate labor productivity has been falling since 2010, in contrast to positive productivity trends in Egypt and Morocco.[78]

- The public sector plays a major role in Jordan's labor market, where civil service employment accounts for 24 percent of total employment and 58 percent of all formal jobs. Government is the primary employer of Jordanians, concentrated in public administration, followed by education and health. Higher education workers are more likely to work in the public sector.
- Few Jordanians work in the agriculture and construction sectors, with poorly remunerated, unskilled jobs filled by foreign workers. In 2017, agricultural workers were primarily Egyptians (73 percent) and Syrian refugees.[79]
- Informality is widespread among non-Jordanian workers and in sectors dominated by non-Jordanians.[80] It is also increasingly affecting the entire labor force. Panel data[81] reveals that the overall share of informal workers rose from 44 percent to 58 percent between 2010 and 2016. Even among employed tertiary graduates, the share not covered by social security rose from a quarter to over a third in the six years of observation.[82]

The dominance of the public sector squeezes private sector growth and job creation. Jobs in private services are ubiquitous but offer relatively poor compensation, require low skill levels, and employ a high share of foreign labor. Productivity and job quality gaps contribute to increased marginalization of Jordanian youth, reflected by high unemployment and other issues. Although the private sector generates jobs, most are low-wage, low-skill, and provide no stability or social security coverage. Migrant workers are willing to take these low-quality jobs, contributing to a vicious cycle of widening employment gaps.

The agriculture sector provides essential employment to some of Jordan's poorest households. Forty percent of agriculture sector households are considered poor.[83] Non-Jordanians characteristically hold agriculture jobs. Much of the work is low-paid, informal, seasonal, and located in remote areas. Agriculture wages are very low, and mostly lack non-wage benefits such as social security, making them informal.[84] Among Jordanian women working in farming, most are engaged in family livestock and crop production rather than waged employment.

Most construction workers are informal wage employees with extremely low levels of education; three-quarters of construction workers have primary education or less, similar to levels observed in agriculture (2019 LFS data). Whereas in many countries the returns to construction sector work are relatively high, given the low levels of education required, construction wages in Jordan are meager, averaging JD266 per month (LFS 2019)., 7 percent lower than the average commerce sector wage and only 15 percent higher than waged earnings in agriculture

Climate change will have profound negative implications for employment, especially for vulnerable workers. Yet this bleak future scenario is not inevitable. Without climate action, climate change could worsen some of the long-standing issues in Jordan's labor market. Yet several climate actions could minimize negative consequences and advance Jordan's employment goals while meeting international commitments.

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[78] A similar trend is reflected in Jordan's Economic Complexity Index since the 1970s. According to the Economic Complexity theory, economic complexity is defined as a measure of the accumulated productive knowledge of a country as reflected in the complexity of the goods it manufactures. Economic complexity is measured by evaluating the diversification and sophistication of a country's basket of manufactured goods (for details, see Jordan Strategy Forum (2017).

[79] WANA (fn19)

[80] See Jordan National Social Protection Strategy background papers, and ILO reports. See also WANA report

[81] The Jordan Labor Market Panel Survey was carried out by the Economic Research Forum in 2010 and 2016. Jordan's LFS data does not capture changes over time at the individual level.

[82] Although the law does not require employers to provide social security to day laborers or agriculture workers, these groups account for only a very small share of workers in informal employment. For further discussion on working conditions, see Razzaz (2017).

[83] Jordan (2020) Green Growth National Action Plan 2021–2025 Agriculture Sector.

[84] By work status and residency status, informality shares of agriculture employment are as follows: 93 percent of Jordanian wage employees; 98 percent of non-Jordanian wage employees; 77 percent of Jordanian own-account workers; 82 percent of non-Jordanian own-account workers; 56 percent of Jordanian employers; 17 percent of non-Jordanian employers; 100 percent of Jordanian contributing family workers (by definition); and 100 percent of non-Jordanian contributing family workers (by definition). Razzaz et al. (2021) (based on LFS data).

4.3.2. Synergies between climate action and better jobs

While climate change will negatively affect jobs and economic production, climate-change measures can help offset impacts and generate job opportunities. An approach is needed that joins climate considerations with economic growth and job creation objectives to identify sectors where such opportunities lie. Climate action can be conceived in multiple ways, whether through multi-sectoral policies or sector-specific actions that address some aspect of climate change. Each sectoral entry point will generate employment effects. Understanding the employment transmission channels of production across different economic sectors in an economy can be aided using Input-Output tables.

In a recently developed tool that overlays Input-Output data with sectoral emissions data, Aguilar-Restrepo et al. (2021) create a framework for comparing the relative contributions of each sector to GHG and air pollutant emissions while considering their respective contributions to GDP and inclusive employment. The authors applied three filter criteria to rank Jordan's economic sectors against global averages related to three desired benefits: creating jobs and economic growth, fostering sustainability, and enhancing inclusion (Aguilar-Restrepo et al., 2021). This approach can identify sectors with potential job creation and their emissions intensity and capacity to offer inclusive employment.[85] By benchmarking these sector measures against other countries, it is possible to identify opportunities where Jordan can catch up to other countries.

The analysis below focuses on four sectors of relevance, namely crop production, food processing, tourism, and transport.[86] It estimates the direct and indirect[87] employment and GHG emissions associated with US$1 million of sector output. For each sector, the employment and emissions generated by US$1 million worth of capital investment are compared in two ways: against other sectors in Jordan and the same sector in other countries. The exercise can identify sectors that can support Jordan's NDC commitments and help the economy deliver more good jobs for its population. The results presented below, taken from Aguilar-Restrepo et al. (2021), focus on job creation potential and GHG emissions.[88] These estimates are complemented by a recent study by the Regional Center for Renewable Energy and Energy Efficiency (RCREEE and GWS 2020)[89], which examines Jordan's renewable energy and energy efficiency sectors and the associated job impacts.

Jordan's energy-related sectors and the water sector generate far higher levels of GHG emissions than other sectors. Oil, gas, electricity, water, and petroleum are highly emitting and generate modest employment levels, albeit with some variation. Transportation activities are the next highest emitting, with modest-to-moderate employment effects. Tourism is not highly emitting but generates modest employment. Food processing and construction, by contrast, generate significant direct and indirect employment per $1 million investment, partly due to low wages and labor-intensive technologies (Figure 29).

Jordan is progressing in its transition to renewable energy, providing stimulus through the construction sector. RCREEE and GWS (2020) document a nine-fold increase in Jordan's renewable energy jobs since 2013. Over 5,000 people in Jordan work in renewable energy, mostly in electricity generation and water heating.[90] In comparison, the electricity sector based on fossil fuels employs about 30,000 workers while mining, gas distribution and related manufacturing employs another 23,000 workers. Regarding energy efficiency employment, around 6,000 workers in the construction sector are engaged in upgrades such as greener lighting and other building improvements. Jordan's 11,000 sustainable energy jobs compare favorably to the 8,800 jobs observed in Egypt (2016) and almost 6,500 in Algeria (Lehr and Banning 2018).

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[85] Note that inclusion in this exercise is defined with respect to female employment share.

[86] Note that chemical manufacturing is also assessed but the results are not presented here.

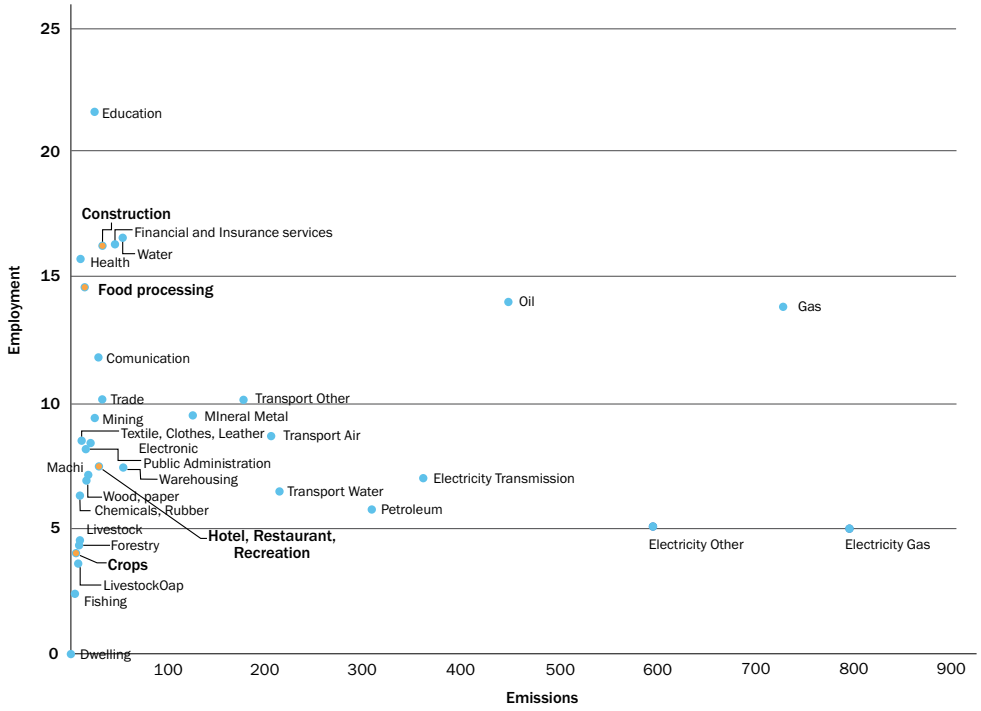
[87] Whereas LFS data captures direct employment within each sector, the Input-Output approach captures employment that is indirectly linked with each sector's production, providing a more comprehensive count.

