The Hashemite Kingdom of Jordan

Jordan's

Second Biennial Update Report (SBUR)

Under The United Nations Framework Convention on Climate Change

December 2020

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FOREWORD

On behalf of the Government of Jordan, it gives me great pleasure to announce the completion of Jordan's Second Biennial Update Report (SBUR) to the United Nations Framework Convention on Climate Change (UNFCCC). The SBUR is directed to policymakers, researchers, practitioners and the general public interested in climate change issues; providing extensive, accurate, and up-to-date information on the progress of Jordan in its recent climate activity. This report is considered the result of the creative and extensive work of many committed Jordanian experts who together have succeeded in giving a comprehensive outlook about climate change in the Jordanian context and outlined Jordan's efforts, expertise and future need to address climate change.

Jordan is undergoing a rapid and effective process of enhancing its institutional and policy-relevant framework for addressing climate change challenges. In August 2014, the Ministry of Environment has established the Directorate of Climate Change giving focus and more weight to fulfilling the UNFCCC commitments. The Directorate ever since, acts as the institutional hub for coordinating all climate change activities in Jordan in relation to the UNFCCC.

Also, a climate change national policy (2013-2020) was issued by identifying the national priorities for adaptation to climate change and mitigation of greenhouse emissions. The policy provides guidance to sector strategies from climate change perspective, where it is a tool for coordination of climate change activities at the national level. Based on this policy, The Ministry of Environment revised the Environment Protection Law, no.52 of 2006 to include and strengthen the climate change articles of the law. The new Environment Protection Law no.6 of the year 2017, includes provisions on climate change goals which later enabled the ministry to develop the climate change bylaw no.79, 2019.

Jordan maintains strong commitment to the objectives developed by the international community for the integrated environmental and economic response to the threat of climate change despite the fact that it contributes only 31.06 million tonnes of carbon dioxide equivalent according to the recent results included in this report's GHG National Inventory of 2016.

By developing the SBUR on Climate Change we have not only stepped forward towards setting a transparency framework for reporting emissions, but also for assessing the potential for reducing climate change emissions in several sectors such as energy, transport, agriculture, and waste.

The SBUR is also considered an international document that informs the global community on our country's take on global climate action. For this, the Ministry of Environment has spent every possible effort to enhance the transparency and comparability of the information contained in its BUR guided by the latest work on modalities, procedures and guidelines for the Transparency Framework for Action and Support referred to in Article 13 of the Paris Agreement.

Finally but most importantly, I would like to extend my appreciation to all national experts who have participated in producing this report for their relentless effort and commitment. These efforts were greatly supported by both Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) and enhances the strategic partnership between the Ministry and GEF-UNDP in the implementation of global environmental conventions.

Minister of Environment
Nabil Masarweh

الجَمعيّة العلميّة المَلكيّة
Royal Scientific Society

Ministry of Environment

Jordan's Second Biennial Update Report was coordinated by the Ministry of Environment and prepared in partnership with the United Nations Development Programme.

An agreement with the Royal Scientific Society was realized to execute the work. Preparation of the Second BUR was a national effort with the participation of experts from different national entities.

ACKNOWLEDGMENT

The United Nations Development Program acknowledges the efforts of all national experts, stakeholders, and institutions that were involved in preparing this report, without whom this work would not have been possible.

We extend special thanks to the Ministry of Environment for their instrumental support, the report has benefited immensely from the continuous and valuable backstopping of the Climate Change Directorate of the Ministry of Environment. Special thanks are also in place for the Royal Scientific Society (RSS) and their experts who were responsible for the preparation of this report.

We would like to express our appreciation to the IPCC GHG Inventory Task Force for its continuous support with regard to the IPCC 2006 Guidelines and Software. We also extend our thanks to Stockholm Environment Institute (SEI) experts for their support in using the Low Emissions Analysis Platform tool in the mitigation analysis. We would also like to acknowledge the efforts of all individuals who assisted in proofreading the overall report.

Data availability was a key factor behind the successful completion of this report, and in this context, we offer our gratitude to all ministries and organizations that are members of the National Climate Change Committee who were crucial in the provision of data.

The United Nations Development Program

PROJECT TEAM

Project Management

Ministry of Environment- Climate Change (CC) Directorate
Belal Shqarin- Climate Change Director
UNDP- Jordan Country Office
Dr. Nedal Al-Ouran - Head of Environment, Climate Change and DRR Pillar
Rana S. Saleh - Environment Programme Analyst
Sami Tarabieh - Projects Coordination Specialist

Coordination, Compilation and Editing of SBUR
Royal Scientific Society/Water and Environment Centre
Rafat Assi- Project Manager
Ruba Ajjour- Project Coordinator

GHG Inventory
- **Team leader:** Ruba Ajjour

- **Energy**
  Lina Mobaideen
  Ashraf Al Rawashdeh
  Mahmoud Al Smairat
  Safwan Bany Saleh
- **IPPU**
  Faraj Altalib
  Ali Al Mashni
  Sayyed Saleh
  Maha Abu Mowais
  Bara' Matalqah
- **Solid Waste**
  Maha Abu Mowais
  Mahmoud Zboon
- **Wastewater**
  Husam Alkilany
- **AFOLU**
  Nancy Alziq
  Ruba Ajjour
  Mohammad Elshebli
- **UNDP/UNEP GSP Review**
  Dr. Carlos Lopez

GHG Mitigation
- **Team leader:** Rafat Assi

- **Energy**
  Mahmoud Alees
  Rafat Assi
  Abed Alghani Arab
- **Transport**
  Jane Raqqad
- **Industrial Processes**
  Jehan Haddad
  Bara' Matalqah
- **Agriculture and Forestry**
  Ruba Ajjour
- **Waste Management**
  Husam Alkilany
- **LEAP Experts- SEI**
  Charlie Heaps and Silvia Ulloa

Domestic MRV

Ruba Ajjour

National Circumstances

Rawia Abdallah

Gaps and Constraints

Maha Alma'ayta

Information on Support Received

Sara Al Haleeq

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ABBREVIATIONS

ACCBAT	Adaptation to Climate Change through improved water demand management in irrigated agriculture by introduction of new technologies and best agricultural practices.
ADC	Aqaba Development Corporation
AF	Alternative Fuel
AFD	Agence Français de Développement
AFOLU	Agriculture, Forestry, and Other Land Use
APCO	Attarat Power Company
ASEZA	Aqaba Special Economic Zone Authority
BMU	German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety
BUR	Biennial Update Report
CARC	Civil Aviation Regulatory Commission
CBJ	Central Bank of Jordan
CCAC	Climate and Clean Air Coalition
CCD	Climate Change Directorate
CDM	Clean Development Mechanism
CEM	Cement
CH_4	Methane
CIRCLE	Climate Impact Research Capacity and Leadership Enhancement
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2eq	Carbon Dioxide Equivalent
COP or CP	Conference of the Parties
CSP	Concentrated Solar Power
DEG	German Investment Corporation
DIAPOL-CE	The Policy Dialogue and Knowledge Management on Low Emissions Development Strategies in the MENA region
DTU	Technical University of Denmark
EC	European Commission
EE	Energy Efficiency
EF	Emission Factor
EMEP/EEA	European Monitoring and Evaluation Programme /European Environment Agency
ENPI CBC	The multilateral cross-border cooperation "Mediterranean Sea Basin Programme- European Neighborhood and Partnership Instrument - ENPI
EPRD	Economic Policy and Regional Development

ABBREVIATIONS

EPC	Engineering, Procurement and Construction
ESCOs	Energy Services Companies
ETF	Enhanced Transparency Framework
EU	European Union
FAO	Food and Agriculture Organization
FBUR	First Biennial Update Report
FSRU	Floating Storage and Regasification Unit
FSV	Facilitative Sharing of Views
GAM	Greater Amman Municipality
GBP	Pound Sterling
GCC	Gulf Cooperation Council
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GGAP	Green Growth Action Plan
GGGI	Global Green Growth Institute
GGNAP	Green Growth National Action Plan
GGR	General Guidance and Reporting
GHG	Greenhouse Gas
GIZ	German Society for International Cooperation
GoJ	Government of Jordan
GR	Growth Rate
GSP	UNDP- UNEP Global Support Program
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
HFO	Heavy Fuel Oil
ICA	International Consultation and Analysis
IFAD	International Fund for Agriculture Development
IFC	International Finance Corporation
IKI	International Climate Initiative
INDCs	Intended Nationally Determined Contributions
IPCC	Inter-governmental Panel on Climate Change
IPP	Independent Power Producer

ABBREVIATIONS

IPPU	Industrial Processes and Product Use
ITS	Intelligent Transportation Systems
JAEC	Jordan Atomic Energy Commission
JCC	Jordan Cooperative Corporation
JCI	Jordan Chamber of Industry
JD	Jordanian Dinar (equal 1.4 USD)
JEF	Jordan Environment Fund
JICA	Japan International Cooperation Agency
JMC	Jordan Maritime Commission
JNRC	Jordan Nuclear Regulatory Commission
JOSCO	Jordan Oil Shale Company
JPR	Jordan Petroleum Refinery
JREEEF	Jordan Renewable Energy and Energy Efficiency Fund
JSMO	Jordan Standards and Metrology Organization
KEMAPCO	Arab Fertilizers and Chemicals Industries LTD
KEXIM	The Export-Import Bank of Korea
KFW	German Development Bank
KIO	Karak International Oil Co.
LEAP	Low Emissions Analysis Platform
LED	Low Emission Development
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LTRC	Land Transport Regulatory Commission
MEMR	Ministry of Energy and Mineral Resources
MIT	Ministry of Industry and Trade
MoA	Ministry of Agriculture
MoEnv	Ministry of Environment
MoF	Ministry of Finance
MoLA	Ministry of Local Administration
MoPWH	Ministry of Public Works and Housing
MoT	Ministry of Transport
MRP	Market Readiness Proposal
MRV	Measurement, Reporting and Verification
MSW	Municipal Solid Waste

ABBREVIATIONS

MSWM	Municipal Solid Waste Management
MWI	Ministry of Water and Irrigation
MW	Megawatts
N_2O	Nitrous Oxide
NA	Not Applicable
NAI	Non Annex I
NAMA	Nationally Appropriate Mitigation Action
NAP	National Action Plan
NARC	National Agricultural Research Centre
NCCC	National Climate Change Committee
NCCP	National Climate Change Policy
NCs	National Communications
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NE	Not Estimated
NEEAP	National Energy Efficiency Action Plan
NEPCO	National Electric Power Company
NMVOC	Non-Methane Volatile Organic Compounds
NO	Not Occurring
NOx	Nitrogen Oxides
NPC	National Petroleum Company
NPV	Net Present Value
NSWMS	National Solid Waste Management Strategy
NUP	National Urban Policies
O&M	Operation & Maintenance
ODS	Ozone Depleting Substances
PA	Paris Agreement
PFCs	Perfluorocarbons
PMR	Partnership for Market Readiness
PMU	Project Management Unit
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PT	Public Transport
PV	Photovoltaic

ABBREVIATIONS

QAIA	Queen Alia International Airport
QIZ	Qualified Industrial Zones
RE	Renewable Energy
REDD+	Reducing emissions from deforestation and forest degradation in developing countries
REEE II-TA	Renewable Energy and Energy Efficiency II-Technical Assistance EU program
RSS	Royal Scientific Society
SAR	Second Assessment Report
SACOS	Saudi Arabian Corp for Oil Shale
SBUR	Second Biennial Update Report
SBI	Subsidiary Body for Implementation
SDC	Swiss Agency for Development and Cooperation
SF_6	Sulfur Hexafluoride
SFERA	Special Fund for Emergency and Rehabilitation
SLCPs	Short-Lived Climate Pollutants
SMBC	Sumitomo Mitsui Banking Corporation
SME	Small Medium Enterprise
SMRs	Small Modular Reactors
SNAP	Supporting National Planning and Action on short-lived climate pollutants
SOC	Soil Organic Carbon
SOx	Sulfur Oxides
SURE	Sustainable Urbanization and Resource Efficiency
SWH	Solar Water Heater
SWM	Solid Waste Management
T&D	Transmission and Distribution
TMPP	Transport Mobility Master Plan
TNA	Technology Needs Assessment
TNC	Third National Communication
TRC	Transport Regulatory Commission
TTE	Team of Technical Experts
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nation Framework Convention on Climate Change

ABBREVIATIONS

UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan
WB	World Bank
WTO	World Trade Organization
WTS	Waste Transfer Station
WUAs	Water Users Associations
WWTP	Wastewater Treatment Plant
YWC	Yarmouk Water Company

UNITS

Du	Dunum (1,000 m^2)
Gg	Gigagram (Kilo tonne)
GJ	Giga Joule
GWh	Giga Watt Hour
ha	Hectare
kg	Kilogram
kgoe	Kilogram Oil Equivalent
km	kilometer
kt	Kilo Tonne
kW	Kilo Watt
kwh	Kilo Watt Hour
m^3/s	Cubic Meter Per Second
MCM	Million Cubic Meter
MJ	Mega Joule
mm	Millimeter
MMcfd	Million Metric Cubic Feet per Day
MMSCM/Y	Million Standard Cubic Meters Per Year
Mmt	Million Metric Tonne
Mtoe	Million Tonnes of Oil Equivalent
MW	Mega Watt
ppm	Parts Per Million
TJ	Tera Joule
TWh	Tera Watt Hour
W	Watt

Jerash

EXECUTIVE SUMMARY

1. NATIONAL CIRCUMSTANCES

Jordan is a relatively small country situated at the heart of the Middle East, and occupying an area of approximately 89,318 square kilometers. Despite the relatively small area, Jordan has a diverse terrain and landscape demonstrating a variety usually found only in large countries. Jordan is divided into twelve administrative areas or governorates. The governorates are subdivided into districts and sub-districts, and within each governorate there are several municipalities.

In order to organise the environmental and climate change institutional set up, the Ministry of Environment was established in 2003 to oversee all environmental affairs. Since then, Jordan has undergone a rapid and effective process of enhancing its relevant institutional and policy framework for addressing climate change challenges. In August 2014, the Directorate of Climate Change was established within the Ministry of Environment. The Directorate acts as the institutional hub for coordinating all climate change activities in Jordan in relation to the UNFCCC. The National Climate Change Policy (2013-2020) was issued by identifying the national priorities for adaptation to climate change and mitigation of greenhouse emissions. Based on the recommendations of this policy, the Ministry of Environment revised the Environment Protection Law, no.52 of 2006 to include and strengthen the articles of the law related to climate change. The new Environment Protection Law no.6 of year 2017, includes provisions on climate change goals which later enabled the Ministry to develop the Climate Change Bylaw no.79, 2019 which aims mainly to regulate the coordination of national efforts among relevant stakeholders to implement mitigation and adaptation measures.

The Jordanian economy is one of the smallest economies in the region. A lack of natural resources, a high population growth rate, the ongoing regional conflicts, the rising cost of health care and the growing expectations of people, have posed challenges to the country's sustainable social and economic development.

Jordan currently imports around 93% of its total energy, comprising almost 8% of Jordan's GDP and placing a strain on its economy. The Ministry of Energy and Mineral Resources has recently published the National Energy Sector Strategy for 2020-2030. This ten-year plan which aims at setting the roadmap to increase self-sufficiency through utilization of domestic natural and renewable resources, as well as expansion of existing energy developments, thus reducing reliance on costly foreign fuel imports that burden its economy. Moreover, the new National Strategy identified renewable energy usage alongside other sources as follows:

- Renewable energy to contribute 31% of electricity generation by the year 2030,
- Increasing energy efficiency in the water sector by 15% by 2025,
- Improving efficient energy consumption in all sectors by 9%.

The largest energy consumer in 2018 was the transport sector with a 49% percent share, followed by household, industrial and other service sectors with 21.5%, 15.5% and 14% share respectively.

Jordan is ranked as the second poorest country in the world in terms of water resources, with less than 100 m^3/capita/year of renewable water resources. While Jordan's population is expected to increase as a result of natural population growth, the country has also experienced population growth due to the influx of multiple waves of refugees putting additional strain on Jordan's already severely limited water resources.

Water use in Jordan is distributed among three different sectors: agriculture, municipal supplies, and industry. In 2017, the agriculture sector was the largest user of the country's water resources, accounting for 52% of the total water supply, while 45% was used for municipal supplies, and 3% for industrial uses.

Jordan's climate is characterized by long, hot, and dry summers and short, cool winters. The climate is influenced by the country's location between the aridity of the Arabian Desert and the humidity of the eastern Mediterranean area. January is the coldest month, with average temperatures ranging from 5°C to 10°C, while August is the hottest month with average temperatures ranging from 20°C to 35°C. Rainfall varies from season to season and from year to year. However, about 75% of the country can be described as having a desert climate with less than 200 millimeters of rain annually. About 70% of the average rainfall in the country falls between November and March, while the period from June to August is often without rain. However during the last ten years, Jordan has been witnessing variations in seasons and average temperatures.

Jordanian agriculture is established along three major climatic regions: the Highlands and Marginal Steppes where most of the rain-fed farming is practiced, the eastern desert (the badia) and the lowlands (Jordan Valley).

The importance of the agricultural sector stems from the fact that it is not only a major source of food, in particular fruits and vegetables, but it is also a source of hard currency from exports. The vast majority of irrigated agricultural production targets fruit trees and vegetables.

The forest vegetation in Jordan can be divided into natural forests that are composed of evergreen shrubs, Pine and Juniper forests as well as broadleaf forests. Private forests are registered in the name of their private owners, and are found mostly in the northern part of Jordan where higher rainfall prevails. These include natural forest vegetation and tree plantations on farms, in the form of windbreaks and shelter-belts. Private forests account for less than 4 % of the total declared forestland.

Transportation infrastructure in Jordan is considered to be relatively well developed within the Middle East. The estimated annual growth in demand for transportation and logistics ranges from 5% to 6% until 2030. Jordan's transportation and logistics sector plays a key role in Jordan's economy and contributes over 8.2% of GDP. Land and air transportation infrastructure is well developed, with plans to improve maritime and railway infrastructure. The Government of Jordan has developed a national transport strategy to upgrade the country's infrastructure and enable the Kingdom to capitalize on its strategic geographical advantages. Currently, transportation is considered to be very energy inefficient, using almost half of the final energy consumption of Jordan.

Jordan experiences a relatively high growth rate in private cars of approximately 5% per year which exceeds the estimated population growth. Public transport (PT) in general is not well organized and lacks the infrastructure and interchanges required for a comfortable journey. There are few mode choices for PT, compared to other countries, and this has led to its low share of trips. The majority of trips in Jordan are made by private car. There has been some growth in the numbers of hybrid and electric cars. However, in 2018, hybrid and electric cars still made up less than a quarter of the private cars in Jordan. A low share of trips are also carried out using regular taxis. A new innovation is the use of ride-hailing apps. Their effect on mobility has yet to be studied in Jordan.

Jordan has experienced a large increase in population over the past decade as a result of a high population growth rate and enforced migration. Economic and cultural development has improved the standard of living and changed consumer habits, resulting in an increase in the volume of municipal solid waste (MSW) over time. Preliminary official estimates refer to more than 20-35% increase in solid waste generation in Jordan following the Syrian crisis, putting a substantial burden on municipalities as well as on the surrounding ecosystems.

MSW management, is one of the most important services provided by municipalities in Jordan. Solid waste is collected from 100 municipalities and is then transported to transfer stations, sanitary landfills or open dumpsites. There are 18 recorded landfills in the country, most of which are not properly designed or operated, demonstrated by their lack of proper lining, leachate collection system, and landfill gas management system. The only sanitary landfill is Al-Ghabawi landfill, which receives 50% of the waste produced in Amman and Zarqa. Al-Ghabawi landfill is located 23 km to the East of Amman over an area of 2,000 Dunums, enough to dispose waste until 2035. In 1989, the Government of Jordan selected Swaqa landfill, 125 km to the South-East of Amman, as a facility to process hazardous waste.

2. NATIONAL GREENHOUSE GAS INVENTORY

The national GHG emissions were estimated for the year 2016 according to 2006 IPCC Guidelines and the 2019 Refinement to the 2006 IPCC Guidelines. The estimation of the overall national inventory was carried out using the 2006 IPCC Inventory Software for non-Annex I Parties. The sectors and subsectors that were considered are the Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry, and Other Land Use (AFOLU) and Waste.

Inventories were prepared on a gas-by-gas basis in units of mass. Estimates of anthropogenic emissions of the direct GHGs of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) were assessed by source and removal by sink. Indirect GHGs were estimated, whenever the activity data were available, using the EEA Guidelines and methodology.

Emissions were estimated in Gigagrams (Gg) for all direct and indirect gases, as well as in Gg of CO_2-equivalent (CO_2eq) for all direct gases. For the conversion from Gg of different GHGs to Gg of CO_2eq, the Global Warming Potential (GWP) values provided in the IPCC SAR were used.

The overall GHG Inventory estimates for Jordan in 2016 were 31,063.32 Gg of CO_2-equivalent (CO_2eq). A breakdown of Jordan's total emissions of GHGs by sector indicated that the energy sector was the major emitter releasing around 76% of total national emissions followed by the waste sector with a contribution of around 12%.

Energy sector

Total emissions from the energy sector were 23,649.47 Gg of CO_2eq in 2016. Fugitive emissions (from oil and natural gas) were negligible, accounting for less than 2%. Within the fuel combustion activities, major emissions resulted from the Energy Industries and Transport subsectors with a share of 37% and 38% respectively. Emissions resulting from "Manufacturing Industries and Construction" and "Other sectors" (Residential, Commercial, and Agriculture) accounted each for 10% and 10 % of the total respectively.

Industrial processes and product use (IPPU) sector

Emissions from the industrial processes sector were 3,177.42 Gg of CO_2eq accounting for 10% of Jordan's total GHG emissions in 2016. The industrial processes sector was a source of NMVOCs emissions and accounted for 32.61 Gg in 2016. In addition to CO_2 and NMVOCs, the sector generated emissions of HFCs with 757.29 Gg of CO_2eq in 2016.

Agriculture, forestry and other land use change sector

The GHG emissions of AFOLU activities accounted for around 1.38% (428.71 Gg of CO_2eq) of Jordan's total GHG emissions in 2016. The emissions were composed of methane and nitrous oxide and were generated by various subcategories.

Waste sector

GHG emissions from the waste sector reached 3,807.73 Gg of CO_2eq, accounting for 12% of Jordan's total GHG emissions in 2016. Most of the emissions were generated by domestic solid waste disposal, which accounted for around 93% (3,559.01 Gg CO_2eq) of total waste emissions in 2016, while wastewater handling accounted for 5% (188.40Gg CO_2eq) of total waste emissions.

GHG Inventory by gas

In 2016, the majority of carbon dioxide emissions resulted from the energy sector accounting for 95% followed by 9% from the IPPU sector. Methane emissions were highest from the waste sector followed by the AFOLU sector with contributions of 70% and 17%, respectively. Nitrous oxide emissions were highest from the AFOLU sector with 57%, followed by the IPPU, energy and waste sectors, with contributions of 18%, 13% and 12%, respectively. As expected, the IPPU sector contributed 100% of HFCs while the NMVOCs emissions resulted from the IPPU and the energy sectors.

Within the energy sector, the main emissions were in the form of CO_2 (97%). Within the IPPU sector, the key GHGs were CO_2 followed by HFCs with shares of 69% and 24%, respectively. Nitrous oxide emissions were highest from the AFOLU sector, with around 57% mainly from fertilizers and manure management. Methane emissions were highest from the waste sector, with 78% and produced from solid waste management.

GHG emissions (+) and removals (-) in Gg CO2eq by Gas and by Sector, 2016

Categories	CO_2	CH_4	N_2O	HFCs	SF_6
	(Gg)	(Gg of CO_2eq)			
Total national emissions and removals	24,385.37	4,675.49	1,245.14	757.29	0.022
Energy	23,054.59	439.38	155.49	NA	NO
IPPU	2,194.88	0.00	225.22	757.29	0.022
AFOLU	-896.76	614.62	710.85	NA, NO	NO
Waste	32.66	3,621.50	153.58	NA	NO

3. GREENHOUSE GAS MITIGATION ANALYSIS

Update of the FBUR baseline scenario: the baseline scenario was updated for all economic sectors of energy, industry, agriculture and forestry in addition to the waste sector, based on the strategies, policies and plans prevailing in the Jordanian context during the time of preparation of this SBUR (2020). This requires a projection of the current levels to future levels for each type of activity. The newly released strategies, policies, action plans and committed projects were reviewed and summarized. In addition, all projects and actions that were part of FBUR baseline scenario were reviewed to update their status. Based on this review, the most probable future trends in activities that will impact and shape the GHG emissions are highlighted.

Strategies, policies and action plans that were reviewed to prepare the updated baseline scenario include:

- Jordan 2025, Vision and National Strategy, issued in May 2015.
- The new Energy National Strategy for 2020-2030, issued in April 2020,
- The 2020-2025 National Agricultural Development Strategy, issued in August 2020,
- The new Solid Waste Management Framework Law issued in March 2020 and entered into force in September 2020,
- National Renaissance Plan (2019-2020), issued in 2018,
- Jordan Economic Growth Plan (2018-2021), issued in 2017,
- The Industrial Policy (2017-2021), issued in 2016.

Update of FBUR GHG mitigation measures: All mitigation projects were reviewed and assessed to identify all those still valid. These projects still considered valid have been updated after adjustments were made to their expected implementation timeline. The emission reduction and the unit cost of emission reduction for each mitigation project have been recalculated taking into consideration several factors, such as the improvement in technologies and changes in prices. Net present value was used in the financial calculations, by converting all present and future revenues and costs over the project's lifetime to a base of today's cost. The same approach was followed in calculating the CO_2eq emissions reduction over the lifetime of the mitigation projects. A discount cost of 8% was used for both the cost and emission reduction calculations. Also, the discounted unit cost of reduced emission reduction was calculated as the quotient of the discounted cost in JD to the discounted emissions in tonnes of CO_2.

The update of FBUR mitigation projects resulted in 23 valid GHG mitigation projects identified within the primary energy, renewable energy, energy efficiency, industry, domestic solid waste and wastewater, and agriculture and forestry sectors and subsectors. Emission reduction in addition to the abatement cost have been recalculated for each proposed mitigation project.

It was concluded from the abatement cost analysis for the valid projects from the FBUR that the most feasible options are the energy mitigation projects. The findings indicated that in particular the projects related to energy efficiency should receive the most attention. The table below shows the marginal abatement cost for all mitigation measures ranked from the highest to the lowest.

Marginal abatement cost for all mitigation measures (ranked from the highest to the lowest)

No.	Project Name	Emissions Reduction Unit Cost (JD/tonne of CO_2eq)
1	100 MW Concentrated Solar Power (CSP 1)	118.68
2	Forestry - Introduction of new plantations in Urban Areas	40.00
3	Rangeland 1- Restoration of Rangeland Areas	18.00
4	Forestry- Introduce new plantations in Northern Area	14.50
5	Rangeland 2- New Protected Rangeland Area as Natural Reserve	10.00
6	Biogas generation by utilizing the sludge generated from Madaba domestic wastewater treatment plant	4.54
7	Biogas generation by utilizing the sludge generated from Baqa'a tertiary domestic wastewater treatment plant	4.48
8	Catalytic Reduction of N_2O inside the Ammonia Burner of the Nitric Acid Plant	0.37
9	Biogas collection and utilization from Al-Dhulil domestic solid waste landfill	-0.50
10	Biogas generation by utilizing the sludge generated from Wadi Arab domestic wastewater treatment plant	-4.00
11	300 MW Concentrated Solar Power (CSP 2)	-7.18
12	Natural gas distribution network in Amman, Zarqa and Aqaba	-13.78
13	Use of steel slag and/or fly ash to substitute the raw materials needed to produce clinker	-22.90
14	Produce new cement product CEM IV with 45% of Pozzolana	-32.00
15	Increase the percentage of Pozzolana in CEM II	-32.10
16	Use of biomass (domestic solid waste or/and sewage sludge) as alternative fuels in cement plants	-69.30
17	Returning un-returned condensate to the feed water tanks in food industry	-108.04
18	Loss reduction in transmission and distribution	-108.52
19	Using regenerative burners instead of conventional burners in the steel industry	-110.03
20	Insulating walls and roofs in 3,500 houses	-183.64
21	Solar water heaters 3 - 30,000 houses	-189.95
22	Insulating pipes, fittings and tanks in food industries	-215.16
23	Promoting climate-smart agricultural practices in the Jordan valley	-1333.00

4. DOMESTIC MEASUREMENT, REPORTING, AND VERIFICATION

During 2016, Jordan with the support of the World Bank has submitted its market readiness proposal (MRP) to the Partnership for Market Readiness Proposal (PMR) initiative. Jordan's MRP outlined a plan for implementing the market readiness components that will be necessary to support the development of appropriate market based instruments.

The PMR initiative in Jordan is led by the Ministry of Environment, in collaboration with an inter-ministerial technical working group. At the current phase, the PMR initiative, has identified the energy and water sectors as priority sectors for mitigation actions (with energy efficiency (EE) and renewable energy (RE) identified as pilot cross-sector interventions). The initiative aimed at fulfilling three components:

- A National MRV system and registry for climate mitigation measures,
- Designing a platform for private sector financing in EE and RE,
- Exploring the potential for market based instruments for climate mitigation measures.

In February 2018, the first milestone was achieved with the development of a multi-tiered integrated MRV system. The first version of the system - still in the experimental phase - covers the public sector energy projects (RE and EE). Adding GHG data and support data at sectoral and national level from different sectors will serve in tracking progress towards NDC commitments.

5. UPDATED GAPS AND CONSTRAINTS, AND RELATED NEEDS

The following are some recommendations for the successful implementation of the climate change bylaw no 79/2019, through support of the committee and technical groups formed according to this bylaw:

- It is recommended that the MoEnv as chair of the NCCC clarify and continually stress the role of different ministries and institutions in the area of climate change and the need for cooperation to fulfil Jordan's commitments,
- Seek support from international capacity building programs to enable and strengthen the, committee and the technical groups, formed according to the climate change bylaw, in areas relevant to their roles,
- It is recommended to invest in building the capacities of the focal points acting in the technical groups and appoint them to their positions for a sufficient period of time (at least 3 years) to be able to strengthen their work and it's highly recommended to prepare their successors in advance,
- Climate change directorates at different ministries and institutions are important vehicles to mainstream climate change into the strategies and policies of their respective institutions. As such, it is recommended that the MoEnv coordinates continuously with these departments and supports them in identifying their capacity building needs.

Jordan's FBUR to the UNFCCC was prepared and submitted in late 2017. After its submission, a Team of Technical Experts (TTE) was tasked with its review. These experts were trained to conduct reviews as part of the ICA according to Decision 2/CP.17, Annex IV.

Following the TTE review and during COP24, Jordan's FBUR was subjected to the Facilitative Sharing of Views (FSV) during the 49th Subsidiary Body for Implementation (SBI 49). The FSV objective is to identify the capacity-building needs of developing countries in order to enhance transparency of mitigation actions. The following are the identified capacity-building needs related to the facilitation of the preparation of subsequent BURs and the NC's:

a. Enhance technical capacity on using surrogate data and other splicing techniques from the 2006 IPCC Guidelines that can help fill gaps of historical data and generate a consistent time series,

b. Develop technical capacity for data collection and estimation of emissions of HFCs on a gas-by-gas basis, particularly capacity-building needs related to collecting data from equipment, disposal and processing raw data from the custom departments and other national and/or international sources,

c. Develop technical capacity to perform key source category analysis, particularly capacity-building needs for executing level and trend analysis, and to use the outcomes of the key category analysis,

d. Develop technical capacity to perform uncertainty analysis, particularly capacity-building needs for the quantification of uncertainties of activity data and emission factors (EFs) and other parameters of each source/sink category, and to use the outcomes of uncertainty analysis,

e. Enhance technical capacity to conduct ongoing surveys to provide accurate data and to integrate climate change questions in existing energy surveys that mainly focus on energy,

f. Enhance capacity for data collection, project labelling and tracking information for reporting the technology support received,

g. Enhance technical capacity for developing national emission factors and using higher tier methods in the categories defined as key and particularly in the AFOLU and waste sectors,

h. Enhance technical capacity to report on mitigation actions that are already implemented or ongoing across all sectors,

i. Enhance technical capacity for establishing a verification and tracking system of GHG reductions for various mitigation actions across all sectors,

j. Enhance capacity in reporting progress and the underlying steps envisaged for the planned mitigation actions and when they will be implemented,

k. Enhance capacity for analysing emission reductions during the implementation period for each mitigation action.

In terms of financial resources needs; the key challenges in financing climate change projects are summarized as follows:

- Due to the Corona pandemic and its negative effects on health, the economy and society, it is expected that financial support from donors will be directed to the health sector to mitigate the effects of this pandemic, and this may negatively affect the availability of the required support from international bodies or public budgets at the national level to implement projects to protect the environment in general and climate change projects in particular,
- Lack of climate finance framework (policy or strategy),
- Banks in Jordan, in general, are interested in providing finance to renewable energy and energy efficiency projects. Banks prefer financing RE projects, particularly those which are of a larger size and linked to their existing client base. EE and smaller sized projects are less preferred,
- To minimize risks, financiers need access to an independent, credible reference body for the accreditation of climate change projects, particularly RE and EE projects. However, technical verifiers are unavailable, and financiers lack technical capacity,
- There is a lack of appropriate financial products,
- Project developers lack technical capacity.

The following are suggested actions and recommendations to address those gaps and needs:

- Expansion of the framework for the MRV system for received support that addresses most of the above gaps, constraints, and needs by establishing a dedicated entity to oversee collecting and verifying received support information related to climate change,
- Strengthen the ability to develop bankable and evidence-based projects,
- It is recommended to raise the capacities of stakeholders to produce bankable viable projects,
- It is recommended to raise the awareness of bankers of technical projects evaluation and assessment,
- Enhance the partnership between the public and private sector.

Roman Theater

1 NATIONAL CIRCUMSTANCES

This chapter describes Jordan's national circumstances that are related directly and indirectly to climate change.

The following sections will be covered:

- Location and Climate
- Governance Structure
- The Environmental and Climate Change Institutional Set Up
- Social Indicators
- Economical Context
- Energy Profile
- Water Resources
- Agriculture and Forestry
- Transportation
- Industry
- Waste Management

1.1 Location and Climate

Jordan is a relatively small country situated at the heart of the Middle East and occupying an area of approximately 89,318 square kilometers. Despite the relatively small area, Jordan has a diverse terrain and landscape demonstrating variety usually found only in large countries.

Jordan's climate is characterized by long, hot, and dry summers and short, cool winters. The climate is influenced by the country's location between the aridity of the Arabian Desert and the humidity of the eastern Mediterranean area. January is the coldest month, with average temperatures ranging from 5°C to 10°C, while August is the hottest month with average temperatures ranging from 20°C to 35°C. Rainfall varies from season to season and from year to year. However, about 75% of the country can be described as having a desert climate with less than 200 millimeters of rain annually. About 70% of the average rainfall in the country falls between November and March, while June through August are often rainless. However during the last ten years, Jordan has been witnessing changes in seasons and average temperatures.

Jordan can be divided into three main geographic and climatic areas: the Jordan Valley, the Mountain Heights Plateau, and the Eastern Desert, or Badia region. The Jordan Valley has the country's most distinctive natural terrain. The northern segment of the Jordan Valley, known in Arabic as the Ghor, is the most fertile region. Several degrees warmer than the rest of the country, its year-round agricultural climate, fertile soils, higher winter rainfall, and extensive summer irrigation have made the Ghor the food basket of Jordan. The Jordan Valley is the location of the Jordan River which extends from the northern border down to the Dead Sea.

The Mountain Heights Plateau is the highlands of Jordan. It extends through the entire length of the western part of the country and separates the Jordan Valley and its margins from the plains of the eastern desert. These areas receive Jordan's highest rainfall, and are the most richly vegetated in the country. This region hosts most of Jordan's population centres, including the cities of Amman, Madaba, Zarqa, Irbid, and Karak.

The Eastern Desert or Badia Region comprises around 75% of Jordan. This area of desert and desert steppe is part of what is known as the North Arab Desert. It stretches into Syria, Iraq, and Saudi Arabia, with elevations varying between 600 and 900 meters above sea level. Climate in the Badia varies widely between day and night, and between summer and winter. Daytime summer temperatures can exceed 40°C, while winter nights can be very cold, dry, and windy. Rainfall is minimal throughout the year, averaging less than 50 millimeters annually. Although the regions of the Badia (or desert) have common harsh desert climate, similar vegetation, and sparse population concentrations, those regions vary considerably according to their geology.

1.2 Governance Structure

The Hashemite Kingdom of Jordan is a constitutional monarchy with a representative government. Jordan is divided into twelve administrative areas or Governorates (Figure 1.1). Each Governorate is managed by a Governor who is designated by the Cabinet based on the recommendation of the Minister of Interior.

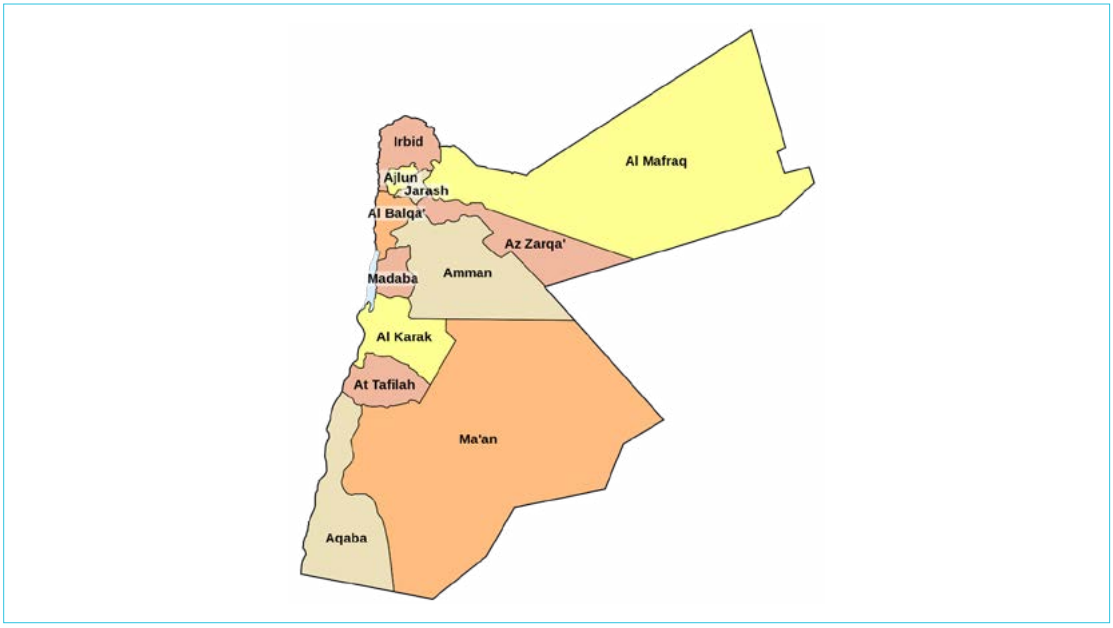

Figure 1.1: The twelve governorates of Jordan.

The Governorates are subdivided into districts, sub-districts, and chief towns and these are managed by civil servants of the Ministry of Interior, whose task is to coordinate and supervise the decentralized services of other ministries under the authority of the Governor. Within governorates there are several municipalities, the Law of 1955 defines the Municipality as being "A financially independent national institution", having a "legal personality" and an administrative autonomy, which is managed by the town council that is composed of the Mayor and 6 to 11 councilors.

1.3 The Environmental and Climate Change Institutional Set Up

The Ministry of Environment was established in 2003 to oversee all environmental affairs. Since then the country has witnessed a steady expansion of the legal and institutional framework for environmental protection. The Ministry of Environment became the focal point for all international environmental conventions including the United Nations Framework Convention on Climate Change (UNFCCC).

Jordan is undergoing a rapid and effective process of enhancing its relevant institutional and policy framework for addressing climate change challenges. In August 2014, the Directorate of Climate Change was established within the Ministry of Environment. The Directorate acts as the institutional hub for coordinating all climate change activities in Jordan in relation to the UNFCCC. The National Climate Change Policy (2013-2020) was issued by identifying the national priorities for adaptation to climate change and mitigation of greenhouse emissions. The policy provides guidance to sector strategies from a

climate change perspective, and it provides a framework for coordination of climate change activities at the national level.

Based on the recommendations of this policy, the Ministry of Environment revised the Environment Protection Law, no.52 of 2006 to add new articles related to climate change and strengthen the existing articles. The new Environment Protection Law no.6 of year 2017, includes provisions on climate change goals which later enabled the ministry to develop the climate change bylaw no.79, 2019.

The climate change bylaw aims to regulate; (a) the coordination of national efforts among relevant stakeholders to implement mitigation and adaptation measures, (b) the development of a legislative framework that maps out plans to combat climate change in the Kingdom and ways to implement them, (c) the streaming of climate change into national plans and the implementation of the goals and principles of the UNFCCC and the Paris Agreement. According to the bylaw, a high-level committee is established under the name "National Committee on Climate Change" which is chaired by the Minister of Environment and consists of 16 high-level members from relevant public authorities. Its functions and powers are identified within the bylaw including the power to form technical teams from governmental and non-governmental agencies represented by civil society institutions, research institutions, universities and the private sector institutions. The teams are mainly tasked with supporting the MoEnv with the NDC, the national adaptation plan and any other reports that should be prepared within Jordan's international commitments and assessing the capacity-building needs of relevant entities related to climate change and contributing to the implementation of awareness-raising and capacity-building activities.