[88] The paper by Aguilar-Restrepo, Lozano-Gracia and Sanchez (2021) rates countries along three indices: growth (which includes jobs as well as value-added), sustainability (which includes emissions and air pollutants), and inclusion (which is measured by female employment share). Rather than presenting the full indices here, we instead focus on employment separately from growth because employment is only indirectly addressed in the growth index (the value of the index for growth is calculated as the minimum between rank-size distribution of jobs created and the rank size distribution of value-added).

[89] The estimates developed by RCREEE and GWS (2020) are based on Jordan's 2016 Input Output table, complemented by regional analysis of structural allocations of renewable energy inputs, and informed by expert consultations in Jordan regarding domestic capacity to manufacture renewable energy inputs.

[90] Note that the renewable energy sector is not defined as a distinct sector in standardized industry coding (such as ISIC Rev. 4), and therefore falls under other sector classifications.

Figure 29. Employment and emissions per US$1 million of sectoral investment



Source: Aguilar-Restrepo, Lozano-Gracia and Sanchez (2021)

The urban concentration of Jordan's economic activity is emissions-intensive for various reasons but has also benefited from agglomeration economies in terms of stimulating job creation. Urban development depends on inefficient road transport. Road transport services create roughly ten direct and indirect jobs for every US$1 million invested but generate nearly 200 tCO2-eq. because they run primarily on oil and natural gas (Aguilar-Restrepo et al. 2021). Transport sector workers are disproportionately male Jordanians, with similar education levels to construction, wholesale, and retail sectors, although transport wages tend to be higher. The sector absorbs 5 percent of employed workers, and nearly a third are self-employed. The level of informality is relatively high.

Whereas construction skills feature prominently in renewable energy installation activities and energy efficiency building upgrades, they are largely comprised of moderate skill levels. This conclusion is consistent with IRENA and ILO (2021) global estimates that over four-fifths of new jobs generated under an energy sustainability scenario will require a secondary education or less. The moderate skill and low construction sector wages limit the sector's attractiveness to Jordanian workers. Aguilar-Restrepo et al. (2021) estimate that 16 direct and indirect jobs would be generated by a $1 million investment in construction, although this high return is partly a function of the sector's low productivity.

This comparative ranking exercise highlights trade-offs between job creation potential and emissions impact in several key sectors. While some sectors perform well in terms of employment, and others perform well in terms of GHG emissions, none perform particularly well in both dimensions. There are therefore opportunities to help the Jordanian economy decouple growth from emissions, moving it further along its green economic transformation path.

a. There are opportunities for low-emissions job creation in food processing, further enhancing the job multiplier effect along the value chain. There is room for upgrading the sector's skill content, shifting toward more specialty products, to generate more attractive work opportunities.

b. The crop sector shows mixed prospects, reflected in its low employment multiplier and relatively low emissions intensity. The rising temperatures and reduced water availability mean some crops will no longer be viable without significant adaptation, which in turn may displace farm workers, which are some of the most vulnerable groups. However, some of Jordan's agriculture products could be replaced to enhance its

untapped export potential.[91] While national food security is important, the sector holds limited potential to create new high-quality jobs unless strategic technological and crop-mix changes are introduced.

c. Tourism is the country's leading export sector with a significant contribution to GDP; however, its structure has created fewer overall jobs, particularly inclusive ones, relative to competitor countries. Its emissions are also higher than comparators.

d. Smarter urbanization and more efficient transport services could bring about significant emissions reduction. Increasing urbanization reduces the transportation demand and can increase agglomeration effects.[92] Investing in transport sector efficiency through expanded public transportation, better road infrastructure, and interurban truck transport connectivity can reduce transport costs for firms and workers. Direct job creation during the construction, operation and maintenance of road infrastructure investment will likely be concentrated in less skilled occupations.

e. Renewable energy and energy efficiency investments are central to the Government's climate commitments, and they are already generating jobs. Yet the potential benefit to Jordan's economy is under what it would be if more Jordanians worked in the sector. As a dynamic emerging market, renewable energy installation services and energy efficiency upgrades will increasingly require a higher mix of occupations, such as service and market sales workers and professionals, similar to those observed in countries more advanced in the green energy transition process (IRENA 2017a and 2017b).[93] In the near term, growing demand for renewable energy installation services and energy efficiency upgrades will offer opportunities for micro firms and independent contractors to enter or expand their operations in response to growing demand. This is expected to create new market opportunities for existing and new construction design and services firms that could absorb some of Jordan's underutilized human capital.

4.3.3. Policy recommendations

Climate impacts will impact workers' livelihoods, ranging from reduced incomes to complete displacement from jobs, but Jordan's highly segmented labor market impedes workers' capacity to find better jobs. Households' ability to respond to income shocks will be impacted. Labor policy instruments to support worker transition to new jobs are critical but insufficient in the context of Jordan's market distortions and inadequate private labor demand. Complementary policies are needed to create the enabling environment to foster economic diversification and job creation in sustainable activities, including green tech and CSA.

Public policies and programs can narrow the gaps that characterize Jordan's segmented labor market; workers can transition more easily by reducing job differences between segments. Policy "nudges" can target labor supply, for instance through education and skills interventions, or labor demand, such as through investment incentives to stimulated SME growth. Coordinated labor and complementary policies are essential to meet the wide-ranging needs and capacities of affected workers and firms in multiple sectors when transitioning to greener, more sustainable activities. Policies should include (a) short-term passive labor transition policies, offering temporary income support through the existing social assistance system, (b) short-term active labor market policies (ALMPs) that help connect workers to potential employers, for example, through job search assistance, soft skills training, and mobility grants. For these policies to be impactful, private sector vacancies/unmet demand for Jordanian labor need to be enacted, (c) longer-term ALMPs that train workers for jobs in sustainable industries and sustainable livelihoods (training in CSA, agri-entrepreneurship, food processing, energy efficiency retrofitting and solar panel installation, for example), (d) programs that stimulate private sector labor demand such as through investment (fiscal) incentives, matching grant or wage subsidy interventions programs to green innovating MSMEs that create jobs, incentives for firm partnership and mentoring, including through higher education institutions, (e) labor regulations that foster labor mobility and promote firm agility to create jobs, and (f) longer-term development policies that support

[91] Agricultural exports have increased strongly since the late 1990s, reaching US$2 billion in 2015, up by more than 400 percent from its 2000 value. Some key constraints identified in the World Bank (2017) study "Enabling the Business of Agriculture" are post-harvest losses, poor quality-standards and insufficient agricultural finance.

[92] Cities like Amman will need to shift their growth patterns along all three dimensions—vertical layering, infill development enabled by future economic productivity, and in some cases horizontal expansion at the city's edge (like East Amman).

[93] Based on international averages estimated by IRENA (2017a) and IRENA (2017b), installation activities primarily use craft occupations (72 percent, compared to 15 percent professional occupations), whereas the operations and maintenance phase of renewable energy typically requires a more balanced occupational mix (38 percent craft workers, 20 percent professional, 16 percent services and market sales, and 15 percent machine operators).

human capital accumulation and labor productivity, including school curriculum reform to build STEM skills, sustainability knowledge, and entrepreneurship skills.

Climate actions can create new growth opportunities through emerging green industries and environmental services. Those include climate-related technology design, adaptation, and services, local innovation by MSMEs to meet changing food or housing needs; low- or high-tech environmental monitoring and services; adapting infrastructure (energy efficiency building retrofits, solar installation); climate-smart agriculture. New green industries will require labor inputs across a mix of skills. Some activities can be adopted by existing workers and firms, such as farm and construction workers whose tasks will shift to greener techniques or inputs, possibly requiring some on-the-job re-training.