1.4 Social Indicators

The following table summarizes the main social indicators in Jordan; including the main demographic data for the Jordanian population, refugees and education and health indicators.

Table 1.1: Social indicators

Population (end of year 2019)	**10,554,000**
Male	5,588,000
Female	4,966,000
Urban (90.3%)	9,529.200
Rural (9.7%)	1,024,800
Age less than 14 years	34.4 %
Age between (20-45) years	39 %
Population Growth Rate	
For years (1952- 1979)	4.8%
For years (1994-2004)	2.6%
For years (2004-2015)	5.3%

The average household income (DOS, 2017 and 2018)	**11,242 JD**
Average annual income for female-headed households	9,534 JD
Average annual income for male-headed households	11,519 JD
The gender pay gap	17%
The female participation in the Jordanian labor market (World Bank, 2020)	15%
Households Headed by Female (IFAD, 2015)	
Own farms (agricultural land)	44%
Own livestock	30%
Households Headed by Male (IFAD, 2015)	
Own farms (Agricultural land)	68%
Own livestock	36%
Refugees (registered as refugees) to End of Year 2019	**755,050**
Roughly Annual Cost providing for refugees (JRP, 2018)	2.9 Billion JD = 8% of GDP
Participation from International Community (%) (JRP, 2018)	5.5%
Syrian refugees (UNHCR,2019)	664,226
In urban areas	80%
In (Al Za,Atari, Mrajeeb Al-farhood, Cyper City and Al-Azraq) Camps	20%
Education in Jordan (DOS,2017)	
Illiteracy rate for those above 15 years old (DOS,2017)	5.1%
Expenditures on education (% of GDP)	3.6%
Health Indicators	
Total annual expenditure per capita (WHO,2014)	798 USD
Expenditures (% of GDP) (WHO,2014)	7.5%
Life expectancy (DOS,2017)	73.5
Infant mortality rate per 1000 capita (UN, 2019)	14
Crude birth rate per 1000 (UN, 2019)	21.5
Crude death rate per 1000 (UN, 2019)	3.9

Source: DOS, 2019 unless otherwise indicated

1.5 Economic Context

The Jordanian economy is one of the smallest economies in the region. A lack of natural resources, a high population growth rate, the ongoing regional conflicts, the rising cost of health care, and the growing expectations of people have posed challenges to the country's sustainable social and economic development. Jordan's economic indicators are illustrated in Table 1.2.

Table 1.2: Economic indicators

General Socio-Economic Indicators for 2018	
Gross Domestic Product (GDP) at current prices	30,482 Million JD
GDP at constant prices	29,474 Million JD
Annual Growth Rates of GDP at Current Prices	3.7%
Annual Growth Rates of GDP at constant Prices	1.9%
Compensation Annual Growth Rates of employees as a percentage of GDP	39.0%
Government final consumption expenditure as a percentage of GDP at current prices	17.1 %
Gross Fixed Capital formation out of GDP at current prices	20.4%
Export of goods and services out of GDP at current prices	35.1%
Imports of goods and services out of GDP at current prices	53.0 %
Labor Market Indicators for 2018 (MoL,2018)	
Labor Force (persons above the age of 15)	1,734,248
Males Economically Active	56.4%
Females Economically Active	15.4%
Unemployed Males	16.5%
Unemployed Females	26.8%

The national accounts statistics published in 2019 by the Central Bank of Jordan and the Department of Statistics (DOS) showed that there was an improvement in GDP per capita at existing prices in 2018 while the GDP growth rate decreased. Table 1.3 shows the national statistics and the percentage of the main contributing sectors to GDP along the last five years (2014-2018).

Table 1.3: National accounts statistics

Indictors	2014	2015	2016	2017	2018
GDP at Current Market Prices (million JD) (2016=100)	25,595.8	26,925.1	27,829.6	28,903.4	29,984.2
GDP at Constant Market Prices (million JD) (2016=100)	26,579.7	27,265.4	27,829.6	28,418.4	28,969.8
GDP Growth Rate at Current Market Prices (%)	7.2	5.2	3.4	3.9	3.7
GDP Growth Rate at Constant Market Prices (%)	3.4	2.6	2.1	2.1	1.9
Economic Activity contribution (%) to GDP					
Manufacturing	16.7	16.5	16.4	16.2	17.9
Wholesale and Retail Trade, Restaurants, and Hotels	10.1	9.9	9.9	9.8	9.4
Transport, Storage, and Communications	14.4	14.5	14.7	14.8	16.5
Finance, Insurance, and Business Services	9.7	9.9	8	8.1	8.4

All categories of the 2017 budget, including domestic revenues, foreign grants, current expenditure, and capital expenditure, showed a decline compared with the year before. The sharp drop in foreign grants from 700 million JD in 2018 compared to 1,236.5 million JD in 2014, came as a shock, as Jordan depends heavily on foreign grants to finance its capital expenditure. The consolidated budget deficit for the central government and government owned units reached 694.8 million JD in 2017, compared to 825.9 million JD within the same period of 2016.

Outstanding external public debt (government and government guaranteed) decreased by 2.6% to reach 11,560 million JD at the end of the second quarter of the year 2018, which represents a decrease in the percentage to GDP from 41.7% at the end of 2017 to 39.8% by the end of the second quarter of 2018. (MOF, 2018).

In contrast, net domestic debt balance increased by 10.6% reaching 15,005 million JD in the same period, net domestic debt as percent of GDP was 51.6 % by the end of the second quarter of 2018 compared to 47.7% of GDP at the end of 2017. The increase of net domestic debt was a result of increasing net outstanding budgetary debt by 1,359 million JD and increasing net outstanding debt of NEPCO and WAJ by 77 million JD.

The net outstanding public debt increased by 4.4% from its level at the end of 2017, reaching about 26,564 million JD, and representing 91.4% of the estimated GDP for 2018.

1.6 Energy Profile

Jordan currently imports around 93% of its total energy, comprising almost 8% of Jordan's GDP and placing a strain on its economy (MEMR, 2019). The Ministry of Energy and Mineral Resources has recently published the National Energy Sector Strategy for 2020-2030. This is a ten-year plan which aims at setting the roadmap to increase self-sufficiency through utilization of domestic natural and renewable resources, as well as expansion of existing energy developments thus reducing reliance on costly foreign fuel imports that burden its economy.

The main objectives for the energy sector as per the strategy:

- Diversification of energy sources by increasing the contribution of local energy sources to the total energy mix,
- Increasing energy efficiency in all sectors,
- Reducing energy costs for the national economy,
- Developing the energy sector system in Jordan to make it a regional centre for the exchange of energy in all its forms.

The Strategy, which assumes 2018 as base year, predicts the changes in contribution of different energy sources in electricity generation between 2020 and 2030 as illustrated in the following charts.

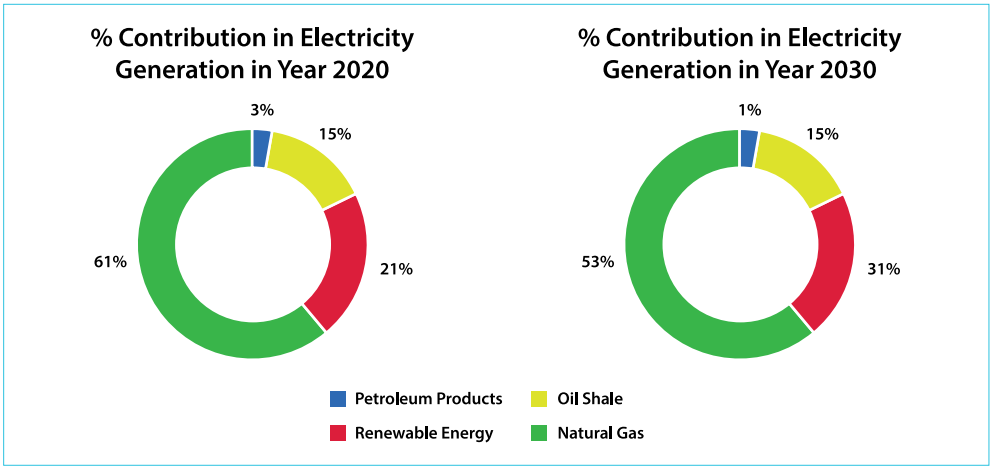

Figure 1.2: The National Energy Strategy (2020-2030) forecast for electricity generation

Moreover, the new National Strategy (2020-2030) identified renewable energy usage alongside other sources as follows:

- Renewable energy to contribute 31% of electricity generation by the year 2030,
- Increasing energy efficiency in the water sector by 15% by 2025,
- Improving efficient energy consumption in all sectors by 9%.

The forecast growth in renewable energy usage will enable the country to enhance energy security, to improve access to affordable energy, to create jobs, and to meet a significant part of the nationally determined contributions (NDCs) target by 2030. The total renewable capacity by the end of 2018 was 1,130 MW and expected to reach 2,400 MW by the end of 2020, accounting for 20% of the generated electricity, compared to 1% in 2014 (MEMR, 2018).

In 2014, a legislative and regulatory framework for renewable energy has been set up by enacting a special renewable energy law as well as developing the needed bylaws and instructions, which promote renewable energy through financial incentives. As a result, many renewable energy power purchase agreements were signed to supply the grid with electricity generated from solar and wind. Many of these projects became operational in 2015.

The largest energy consumer in 2018 was the transport sector with a 49% percent share followed by household, industrial and other services sectors with 21.5%, 15.5% and 14% share respectively. Figure (1.3) shows the final energy consumption in Jordan by sector for the year 2018.

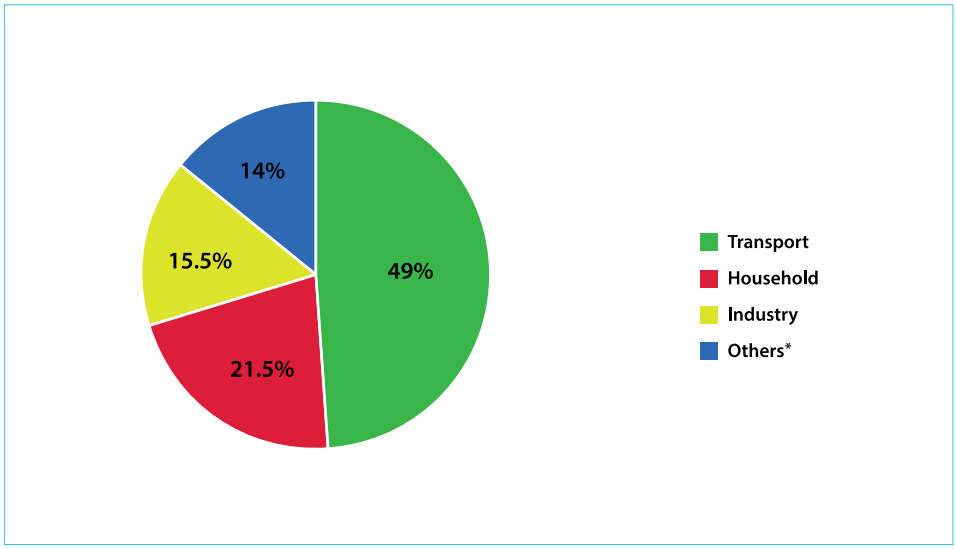

Figure 1.3: Energy consumption per sector, 2018

* Others: Commercial and agricultural sectors along with streetlight. Source: MEMR, 2019

The interruption of the Egyptian gas supply forced the Jordanian government to look for new sources of natural gas. The construction of a Liquefied Natural Gas (LNG) jetty project at Aqaba port, the connection to the Arab gas pipeline, and the leasing of a Floating Storage and Regasification Unit (FSRU) were successfully implemented and put into commercial operation in September 2015. In 2018, 88.8% of electricity generated in the Kingdom was based on imported natural gas. Eventually, Jordan will develop the ability to meet all its needs for natural gas: for electricity generation and for industrial use.

Jordan possesses one of the largest oil shale reserves in the world with total deposits estimated at 70 billion tonnes, containing more than seven billion tonnes of oils. It is planned that by 2020, 470 MW of electric generating capacity will be under operation from the Attarat Oil shale project signed in 2014 (MEMR, 2018). The Attarat Power Plant is an oil shale-fueled power plant under construction in the Attarat Um Ghudran area, 50 kilometres (31 mi) east of Al Qatranah in Jordan.

This project is being developed by the Attarat Power Company (APCO) (which is a partnership between YTL Power International (45%), Guangdong Yudean Group (45%) and Eesti Energia (%10)), to be the first oil shale fired power station and open cast mine to commercially utilize Jordan's oil shale. APCO has entered into a -30 year agreement with NEPCO for the sale of the entire electrical capacity and net electrical output following construction of the power station. The power plant will have 554 MW gross and 477 MW net capacity and it will consist of two circulating-fluidized-bed units. It is expected to meet 10-15% of Jordan´s annual power demand.

Additionally, Jordan has developed a strategy for utilizing nuclear power to supply the country with 30% of its demand for electricity by 2030, with surplus destined for export. A nuclear power committee was set up in 2007 and a law was enacted to establish the Jordan Atomic Energy Commission (JAEC) and the Jordan Nuclear Regulatory Commission (JNRC). In December 2016, JAEC in cooperation with a consortium headed by the Korean Atomic Energy Research

Institute inaugurated the 5 MW Jordan Research and Training Reactor. The facility is the first nuclear reactor in the county. It will provide radioactive isotopes for medical applications in Jordan, and will provide training for students at the Jordan University of Science and Technology to prepare a skilled workforce for the country's planned commercial nuclear power reactors.

The country was aiming to have two 1,000 MW nuclear power units in operation by 2025, by the Rosatom Company, but is now considering the use of small modular reactors (SMRs) instead which seems to be the more appropriate in bridging the gap in the Jordanian electricity generation mix.

1.7 Water Resources

Jordan is ranked as the second poorest country in the world in terms of water resources, with less than 100 m^3/capita/year of renewable water resources (MWI, 2017). While Jordan's population is expected to increase as a result of natural population growth, the country has also experienced population growth due to the influx of multiple waves of refugees putting additional strain on Jordan's already severely limited water resources.

Water use in Jordan is distributed among three different sectors: agriculture, municipal supplies, and industry. In 2017, the agriculture sector was the largest user of the country's water resources, accounting for 52% of the total water supply, while 45% was used for Municipal supplies, and 3% for industrial uses, as indicated by Figure 1.4.

According to 2017 figures, about 46% of the agricultural demand is met by groundwater resources and the rest is met by surface and treated water, as shown in Table 1.4 (MWI, 2017). The majority of irrigated land in Jordan is located

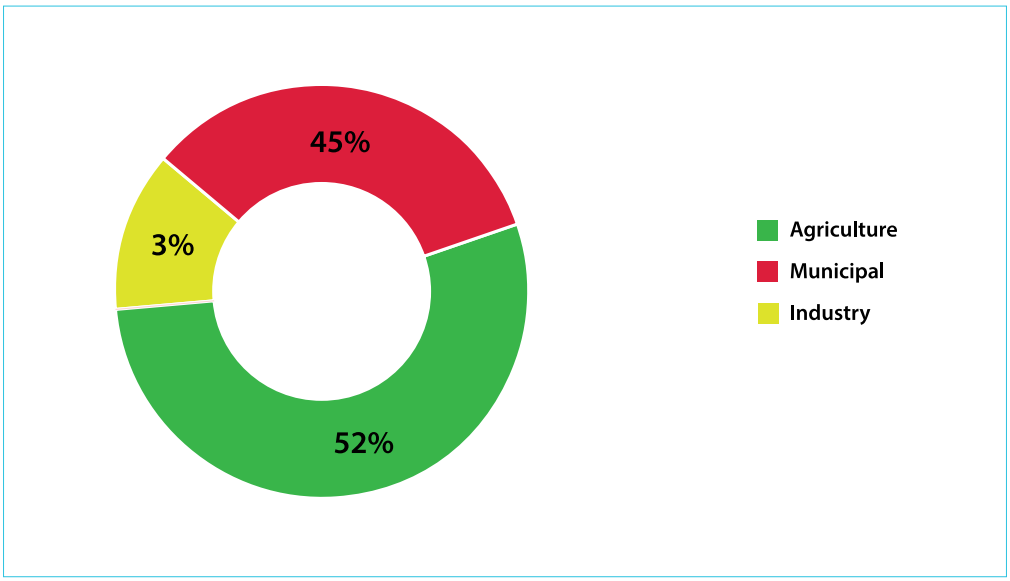

Figure 1.4: Water use by sector, 2017

in the highlands and desert areas (about 52,700 hectares), and in the Jordan Valley (about 31,600 hectares).

About 72% of the water supply for domestic uses is met by groundwater sources. The potable water infrastructure in Jordan is not very efficient. The water loss was estimated as 48% in 2017 compared to 43% in 2010, divided into more than 50% as administrative loss and less than 50% as physical loss from the networks. (MWI, 2017)

About 85% of the industrial demand is met by groundwater resources. It is worth noting that industrial water demand is projected to increase, due to anticipated expansion in industrial enterprises as a result of Jordan's inclusion in the World Trade Organization (WTO), the free trade agreements signed between Jordan and the United States, and the establishment of free zones in different regions of Jordan. These agreements make Jordan a desirable destination for regional investors and manufacturers.

Table 1.4: Water sources for different sectors

Water Source	Sector			Total (MCM)	Percentage of the total
	Domestic	Industrial	Agriculture		
Groundwater	338.4	27.2	253.2	618.8	59 %
Surface water	131.3	2.4	154.4	288.1	27 %
Treated Wastewater	0	2.5	144.2	146.7	14 %
Total	469.7	32.1	551.8	1,053.6	100 %
Percentage of the total	45%	3%	52%	100%	

Source: MWI, 2017

Groundwater contributes about 59% to the total water supply. Of the twelve major groundwater basins, ten are over-extracted. Increasing overall water extraction to meet national needs carries a high cost. Jordan is now accessing nonrenewable water resources from fossilized deep-water aquifers. Underground water from the non-renewable Disi aquifer (about 100 MCM) is being used to meet Jordan's water supply for domestic use, while treated wastewater (147 MCM) is being used mostly to meet the country's agricultural needs (MWI, 2017). Surface water supplies account for 27% of Jordan's total water supply estimated as 288.1 MCM in 2017.

Jordan's population was 10.3 million in 2018 and it is expected to reach 19 million by 2050 under business-as-usual scenario (DOS, 2018). The proportion of water used for domestic purposes may increase by 50-60% in the same time period. By 2025, water demand will exceed available water resources by more than 26%, but this deficit is projected to decline to 6% when the Red Sea-Dead Sea project is put into operation (MWI, 2016).

Water shortage in Jordan is a chronic problem and will continue to be so for years to come. If current domestic, agricultural, and industrial water-use practices are not improved, the water supply in Jordan will deplete in quantity and quality over time. Overdraft of groundwater and surface water is creating a tremendous stress on the water supply in Jordan. The reduced flow of surface water to the Dead Sea is also a source of concern.

Despite Jordan's severe water scarcity, more than 94% of Jordanians have access to safe drinking water and 65% have access to improved sanitation. These are some of the highest rates in the Middle East and North Africa region. However, water supply is intermittent, and the rooftop tanks have become an integral part of the supply water storage system. Around 50% of Jordanians are supplied by water once a week (24 hours) while the rest are supplied by a higher rate (more than 24 hours per week) (MWI, 2017). Since the Disi-Amman Conveyor Project became

operational in the summer of 2013, the continuity of water supply to Amman has improved. However, population centres in the northern governorates have not benefitted fully because of increased demand driven by the concentration of Syrian refugees in the north. Aqaba has continuous water supply from the Disi Aquifer. It is planned to bridge the remaining gap between demand and supply through increased use of non-conventional water including reclaimed water and desalinated seawater to be provided by the Red Sea-Dead Sea project in the near future. The National Water Strategy emphasizes desalination as well as treated wastewater reuse to meet shortfalls in freshwater availability (MWI, 2017).

The Jordan National Water Strategy 2016-2025 has identified treated wastewater, when mixed with surface water, as a source of irrigation water. In 2017, the amount of treated wastewater exceeded 163 MCM. There are 33 public working wastewater treatment plants in Jordan, most of which use activated sludge. They are either operated by the Water Authority of Jordan (WAJ) or managed by the Project Management Unit (PMU) at the Ministry of Water and Irrigation (MWI) through contracts with the private sector. The Samra Wastewater Treatment Plant (WWTP) receives more than 70% of the country's total generated wastewater.

According to MWI figures, the ratio of industrial to total water use in 2017 was very small (5.2%). Industrial wastewater discharged to wadis and other surface water bodies was first regulated by Martial Law issued in 1981, to force all industries to treat their wastewater before discharge to receiving water bodies. A number of industrial entities divert their wastewater to the public sewer system according to WAJ regulation No. 18/1998.

1.8 Agriculture and Forestry

Jordanian agriculture is established along three major climatic regions with various landscape classification (Figure 1.5) among which: the highlands and marginal steppes where most of the rain-fed farming is practiced, the Badia (deserts and rangeland; mostly livestock systems and some cultivation in watersheds and from deep bore irrigation), and the lowlands (Jordan Valley) that thinly stretches from the North West to the South West.

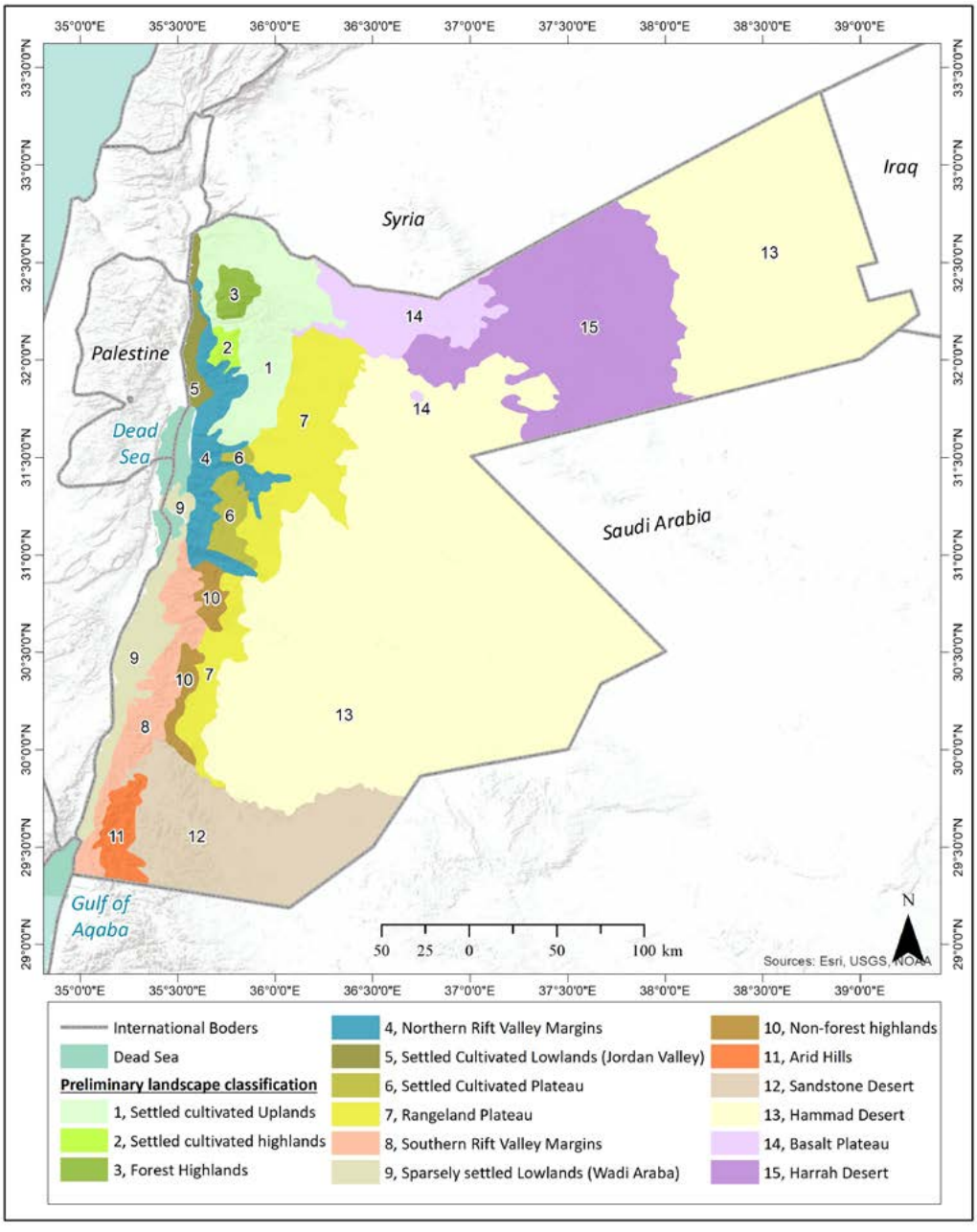

Figure 1.5: Preliminary Landscape classification (Created by Natalia BOULAD, 2019)

The importance of the agricultural sector stems from the fact that it is not only a major source of food, in particular fruits and vegetables, but it is also a source of hard currency from exports. In addition, the agro-industrial sector is characterized by a large number of small enterprises. The vast majority of irrigated agricultural production targets fruit trees and vegetables. More than 90% of irrigated areas in Jordan are dedicated to the cultivation of fruit trees and vegetables.

Table 1.5: Indicators of agricultural sector

Socio-economic Indicators for Agriculture in Jordan	
The contribution of Agriculture to GDP in 1974 (Central Bank of Jordan, 2018)	20%
The contribution of Agriculture to GDP in 2018 (Central Bank of Jordan, 2018)	6.1%
The value of contribution to GDP in 1974 (Central Bank of Jordan Periodic Reports, 2018)	57 Million JD
The value of contribution to GDP in 1974 (Central Bank of Jordan Periodic Reports, 2018)	1,687.9 Million JD
% of active employees	1.7%
Non-Jordanian workers holding work permits in Agriculture in 2017 (DOS,2017)	81,691
Number of Males	79,685
Number of Females	2006

Agricultural product exports are a significant contributor to Jordan's overall export profile; strong productivity and competitiveness of the sector are clearly shown despite its relatively small contribution of 6.1% to the country's GDP. The Jordanian agriculture exports represented approximately 18% of Jordan's exports (or US$ 6.2 billion) in 2016. Exporting agricultural produce has been affected by the conflict in Syria, causing a severe decline of around 25% as well as disrupting overland exports to other markets (Oxford Business Group, 2015).

Agriculture is mostly influenced by water availability and the ability to use advanced practices, technologies, and interventions to adapt to the impacts of climate change. Over the past two decades, Jordan has witnessed a drastic drop in rainfall and prolonged drought periods. According to Jordan's Third National Communication (TNC) report outcomes, it is projected to witness a decrease in precipitation by 15-60% and a rise of 1-4°C in temperatures. These climatic changes will have serious negative consequences on natural ecosystems, river basins, watersheds, and biodiversity.

The forest vegetation in Jordan can be divided into natural forests that are composed of evergreen shrubs, pine and juniper forests as well as broadleaf forests. Private forests are registered in the name of their private owners and are found mostly in the northern part of Jordan where higher rainfall is prevailing. They include natural forest vegetation and tree plantations on farms, in the form of windbreaks and shelter-belts. Private forests account for less than 4 % of the total declared forestland.

1.9 Transportation

Transportation is a key sector for Jordan, providing a necessary service to promote economic growth. Currently it is considered to be very energy inefficient (ACT Alliance repot, 2018), using almost half of the final energy consumption of Jordan (MEMR Brochure, 2019). The estimated annual growth in demand for transportation and logistics ranges from 5% to 6% until 2030. Jordan's

transportation and logistics sector plays a key role in Jordan's economy and contributes over 8.2% of GDP. (Jordan Investment Commission, 2017). Land, maritime and air transportation infrastructure are well developed, and there are plans to develop railway infrastructure. The Government of Jordan has developed a national transport strategy to upgrade the country's infrastructure and enable the Kingdom to capitalize on its strategic geographical advantages.

Today, there is an extensive 80,000 square kilometers road network which spans across the Kingdom, connecting it with neighboring countries.

There is no regular passenger rail in the country. The Hejaz railway which runs the length of the country from north to south, has not been used for many years and would need extensive renovation, to be put back into operation. The service from Amman to Syria was halted about 10 years ago, and the only passenger railway trips are for on-demand tourist trips travelling from Amman to Jiza, a short distance to the south of the city.

The Kingdom serves as an important regional transport hub between Gulf Cooperation Council (GCC) countries and Turkey and Europe, and also between Iraq and the Red Sea and the Mediterranean.

There are three airports in Jordan: Queen Alia International Airport (QAIA), the main airport, and Amman Civil Airport, both in Amman Governorate and King Hussein International Airport in Aqaba. The only scheduled internal flights are passenger flights between QAIA and Aqaba.

The port city of Aqaba, on the Red Sea, provides the only gateway to shipping for the country and is therefore an important centre for freight.

Additionally, the transport sector in the inventories of 2012 and 2016 was estimated to have contributed to 26% and 28% respectively of the greenhouse gas emissions, making it the largest emitter after the energy industries (electricity generation). The available national inventories, show that the share of emissions for the transport sector are rising at an increasing rate, and that the share of emissions within the inventories are rising, see table below.

Table 1.6: Transport GHG emissions from national inventories

Year	2006	2010	2012	2016
Transport Emissions Gg/CO_2	4,706	5,297	7,392	8,787
% of National GHG Emissions	16	23	26	28

Source: TNC and BURs.

The majority of trips in Jordan are made by private cars as indicated in the modal split in table 1.7. The Ministry of Transport (MoT) estimated this to be 35% of trips for 2010, based on household surveys and this was backed up by the household survey carried out in Amman in 2008, which estimated that 33% of trips were made by private car. It is expected that these percentages will have increased since these surveys were carried out. (MOT, 2014)

Table 1.7: Modal split (%) for trips in Amman and Jordan

	Private car	Public transport	Taxi	School bus	Private bus	Walking
Jordan	35	14	10	13	3	25
Amman	33	14	9	13	5	26

Source: GAM, 2010

Jordan experiences a relatively high growth rate in private cars of approximately 5% per year, which exceeds the estimated population growth. (GAM, 2010)

There has been some growth in the numbers of hybrid and electric cars. However, their popularity is strongly dependent on government policy, which until now has not been consistent. In 2018, hybrid and electric cars still made up less than a quarter of the private cars in Jordan, as shown in the table below.

Table 1.8: Number of private cars by fuel type in 2018

	Gasoline	Hybrid	Electric	Total
No of Vehicles	892,875	244,080	16,017	1,153,271
% of Vehicles	77.4	21.2	1.4	100

Source: DOS, 2014-2018

A law has been passed that any new gas station, must also provide electric charging points. However, until now, charging stations have not been provided in sufficient numbers to encourage the uptake of electric vehicles. Currently there are only around 50 charging stations for the whole country, and an agreement signed with German Company e-Charge in 2018 to provide 10,000 Electric vehicles (EV) charging stations has not yet been implemented. (Electromaps, 2020)

The uptake of electric cars has been slow and they currently make up only 1% of the private cars in Jordan. As can be seen in the table below most of these are in Amman, although the numbers increased sharply in 2019 in Zarqa and Irbid.

Table 1.9: Electric cars registered in Amman and in Jordan

Year	Jordan	Amman	% in Amman
2015	564	291	52
2016	1,838	1,270	69
2017	9,593	8,632	90
2018	16,017	15,023	94
2019	21,511	16,527	77

Source: DOS, 2020 (unpublished data through e-mail)

Public transport (PT) in general is not well organized and lacks the infrastructure and interchanges required for a comfortable journey. There are few mode choices for PT, compared to other countries, the available modes being: large bus, minibus and shared taxis (running on fixed routes). There is also a lack of accessibility – with the coverage of PT services in Jordan below the international average. In general PT is considered suitable only for those with no other option and this has led to its low share of trips.

There is even lower share of trips carried out using regular taxis, although these are not generally available outside of main centres. A new innovation is the use of ride-hailing apps and several companies notably Uber and Careem, have become very popular after initial licensing issues were resolved.

As a consequence of the introduction of ride-hailing apps, a law was issued in 2017, which prohibits anyone from providing services relating to the transportation of passengers without

being registered and licensed with the Land Transport Regulatory Commission (LTRC). Within this framework, two regulations were issued in 2018, which allowed for the complete licensing and registration of companies using ride-hailing applications: the Regulation concerning the Transportation of Passengers through Smart Applications and the Instructions Regulating the Transportation of Passengers through Smart Applications.

There are currently about 12,500 vehicles in Jordan licensed for use with ride hailing apps. Their effect on mobility has not yet been studied in Jordan, so it is not clear whether trips are shifting from regular taxi, public transport or private car or whether they are enabling "untapped demand", trips that would not otherwise be made.

Uber and Careem cars have the advantage of not taking up space for parking. In fact difficulty of finding parking is one reason why people may choose to use their services. Additionally, since they do not circulate looking for rides, there are expected to be reductions in congestion, fuel consumption and emissions, compared to regular taxis.

Concerning freight, the current modes used for transport for imports and exports are by truck, plane, ship and pipeline. Truck is the most versatile, with the most clearance points. Air freight is transported through the three airports in Amman and Aqaba and shipping freight is transported though Aqaba Port. Pipelines are used for import of natural gas through Aqaba.

The table 1.10 below shows the amount of transported freight by weight, by mode and year. There are no clear trends in the data.

Table 1.10: Freight transported by mode (gross weight in 1000 tonnes)

	2014	2015	2016	2017	2018
Trucks	8,840	7,357	6,977	7,250	8,564
Planes	67	76	79	83	73
Ship	21,075	21,316	23,361	22,506	20,998
Pipeline	229	234	0	0	419
Total	30,212	28,982	30,417	29,839	30,054

In the table below the percentage, by weight, transported by each mode are compared. It can be seen that the most important mode for freight transport is ship, although this has been decreasing over the last few years. The second most important mode is truck, which has shown a corresponding increase over the last few years. The share of freight, by weight, transported by plane and by pipeline, is minimal.

Table 1.11: Freight transported by mode in %

	2014	2015	2016	2017	2018
Trucks	29	25	23	24	28
Planes	0	0	0	0	0
Ship	70	74	77	75	70
Pipeline	1	1	0	0	1
Total	100	100	100	100	100

Governance and Structure of the Transportation Sector

Transport in Jordan is the responsibility of the Ministry of Transport (MoT) operating under Transport Law No.89, 2003. MoT is responsible for developing the transport general policies and strategies and supervising their implementation in coordination and collaboration with the relevant entities. It is also responsible for regulating and monitoring both public and freight transport. MoT cedes its responsibilities concerning planning and implementation of transport to two organizations in different areas of Jordan. These are Greater Amman Municipality (GAM) and Aqaba Special Economic Zone Authority (ASEZA).

Ministry of Transport carries out its responsibilities in coordination with the related Government organizations described below:

- Civil Aviation Regulatory Commission (CARC) was established in 2007 to replace the Civil Aviation Authority (CAA) in accordance with article 68 of the civil aviation law number 41 of 2007. The function of CARC is to regulate all affairs pertaining to civil aviation including safety, security, economic and environmental aspects,
- The Transport Regulatory Commission- In July 2020 the cabinet agreed to combine three transport organizations into the Transport Regulatory Commission. These former organizations are: Land Transport Regulatory Commission (LTRC), the Jordan Maritime Commission (JMC) and the Jordan-Hejaz Railway Corporation,
- The Land Transport Regulatory Commission was established in 2010 to take over from the former Public Transport Regulatory Commission (PTRC), but with additional responsibility for freight transport, by road. Its function is to regulate and monitor land transport and services, and its institutional objectives include: increasing operational efficiency of PT services, improving mobility of urban and rural populations and the development of environmentally sustainable PT services,
- Jordan Maritime Commission (JMC) was established by royal decree in 2002 under the title of Jordan Maritime Authority. The name was revised to JMC in 2014. JMC operates under the Jordan Maritime Authority Law No. (46) Issued in 2006. Its function is to regulate, supervise and develop the maritime sector,
- The Jordan-Hejaz Railway Corporation was established in 1952, and it manages and invests in the properties of the railway between Ma'an and the Syrian border. It was used for transporting freight between Jordan and Syria up until services were stopped about 10 years ago as a result of the conflict in Syria.

Greater Amman Municipality which has almost 40% of the population of Jordan is responsible for all PT taking place completely inside its borders, an area of 800 km^2. This responsibility was assumed in 2007 based on a law granting the municipality, planning and regulatory authorities over PT. The integrated Transportation and Traffic Management Directorate was established shortly after this, to bring together these newly granted roles with GAM's existing traffic engineering functions.

Aqaba Special Economic Zone Authority (ASEZA) was created in 2001, within the Aqaba Governorate as a separate governance entity, covering an area of 375 km^2 around the port city of Aqaba, including Jordan's entire 27 km marine coastline. ASEZA has held responsibility for PT within the Aqaba Municipality and between Amman and Aqaba since 2000. ASEZA is also responsible for the port areas, the King Hussein International Airport and the section of the Hejaz Railway between Aqaba and Ma'an and the additional link to the phosphate mines.

Ministry of Public Works and Housing (MoPWH) undertakes the construction and development of the network of roads in the country and is responsible for setting plans and preparing the studies and designs necessary for their construction. In addition, they undertake tasks assigned by the Government of Jordan. A similar role is carried out within Greater Amman Municipality by the Department of Public Works and Housing within GAM and in Aqaba by the Department of Public Works within ASEZA.

1.10 Industry

Jordan is attractive for foreign investments in the Middle East primarily due to its political stability and its central location in the region. Industry in Jordan is principally dominated by manufacturing and mining.

Qualified Industrial Zones (QIZ) are business parks that are recognized as free trade zones set up in collaboration with the United States. Jordan is one of two countries to have this arrangement, the other being Egypt.

In Jordan, the Qualified Industrial Zones are:

- Al-Hassan Industrial Estate,
- Al-Hussein Ibn Abdullah II Industrial Estate,
- Jordan Industrial Estate Corporation,
- Jordan Cyber City,
- Al-Tajamouat Industrial Estate,
- Gateway QIZ,
- Aqaba Industrial Estate,
- Ad-Dulayl Industrial Park,
- El-Zai Ready-wear Manufacturing Company.

The manufacturing sector includes leather and footwear manufacturing, chemicals, plastics, IT, furniture, food, packaging, and manufacturing of engineering technology. The contribution of manufacturing to GDP increased to 1347 million JD in the second quarter of 2019 from 1208.80 JD Million in the first quarter of 2019.

The mining industry sector is one of the most important strategic industries. Mining contributes to the employment of local labor and caters to the needs of the market for raw materials, while being a source of hard currency.

The contribution of mining to GDP increased to 175 million JD in the second quarter of 2019 from 162.8 million JD in the first quarter of 2019.

The mining sector consists of the following sub-sectors:

- Phosphate and potash,
- Cement and chalk mining,
- Mining and extraction of limestone to produce calcium carbonate,
- Mining and manufacturing kaolin, gypsum, and silica,
- Extracting and crushing stone tablets, slabs, marble, and granite stones and sand.

Phosphate and potash are the most significant natural resources in Jordan. The sector relies primarily on large investments, driving several firms to invest in such a promising field. The mining sector is the third largest industrial sector in terms of invested capital and the fourth largest sector in terms of exports in 2014. It also ranked first in terms of foreign investments in Jordan. Moreover, products from mining are used as raw material inputs for other industries such as fertilizers. Positive outlooks loom large as domestic value-added activities are increasingly combined with investing in other areas, such as shale oil and uranium. This requires activating the exploitation of untapped raw materials in the Kingdom to create products that meet the global demand for energy.

1.11 Waste Management

Jordan has experienced a large increase in population over the past decade as a result of a high population growth rate and enforced migration. Economic and cultural development has improved the standard of living and changed consumer habits, resulting in an increase in the volume of municipal solid waste (MSW) over time. No official

statistics have been disclosed regarding the increase in solid waste generation after the influx of Syrian refugees. However, preliminary official estimates refer to more than 20-35% increase in solid waste generation in Jordan following the Syrian crisis, putting a substantial burden on municipalities as well as on the surrounding ecosystems.

MSW management, is one of the most important services provided by municipalities in Jordan. Solid waste collected from 100 municipalities is then transported to transfer stations, sanitary landfills or open dumpsites. There are 18 recorded landfills in the country, most of which are not properly designed or operated, demonstrated by their lack of proper lining, leachate collection system, and landfill gas management system. The only sanitary landfill is Al-Ghabawi landfill, which receives 50% of the waste produced in Amman and Zarqa. Al-Ghabawi landfill is located 23 km to the East of Amman over an area of 2,000 Dunums, enough to dispose waste until 2035, using safe refuse/tipping techniques. The Greater Amman Municipality purchased 1,000 Dunums from surrounding lands to rent out to the private sector to encourage investment in waste segregation and recycling.

In 1989, the Government of Jordan designated Swaqa landfill, 125 km to the South-East of Amman, as a facility to process hazardous waste**.** The landfill is overseen and operated by the Ministry of Environment. The Ministry of Environment has also founded a centre in Swaqa landfill to oversee the disposal of electronic waste in a safe manner to discourage improper storage and illegal re-selling. In general, the sector is in need of studies to investigate the potential of waste recycling.

It's important to note that Bio-waste (organic waste) dominates MSW; approximately 60% are food waste, 14% paper and cardboards, 10% plastics. Therefore, MSW contains sufficient putrescible material which emit LFG (methane & CO_2) for many years presenting a long-term explosive and toxic hazard. Additionally, hazardous and non-MSW are not segregated and continue to reach final disposal sites posing serious health risks for workers.