Decentralized renewable energy, solar water heating, biogas capture and reuse in wastewater treatment plants, water and energy efficiency investments, rainwater harvesting,[94] and water-efficient agriculture emerge as cost-effective approaches to reducing GHG emissions and creating jobs.[95] Climate actions in these categories often have fiscal and financial benefits, saving money from the public budget or generating a profit due to short payback periods.

Climate actions can create many jobs in renewable energy, but even more in the construction and agri-food sectors.[96] Estimates by RCREEE and GWS (2020) suggest that the number of construction jobs generated by energy efficiency upgrades to lighting and buildings exceeds the number of jobs in the renewable energy sector. In the agri-food sector's case, climate actions may be necessary to maintain jobs lost due to climate change. Renewable energy and energy efficiency investments and initiatives will principally generate construction-related work requiring modest upskilling for many workers. However, there will be a demand for technicians and those with management and other skills. In agriculture and construction, start-ups will have significant scope to enter new green market niches.

The higher skill level required for many jobs created through climate actions could attract Jordanian workers, including entrepreneurs. For example, there is significant scope for the entry of new green building firms to perform energy efficiency audits and retrofits and install rooftop solar, and for new entries in residential solar water heating and greenhouses. Agri-entrepreneurship in food processing holds potential for new firms to emerge and exploit new markets, domestic and external. Jordanians will still value adequate compensation, job security, and social security coverage, which means there may still be a gap between labor demand and supply if Jordanians are unwilling to take up these new jobs.

Climate actions can be growth- and jobs-generating in Jordan if accompanied by labor policies supporting supply and demand. Entrepreneurship training and support will facilitate start-ups and furnish the skills needed for success. The curriculum reform supporting innovative thinking, entrepreneurship, and soft skills will be a strategic investment in the next generation of graduates seeking good quality employment outside the public sector. Training in sustainability principles through STEM and climate-change knowledge, and specifically in green technology applications at the mid and high-skill levels will be essential for meeting the emerging demand for energy transition, energy efficiency investments, and environmental services.

Climate actions can prioritize vulnerable groups through targeted interventions based on a deeper understanding of their short- and long-term adaptation needs. These could include geographically marginal communities affected by ecosystems degradation, such as in the Badia. Public programs such as payments for environmental services related to land conservation and biodiversity protection can sustain livelihoods in these remote areas while generating positive environmental outcomes.

[94] See FAO (2016) for discussion.

[95] IFC (2021) and U.S. Environmental Protection Agency (2018) both conclude that per US$1 million in sector output, decentralized climate actions (renewable energy and energy efficiency) generate more jobs than centralized renewable energy generation investments.

[96] Note that much of the research estimating the level of future job creation based on modeling the pass-through of future investments in renewable energy to the rest of the economy is based on advanced economies and thus is not directly applicable to Jordan.

5. Conclusion and recommendations

The CCDR aligns Jordan's economic modernization vision with the country's climate change commitments toward long-term sustainability. Jordan is a natural resource-scarce and human resource-rich country, with a small contribution to global GHG emissions but facing an increasingly and severely damaging impact of climate change. The CCDR adopted a cross-sector nexus approach to identify priority interventions for enhancing water-energy-food security with adaptation to climate change as the primary climate change co-benefit and for transforming the urban-transport-energy nexus with mitigation and resilience as the primary climate change co-benefits. The recommendations on policy measures and investment needs have been prioritized based on their development benefits, particularly improved resource-use efficiency, reduced fiscal burden, social inclusion and their level of urgency. These recommendations align with the recently released Vision for Economic Modernization, as noted in Table 10. The CCDR also presents recommendations based on analyses of the potential financing sources and approaches to addressing investment needs. All recommendations seek to align short-term benefits for the Jordanian people with the potential for creating long-term climate-responsive economic growth and protecting Jordan's people, economy and natural resources from climate risks.

Table 10. Summary climate investment needs (2030 horizon)

CCDR Focus	Climate Investment Needs (2022-30)	Climate Change Priorities (2030-2050)	Economic Modernization Vision (2022–33)
Enhancing Water Energy- Food Security	Reducing fresh water use in agriculture while safeguarding livelihoods	Increasing water productivity; improving resource-use efficiency	
	Boosting system-wide resilience with a focus on drought		
	Ensuring the financial sustainability of the water and energy sectors in a context of increasing water scarcity		
Greening Urban-Transport-Energy Nexus	Leveraging mitigation opportunities in the agri-food and water sectors	Increasing the share of RE Solutions; reducing GHG emissions from energy and waste; improving resource-use efficiency	
	Integrating green urban-transport planning, reforming public transport, and deploying transit-oriented development.		
	Investing in green infrastructure for urban rejuvenation, waste management, and circular economy		
	Facilitate deep penetration of energy efficiency (EE) in all sectors		
Inclusive transition for workers	Passive and active labor market policies	Creating green jobs, Creating climate business opportunities, Improving investment in resource-use efficiency	
	Labor regulations fostering mobility and firm agility to create jobs		
	Revamped school curricula for green jobs		
Unlocking finance for climate action	Improving government practices for efficiency and impact		
	Improving fiscal discipline, budgeting, and transparency		
	Strengthening the financial sector to mobilize private investment		
	Enhancing strategic partnerships for engaging the private sector		

Note: The color pattern in the right column reflects the degree of focus in the Economic Modernization Vision

5.1. Ensuring climate-responsive economic modernization

Building long-term resilience in Jordanian society is key to reducing recurrent exogenous shocks affecting people and economic growth. In the past decades, regional conflict, the related refugee crisis, and recurrent global economic challenges have increased short-termism in planning and policy. As Jordan emerges from the COVID19 pandemic, the economy now faces the twin problems of rising fuel and food prices brought on by the war in Ukraine and increasing interest rates designed to tackle inflation. Climate change need not add to this uncertainty. Shifting to a longer-term time horizon is essential for setting policy goals that are effective climate actions and socio-economically transformational. Through sound policies, innovation, entrepreneurship, and citizen engagement, Jordan can attract investment and encourage the behavioral

change necessary to address climate and development challenges.

Jordan is facing high climate change adaptation costs, and financing pressing adaptation is a priority. A combination of carefully coordinated policies and investments across key sectors will be needed; with private investments expected to play a significant role. This calls for greater engagement with the private sector on the climate change agenda and progress in addressing barriers to greater private sector involvement, as discussed in this CCDR. Mobilizing new and innovative sources of finance could also play an important role. Several opportunities have been explored in Chapter 4.

The transport, industry, and electricity sectors will lead the way to decarbonization in Jordan. The transport sector is Jordan's main consumer of fossil fuels, particularly liquid fuels. Improving public transport to reduce dependence on passenger vehicles presents the most important opportunity to reduce air pollution and GHG emissions and create equitable, inclusive, and safe mobility options. The electricity sector is on a low-carbon pathway, with abundant solar and wind resources. This could allow electric vehicles to reduce to near-zero GHG emissions. This requires a comprehensive vision, policy, and institutional framework for mobility. Consultation with the large, essentially export-oriented, industrial sector indicates a strong awareness of the ramifications of climate change on business. So far, all investment decisions, climate mitigation or adaptation, were influenced by high energy prices and water scarcity. There remains significant potential to continue the path towards decarbonization and explore new avenues for investment and export of low-carbon products.

Jordan has a strong foundation of climate policy framework, which can help the country enhance participation in global climate change dialogue, engage with future carbon markets, create and support climate action in the country and the region, and build robust and inclusive governance for mainstreaming climate change in development. The effectiveness of this and all other policies lies in quality, pace, and perseverance in implementation. This requires strengthening institutional capacity regarding staffing and expertise, improved government and private sector coordination, and deeper engagement with academia, civil society, and citizens. Jordan has recently begun preparing the Long-Term Strategy for Low-Carbon and Climate Resilient Development (2050) as part of the Paris Agreement. This process should create a robust social dialogue and public engagement toward defining and implementing a 'Whole-of-Economy' vision for a green Jordan.

5.2. Thinking long-term and acting now

The recently launched ten-year Vision for Economic Modernization seeks to unleash Jordan's economic potential and improve Jordanians' quality and standard of living by enhancing services, including education, health care, transport, and infrastructure. The Vision identifies bolstering innovation and entrepreneurship and efficiency and productivity as key to sustainable growth. The findings in the CCDR align with this new economic vision and recognizes a renewed urgency for action. Status quo is not an option. Today's actions to address climate change and development challenges will benefit the Jordanian people, natural resources, and the economy while addressing pressing adaptation needs across sectors and generations. The government's commitment to the climate change agenda and sustainable economic growth is widely acknowledged; this must translate into credible progress towards faster implementation.

Encouragement of innovation and entrepreneurship, a key pillar of the new Vision for Economic Modernization, must apply to innovation services to promote resource-use efficiency and new technology applications in energy, agriculture, and industry. It is common for the discussion in these areas to focus on Information Technology (IT) and IT Enabled Services (ITeS), linked with the global market. However, there is a significant opportunity to encourage youth engagement in revitalizing sectors and services crucial for sustainable growth. Jordan has a dynamic community of entrepreneurs and enterprises interested in green business opportunities. Local adaptation of technology solutions and service industry business models across sectors could help improve productivity and efficiency. Technology examples include, solar heating and cooling, agricultural technologies such as aeroponics, aquaponics, hydroponics, and electric mobility. Service industry examples include energy services company (ESCO), potentially for energy management in facilities, and provision of heating/cooling as service.

Human capital is Jordan's greatest asset, creating avenues to address behavior change and youth employment. Creating more jobs faster is essential, especially to gainfully engage youth and women in the economy and society. The current challenges with youth employment and the very low rate of participation of Jordanian women in the labor force are fundamental issues that require comprehensive labor market reform. As discussed in Chapter 4, climate actions can create new employment opportunities across sectors, skill levels, and urban and rural areas. Proactive measures to address climate change offer an opportunity to begin the long-term process of structural change in the job market, creating new opportunities and building the labor force of the future.

Building a strong foundation for inclusive and sustainable growth will reduce future uncertainties due to climate change. Accelerated progress on structural reforms, enhancing institutional capacity, and strengthening policy enforcement are critical elements for building private sector confidence, and encouraging growth and investments. The recommendations from this CCDR should be considered as the government implements the ongoing reform program and designs the roadmap for implementing the new Vision for Economic Modernization.

Appendix–The Macro-Fiscal Model for Climate Change (MFMod-CC)

Brief description of MFMod-CC

MFMOD is a macrostructural standalone model frequently used by the World Bank for economic monitoring products, medium-term growth, and macroeconomic forecasts. This dynamic model features intertemporal consumption utility optimization and firm expenditure minimization; sticky prices and wages; distinguishes consumer and producer prices; detailed fiscal and external balances; sectoral VA; international linkages through trade, commodities, remittances, and tourism; and is based on time series with annual data. The model contains several factors that disturb the economic equilibrium, including tax wages, investment adjustment costs, short-run prices, and wage stickiness. Key features include a focus on price levels, inflation, exchange rates, monetary policy's role—using interest rate as policy instrument—costly debt accumulation, and exogenous total factor productivity (TFP).

The MFMod-CC extends the core MFMod macrostructural model, including a standard set of variables and equations necessary for forecasting, economic policy, and budgetary planning analyses typically conducted by central ministries. A detailed technical description of MFMod is provided in Burns et al. (2019), while Burns et al. (2021) describe some of the climate change extensions included in the MFMod-CC.

The long-run behavior of the model follows a neo-classical framework. The equations' functional forms are derived from economic theory, where household tends to optimize consumption decisions to maximize utility, and firms minimize costs by adjusting their use of factor inputs. Although not fully micro-consistent in the way that CGE or DSGE models are, MFMod-CC is a general equilibrium model that covers the entire macroeconomy by linking various accounts through a set of identities and behavioral equations. While the functional forms of equations are similar across countries, parameters at the country level are country-specific, being econometrically estimated or calibrated to the specific features of the economy. An error-correction formulation for most behavioral equations means that the model's speed of adjustment (a reflection of underlining rigidities) is country-specific and data-driven. Formulated in this way, external and domestic shocks (including climate and policy shocks) will immediately affect the model's long-run equilibrium state. However, adjusting to that new equilibrium will be gradual, reflecting labor market, product and capital market rigidities.

The model's climate extensions draw from existing literature to introduce emissions and pollution modules, damage functions from higher temperatures, pollution and flooding, and an adaptation module to analyze the economic benefits of adaptation investments, notably in the water sector. The extended model incorporates the following features:

- **A more disaggregated energy sector,** integrated into the model's production and consumption sides;
- **An emissions and pollution module** was added to track and convert emissions from each form of energy into CO2 equivalents. Particulate pollution from the burning of different hydrocarbons and their impacts on human health, labor productivity, and health-care expenditures are also tracked;
- **Damage functions** were introduced to capture how climate change affects the economy. In the standard model, higher temperatures aggregate labor and agricultural productivity following estimates from Roson and Sartori (2016). Changes in rainfall levels and patterns are also tracked as the increased and severity of flooding and the damages inflicted on the capital stock;
- **Adaptation investment functions** were introduced to explain how investments to increase the economy's climate resilience can reduce damages that might otherwise occur. The benefits of avoiding an increase in water scarcity were calibrated to the damages presented in Taheripour et al. (2020), which estimated the economic impacts of increased water scarcity in the Middle East, including Jordan.

Scenarios' assumptions and results

Four scenarios are produced, independent from each other, to simulate their effects on the growth and macroeconomic benchmark. The scenarios' modeling follows a clear structure that allows for simple and

reasonable comparisons of the influence of climate challenges and policy responses. The modeling sets a benchmark at the outset that purely reflects the Jordanian economy's growth and macroeconomic features.

The scenarios progressively simulate the impacts of (a) climate change damages on the economy, excluding water scarcity effects, (b) water scarcity scenarios based on the Water in the Balance report, (c) a combination of high and low costs interventions for desalination and conveyance, and non-revenue water reduction, and (d) priority infrastructure investments additional to the investment plans reflected in the growth and macroeconomic benchmark. These scenarios can be treated independently from each other. Through this approach, it is possible to isolate each scenario's influence on the economy and derive trade-offs.

Scenario results are presented in CCDR standardized tables, capturing deviations from the growth and macroeconomic benchmark. They are interpreted accordingly in the CCDR's main text. For instance, a Real GDP result of -0.7 for 2050 indicates that, by 2050, there will be a -0.7 percent decline in the real GDP average growth rate compared to that projected in the baseline scenario for 2050. It indicates a drop in the growth rate from the baseline resulting from the changes under consideration, and not that the average growth rate is -0.7 percent.

The benchmark growth and macroeconomic baseline

A pure growth and macroeconomic benchmark denotes business-as-usual government expenditure, productivity growth, and no further climate change impacts or mitigation/adaptation interventions. Therefore, there is no climate change action in this baseline, and it does not include large projects to increase water supply, such as the AAC. The AAC and other interventions play key roles in the scenarios simulated below, reflecting the impact of investments and shocks on the benchmark, as presented below.

Assumptions:

Long-term growth in MFMod is determined by capital accumulation, and labor force and productivity growth. In the baseline, TFP growth is assumed to continue over the forecast period at the same rate as over the most recent 15-year period. Labor force growth is assumed to grow with the working-age population as forecast by the United Nations (https://population.un.org/wpp/). Capital accumulation proceeds in line with investment behavior, which in turn is determined by productivity and labor force growth and factors such as inflation and the business climate, which determine the cost of capital. While these items are endogenous in the model, they are assumed to be constant in the baseline. Under simulation, long-term growth will respond to changes in variables such as interest rates and inflation.

Employment in MFMod-CC for Jordan is not broken down by sectors. The modeling explicitly allows for unemployment and non-participation. In the baseline, the structural unemployment rate is assumed to be a constant share of the labor force, and the labor force a constant share of the working-age population. No distinction is made between foreign, domestic, or refugee workers. Under simulation, when demand is over (less than) supply, the unemployment rate will temporarily fall (rise) below (above) its equilibrium rate. The speed of adjustment back to equilibrium reflects rigidities in the labor market and is estimated econometrically, based on historical time series data.

Regarding water scarcity and the AAC, the growth and macroeconomic benchmark assumes a counterfactual business-as-usual scenario without any climate change and, therefore, no additional water scarcity. This baseline assumes no additional investment beyond what would naturally be required to maintain the existing capital stock. Bringing the AAC fully to the baseline can be done, but all the scenarios must be redone. Key implications would be higher debt to GDP rates than in the current baseline, slower growth (due to higher debt), and logically reduced damages since much of the increase in water shortage would have been eliminated by the AAC.

Specific assumptions are as follows:

- Time horizon: 2020–2050.
- Time series incorporate historical data and extrapolate current economic trends through a slow adjustment path. The sectoral composition shifts gradually towards Services, while Industry and Agriculture slightly reduce their contributions to the overall economy, reflecting their gradually slowing productivity.
- Short- to medium-term macroeconomic projections: headline macroeconomic framework consistent with IMF's 3rd Review completed in October 2021, running up to 2026.