In Jordan, 48% of MSW is landfilled, 45% is openly dumped and only 7% recycled. As a matter of fact, recycling is mostly done by waste pickers informally with no operational facility in place. Furthermore, it is estimated that in 2034, MSW will reach 5.2 million tonnes (EC, 2016). Considering these foreseeable challenges, in 2015 the Government of Jordan took a step forward with the Decision No. 11392/02, and approved its first National Solid Waste Management Strategy 2015-2034 (NSWMS) in line with the revised EU Waste Framework Directive 2008/98/EC which focuses on waste prevention and with the EU-Jordan Compact 2016-2020 which sets the sustainable use and management of natural resources as one of its priorities. The Strategy's main objective is to renovate the old, inefficient, costly and environmentally unstable municipal solid waste management system and convert it to a modern and integrated one using the Three R's approach (Reduce-Reuse-Recycle) within a span of 20 years. In particular, it seeks to prohibit the unsafe disposal of MSW and omit the disposal of industrial, construction, and medical wastes from facilities. In numeric-terms, 50% of existing dumpsites should be closed and 20 new transfer stations plus 10 new sanitary landfills should be constructed (NSWMS, 2015).

Table 1.12: Approved targets for MSWM in Jordan (NSWMS, 2015-2034)

No.	Subject of Target	Proposed Targets for Jordan		
		Short-term Period (2015-2019)	Mid-term Period (2020-2024)	Long-term Period (2025-2034)
1	Catering for the emergency needs for MSWM due to the refugees' influx	Done	(if the situation continues)	(if the situation continues)
2	Coverage of MSW street-cleaning and collection services	-	100%	-
3	Set-up of separate collection systems for recyclables (at least paper, metal, plastic and glass)	-	-	100 % by 2034
4	Preparing for re-use and recycling of MSW materials (at least paper, metal, plastic and glass)	-	-	50% by weight by 2034
5	Cease of operation of uncontrolled or unlicensed disposal sites	50% by 2019	100% by 2024	-
6	Reduction of bio-waste ending-up to landfills	-	-	75% by weight by 2034 (according to 2024 amounts)
7	Recovery of packaging waste (including reuse, materials' recovery and energy recovery)	-	-	25% by weight by 2034
8	Recycling of packaging waste	-	-	15% by weight by 2034

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Amman

2 NATIONAL GREENHOUSE GAS INVENTORY

2.1 Introduction

The GHG Inventory (emissions and removals) was prepared following Decision 17/CP.8, which states that:

- Each non-Annex I Party shall, as appropriate and to the extent possible, provide in its national inventory, on a gas-by-gas basis and in units of mass, estimates of anthropogenic emissions of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) by sources and removals by sinks.
- Non-Annex I Parties are encouraged, as appropriate, to provide information on anthropogenic emissions by sources of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF6).
- Non-Annex I Parties are also encouraged, as appropriate, to report on anthropogenic emission by sources of other greenhouse gases such as carbon monoxide (CO), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOC). Other gases not controlled by the Montreal Protocol, such as sulphur oxides (SOx), included in the IPCC Guidelines may be included at the discretion of the Parties.

The GHG national inventory chapter addresses emissions of carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Those gases are supported by the software and the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines. Non-methane volatile organic compounds (NMVOCs) emissions resulting from the solvents subsector were estimated using European Monitoring and Evaluation Programme (EMEP/EEA) air pollutant emission inventory guidebook 2019.

2.2 Institutional Arrangements

The Ministry of Environment is the focal point for issues relevant to the UNFCCC and is responsible for ensuring that Jordan's commitments are met. Preparation of Jordan's Second Biennial Update Report (SBUR) was coordinated by the Ministry of Environment in partnership with UNDP.

An agreement with the Royal Scientific Society (a national non-governmental, not-for-profit scientific organization) was realized to achieve the work. The GHG inventory development was accomplished with the participation of a pool of national experts representing different national entities, as demonstrated by the organizational chart in Figure 2.1.

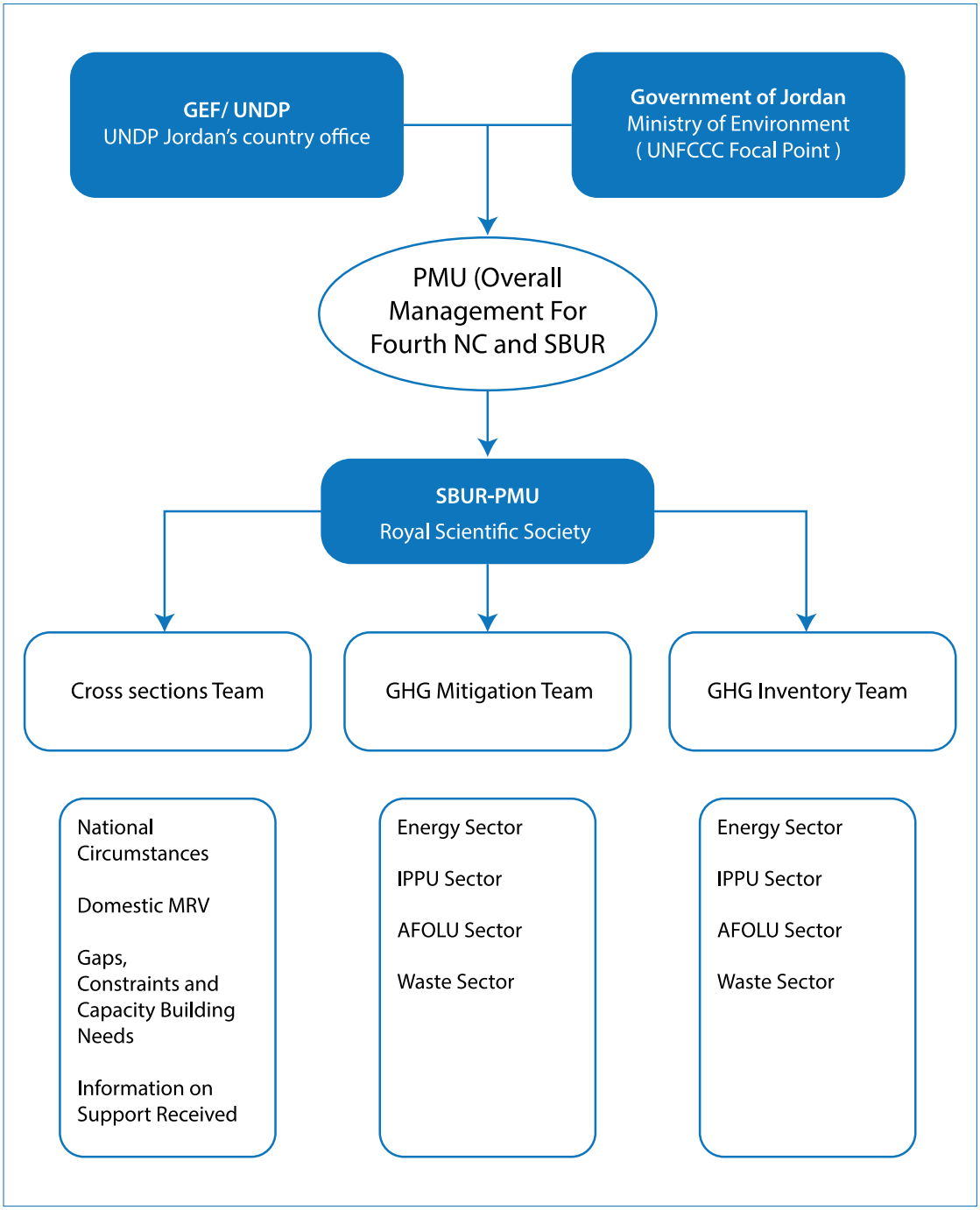


Figure 2.1: GHG inventory organizational chart

2.3 Methodology and Inventory Estimation

The national GHG emissions were estimated for the years 2016 according to 2006 IPCC Guidelines and the 2019 Refinement[1] to the 2006 IPCC Guidelines.

The estimation of the overall national inventory was carried out using the IPCC Inventory Software for Parties not included in Annex I of the UNFCCC (ver. 2.691, released on 23 January 2020).

The sectors and subsectors that were considered are the following:

1. Energy:

- Stationary Combustion,
- Mobile Combustion,
- Fugitive Emissions.

2. Industrial Processes and Product Use (IPPU):

- Mineral Industry Emissions,
- Chemical Industry Emissions,
- Metal Industry Emissions,
- Non-Energy Products from Fuels and Solvent Use,
- Emissions of Fluorinated Substitutes for Ozone Depleting Substances and Other Product Manufacture and Use.

3. Agriculture, Forestry, and Other Land Use (AFOLU):

- Cropland and Forest Land,
- Emissions from Livestock and Manure Management,
- N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application.

4. Waste Generation, Composition, and Management Data:

- Solid Waste Disposal,
- Biological Treatment of Solid Waste,
- Incineration and Open Burning of Waste,
- Wastewater Treatment and Discharge.

In May 2019 at IPCC 49th Session, the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was adopted by the IPCC in Kyoto, Japan (Decision IPCC-XLIX-9). The IPCC authors have examined a wide range of inventory methodologies and updated them, where scientific advances and new knowledge made this necessary, following the IPCC decision. The 2019 Refinement does not revise the 2006 Guidelines, but updates, supplements and/or elaborates the 2006 Guidelines where gaps or out of date science have been identified. It will not replace the 2006 Guidelines, and should be used in conjunction with the 2006 Guidelines. The structure of 2019 Refinement is the same structure as that of the 2006 Guidelines to make it easier for inventory compilers to use the 2019 Refinement with the 2006 Guidelines. It includes an Overview Chapter and five volumes (General Guidance and Reporting (GGR), Energy, IPPU, Agriculture, AFOLU and Waste). The changes are indicated in each volume as Annex "Mapping table" listing the types of refinements that have been done on the volume.

In brief, the main changes that were introduced to the different volumes are as follows:

- In Volume 1, adding a new guidance to all chapters,
- In Volume 2, introducing methodological issues in the stationary combustion and in the fugitive emissions chapters; adding new section for fuel transformation and updating emission factors. Additionally, updating the worksheet of the oil and natural gas systems,
- In volume 3, including updates for the emission factors, and adding a new section for hydrogen production,
- In Volume 4, developing new guidance, updating carbon stock change factors and developing a new tier 2 method that requires less activity data than the current default method.

1. All updates, supplements and/or elaborates on the 2006 Guidelines were identified and adopted in this chapter.

- Finally, in volume 5, updating the default data, updating the wastewater treatment chapter to reflect additional types of treatment and disposal systems.

The guidance on appropriate estimation methods within the 2006 IPCC Guidelines that includes cross-sectoral good practice guidance for inventory preparation were consulted. It includes methods for collection of activity data, key category analysis, quality assurance and control, and inventory planning and documentation.

Inventories were prepared on a gas-by-gas basis and in units of mass. Estimates of anthropogenic emissions of the direct GHGs of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) were assessed by sources and removals by sinks. Most sectors and subsectors used Tier 1.

Indirect GHGs were estimated, whenever the activity data were available, using the EMEP Guidelines and methodology.

For reporting purposes, the notation keys NO (not occurring) or NE (not estimated) and NA (not applicable) were used as necessary in the inventory reporting tables.

Emissions were estimated in Gigagrams (Gg) for all direct and indirect gases, as well as in Gg of CO_2-equivalent (CO_2eq) for all direct gases. For the conversion from Gg of different GHGs to Gg of CO_2eq, the Global Warming Potential (GWP) values provided in the IPCC Second Assessment Report (SAR) temporal horizon 100 years were used. The following sections report Jordan's GHG inventories by sector and on a gas by gas basis.

2.4 GHG Inventories by Sector

According to the overall GHG Inventory estimates, Jordan contributed 31,063.32 Gg of CO_2eq in 2016. A breakdown of Jordan's total emissions of GHGs by sector indicated that the Energy Sector is the major emitter accounting for around 76% of total national emissions followed by the Waste Sector with a contribution of around 12%. GHG emissions by sector in 2016 are shown in Table 2.1 and Figure 2.2.

Table 2.1: GHG aggregate emissions in Gg CO_2eq by sector, 2016

Categories	Emissions Gg CO_2 eq	Percentage of the overall
Total National Emissions and Removals	31,063.32	100%
Energy	23,649.47	76.13%
Industrial Processes and Product Use	3,177.42	10.23%
Agriculture, Forestry, and Other Land Use	428.71	1.38%
Waste	3,807.73	12.26%

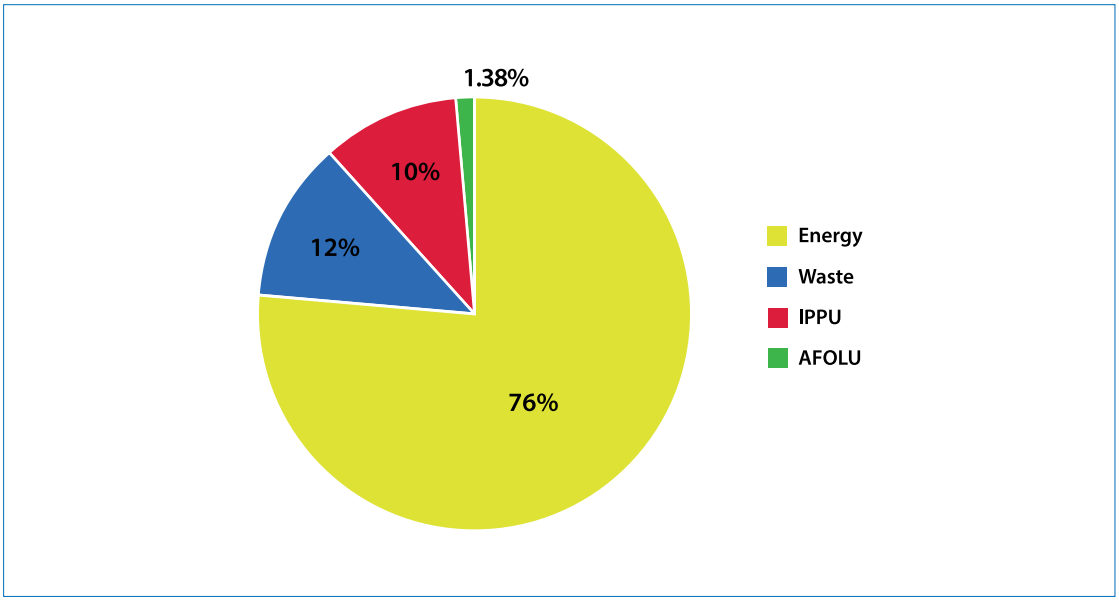


Figure 2.2: GHG aggregate emissions (%) by sector, 2016

In the sections below, a detailed description is given for the emissions resulting from the sectors in year 2016.

2.4.1 Energy sector

Jordan currently imports around 93% of its total energy comprising almost 8% of Jordan's GDP and placing a strain on its economy (MEMR, 2019). The Ministry of Energy and Mineral Resources has recently published the National Energy Sector Strategy for 2020-2030. This is a ten-year plan which aims at setting the roadmap to increase self-sufficiency through utilization of domestic natural and renewable resources, as well as expansion of existing energy developments thus reducing reliance on costly foreign fuel imports that burden its economy.

The main objectives for the energy sector as per the strategy:

- Diversification of energy sources by increasing the contribution of local energy sources to the total energy mix,
- Increasing energy efficiency in all sectors,
- Reducing energy costs for the national economy,
- Developing the energy sector system in Jordan to make it a regional centre for the exchange of energy in all its forms.

Moreover, the new National Strategy (2020-2030) identified renewable energy usage alongside other sources as follows:

- Renewable energy to contribute 31% of electricity generation by the year 2030,
- Increasing energy efficiency in the water sector by 15% by 2025,
- Improving efficient energy consumption in all sectors by 9%.

The forecast growth in renewable energy usage will enable the country to enhance energy security, to improve access to affordable energy, to create jobs, and to meet a significant part of the NDCs target by 2030. The total renewable capacity by the end of 2018 was 1,130 MW and was expected to reach 2,400 MW by the end of 2020, accounting for 20% of the generated electricity, compared to 1% in 2014 (MEMR, 2018). The largest energy consumer in 2018 was the transport sector with a 49% share followed by household, industrial and other services sectors with 21.5%, 15.5% and 14% share respectively.

Energy-related activities have a dominant share of GHG emissions in Jordan. Emissions from this sector are classified into two main categories:

- Emissions from fuel combustion,
- Non-combustion (fugitive) emissions.

GHGs Emissions in 2016

Total emissions from the energy sector were 23,649.47 Gg of CO_2eq in 2016, resulting primarily from fuel combustion activities, as shown in Table 2.2. Fugitive emissions (from oil and natural gas) were negligible, accounting for less than 2%.

Within the fuel combustion activities, major emissions resulted from the Energy Industries and Transport subsectors with shares of 37% and 38% respectively. Emissions resulting from "Manufacturing Industries and Construction" and "Other sectors" (Residential, Commercial, and Agriculture) accounted for 10% and 10% respectively of the total, as indicated in Figure 2.3.

Table 2.2: Energy sector aggregated emissions, 2016

Categories	Net CO_2	CH_4	N_2O	Aggregated emissions in (Gg CO_2 eq)
	Gg	Gg of CO_2 eq		
ENERGY SECTOR	23,054.59	439.38	155.49	23,649.47
Fuel Combustion Activities	23,032.67	60.10	155.39	23,248.15
Energy Industries	8,956.12	4.35	9.12	8,969.59
Manufacturing Industries and Construction	2,432.06	1.41	7.01	2,440.47
Transport	8,609.48	43.73	133.50	8,786.71
Other Sectors (Residential, Commercial, and Agriculture)	2,354.95	8.88	4.40	2,368.23
Non-Specified	680.06	1.73	1.36	683.15
Fugitive emissions (Oil and Natural Gas)	21.92	379.29	0.10	401.31

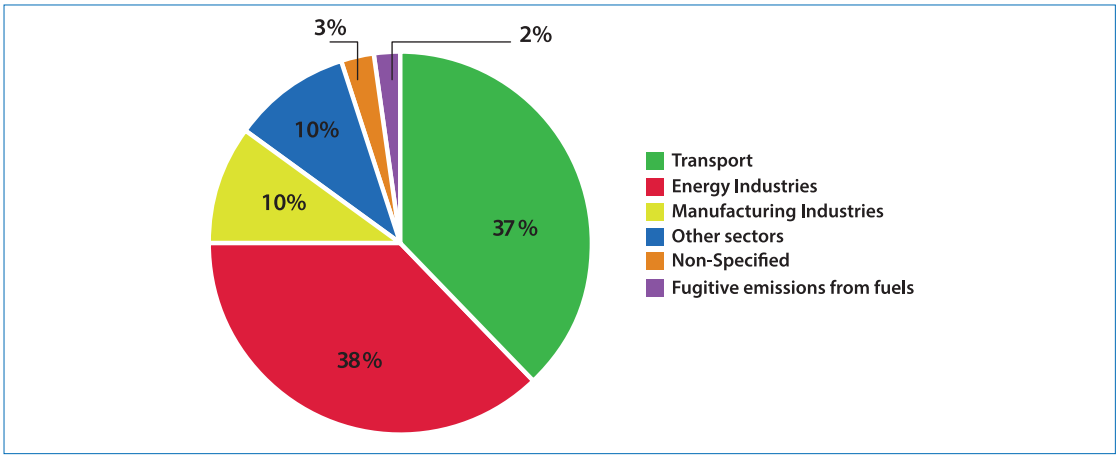


Figure 2.3: Shares of emission (%) per subsector within the energy sector, 2016

International Bunkers, 2016

As per Decision 17/CP, to the extent possible, and if data are available, non-Annex I Parties should report emissions from international aviation and international water-borne navigation separately in their inventories. Emission estimates from these sources should not be included in the national totals and should be reported only as information items. Estimated emissions (Gg) are shown in Table 2.3.

Table 2.3: Emissions reported as item information under memo 5, 2016

Emissions	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)
International Bunkers	1,221.73	0.7170	9.947
International Aviation (International Bunkers)	950.89	0.1530	7.873
International water-borne navigation (International bunkers)	270.8436	0.564	2.074

2.4.2 Industrial processes and product use (IPPU) sector

The industrial sector in Jordan is considered to be one of the main pillars for the Jordanian economy, having noticeable and multiple contributions in the economic and social development process. The industrial sector contributed directly to about 24% of the national Gross Domestic Product (GDP) during 2017, employing more than 240,000 people, most of them Jordanians, in some 18,000 industrial facilities across the Kingdom (Jordan Investment Commission, 2017).

The industrial sector consists mainly of two types, the manufacturing (converting) sector which includes the chemical, electrical, engineering and construction, food and beverages, glass and ceramic, tobacco and cigarettes, paper and cardboard, pharmaceutical and medical, printing and packaging and textile and leathers industries. The second type is the mining sector that includes phosphate, potash, salt, carbonate, lime and limestone, fertilizers, cement and construction materials production, as well as the minerals extracted from mines and quarries.