- Commodity prices projections are from the World Bank's Prospects Group, until 2035.
- External demand aggregates are from the latest World Bank's Macro Poverty Outlook up to 2024.
- Longer-run projections are determined by model dynamics.

Table A1. Jordan- baseline benchmark for long-term growth

	Supply side (%annual growth rates)			Sectoral decomposition (% of GDP at market prices)			
	TFP	Capital stock	Potential GDP	Agriculture	Industry	Services	Net taxes
Historical trends							
1980-2020	0.68	3.64	3.89	5.44	24.97	61.32	8.27
2010-2020	-0.52	2.84	2.65	4.60	24.77	57.68	12.95
Baseline							
Adjusted baseline							
2050	0.32	3.09	2.64	3.90	19.00	67.60	9.50

Note: "adjusted baseline" takes the Jordan CE team's assumption on the sectoral shares in 2050

Source: World Bank staff and IMF's 3rd Review completed in October 2021.

Scenario 1: Assessing the impact of heat on agriculture yield and labor productivity

This scenario simulates the effects of reduced labor productivity due to heat, flooding damage, and rising temperatures on agricultural yields[97] in RCP2.6, RCP4.5, and RCP8.5 on the growth and macroeconomic benchmark. The results reflect the combination of the three types of damage for each RCP. For instance, the reported results for RCP 8.5 reflect the combination of damage functions in agricultural yields due to heat, labor productivity due to heat, and flooding. This scenario does not include a further reduction in water availability beyond current levels of water scarcity.

Assumptions:

- **Heat and labor productivity:** estimated workdays lost for outside workers taken from the report Climate Change and Labour: Impacts of Heat in the Workplace (UNDP, 2016). Damages are calculated against a baseline that includes pre-existing temperature increases. As no heat damage data exists for Jordan, the estimated working hours lost are calibrated to match UNDP estimates for Tunisia. Lost workdays modify effective labor in the production function: they reduce potential output and labor supply (extensive margin), reducing consumption and investment. Aggregate supply and demand impact prices, causing indirect effects on the economy.
- **Flooding damage:** Flood damages in US$ from the 2015 Global Assessment Report on Disaster risk reduction (GAR 15). The modeling includes deterministic (expected value losses) and stochastic (drawn from an empirical distribution) shocks for different RCP scenarios.
- **Agricultural yields:** Rising temperatures change agricultural productivity against a baseline where no temperature increases are assumed. The agriculture impact by RCP is aggregated by summing up the Total Production change between different RCPs to the No-Climate Change baseline by the IMPACT model (2015 by IFPRI) at the crop- and livestock-level, weighted that specific crop/livestock share of total agriculture production in 2019 by FAOSTAT (the last historical year). The aggregated impact shows very small but positive changes in agriculture production for Jordan under RCP 4.5 and RCP 8.5. It is important to note that the IMPACT modeling has the following limitations: (a) the model incorporates only precipitation and temperature variability and presumes no changes in groundwater or irrigation water availability; (b) estimated yield improvements are relative to other local crops and the same crop globally; (c) the model assumes the adoption of new technologies, e.g., heat-tolerant crop varieties, is increasing over time, following a logistic adoption function, therefore partially increased yields are due to technological improvements; (d) the model covers a limited number of value chains, and (e) the IMPACT model does not adequately incorporate the effect of increased drought frequency and climate change on the livestock sector—which represents 50 percent of the agriculture sector—due to model and data

[97] Only part of the agriculture sector is modeled, in particular a large component of the livestock sector is not modelled

limitations.

- **These findings are consistent with the Water in Balance study (2020)**, which finds an increase in the productivity of oil crops, vegetables, and fruit, but a decrease in wheat and coarse grains under increased temperature. The findings are less positive than the regional MNA estimates (without adaptation) in the "Climate Change Impacts and Mitigation in the Developing World: An Integrated Assessment of the Agriculture and Forestry Sectors" paper (2015, World Bank). The modeling connects the aggregated agricultural output changes for RCP 4.5 and 8.5 to the supply side. The agricultural impact changes TFP because the same amount of capital and labor under different RCPs produce a different amount of output compared to the baseline. Since MFMoD estimates whole-economy TFP only, the agriculture impact is rescaled by the share of real Agriculture Value Added to GDP in the last historical year, 2020.

The agricultural yield damages do not include water scarcity impacts. The IMPACT model assumes that water continues to be available without constraints during the whole period considered. Water scarcity is, however, explored in other scenarios results below.

For Jordan, the current selection focus on damages across three climate scenarios:

- **RCP 2.6:** Damage to labor productivity due to heat, flooding, and a combination of these 2.
- **RCP 4.5 and RCP 8.5:** Damage to agricultural yields and labor productivity due to heat, flooding, and a combination of these three factors.

MFMoD for Jordan is extended to include the following climate change features:

The National Income Accounts (NIA)-Production breakdown incorporates agriculture (total), water, energy (distinguishing electricity and non-electricity), other industries, and services; and an Input-Output mapping to final and intermediate demand. Jordan authorities produce NIA. On water issues, as in other sectors, standard procedures indicate that sectoral departments process sectoral information, which is transmitted to the statistics department and duly cleared. The statistical department processes and integrates the information in its national accounting statistics. Therefore, the NIA does not contain an independently conducted water supply and demand analysis.

The energy sector enters the demand and production sides and is further disaggregated by fuel type (coal, oil, gas, and renewables: hydro, solar, and wind). 'True prices' of energy include subsidies.

Results from economic activity and three types are considered: (a) PM2.5 from combustion, affecting productivity and health expenditure; (b) energy CO2 pollution from combustion, generated by fossil fuels for electricity and non-electricity; and (c) economy-wide pollution from sectoral activity in agriculture, energy, industry, and solid waste.

Damages and protection channels are built-in to treat: (a) abrupt, destructive climate events, such as pluvial flooding that destroys capital stock and requires adaptation, and (b) the gradual long-term impact of higher temperatures on productivity, impacting labor and agriculture.

Results:

Results are presented according to the CCDR guidance, with interpretations reflected in the main report.

Table A2. Jordan - Impact of heat on growth-macro baseline

	Baseline				RCP 2.6			RCP 4.5			RCP 8.5		
	2020	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
					Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*		
Average Growth (%)													
Real GDP	2.0	2.7	3.1	3.4	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
Real GDP per capita	-1.4	2.2	2.0	2.5	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
*Per Capita Income and Consumption (Constant 2020 USD)**													
Real GDP Per Capita	4,289	5,350	6,498	8,345	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
Real Household Consumption Per Capita	3,491	5,023	6,522	7,506	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Shares in GDP (% of GDP)													
Private Consumption	80.5	92.9	99.3	89.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Government Consumption	17.9	17.2	14.9	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Private Investment	14.5	17.2	20.3	22.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Government Investment	2.6	3.4	3.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Exports	-16.8	-31.9	-39.1	-29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Sectoral shares in GDP (% of GDP)													
Agriculture	5.5	5.1	4.7	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industry	27.5	25.3	23.1	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services	67.0	69.6	72.2	74.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDP expenditure components changes in levels (as % of baseline)													
Private Consumption					0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Government Consumption					0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Private Investment					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Government Investment					0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Exports					0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
Imports					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDP sector changes in levels (as % of baseline)													
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
Industry	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
Services	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
Real wages	5394.3	8503.6	9592.9	10654.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.3
External balance (% of GDP)													
Exports, Goods and Services	23.7	37.7	32.6	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Imports, Goods and Services	42.2	56.0	65.0	62.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Current Account Balance	-8.1	-7.8	-22.6	-19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Fiscal Aggregates (% of GDP)													
Fiscal revenue	22.7	23.5	24.3	22.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fiscal expenditure	29.9	30.4	30.4	27.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- o/w Interest payments	4.2	3.9	3.9	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Budget deficit	-7.3	-5.3	-5.7	-4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Public debt	109.0	114.2	111.7	96.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
- o/w External Public Debt	45.4	36.8	32.4	26.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Emissions													
Emissions (Mtons C02)	21.1	17.1	24.2	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Emissions per unit of ouput (tons C02)	713.5	444.0	463.2	410.8	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.2
Impact channels (% of GDP)													
Total					0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
-o/w Agriculture					n/a	n/a	n/a	0.1	0.1	0.2	0.1	0.1	0.1
-o/w Labor Productivity (Heat)					0.0	0.0	-0.1	0.0	-0.1	-0.2	-0.1	-0.2	-0.4
-o/w Flooding					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum Items													
Population (Millions)	10.2	10.7	11.9	12.9									

** Deviations from baseline are expressed as percent of baseline level for Real GDP Per Capita, Emissions, and Carbon Price. For all other variables deviations from baseline are expressed as percentage points of GDP in the corresponding scenario less the % of GDP in the baseline scenario. Damages are not additive.*

(1) Average annual growth since preceding decade (2010 for the first column)

Source: World Bank staff, using MFMoD – CC for Jordan.

Scenario 2: Impacts of increasingly severe water scarcity

This scenario reproduces the effects of increased water scarcity on real GDP and sectoral performance from the Water in the Balance report (WiB, 2020). It clarifies the conditions under which these results are obtained. The WiB report examines the impact on the economy of a 5, 10, and 20 percent increase in water scarcity in Jordan and finds that the real GDP growth rate would decline by -0.5 to -6.8 percent in the long run against the baseline. Results depend on the extent of the assumed water scarcity and the specific modeling assumptions. These effects are significantly larger than the mild effects derived in Scenario 1, based on climate-related damage functions that do not consider increasing water scarcity. The review of the results

confirms the importance of water in long-run economic growth for Jordan and the implied trade-offs for its development path.

This self-standing scenario explores the impact of severe water scarcity on the growth and macroeconomic benchmark without including other climate change damages. The baseline scenario excludes climate change and additional water damages beyond those implicit in the historical data. Water-related damages implicit to the historical data are not identified but will contribute to lower estimates of productivity growth than if those damages had not occurred.

Assumptions:

MFMod is recalibrated to replicate WiB results; therefore, the assumptions in this scenario are those retained in the WiB report. This recalibration allows for examining the strengths and implications of those assumptions. As in the WiB report, it is assumed that there could be a 5, 10, and 20 percent increase in water scarcity in Jordan, each with distinct impacts on the economy over the long run.

The overall impact of water scarcity increases on real GDP growth was calibrated to reproduce the decline in average real GDP growth rates compared with the baseline, as in WiB. This was achieved by reducing agricultural output by an amount consistent with the WiB estimates and reducing total factor productivity in the rest of the economy by an amount sufficient to reproduce the overall WiB impact.

Government revenues and expenditures, deficits and debts, domestic aggregate demand—investment, consumption, exports, and imports—and foreign investment were all assumed to react to the decline in GDP in line with historical behavior as encapsulated in the MFMod model's econometric equations.

While water availability decreases are a likely outcome of climate change[98], the scenarios run in WiB do not include the full range of damages from climate change and reflect the damages due to increased water scarcity alone. This feature is replicated in MFMod for this scenario. As a result, Scenario 1, which focuses on the impact of heat on agriculture yields, labor productivity, and flooding, differs from Scenario 2, which focuses only on the impact of increased water scarcity.

A fundamental assumption in WiB that explains 87 percent of the negative impact on GDP is that capital and labor are immobile, though WiB also includes scenarios where capital and labor are allowed to reallocate; such assumptions are integrated into MFMod.

Results:

Results are presented according to the CCDR guidance, with interpretations reflected in the main report.

Table A3. Jordan - Impact of increasing water scarcity on the benchmark growth-macro baseline.

	Baseline				5% water scarcity - Agriculture only			10% water scarcity - Agriculture only			20% water scarcity- Agriculture only			20% water scarcity + Primary sectoral effects			20% water scarcity + Primary + Labor capital immobility			20% water scarcity + 100% capital and labor immobility		
	2020	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
					Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*		
Average Growth (%)																						
Real GDP	1,0	1,3	1,5	1,7	0,0	-0,1	-0,1	0,0	-0,1	-0,1	-0,1	-0,2	-0,4	-0,3	-0,7	-1,1	-1,1	-2,8	-4,5	-1,7	-4,1	-6,6
Real GDP per capita	-0,7	1,1	1,0	1,3	0,0	-0,1	-0,1	0,0	-0,1	-0,1	-0,1	-0,2	-0,4	-0,3	-0,7	-1,1	-1,1	-2,8	-4,5	-1,7	-4,1	-6,6
Per Capita Income and Consumption (Constant 2020 USD)*																						
Real GDP Per Capita	4.289	5.350	6.498	8.345	0,0	-0,1	-0,1	0,0	-0,1	-0,1	-0,1	-0,2	-0,4	-0,3	-0,7	-1,1	-1,1	-2,8	-4,5	-1,7	-4,1	-6,6
Real Household Consumption Per Capita	3.491	5.023	6.522	7.506	-0,1	-0,1	-0,1	-0,1	-0,1	-0,2	-0,1	-0,3	-0,5	-0,4	-1,0	-1,7	-1,4	-3,8	-6,4	-2,1	-5,7	-9,5
Shares in GDP (% of GDP)																						
Private Consumption	80,5	92,9	99,3	89,0	0,0	0,0	0,0	0,0	0,0	-0,1	0,0	-0,1	-0,1	-0,1	-0,3	-0,5	-0,2	-1,0	-1,8	-0,4	-1,6	-2,8
Government Consumption	17,9	17,2	14,9	13,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	0,0	-0,1	-0,3	0,0	-0,2	-0,4
Private Investment	14,5	17,2	20,3	22,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,2	0,2	0,2	0,3
Government Investment	2,6	3,4	3,5	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	-0,2	0,0	-0,1	-0,3
Net Exports	-16,8	-31,9	-39,1	-29,9	0,0	0,1	0,1	0,0	0,1	0,1	0,0	0,2	0,3	0,1	0,6	0,8	0,5	2,2	3,3	0,8	3,2	4,8
Sectoral shares in GDP (% of GDP)																						
Agriculture	5,5	5,1	4,7	4,3	0,0	0,0	0,0	0,0	-0,1	-0,1	-0,1	-0,2	-0,2	-0,1	-0,2	-0,3	-0,2	-0,2	-0,4	-0,2	-0,2	-0,5
Industry	27,5	25,3	23,1	21,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Services	67,0	69,6	72,2	74,7	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,1	0,2	0,2	0,2	0,2	0,4	0,2	0,2	0,5
External balance (% of GDP)																						
Exports, Goods and Services	23,7	37,7	32,6	33,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,4	0,3	0,9	1,4	0,5	1,3	2,1
Imports, Goods and Services	42,2	56,0	65,0	62,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	0,0	-0,1	-0,2	0,0	-0,5	-1,0	0,0	-0,7	-1,5

[98] The scientific consensus is 30 percent increase in water scarcity in Jordan by 2040 based on current trends. See among other sources: GIZ, 2020, Rapid Assessment of the Consequences of Declining Resources Availability and Exploitability for the Existing Water Supply Infrastructure.

Current Account Balance	-8,1	-7,8	-22,6	-19,9	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,1	0,2	0,1	0,4	0,6	0,4	1,4	2,5	0,6	2,1	3,7
Fiscal Aggregates (% of GDP)																						
Fiscal revenue	22,7	23,5	24,3	22,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	-0,1	-0,1	-0,3	-0,4	-0,2	-0,4	-0,7
Fiscal expenditure	29,9	30,4	30,4	27,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	0,0	-0,1	-0,3	0,0	-0,1	-0,4
- o/w Interest payments	4,2	3,9	3,9	3,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,2
Budget deficit	-7,3	-5,3	-5,7	-4,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	-0,2	-0,2	-0,1	-0,2	-0,2
Public debt	109,0	114,2	111,7	96,9	0,0	0,1	0,1	0,0	0,1	0,1	0,1	0,3	0,3	0,3	0,8	1,0	1,1	3,1	3,9	1,6	4,7	5,9
- o/w External Public Debt	45,4	36,8	32,4	26,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,1	0,2	0,3	0,3	0,9	1,1	0,5	1,4	1,6
Emissions																						
-1	21,1	17,1	24,2	30,0	-0,1	-0,1	-0,1	0,0	-0,1	-0,2	-0,1	-0,3	-0,5	-0,3	-1,0	-1,6	-1,3	-3,8	-6,3	-1,9	-5,7	-9,3
-1	713,5	444,0	463,2	410,8	0,0	0,0	0,0	0,0	0,0	-0,1	0,0	-0,1	-0,2	0,0	-0,3	-0,5	-0,2	-1,1	-1,9	-0,3	-1,6	-2,8
Damages																						
Air polution (PM2.5)	10,2	10,7	11,9	12,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Working days lost	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Heat related health expenditure (% of GDP)	1,3	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Memorandum Items																						
Population (Millions)	0,0	0,0	0,0	0,0																		

* Deviations from baseline are expressed as percent of baseline level for Real GDP Per Capita, Emissions, and Carbon Price. For all other variables deviations from baseline are expressed as percentage points of GDP in the corresponding scenario less the % of GDP in the baseline scenario. Damages are not additive.