The IPPU sector in Jordan includes emissions generated from a range of mineral and chemical industries such as cement production, lime production, glass production, use of carbonates (such as limestone and dolomite), production and use of soda ash, ammonia production and nitric acid production, etc.

GHG Emissions in 2016

In 2016, emissions from industrial processes sector were 3,177.42 Gg of CO_2eq accounting for 10% of Jordan's total GHG emissions. The emissions were generated mainly from:

- Mineral Industry (mainly cement production),
- Products used as substitutes for Ozone Depleting Substances (ODS) (mainly Refrigeration, Air Conditioning, and Fire Protection),
- The Chemicals Industry (mainly Nitric Acid production Subsectors.

The IPPU sector was a source of NMVOCs emissions and accounted for 32.61 Gg. In addition to CO_2 and NMVOCs, the sector generated emissions of HFCs with 757.29 Gg of CO_2eq. Estimated emissions (Gg of CO_2eq) are shown in Table 2.4 and Figure 2.4, while Table 2.5 shows the emissions from the minerals industry subsectors of the IPPU.

Table 2.4: Emissions of industrial subsectors, 2016

Categories	CO_2	N_2O	HFCs	SF_6	**Total**	NMVOCs
	Gg	Gg CO_2 eq				Gg
Industrial Processes and Product Use	2,194.88	225.22	757.29	0.04	**3177.44**	32.61
Mineral Industry	1,816.55	NO	NA	NO	**1,816.55**	NO
Chemical Industry	NO	209.93	NO	NO	**209.93**	NO
Metal Industry (Iron and Steel Production)	361.76	NO	NO	NO	**361.76**	NO
Non-Energy Products from Fuels and Solvent Use	16.58	NA	NA	NO	**16.58**	29.28
Product Uses as Substitutes for ODS	NA	NA	757.29	NO	**757.29**	NA
Other Product Manufacture and Use (N_2O from Product Uses)	NO	15.29	NO	0.04	**15.33**	NA, NO
Other (Food and beverage Industry)	NA	NA	NA	NO	**NA**	3.33

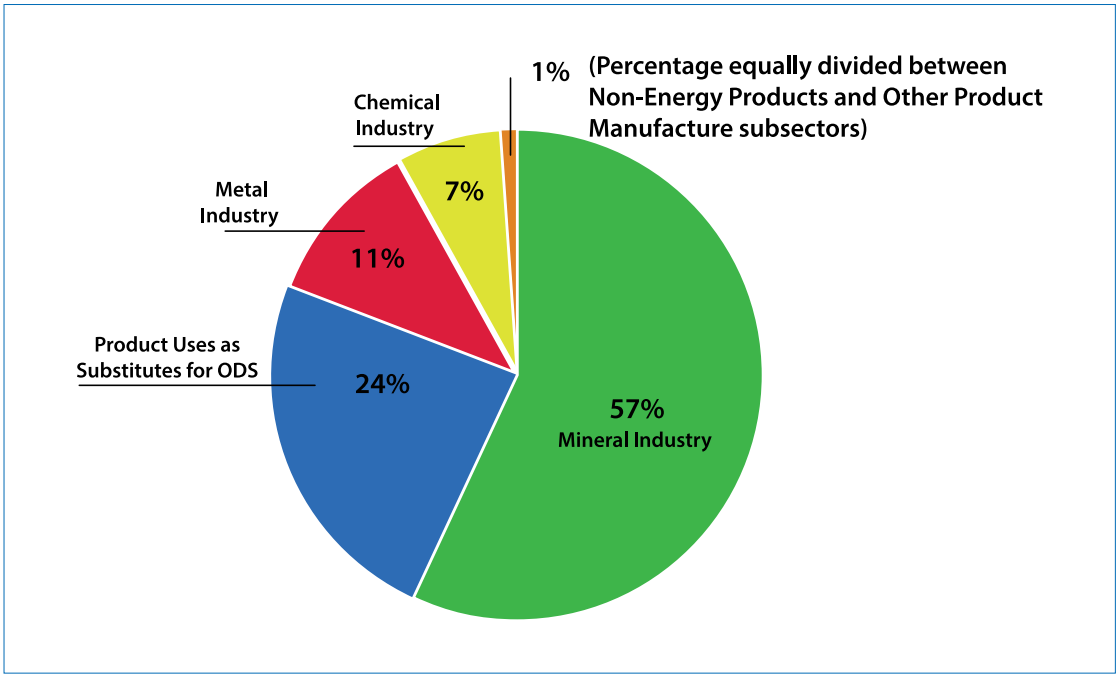


Figure 2.4: Emissions from industrial subsectors, 2016

Table 2.5: Emissions of mineral industry, 2016

Categories	Gg CO_2 eq	%
MINERAL INDUSTRY	1,816.55	100
Cement production	1,751.43	96
Lime production	NO*	NO*
Other Process Uses of Carbonates and other Uses of Soda Ash	65.12	4

* The only factory has been closed since 2012

2.4.3 Agriculture, forestry and other land use change sector

Jordanian agriculture is established in three major climatic regions: the highlands and marginal steppes where most of the rain-fed farming is practiced, the Badia (mostly livestock systems and some cultivation in watersheds and from deep bore irrigation), and the lowlands (Jordan Valley), which stretches thinly from the North West to the South West.

The highlands have a Mediterranean climate characterized by a hot, dry summer and a cool, wet winter separated by two short transitional periods. The southern and eastern parts of the country are arid with hot dry summers and cold dry winters. Temperature increases towards the south, with exceptions in some southern highlands. Precipitation is extremely variable and is confined largely to the winter and early spring seasons. It ranges from over 500mm in the highlands to less than 50mm in the east. The long-term average annual precipitation is 8,317 million cubic meters, of which, about 92.5% is lost to evaporation. The Eastern Desert (also known as the Badia) that lies east of the mountainous region and covers about 80% of the land area of Jordan has a low precipitation (the Updated Rangeland Strategy for Jordan, 2014).

According to the Ministry of Agriculture 2018 statistical report, cultivated land accounts for (2.3-2.8 million dunums). On average, irrigated areas comprise around 1 million dunums (60% of the cultivated areas), whereas on average rainfed areas make up around 1.5 million dunums (40% of the cultivated areas).

The contribution of agriculture to the GDP, in relative terms, declined sharply from 40% in the 1950s to 4.8% in 2018. Irrespective of how humble the contribution of agriculture is to GDP and economic performance, farming remains important. The importance of the agricultural sector stems from the fact that it is not only a major source of food, particularly dairy products, fruits and vegetables, but it is also a source of livelihood for around 25-30% of the total poor population (livestock keepers, smallholder farm households, and landless former agriculturalists) living in rural areas (World Bank- Technical Note, 2018).

GHG Emissions in 2016

The GHG emissions of AFOLU activities accounted for around 1.38% (428.71 Gg of CO_2eq) of Jordan's total GHG emissions in 2016, acting as a net emission source. The emissions were composed of methane and nitrous oxide and were generated by various subcategories. AFOLU emissions and removals are shown in Table 2.6 and Figure 2.5.

Table 2.6: Emissions of the AFOLU sector, 2016

Categories	Net CO_2 (Gg)	CH_4 (Gg CO_2 eq)	N_2O (Gg CO_2 eq)	Net (Gg CO_2 eq)
Agriculture, Forestry, and Other Land Use	-896.76	614.6	710.9	428.71
Livestock	NA	610	20.44	630.45
Land	-922.54	NA	NA	-922.54
Aggregate sources and non-CO_2 emissions sources on land	25.78	4.611	690.4	720.80

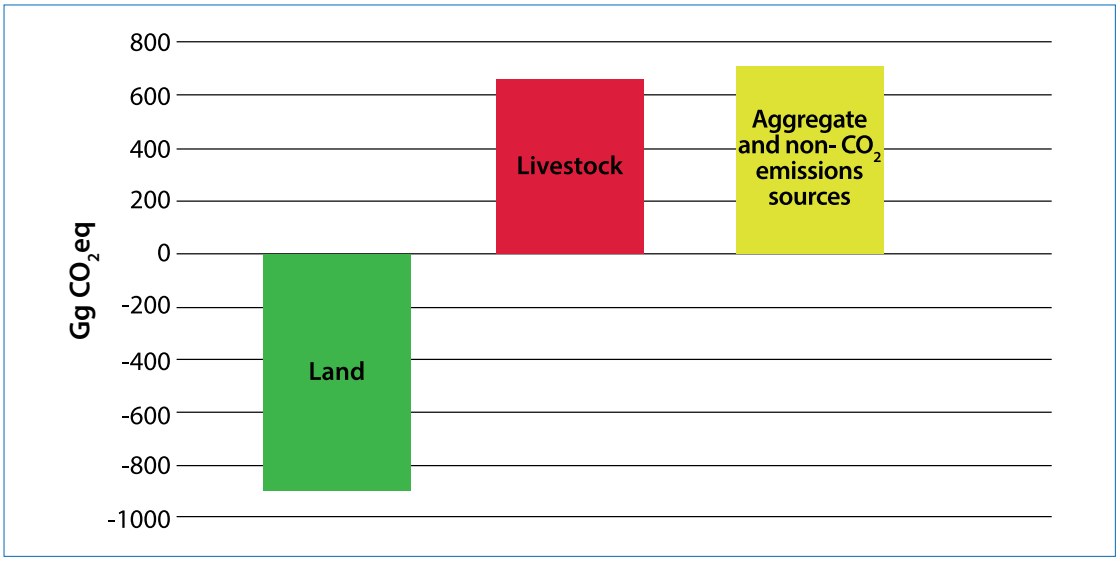


Figure 2.5: Emissions of the AFOLU sector (Gg CO_2eq), 2016

2.4.4 Waste sector

Jordan has experienced a large increase in population over the past decade as a result of a high population growth rate and enforced migration. Economic and cultural development have improved the standard of living and changed consumer habits, resulting in an increase in the volume of MSW over time. No official statistics have been disclosed regarding the increase in solid waste generation after the influx of Syrian refugees. However, preliminary official estimates refer to more than a 20-35% increase in solid waste generation in Jordan following the Syrian crisis, putting a substantial burden on municipalities as well as on the surrounding ecosystems.

MSW management, is one of the most important services provided by municipalities in Jordan. Solid waste collected from 100 municipalities is then transported to transfer stations, sanitary landfills or open dumpsites. There are 18 recorded landfills in the country, most of which are not properly designed or operated, demonstrated by their lack of proper lining, leachate collection system, and landfill gas management system. The only sanitary landfill is Al-Ghabawi landfill, which receives 50% of the waste produced in Amman and Zarqa. Al-Ghabawi landfill is located 23 km to the east of Amman, and covers an area of over 2,000 Dunums, enough to dispose waste until 2035, using safe refuse/tipping techniques. Additionally,

the Greater Amman Municipality purchased 1,000 dunums from surrounding lands to rent out to the private sector to encourage investment in waste segregation and recycling.

GHG Emissions in 2016

In 2016, GHG emissions from the waste sector reached 3,807.73 Gg of CO_2eq, accounting for 12% of Jordan's total GHG emissions. Most of the emissions were generated by domestic solid waste disposal, which accounted for around 93% (3559.01 Gg of CO_2eq) of total waste emissions, while wastewater handling accounted for 5% (188.40Gg of CO_2eq) of total waste emissions. Table 2.7 and Figure 2.6 show 2016 emissions breakdown by the waste sector.

Table 2.7: Emissions of the waste sector, 2016

Categories	CO_2 (Gg)	CH_4 (Gg CO_2 eq)	N_2O (Gg CO_2 eq)	Total CO_2eq (Gg)
Waste	32.66	3,621.50	153.58	3807.73
Solid Waste Disposal	NA	3,559.01	NA	3,559.01
Incineration and Open Burning of Waste	32.66	23.11	4.56	60.32
Wastewater Treatment and Discharge	NA	39.38	149.02	188.40

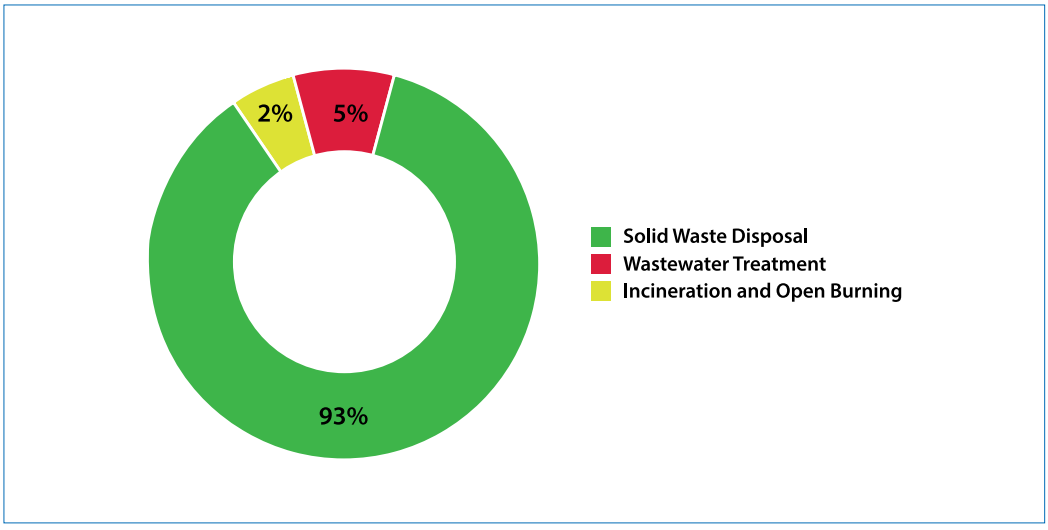


Figure 2.6: Emissions (%) by the waste sector, 2016

2.5 GHG Inventory by Gas

2.5.1 GHG Emissions in 2016

The share of carbon dioxide was the largest with a contribution of 24,385.37 Gg, accounting for 79% of all GHGs emissions, followed by CH_4 with a contribution of 4,675.49 Gg of CO_2eq at only 15%, as indicated in Figure 2.7.

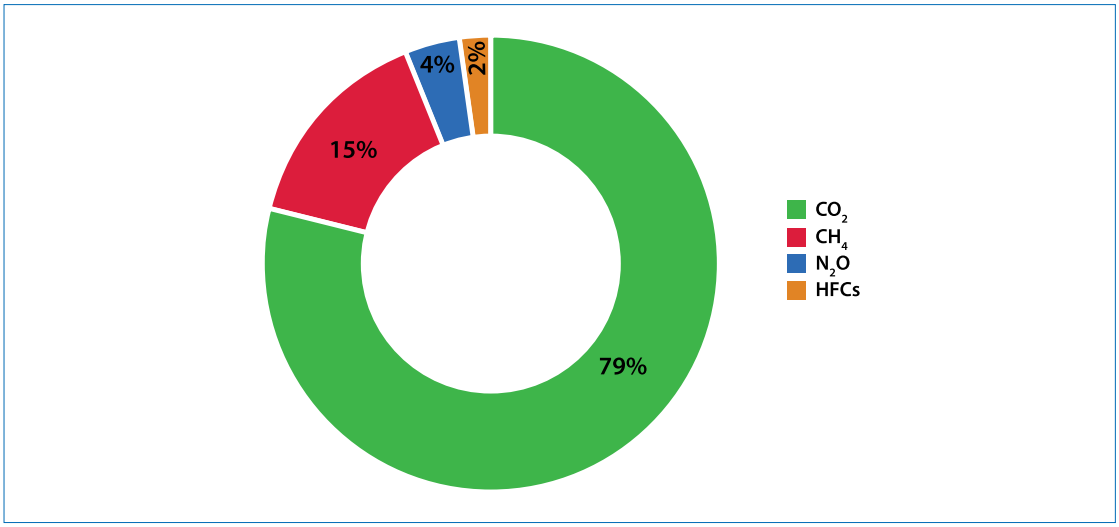


Figure 2.7: National emissions (%) by gas, 2016

In 2016, the majority of carbon dioxide emissions were produced by the energy sector accounting for 95%, followed by 9% from the IPPU sector. Methane emissions were highest from the waste sector followed by the AFOLU sector with contributions of 70% and 17%, respectively. Nitrous oxide emissions were highest from the AFOLU sector with 57%, followed by the IPPU, Energy and waste sectors, with contributions of 18%, 13% and 12%, respectively. As expected, the IPPU sector contributed 100% of HFCs while the NMVOCs emissions resulted from the IPPU and the energy sectors.

Within the energy sector, the main emissions were in the form of CO_2 (97%). Within the IPPU sector, the key GHGs were CO_2 followed by HFCs with shares of 69% and 24%, respectively. Nitrous oxide emissions were highest from the AFOLU sector, with around 57% mainly from fertilizers and manure management. Methane emissions were highest from the waste sector, with 78% and produced from solid waste management, as shown in Table 2.8 and Figure 2.8.

Table 2.8: GHG emissions (+) and removals (-) in Gg CO_2eq by Gas and by Sector, 2016

Categories	CO_2	CH_4	N_2O	HFCs	SF_6
	Gg	Gg CO_2eq			
Total National Emissions and Removals	24,385.37	4,675.49	1,245.14	757.29	0.022
Energy	23,054.59	439.38	155.49	NA	NO
IPPU	2,194.88	0.00	225.22	757.29	0.022
AFOLU	-896.76	614.62	710.85	NA, NO	NO
Waste	32.66	3,621.50	153.58	NA	NO

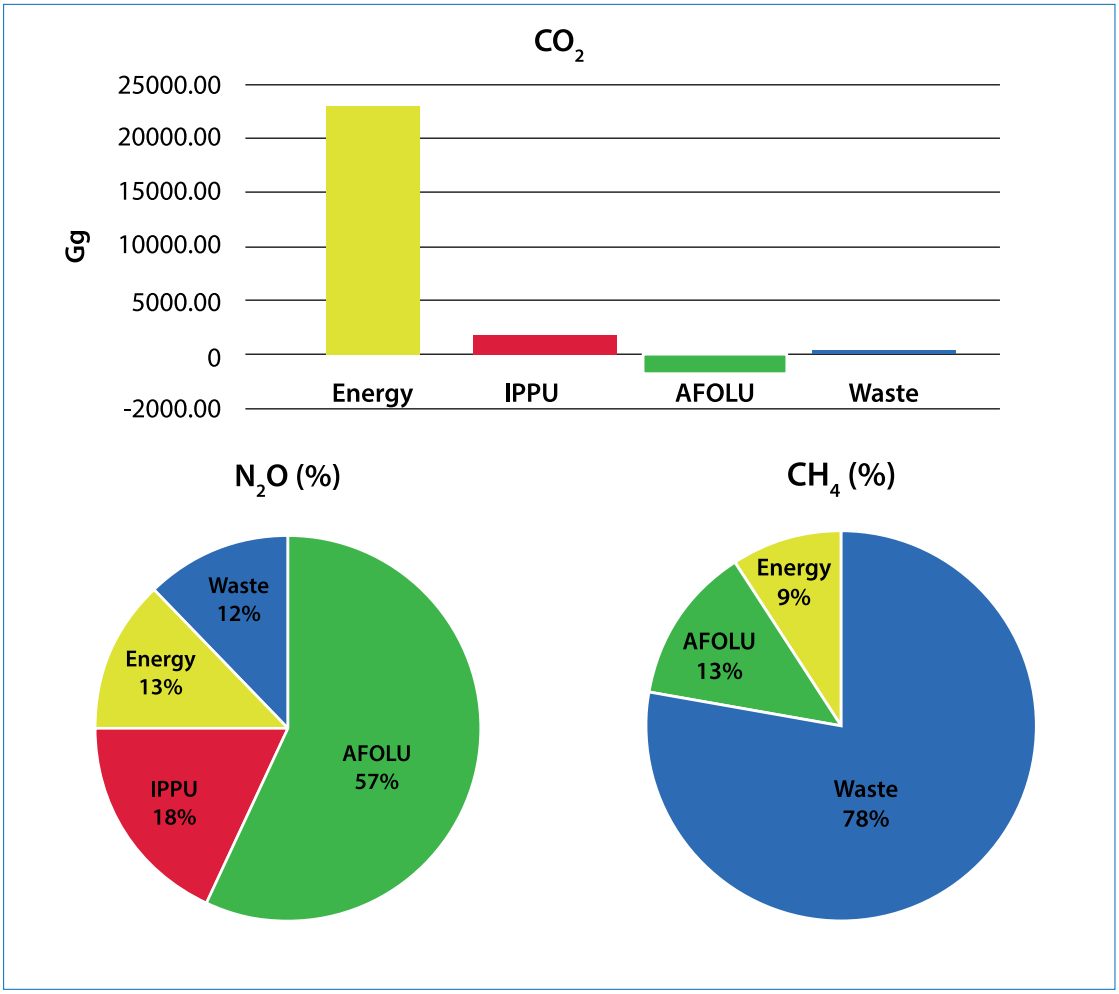


Figure 2.8: GHG emissions by gas for all sectors, 2016

2.5.2 Indirect GHGs and other gases not controlled by the Montreal Protocol

Emissions were calculated for indirect GHGs (CO, NO_x, NMVOC) and other gases not controlled by the Montreal Protocol such as (SO_x). The calculations were performed using the EMEP/EEA air pollutant emission inventory guidebook 2019. Results of 2016 are shown in Table 2.9

Table 2.9: Indirect GHGs and other gases not controlled by the Montreal Protocol, 2016

Greenhouse gas source and sink categories	CO	NOx	NMVOCs	SOx
	Gg			
Total National Emissions and Removals	46.17	131.45	57.01	0.19
1 - Energy	46.17	131.45	23.79	0.19
1A - Fuel Combustion Activities	46.17	131.45	16.87	0.19
1A1 - Energy Industries	4.68	14.1	0.36	54.25
1A2 - Manufacturing Industries and Construction	6.14	9.94	0.92	14.73
1A3 - Transport	46.17	131.45	16.87	0.19
1A4 - Other Sectors	2.16	2.35	6.04	0.01
1A5 - Other	0.84	2.77	0.19	0.0189
1B - Fugitive Emissions from Fuels	NE	NE	6.92	NE
1B1 - Solid Fuels	NO	NO	NO	NO
1B2 - Oil and Natural Gas	NE	NE	6.92	NE
2 - Industrial Processes (Food & Beverages Industry)	NO	NO	3.41	NO
3 - Solvent and Other Product Use	NO	NO	29.81	NO

2.6 Total National Emissions and Removals

Total emissions from all sectors and subsectors in 2016 as generated by the IPCC software (NAI Reporting Tables) are shown in Tables 2.10.