(1) Average annual growth since preceding period (2010 for the first column)

Source: World Bank staff and WiB report.

In this table, the column headings report results that correspond to WiB scenarios:

5 percent water scarcity – Agriculture only: The scenario results from a 5 percent increase in water scarcity, with impacts reflecting only those in the agriculture sector;

10 percent water scarcity – Agriculture only: The scenario results from a 10 percent increase in water scarcity, with impacts reflecting only those in the agriculture sector;

20 percent water scarcity – Agriculture only: The scenario results from a 20 percent increase in water scarcity, with impacts reflecting only those in the agriculture sector;

20 percent water scarcity + Primary sectors: The scenario results from a 20 percent increase in water scarcity, with impacts on primary productive sectors contributing to GDP, free of constraints on capital and labor mobility;

20 percent water scarcity + Primary sectors + Labor capital: The scenario results from a 20 percent increase in water scarcity, with impacts on primary productive sectors contributing to GDP and some capital and labor mobility constraints. Note, WiB is unclear about the specifics; MFMod calibrates capital and labor mobility to achieve WiB results;

20 percent water scarcity + 100 percent capital and labor: The scenario results from a 20 percent increase in water scarcity and full immobility of capital and labor.

Scenario 3: Selected water scarcity adaptation measures

This scenario comprises four sub-scenarios resulting from a combination of high-cost/low-cost interventions in desalination/conveyance and non-revenue water reduction. These combinations aim to resorb 200 MCM of additional water scarcity in Jordan, corresponding to a 20 percent increase in water scarcity, as in the WiB report.

Assumptions:

- Damages from water scarcity are assumed to be equal to the values coming from the 20 percent increase in water scarcity in the WiB report;
- High-cost and low-cost interventions are identified for the desalination and conveyance investments and the non-revenue water reduction investments. The energy cost associated with the high-cost scenario is 96 fils/kWh, which is the cost recovery tariff for the energy sector. The energy cost associated with the low-cost scenario is 57 fils/kWh. The costs of desalination/conveyance in this scenario are based on the current information around the AAC project that is based on the cost structure of the Disi pipeline PPP;
- It is assumed that through these interventions, the 200 MCM shortfall in water supply by 2050 will be eliminated, equivalent to the full elimination of the additional water scarcity from the WiB scenarios;
- Half of the additional water is assumed to be derived from NRW reduction, and the other half from desalination, with their respective costs and CAPEX/OPEX distribution. For desalination and conveyance, most costs are OPEX, driven by additional electricity costs – the difference in the high and low figures is

largely due to the electricity price for the AAC. AAC CAPEX costs equate to the AAC's total cost allocated evenly from 2027 to 2040 to derive the annual figure. For all results that include the AAC, figures are based on information shared among the development partner community. The final CAPEX/OPEX costs will be determined only at the financial close. The distribution of CAPEX/OPEX is as follows:

Table A4. Cost assumptions under each scenario

	Low cost - Desal & conveyance	High cost - Desal & conveyance
Low cost - NRW Reductions	Desal low: JD 100.1 m per 100 MCM, [CAPEX 40.2%, OPEX 59.8%] NRW low: JD 54.9 m per 100 MCM, [97.5% CAPEX, 2.5% OPEX]	Desal High: JD 182.7 m per 100 MCM, [CAPEX 36.8%, OPEX 63.2%] NRW low: JD 54.9 m per 100 MCM, [97.5% CAPEX, 2.5% OPEX]
High cost – NRW Reductions	Desal low: JD 100.1 m per 100 MCM, [CAPEX 40.2%, OPEX 59.8%] NRW High: JD 97 m per 100MCM, [97.5% CAPEX, 2.5% OPEX]	Desal High: JD 182.7 m per 100 MCM, [CAPEX 36.8%, OPEX 63.2%] NRW High: JD 97 m per 100MCM, [97.5% CAPEX, 2.5% OPEX]

- It is assumed that CAPEX does not add to the productive capacity of the economy beyond reducing the damages;
- Spending on CAPEX/OPEX is assumed to be financed by the government via debt financing, and domestic savers and foreign investors contribute to the financing;
- A key assumption is that for every 10 percent increase in the government's debt-to-GDP ratio, the interest rate on its debt rises by 1 percentage point.

Two main channels are at work in these scenarios: (a) reducing or eliminating the damages caused by additional water scarcity, as estimated in WiB. All the adaptation scenarios assume that the initial impact on GDP is the same, i.e., eliminating the damages from increased water scarcity, equivalent to 200 MCM. The only difference across scenarios is the amount of spending associated with each and the mechanism by which the reduction in water scarcity is achieved, as per Table A4; and (b) there are crowding out effects caused by increased government financing of investment needs.

Results:

Results are presented according to the CCDR guidance, with interpretations reflected in the main report

Table A5. Jordan - Impact of selected adaptation measure, combining desalination/conveyance with non-revenue water reduction, on the benchmark growth-macro baseline.

	Baseline				Low-cost Desal + Low-cost NRW scenario			High-cost Desal + Low-cost NRW scenario			Low-cost Desal + High-cost NRW scenario			High-cost Desal + High-cost NRW scenario		
	2020	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
					Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*			Deviation from Baseline (Percent)*		
Average Growth (%)																
Real GDP	2,0	2,7	3,1	3,4	-0,1	-0,6	-2,2	-0,1	-1,0	-3,6	-0,1	-0,7	-2,9	-0,1	-1,1	-4,5
Real GDP per capita	-1,4	2,2	2,0	2,5	-0,1	-0,6	-2,2	-0,1	-1,0	-3,6	-0,1	-0,7	-2,9	-0,1	-1,1	-4,5
Per Capita Income and Consumption (Constant 2020 USD)*																
Real GDP Per Capita	4.289	5.350	6.498	8.345	-0,1	-0,6	-2,2	-0,1	-1,0	-3,6	-0,1	-0,7	-2,9	-0,1	-1,1	-4,5
Real Household Consumption Per Capita	3.491	5.023	6.522	7.506	0,0	-0,3	-1,1	0,0	-0,5	-1,9	0,1	-0,4	-1,5	0,1	-0,6	-2,4
Shares in GDP (% of GDP)																
Private Consumption	80,5	92,9	99,3	89,0	0,1	0,3	0,9	0,1	0,4	1,5	0,1	0,3	1,3	0,2	0,5	2,0
Government Consumption	17,9	17,2	14,9	13,9	0,2	0,3	0,5	0,4	0,5	0,9	0,2	0,3	0,6	0,4	0,5	1,1
Private Investment	14,5	17,2	20,3	22,9	-0,1	-0,7	-1,5	-0,1	-1,0	-2,3	-0,2	-1,0	-2,1	-0,2	-1,3	-3,0
Government Investment	2,6	3,4	3,5	3,0	0,2	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,5	0,4	0,5	0,6