Table 2.10: Overall 2016 GHG inventory (NAI Reporting Table 1 and 2 from IPCC 2006 software)

Table 1-NAI Reporting: Inventory Year: 2016

Greenhouse gas source and sink categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	CO Gg	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
Total National Emissions and Removals	24,346.88	204.58	4.016	122.01	42.94	55.31	0.18
1 - Energy	23,054.60	20.92	0.5016	122.01	42.94	22.70	0.18
1A - Fuel Combustion Activities	23,032.68	2.86	0.5013	122.01	42.94	15.66	0.18
1A1 - Energy Industries	8,956.120	0.207	0.029	4.65	13.54	0.35	46.82
1A2 - Manufacturing Industries and Construction (ISIC)	2,432.063	0.067	0.023	7.95	11.42	1.14	16.76
1A3 - Transport	8,609.479	2.082	0.43	122.01	42.94	15.66	0.18
1A4 - Other Sectors	2,354.952	0.423	0.014	6.65	6.87	1.75	0.39
1A5 - Other	680.062	0.082	0.004	0.72	2.30	0.20	0.0162
1B - Fugitive Emissions from Fuels	21.93	18.0614	0.0003	NE	NE	7.04	NE
1B1 - Solid Fuels	NO	NO	NO	NO	NO	NO	NO
1B2 - Oil and Natural Gas	21.925	18.0614	0.0003	NE	NE	7.04	NE
2 - Industrial Processes	2,178.31	NA	0.677	NO	NO	3.33	NO
2A - Mineral Products	1,816.55	NA	NA	NO	NO	NA	NO
2B - Chemical Industry	NA	NA	0.677	NO	NO	NA	NO
2C - Metal Production	361.76	NA	NA	NO	NO	NA	NO
2D - Other Production	NA	NA		NO	NO	NA	NO
2E - Production of Halocarbons and Sulphur Hexafluoride				NO	NO	NA	NO
2F - Consumption of Halocarbons and Sulphur Hexafluoride				NO	NO	NA	NO
2G - Other (Food and Beverages Industry)	NO	NO	NO	NO	NO	3.33	NO
3 - Solvent and Other Product Use	16.575	NO	0.049	NO	NO	29.28	NO
4 - Agriculture		29.048	2.293	NE	NA	NA	NA
4A - Enteric Fermentation		27.337		NA	NA	NA	NO
4B - Manure Management		1.711	0.069	NA	NA	NA	NO
4C - Rice Cultivation		NO		NO	NO	NO	NO
4D - Agricultural Soils			2.224	NA	NA	NA	NO
4E - Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO
4F - Field Burning of Agricultural Residues		NA	NA	NE	NE	NE	NE
4G - Other (please specify)				NO	NO	NO	NO
5 - Land-Use Change & Forestry	-922.543	0.2197	NA	NA	NA	NA	NA
5A - Changes in Forest and Other Woody Biomass Stocks	-922.543			NA	NA	NA	NO
5B - Forest and Grassland Conversion	NA	NA	NA	NA	NA	NA	NO

Greenhouse gas source and sink categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	CO Gg	NO_x (Gg)	NMVOCs (Gg)	SO_x (Gg)
5C - Abandonment of Managed Lands	NA			NA	NA	NA	NO
5D - CO	NA		NA	NA	NA	NA	NO
5E - Other (biomass burning)	NA	0.2197	NA	NA	NA	NA	NA
6 - Waste	32.66	172.45	0.50	NO	NO	NO	NO
6A - Solid Waste Disposal on Land		169.48		NA	NA	NA	NO
6B - Wastewater Handling		1.88	0.481	NA	NA	NA	NO
6C - Waste Incineration	1.87	NE	NE	NA	NA	NA	NO
6D - Other (open burning)	30.797	1.10	0.015	NA	NA	NA	NO
7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
Memo Items							
International Bunkers	1,221.732	0.031	0.034	NE	NE	NE	NE
1A3a1 - International Aviation	950.889	0.007	0.027	NE	NE	NE	NE
1A3d1 - International Marine (Bunkers)	270.844	0.025	0.007	NE	NE	NE	NE
Multilateral operations	NO	NO	NO				
CO_2 emissions from biomass	54.984						

Table 2-NAI Reporting: Inventory Year: 2016

	HFC			PFC			SF_6
Greenhouse gas source and sink categories	HFC-23 (Gg)	HFC-134 (Gg)	Other ($Gg-CO_2$)	CF_4 (Gg)	$C2F_6$ (Gg)	Other ($Gg-CO_2$)	SF_6 (Gg)
Total National Emissions and Removals	NA	NA	757.29	NE	NE	NE	0.000001
1 - Energy							
2 - Industrial Processes	NA	NA	757.29	NE	NE	NE	0.000001
2A - Mineral Products							
2B - Chemical Industry							
2C - Metal Production	NA	NA	NA	NE	NE	NE	NA
2D - Other Production							
2E - Production of Halocarbons and Sulphur Hexafluoride	NA	NA	NA	NE	NE	NE	NA
2F - Consumption of Halocarbons and Sulphur Hexafluoride	NA	NA	757.29	NE	NE	NE	0.000001
2G - Other (please specify)							
3 - Solvent and Other Product Use							
4 - Agriculture							
5 - Land-Use Change & Forestry							
6 - Waste							
7 - Other (please specify)							

2.7 Reference Approach

The Reference Approach and the Sectoral Approach often yield different results because the Reference Approach is a top-down approach using the country's energy supply data and has no detailed information on how the individual fuels are used in each sector. This approach provides estimates of CO_2 to compare with estimates derived using a Sectoral Approach. The Reference Approach provides an upper bound to the Sectoral Approach '1A Fuel Combustion', because some of the carbon in the fuel is not combusted but is released as fugitive emissions (as leakage or evaporation in the production and/or transformation stage). Calculating CO_2 emissions with the two approaches can lead to different results for some countries.

The Reference Approach was used to calculate energy sector emissions in 2016 and the results were compared to those of the Sectoral Approach. The gap between the two approaches should be relatively small (5% or less). For Jordan, the calculated differences were acceptable; less than 5%, as indicated in Table 2.11.

Table 2.11: Reference approach vs sectoral approach for the year 2016

Year	Reference Approach	Sectoral	Difference
	CO_2 Emissions (Gg)		%
2016	24,017.75	23,043.18	4.23

GHG emissions were also estimated using the Reference Approach for the time series (2013-2016) (Table 2.12 and Figure 2.9).

The outcomes indicated a steady increase in the energy consumption for 2013-2016, and an unexpected decrease in 2015 emissions was noticed which was due to a change in the energy mix of electricity generation in the form of using natural gas a less carbon intense fuel than Diesel.

Table 2.12: Energy consumption and emissions for the time series (2013-2016)

Year	Energy Consumption (TJ)	CO_2 (Gg)
2013	317,581.57	22,772.64
2014	327,784.75	24,136.90
2015	345,185.21	23,936.91
2016	379,660.75	24,017.75

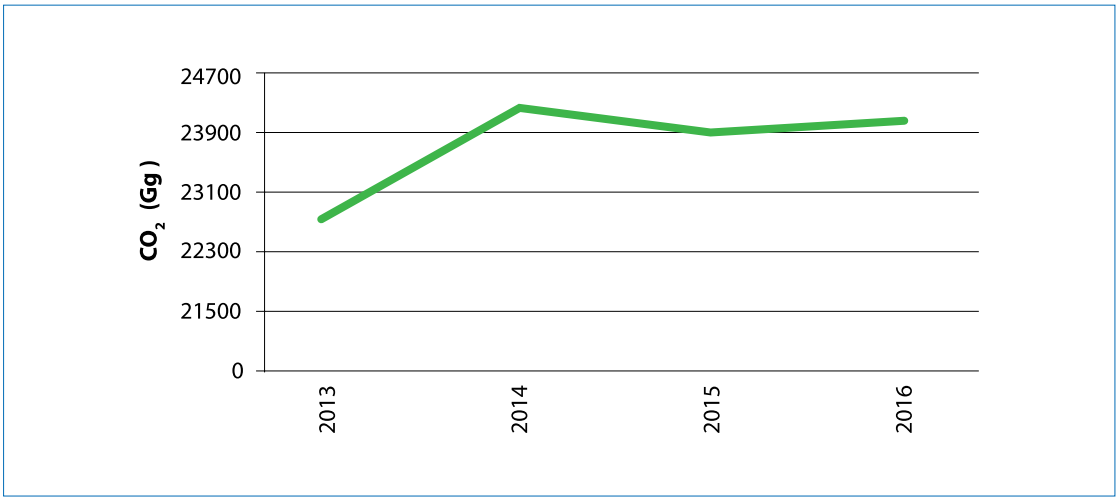


Figure 2.9: Variations in emissions for the time series (2013-2016)

2.8 Time Series and Comparison between Current and Previous Inventories

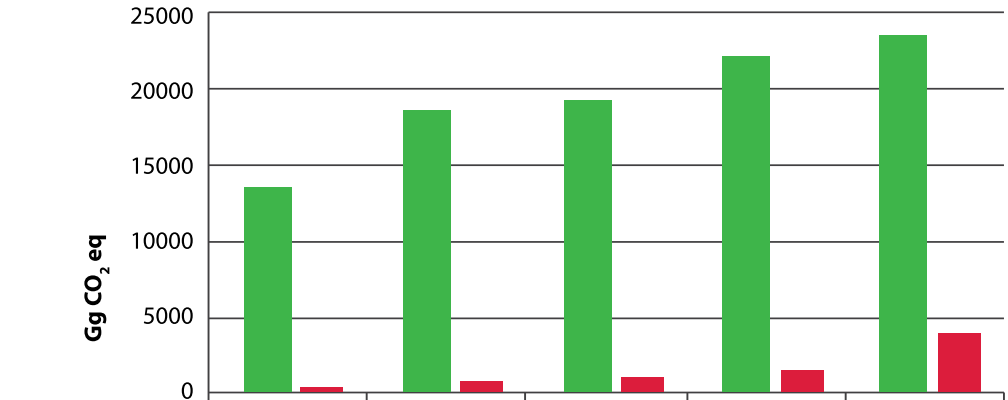
The time series is a central component of the greenhouse gas inventory because it provides information on historical emissions trends and tracks the effects of strategies to reduce emissions at the national level. As is the case with estimates for individual years, emission trends should be neither over nor underestimated as far as can be judged.

All emissions estimates in a time series should be estimated consistently, which means that as far as possible, the time series should be calculated using the same method and data sources in all years. Using different methods and data in a time series could introduce bias because the estimated emission trend will reflect not only real changes in emissions or removals but also the pattern of methodological refinements. Chapter five, volume one of the 2006 IPCC Guidelines was consulted in terms of good practices ensuring time series consistency.

Recalculations were carried out for the years 2010 and 2012. Also, techniques for combining or "splicing" different methods or data sets to compensate for incomplete or missing data were used for estimating years the 2000 and 2006.

Figure 2.10 and Table 2.13 provides an overview of time series estimation:

- As expected, an increase in GHG emissions was noticed between the different years due to population growth and increased economic activities,
- The category 1.B - Fugitive emissions from fuels for the years 2010 and 2012 were recalculated using the correct emissions factor for onshore - developing country and this resulted in new figures (from 1.02 and 1.26 Gg CO_2eq to 235.98 Gg CO_2eq and 336.75 Gg CO_2eq respectively),
- Also, the 2.D - Non-Energy Products from Fuels and Solvent Use category was recalculated for the years 2010 and 2012 due to an error in emission factor unit conversion. Results were modified from 208.80 Gg CO_2eq and 226.88 Gg CO_2eq to 2.85 Gg CO_2eq and 3.09 Gg CO_2eq,
- All sectors for 1994 will be calculated as part of the third BUR. Collecting data was challenging due to difficulties in getting the activity data in due time,
- The IPPU and AFOLU sectors for the years 2000 and 2006 were not estimated due to difficulties in getting the activity data in due time. Recalculation will be carried out as part of the third BUR.



	2000	2006	2010	2012	2016
Energy	14016.09	18508.44	19260.38	22823.63	23649.47
Waste	811.52	1271.36	1567.49	1635.14	3807.73

Figure 2.10: Comparison between time series for the energy and the waste sectors

The above figure illustrates a comparison between the energy and waste sectors for the years of 2000, 2006, 2010, 2012, and 2016. There is a normal trend of increase through the various years that could be attributed to population increase and economic growth.

Table 2.13: Comparison between a time series of National GHG Inventories

Categories/Years	2000	2006	2010	2012	2016
	Gg CO_2 eq				
Total National Emissions and Removals	**14,827.61**	**19,779.8**	**23,170.94**	**28,110.71**	**31,063.32**
1 - Energy	14,016.09	18,508.44	19,260.38*	22,823.63*	23,649.47
2 - Industrial Processes and Product Use	NE**	NE**	1,776.09*	3,144.71*	3,177.42
3 - Agriculture, Forestry, and Other Land Use	NE**	NE**	180.5	237.29	428.71
4 - Waste	811.52	1,271.36	1,567.49	1,635.14	3,807.73
Memo Items (5)					
International Bunkers	523.53	905.40	1,078.11	1,110.02	4,320.36
1.A.3.a.i - International Aviation (International Bunkers)	519.04	734.85	1,016.41	1,044.24	3,394.73
1.A.3.d.i - International water-borne navigation (International bunkers)	4.49	162.49	52.2602	56.0552	925.63
1.A.5.c - Multilateral Operations	NO	NO	NO	NO	NO

* These categories have been recalculated
** These categories were not estimated (they will be estimated as part of the third BUR)

2.9 Key Category Analysis

The key category analysis is an essential element for inventory development and a driving factor to improve its quality. Non-Annex I Parties are encouraged (Decision 17/CP.8), to the extent possible, to undertake any key category analysis to assist in developing inventories that better reflect their national circumstances. The analysis was carried out based on IPCC 2006 Guidelines and Software. Jordan used "level" key category analysis where the contribution of each source or sink category to the total national inventory level was calculated. The key categories according to the guidelines are those that, when summed together in descending order of magnitude, add up to 95% of the sum of all level assessment.

In categories that are identified as key, parties should try to use a recommended method, in accordance with the corresponding decision tree in the 2006 IPCC Guidelines. It is recommended that Jordan searches for alternatives to gradually apply in future inventory submissions, to the extent possible and based on software readiness and national circumstances, Tier 2 methods in the categories identified as key.

As shown in Table 2.14 for the year 2016, the key category analysis resulted in thirteen subcategories; the top four accounting for around 64.9% of all emissions, were:

- Fuel Combustion Activities subcategories: Energy Industries (Gaseous Fuels), Road Transportation, Energy Industries (Liquid Fuels), and other sectors (commercial/institutional and residential-Liquid Fuels),
- The solid waste management subcategory.

Table 2.14: Key category analysis (level assessment), 2016

A	B	C	D	F	G
IPCC Category code	IPCC Category	GHG	2016 Emissions CO_2eq (Gg)	2016 Emissions Level from the Given Category	Cumulative Total % of Column F
1.A.3.b	Road Transportation	CO_2	8566.56	0.26	26.4%
1.A.1	Energy Industries - Gaseous Fuels	CO_2	6495.61	0.20	46.3%
4.A	Solid Waste Disposal	CH_4	3559.01	0.11	57.3%
1.A.1	Energy Industries - Liquid Fuels	CO_2	2460.51	0.08	64.9%
1.A.4	Other Sectors - Liquid Fuels	CO_2	2365.46	0.07	72.1%
2.A.1	Cement production	CO_2	1751.43	0.05	77.5%
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	1669.84	0.05	82.7%
3.B.1.a	Forest land Remaining Forest land	CO_2	-922.77	0.03	85.5%
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	762.23	0.02	87.9%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	737.23	0.02	90.1%
1.A.5	Non-Specified - Liquid Fuels	CO_2	680.06	0.02	92.2%
3.A.1	Enteric Fermentation	CH_4	574.08	0.02	94.0%
3.C.4	Direct N_2O Emissions from managed soils	N_2O	510.55	0.02	95.6%

2.10 Uncertainty Analysis

The uncertainty analysis is one of the main activities of the inventory process. Uncertainty information is intended to help prioritize efforts to improve the accuracy of inventories and guide decisions on the methodological choice.

The analysis was carried out based on IPCC 2006 Guidelines and Software. "Approach 1: Propagation of Error" was used. Approach 1 is based upon error propagation and is used to estimate uncertainty in individual categories in the inventory as a whole, and in trends between 2016 and the base year 2010. The uncertainty analysis was based on Tier 1 approach and covers all source-categories and all direct greenhouse gases. The uncertainty estimation for the activity data and emission factors was based on typical values of the IPCC.

The results indicate that net emissions in 2016 were 26,794.86 Gg of CO_2eq with an uncertainty of ±5%, which corresponds to a 95% probability

range of 27,598.71 to 25,991.01 Gg of CO_2eq. Based upon the total base year of 2010 and year 2016 inventories, the average trend is a 34% increase in emissions from 2010 to 2016. The uncertainty in the trend is ±4% (percentage points), which corresponds to a 95% probability range for the trend with respect to base year emissions.

2.11 GHG Inventory Quality Control/Quality Assurance and Review

Jordan acknowledges the need for having a manual for national QC/QA procedures for GHG inventory estimation. This has been listed in Jordan's future improvement plans (section 2.12). Also, during the preparation of the GHG Inventories, the inventory team and the BUR project management team carried out the following tasks:

- Overall assessment technical reviews, and accuracy checks performed by the compilers to ensure consistency, accuracy, completeness and avoid double counting,
- Checking the accuracy of data input from the original references and confirm that correct references were used as well as ensuring that no transcription errors exist,
- Checking that parameter and emission units are correctly recorded and that appropriate conversion factors are used and checking as well for consistency if more than one expert used same conversions and factor among various subsectors,
- Checking that the movement of inventory data among processing steps is correct,
- Checking that there is detailed internal documentation to support the estimates and enable full reconstruction of the estimate,
- Checking that inventory data are archived and stored to facilitate detailed review,

In terms of quality assurance the national GHG inventory chapter was subjected to an international review which was coordinated by the UNDP-UNEP Global Support Program (GSP) and was conducted from 7 to 13 October 2020 by Dr. Carlos López, consultant in national GHG emissions inventories. The review examined mainly the adherence of the inventory chapter to the requirements indicated in the UNFCCC Decision 17/CP.8 Annex, the UNFCCC Decision 2/CP.17 Annex III, and to the advice of the IPCC Guidelines and Guidance. The outcomes of the review resulted in several direct actions to improve the chapter and an inventory future improvement plan (IIP); described in details in the following section.