Net Exports	-16,8	-31,9	-39,1	-29,9	-0,4	0,1	0,4	-0,6	0,1	0,5	-0,5	0,2	0,6	-0,7	0,2	0,7
Sectoral shares in GDP (% of GDP)																
Agriculture	5,5	5,1	4,7	4,3	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0
Industry	27,5	25,3	23,1	21,0	0,0	0,0	-0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Services	67,0	69,6	72,2	74,7	0,0	0,0	0,2	0,0	-0,1	-0,1	0,0	0,0	0,0	0,0	0,0	0,0
GDP expenditure components changes in levels (as a % of baseline)																
Private Consumption					0,0	-0,3	-1,1	0,0	-0,5	-1,9	0,1	-0,4	-1,5	0,1	-0,6	-2,4
Government Consumption					1,1	1,3	1,4	2,1	2,5	2,7	1,1	1,3	1,5	2,1	2,5	2,8
Private Investment					-0,7	-4,1	-8,7	-0,9	-6,1	-13,4	-1,0	-5,5	-11,7	-1,2	-7,5	-16,9
Government Investment					7,0	7,3	8,1	8,9	9,2	9,8	10,1	10,6	11,7	12,0	12,4	13,2
Exports					-0,2	-0,3	-1,0	-0,3	-0,5	-1,8	-0,2	-0,3	-1,3	-0,4	-0,6	-2,2
Imports					0,6	-0,3	-1,2	0,9	-0,4	-1,8	0,7	-0,4	-1,6	1,0	-0,5	-2,3
GDP Sectors changes in levels (as a % of baseline)																
Agriculture					0,1	-0,2	-1,5	0,2	-0,3	-2,4	0,0	-0,5	-2,5	0,1	-0,6	-3,6
Industry					-0,2	-0,8	-3,0	-0,1	-0,9	-3,4	-0,1	-0,7	-2,9	-0,1	-1,1	-4,5
Services					0,0	-0,6	-2,0	-0,1	-1,1	-3,7	-0,1	-0,8	-2,9	-0,1	-1,2	-4,6
Real wages					-0,2	-0,3	-1,3	-0,4	-0,6	-2,3	-0,3	-0,4	-1,7	-0,4	-0,7	-2,8
External balance (% of GDP)																
Exports, Goods and Services	23,7	37,7	32,6	33,5	-0,1	0,3	0,8	-0,1	0,4	1,4	-0,1	0,4	1,2	-0,1	0,5	1,9
Imports, Goods and Services	42,2	56,0	65,0	62,3	0,2	0,4	0,9	0,3	0,6	1,8	0,3	0,5	1,4	0,4	0,8	2,5
Current Account Balance	-8,1	-7,8	-22,6	-19,9	-0,5	-0,6	-1,1	-0,7	-1,1	-2,2	-0,6	-0,8	-1,7	-0,9	-1,3	-3,2
Fiscal Aggregates (% of GDP)																
Fiscal revenue	22,7	23,5	24,3	22,8	0,0	0,1	0,2	0,0	0,1	0,4	0,0	0,1	0,3	0,0	0,2	0,5
Fiscal expenditure	29,9	30,4	30,4	27,2	0,8	1,9	3,4	1,2	3,0	6,2	1,0	2,6	5,0	1,4	3,7	8,6
- o/w Interest payments	4,2	3,9	3,9	3,4	0,5	2,0	4,1	0,8	3,2	7,7	0,7	2,7	6,2	0,9	4,0	11,0
Budget deficit	-7,3	-5,3	-5,7	-4,4	-0,8	-1,8	-3,2	-1,1	-2,8	-5,8	-1,0	-2,4	-4,7	-1,4	-3,5	-8,1
Public debt	109,0	114,2	111,7	96,9	3,7	13,4	27,7	5,4	20,4	46,4	5,0	17,9	39,1	6,6	25,2	61,6
- o/w External Public Debt	45,4	36,8	32,4	26,5	0,9	3,4	7,0	1,4	5,1	11,6	1,3	4,5	9,8	1,7	6,4	15,5
Memorandum Items																
Population (Millions)	0,0	0,0	0,0	0,0												

* Deviations from baseline are expressed as percent of baseline level for Real GDP Per Capita, Emissions, and Carbon Price. For all other variables deviations from

* Deviations from baseline are expressed as percent of baseline level for Real GDP Per Capita, Emissions, and Carbon Price. For all other variables deviations from

(1) Average annual growth since preceding period (2010 for the first column)

Source: World Bank staff

Scenario 4: Additional priority investments for climate-responsive development

This scenario focuses on the economic impact on the growth macroeconomic benchmark of the single-site large infrastructure investments and multi-site infrastructure investments, all aggregated and extracted from the list of priority investments identified in Chapter 3 of this CCDR. These investments are assumed to be productive capital investments. They are expected to positively impact long-term real growth. These positive impacts interact with other economic impacts based on the model dynamics, as expected in a structural macro-econometric model. At the same time, this scenario is not a climate change scenario in that these potential investment programs are not accompanied by quantified information on how they would contribute to adaptation/mitigation plans, nor on the specific benefits that would counter climate change damage functions. As a result, the scenario produced is closer to a conventional investment increase scenario.

Assumptions:

The total amount anticipated as investment needs is about US$9.5 billion (treated as real 2020 US$), mostly on infrastructure, spread over eight years with different annual implementation schedules. These investments are assumed to be productive capital investments, not accompanied by explicitly provided quantified benefits in increasing productivity or efficiency at the sectoral levels. In other words, this scenario does not include information on how these potential investments would contribute to adaptation/mitigation plans or the specific benefits that would counter climate change damage functions. Investments and financing sources are summarized in Table A6:

Table A6. Jordan - single- and multi-site infrastructure investments.

Investments (in US$ million)	Total 2023-2030
Total Investment	$9,505.1
o/w Public Investment (including Grants)	$3,521.5
o/w Grants	$1,901.0
Private Investment	$5,983.6

Source: World Bank staff estimates

The list excludes projects such as BRT I, AAC, and some EE actions. As such, the scenario results pertain to the listed projects' economic impact on the growth and macroeconomic benchmark. This neither includes climate change action nor the impacts of the projects excluded from the list of potential projects above. Finally, as the investment period stops in 2030, the scenario results being extended to 2050 reflect economy-wide dynamics resulting from the model structure after the end of the investment period. The date on the list of potential projects, the financing needs, and the sources of financing in this scenario reflect data as of August 2022.

Results:

Results are presented according to the CCDR guidance, with interpretations reflected in the main report.

Table A7. Jordan - impact of infrastructure investments on growth and macroeconomic benchmark.

	Baseline				Infrastructure Priority Interventions		
	2020	2030	2040	2050	2030	2040	2050
					Deviation from Baseline (Percent)*		
Average Growth (%)							
Real GDP	2,0	2,7	3,1	3,4	0,1	2,5	1,1
Real GDP per capita	-1,4	2,2	2,0	2,5	0,1	2,5	1,1
Per Capita Income and Consumption (Constant 2020 USD)*							
Real GDP Per Capita	4.289	5.351	6.503	8.353	0,1	2,5	1,1
Real Household Consumption Per Capita	3.491	5.022	6.520	7.503	-0,1	1,3	0,7
Shares in GDP (% of GDP)							
Private Consumption	80,5	92,8	99,2	88,9	-0,2	-1,2	-0,3
Government Consumption	17,9	17,2	14,9	13,9	-0,2	-1,1	-0,9
Private Investment	14,5	17,2	20,3	22,9	0,9	-0,5	-0,2
Government Investment	2,6	3,4	3,5	3,0	0,7	0,3	0,1
Net Exports	-16,8	-31,8	-39,0	-29,8	-1,2	1,6	1,2
Sectoral shares in GDP (% of GDP)							
Agriculture	5,5	5,1	4,7	4,3	0,0	0,0	0,0
Industry	27,5	25,3	23,1	21,0	0,0	0,0	0,0
Services	67,0	69,6	72,2	74,7	0,0	0,0	0,0
GDP expenditure components changes in levels (as % of baseline)							
Private Consumption					-0,1	1,3	0,7
Government Consumption					-1,1	-5,0	-5,8
Private Investment					5,6	0,0	0,0
Government Investment					19,7	10,2	2,8
Exports					-0,9	3,0	2,2
Imports					1,5	-1,2	-0,8
GDP sector changes in levels (as % of baseline)							
Agriculture	0,0	0,0	0,0	0,0	0,1	2,5	1,1
Industry	0,0	0,0	0,0	0,0	0,1	2,5	1,1
Services	0,0	0,0	0,0	0,0	0,1	2,5	1,1
Real wages	5394,3	8503,0	9591,4	10651,3	1,1	2,7	1,5

External balance (% of GDP)							
Exports, Goods and Services	23,7	37,7	32,6	33,4	-0,1	0,6	0,4
Imports, Goods and Services	42,2	56,0	64,9	62,1	1,4	-0,7	-0,6
Current Account Balance	-8,1	-7,7	-22,5	-19,7	-1,8	0,8	0,6
Fiscal Aggregates (% of GDP)							
Fiscal revenue	22,7	23,5	24,2	22,8	0,4	0,2	0,1
Fiscal expenditure	29,9	30,4	30,4	27,2	1,6	1,0	0,8
- o/w Interest payments	4,2	3,9	3,9	3,4	1,1	1,7	1,5
Budget deficit	-7,3	-5,3	-5,7	-4,4	-1,2	-0,8	-0,7
Public debt	109,0	114,1	111,6	96,8	7,4	11,2	10,9
- o/w External Public Debt	45,4	36,8	32,4	26,5	2,0	2,9	2,7
Emissions							
Emissions (Mtons C02)	21,1	17,1	24,2	30,0	-0,6	-0,1	0,0
Emissions per unit of ouput (tons C02)	713,5	443,9	462,8	410,3	-0,8	-2,5	-1,1
Impact (% of GDP)							
Large Infrastructure Investments					0,1	2,5	1,1
Memorandum Items							
Population (Millions)	10,2	10,7	11,9	12,9			

* Deviations from baseline are expressed as percent of baseline level for Real GDP Per Capita, Emissions, and Carbon Price. For all other variables deviations from baseline are expressed as percentage points of GDP in the corresponding scenario less the % of GDP in the baseline scenario.

(1) Average annual growth since preceding period (2010 for the first column)

Source: World Bank staff

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