2.12 Future Improvement Plan

Several actions were identified by the GSP reviewer. The improvements are listed below and are rated according to urgency as; immediate, short term and long term actions:

- The activity data used in the estimate, especially in the subcategories identified as key or significant , should be improved as much as possible, in order to use tier 2. Also, actions to improve data, methods, EF and other estimation parameters (OEP) should be prioritized in key categories to use tier 2 (especially in the subcategory 2F1a, 4A Solid Waste Disposal, 3A1c Sheep and 3B Land). **(short term and long term**),
- The documentation boxes and worksheet remarks included within the software should be added. **(short term**),
- The completeness of the inventory should be improved by: **(short term to long term**),
  - Improving the estimation and reporting of precursor gas emissions in future inventory submissions (activity data and EF are mostly available),
  - Incorporating among the precursor gases, the estimation of NH_3 emissions. This would make it possible to calculate in category 5A the indirect N_2O Emissions derived from the atmospheric deposition of Nitrogen from non agriculture sources,
  - The precursor gas emissions of these subcategories from the second order subcategories 1.A.3.a.i - International aviation

and 1.A.3.d.i - International water-borne navigation (international bunkers) should be estimated and should be reported; using the notation key NE (not-estimated) in the reporting tables, as necessary,

- The key analysis -trend assessment should be used after improving issues related to the time series of the inventory. Also, qualitative criteria should be applied to the categories located at the threshold of 95-97% of cumulative emissions. (short term),
- Prepare a QA/QC and verification plan and manual for the coming inventory (short term).

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AlHusseini Mosque

3 GREENHOUSE GAS MITIGATION ANALYSIS

3.1 Introduction and Methodology

As per decision 2/CP17 Annex III- "UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention" paragraph IV describing what should be included in the mitigation actions section:

- Non-Annex I Parties should provide information, in a tabular format, on actions to mitigate climate change, by addressing anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol,
- For each mitigation action or groups of mitigation actions, Parties shall provide the following information, to the extent possible:

a. Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals and progress indicators;

b. Information on methodologies and assumptions;

c. Objectives of the action and steps taken or envisaged to achieve that action;

d. Information on the progress of implementation of the mitigation actions and the underlying steps taken or envisaged, and the results achieved, such as estimated outcomes (metrics depending on type of action) and estimated emission reductions, to the extent possible;

e. Information on international market mechanisms.

- Parties should provide information on the description of domestic measurement, reporting and verification arrangements. (Detailed in chapter4 of this report).

Based on the above requirements, this chapter has been prepared to update the baseline scenario and the FBUR mitigation measures as briefly described in the following paragraphs.

- Update of the baseline scenario: A baseline scenario reflects a future in which there are no policies or programs designed to encourage or require actions that reduce GHG emissions or enhance carbon sinks.

  The FBUR baseline scenario was updated for all economic sectors of energy, industry, agriculture and forestry in addition to the waste sector, based on the strategies, policies and plans prevailing in the Jordanian context during the time of preparation of this SBUR (2020). This requires a projection of the current levels to future levels of each type of activity. The newly released strategies, policies, action plans and committed projects were reviewed and summarized. In addition, all projects and actions that were part of FBUR baseline scenario were reviewed to update their status. Based on this review, the most probable future trends in activities that will impact and shape the GHG emissions are highlighted.

Strategies, policies and action plans that were reviewed to prepare the updated baseline scenario include:

- The new Energy National Strategy for 2020-2030, issued in April 2020,
- The 2020-2025 National Agricultural Development Strategy, issued in August 2020,
- The new solid waste management framework law issued in March 2020 and entered in force in September 2020,
- National Renaissance Plan (2019-2020), issued in 2018,
- Jordan Economic Growth Plan (2018-2021), issued in 2017,
- The Industrial Policy (2017-2021), issued in 2016,

- Update of FBUR mitigation measures: All FBUR mitigation projects were reviewed and assessed to identify all those still valid. The valid projects were updated, after adjustments were made in their expected implementation timeline. The emission reduction and the unit cost of emission reduction for each mitigation project have been recalculated taking into consideration several factors such as the

improvement in technologies and changes in prices. Net present value was used in the financial calculations, by converting all present and future revenues and costs over the project's lifetime to a base of today's cost. The same approach was followed in calculating the CO_2eq emissions reduction over the lifetime of the mitigation projects. A discount rate of 8% was used for both the cost and emission reduction calculations. Also, the discounted unit cost of reduced emission reduction was calculated as the quotient of the discounted cost in JD to the discounted emission in tonnes CO_2. The updated FBUR mitigation projects include 23 GHG mitigation measures in the sectors and subsectors of primary energy, renewable energy, energy efficiency, industries, domestic solid waste and wastewater, and agriculture and forestry.

3.2 Baseline Scenario for the Different Sectors

3.2.1 Baseline scenario for the energy sector

A. The Current Status of the Infrastructure Energy Projects Listed in the FBUR

A.1 The delayed energy infrastructure projects

Expansion of Jordan Oil Refinery Project

A decision was made to implement an expansion to Jordan Petroleum Refinery Company (JPRC), in order to improve the specifications of the petroleum products and to convert heavy petroleum derivatives to light products. Having an environmental management system is a requirement from the IFC to grant the JPRC loan for expansion. Early 2020, the Refinery Company published a call for services, specifically to undertake the planning of an environmental management system, that includes environmental impact assessment, environmental audit, health and safety and risk assessment. Due to COVID-19, the implementation of this assessment was delayed and accordingly the expansion has been delayed. The expected date of completion for the project is now 2025, instead of 2022.

Construction of the Iraqi Crude Oil Pipeline

Due to the political situation in the region a delay occurred in the construction of the Iraqi crude oil pipeline, which was supposed to transport Iraqi crude oil across Jordanian territory to the export terminal in Aqaba with a capacity of 1 million barrels/day, in addition to a branch to supply Jordan Oil Refinery with 150 thousand barrels/day. The date of completion for the construction and operation of the pipeline is expected to be 2027 instead of 2022.

Oil shale surface retorting projects

All the companies working in surface retorting of oil shale are still unable to fulfill the agreed obligations in their production schedules, due to changes in economic feasibility. All the oil shale companies have been asked to postpone their project development period some of the oil shale companies have closed.

Nuclear Power Plant of 1,000 MW

In February 2019, the Ministerial Council took a decision to cancel the construction of the nuclear power plant with a proposed capacity of 1,000 MW, which was planned to be operational and contributing to the electricity system in 2023. This is due to the over committed electricity generation capacity in terms of MW. The council decided to consider the introduction of smaller reactors instead.

The third round of the renewable energy projects

The decision was taken in the Ministry of Energy and Mineral Resources to delay the third round of the renewable energy projects which consists of four 50 MW solar and two 50 MW wind projects due to the decrease in the growth rate of electricity demand, which was 0-1.5% during the period 2017-2019, and due to the over-committed generation capacity in terms of MW.

A.2 The completed infrastructure projects

Many infrastructure projects, policies, laws and bylaws have witnessed successful implementation as follows.

Crude oil and oil products storage

All of the strategic projects to increase the storage capacities of crude oil and oil products were completed on EPC basis and put in operation as planned at the end of 2017, these projects are listed below:

- Construction of 100 thousand tonnes storage capacity for crude oil in Aqaba,
- Construction of strategic storage capacities for light oil products with a capacity of 250-300 thousand tonnes, and 8 thousand tonnes for LPG in Almadonah area, in central Jordan,
- Establishment of the Oil Logistics Company in 2017 to secure the strategic storage capacity of oil and oil products needed for the country.

Electricity generation and transmission projects

- The new Zarqa Power Plant Project was completed, with a capacity of 485 MW, at the site of the previous Hussein Power Plant. The plant owned by ACWA Power Company, operates mainly on natural gas as primary fuel and diesel as secondary fuel. The project was successfully completed and put into operation in the year 2019.
- The first electric power plant using coke and coal was completed in Al Karak governorate of Jordan, with a generation capacity of 30 MW. The plant is equipped with the latest equipment and technologies in addition to the adherence to the internationally recognized environmental standards. The plant was put into operation in 2018.
- In mid-2019, the Green Corridor Project was completed and put into operation. The project's aim is to transmit between 800-1,000 MW of electricity from renewable energy sources, from the south to the load centres in other regions in Jordan. This project will accommodate electrical power generated from new renewable energy sources.

Natural gas projects

The construction of the natural gas pipeline in the north of Jordan, designed to import natural gas from Nobel Energy Company was completed in 2020. The pipeline was constructed according to the agreement signed between the National Power Company (NEPCO) and Nobel Energy in 2018.

Renewable energy projects

A remarkable achievement in the completion of renewable energy projects for electricity generation has been achieved. All the renewable energy projects listed and considered in the baseline scenario in the FBUR and planned to be executed by the end of 2019, were completed in due time, as planned.

By the end of 2019, 850 MW of solar and 375 MW of wind projects were connected to the grid, including 150 MW net metering projects and 130 MW wheeling projects. Table 3.1 illustrates the completed renewable projects as of the end of 2019.

Table 3.1: The completed renewable energy projects (capacities more than 5MW) as of the end of 2019

	Project	Status	Date of operation	Capacity
Wind Energy				
1	Wind Project at Tafila	In operation	Sept. 2015	117 MW
2	Wind Project at Ma'an / Gulf Grant	In operation	March 2016	80 MW
3	First round of direct proposal - Al rajaf project - Fujeej project	In operation	Mid 2018	 82 MW 90 MW
Solar PV				
4	Solar PV Project at Mafraq	In operation	2015	10 MW
5	Solar PV Project at Azraq/ Spanish Grant	In operation	March 2016	5 MW
6	Solar PV Projects/Direct Proposal Submission- Stage I/ 12 Projects - 9 of which in Ma'an	In operation	2016-2017	200 MW
7	Solar PV Projects/Direct Proposal Submission- Stage II- North & east parts of Kingdom	In operation	2016-2017	200 MW
8	Solar PV Project at Qweira / Gulf Grant	In operation	March 2018	100 MW
9	Second round of the direct proposal. Mafraq project	In operation	Mid 2018	100 MW
10	Large industrial (Lafarge project)	In operation	2019	15 MW

A.3 The energy infrastructure projects currently under construction.

Al-Attarat oil shale project.

The first electric power plant with direct burning of oil shale is being implemented with a generating capacity of 470 MW and an investment cost of 2.2 billion US $. The first unit, with a capacity of 235 MW was expected to be operational in October 2020 but was delayed due to COVID-19 conditions while the second unit with the same capacity will be operational in mid-2021.

The renewable energy projects

All the renewable energy projects that were listed in the energy baseline scenario in the FBUR proposed to become operational during the period 2020 -2025 are currently being implemented, except the third round of direct proposals consisting of four 50 MW solar energy two 50 MW wind energy installations, which were canceled as mentioned earlier. Table 3.2 illustrates the renewable energy projects under construction.

Table 3.2: The renewable energy projects under construction

	Project Name		Capacity (MW)	Operation Date
Wind Energy projects	First round of the direct offers: - Shobak project (45) MW - Mas project (100) MW - Daihan project (51) MW - El-Abour project (51) MW		247	 - Fourth quarter of 2020 - July 2020 - Second quarter 2021 - Second quarter 2021
Solar Energy projects	Second round of the direct offers: Mafraq development projects (50) MW Al Safawi project (50) MW		100	Fourth quarter of 2019
	Baynouna project		200	Fourth quarter of 2020
	Al-Risha PV Project		50	Fourth quarter of 2019
	East Amman Project		40	Fourth quarter of 2019
	AL-Qatranna PV Project		30	Waiting to sign the PPA
	AL-Hussiniha (Philadelphia) PV Project		50	Second quarter 2021
	Al-Haq PV Project		50	Mid 2023
	Universities Projects		40	2022
	Wheeling Projects/ NEPCO's Transmission Grid		370	2023
	Medium Industries		100	2023/2024
	Small Solar Systems(less than 5 MW)	Net Metering Projects	150	2022
		Wheeling Projects	130	2022

B. The Energy Baseline Scenario in the SBUR for the Period 2016-2066

In order to build the energy demand and supply baseline scenario in the SBUR, several matters and issues which will affect and drive the energy scenario will be considered. The most important of these are as follows.

B.1 The over commitment of electricity generation capacity in the country

The generation capacity of thermal power plants as of the end of September 2019 reached (4,257 MW) and while the generation capacity of renewable energy projects (solar and wind) reached (1,130 MW). Comparatively the maximum peak load for the first half of 2019 was around 3,000 MW.

This volume of available generating capacity is large compared to the maximum peak load and even, considering the capacity of conventional generation stations only, exceeds it by 30%.

This is in contrast to the internationally recognized practices in this industry, which has limits of 10% -15%, especially in electrical systems that are connected to electric networks similar to the Jordanian network. This causes significant costs for the electrical system, since there is a commitment to pay for the cost of capacity for the power stations,

even if their operation is suspended, according to the Energy Purchase Agreement, which is based on the principle of take or pay. Continuous operation of the power stations is not needed as a result of the decline in growth rates in electricity demand due to many reasons, among these:

- A high growth rate for the peak load of 6.2% annually was adopted in the electrical system expansion planning. However, the actual growth rate during the three years of (2017-2019) ranged between (0% - 2%). This was a result of consumers' tendency to increase the use of energy-saving technologies, and to expand dependence on self-generation through small and large renewable energy projects, and
- Economic growth decline as a result of political conditions in the region.

B.2 The new National Energy Strategy for the period 2020-2030

The Ministry of Energy issued a new energy strategy for the period 2020-2030 and it was approved by the Ministerial Council in March 2020 together with a framework implementation plan. The new energy strategy re- estimated the annual growth rate of the primary energy demand for the period 2020-2030 to be 0.9%, and the annual growth rate of the electricity demand for the same period to be 1.1% compared to 2.4% and 4.1% for primary energy demand and electricity demand respectively considered in the previous energy strategy (2015-2025). Table (3.3) illustrate the comparison of the electricity demand in GWh between the two strategies.

Table 3.3: Comparison of electricity demand (GWh) within the two energy strategies

Years	2020	2023	2025	2030
Energy Strategy 2020-2030	17,672	17,950	18,686	19,701
Energy Strategy 2015-2025	23,150	26,470	28,900	34,990

The new strategy aims to achieve energy security for the country and to increase the contribution of the local resources in the energy mix. It also aims to decrease the heavy burden of the energy cost on the national economy and to study the impacts of renewable energy projects on the electricity generation system.

Considering the above mentioned issues and facts, and according to the previous energy strategy 2015-2025 and the new energy strategy 2020-2030 with their components and the implementation plans; the most probable baseline scenario in the energy sector will be based on the adopted goals, policies, and laws, and the planned and committed projects within the energy strategies.

Policies, projects and activities considered in the baseline scenario up to 2030 and beyond to 2066

The most reliable policies, projects and activities considered in the baseline scenario up to 2030 and beyond to the year 2066 are summarized in the following sections.

The Field of Oil and Oil Products

The main policy: Securing the needs of the Kingdom's crude oil and oil products. Securing the Kingdom's oil products needs will be achieved by the following:

- Jordan Petroleum Refinery will continue to produce 14 thousand tonnes per day (100 thousand barrels) to meet 60% of the need of the domestic market for oil products, according to 2015 statistics. The remainder of the needs of the domestic market for oil products will be imported. This arrangement is proposed to last up to 2040.
- Implement the expansion of the Jordan Petroleum Refinery in order to convert heavy petroleum derivatives to light products and improve the specifications of petroleum products. The expansion is planned to be completed by 2026.

- Continue to meet Jordan's needs for crude oil by importing oil from Saudi Arabia by sea, then transporting it in oil tankers to the oil refinery in the centre area of the kingdom. This is planned to continue up to 2027.
- Construction of the Iraqi crude oil pipeline to export Iraqi crude oil across Jordanian territory to the export terminal in Aqaba with a capacity of 1 million barrels/day in addition to a branch to supply Jordan Oil Refinery with 150 thousand barrels/day. The pipeline is expected to be completed in 2027.
- The continuation of the policy of liberalization of prices of petroleum products, and pricing oil products on a monthly basis in accordance with international oil prices. The pricing policy is the most successful mechanism and technique to improve the efficiency of consumption.

The Field of Natural Gas

The main policy: diversifying the natural gas resources**.**

After the completion and construction of LNG terminal in Aqaba which went into commercial operation in September 2015, Jordan has the ability to meet all the country's needs for natural gas for electricity generation and for the industrial sector.

Currently, Jordan imports natural gas by three routes: via the LNG terminal in Aqaba which went into commercial operation in September 2015, via the Arab Gas Pipeline from Egypt and via pipeline from the Noble Energy Company on a take or pay basis.

In 2019, 86% of the electricity generation of the Kingdom was based on natural gas imported via the LNG terminal and Egyptian natural gas.

The natural gas needed for electricity generation during the period 2016-2022 was estimated to be 350-420 Million Metric Cubic Feet per Day (MMcfd). However in the period 2023-2025, the quantity will be decreased to 250-350 MMcfd, due to the operation of the oil shale power plants.

The demand of the industrial sector for natural gas is estimated to be 150 MMcfd in the same period of 2023-2025.

In addition, the National Petroleum Company (NPC) plans to develop the Risha gas field, in Jordan, to increase natural gas production from the site, to 50 MMcfd as a 1st stage. NPC has announced the Risha field as an investment opportunity, and is aiming to attract a strategic partner for this project.

In regard to utilizing waste to generate electricity, the following two projects will be considered:

- A power plant will be built, which will operate on direct burning of solid waste, with a capacity of (50 MW) in the Central Area of the Kingdom.
- A bio–gas power plant will be built, with a capacity of (25 MW), in Ghabawi area, East of Amman, , to be operational, in 2022.

The Field of Renewable Energy

The main policy**:** utilizing the renewable energy resources to generate electricity.

In light of the large progress in utilizing the renewable energy resources to generate electricity, the total capacity of the constructed, under construction and committed projects during the period 2020-2023 will reach 2400 MW as illustrated earlier. Considering the NEPCO situation, the total new capacity of wind and solar energy to be added to the system during the period 2024-2030 will be 600 MW of which 400 MW will be wheeling and net metering systems.

The Field of Oil Shale

The main policy: utilizing the oil shale resources to generate electricity and produce oil.

- **Oil shale projects for electricity generation**

Due to the over-committed generating capacity in terms of MW, the second direct burning of oil shale project for electricity generation will be considered in the year 2028.

- **Oil shale projects for extraction of oil shale**

All oil shale companies were asked to postpone the development period, and some of the oil shale companies have closed their businesses. Oil shale companies that asked for development period extension were Jordan Oil Shale Company (JOSCO) which was intending to produce 20,000 barrels of oil shale in 2025, Jordan Oil Shale Energy Company (JOSE) intending to produce 20,000 barrels/day in 2025, Karak International Oil Company (KIO) intending to produce 25,000 barrels/day in 2024, and Saudi Arabian Corp for Oil Shale (SACOS) intending to produce 20,000 barrels/day in 2025.

The Field of Nuclear Energy

Considering the over committed generating capacity in terms of MW, in the national electric system, introducing nuclear energy as an alternative for electricity generation will be considered after the year 2030. The Atomic Energy Commission is conducting a study to find the best technology to construct small nuclear reactors in several locations in Jordan territory, from two to six units with a capacity of 110 MW for each unit.

3.2.2 Baseline scenario for the transport sector

A. Sector Policies and Strategies

A.1 Strategies, policies and plans at the national level

Transport in Jordan is the responsibility of the Ministry of Transport (MoT) operating under Transport Law No. 89, 2003. Jordan's Long Term National Transport Strategy and Action Plan set out the sector policies and strategies. Key policies include:

- Implementing a multi modal approach to include rail, with good interconnections between modes, networks and transport services.
- Protecting the environment, by increasing the modal share of low-carbon transport modes, and improving energy efficiency by promoting innovative technologies.
- Providing a greater degree of accessibility, particularly where current provision of public transport services are poor or inadequate.

Based on these main policies a number of strategies were developed to achieve the goals set out for the sector. These strategies were adapted to form five alternative scenarios. These were prioritized by incorporating Cost-Benefit Analysis (CBA) results into a Multi-Criteria Analysis framework, which considered impacts of the scenarios over the six criteria: regional, technical, social, policy, economic and financial and environmental.

The chosen scenario was the scenario termed the "Environmental Option". This scenario was built (within the strategy) selecting measures aimed at reducing the impacts of the transport sector on the environment (i.e. emissions, effects of climate change, noise and land use). In the 'Environmental' Scenario public transport was given a high priority, with strategies aimed at shifting modal shares from private to mass transit. These included improvement of networks, including the implementation of the Hejaz railway along its entire route from Aqaba to the Syrian border and also setting minimum safety and quality standards for public transport vehicles. Concerning the road sector, the included strategies placed higher importance on maintenance and safety-enhancing measures for the existing network, rather than extensive road-building. Further strategies concerned minimum safety and emissions standards for freight vehicles.

National Climate Change Policy

One of the key national policies that tackled the Transport sector was the National Climate Change Policy for Jordan 2013-2020. For the transport sector, the policy identified the following strategic climate change objectives:

- To integrate climate change mitigation objectives and the impact of GHG emissions into transport policies, strategies and action plans,
- To promote use of energy efficient, low carbon technologies, and increase understanding of their mitigation impact,
- To promote low carbon energy efficient modes of transport.

The report also recommended measures to achieve the afore-mentioned objectives:

- Developing and strengthening local capacities in assessment of different transport modes and their mitigation effect,
- Improving data collection related to activity data, emissions and emissions factors,
- Developing Nationally Appropriate Mitigation Actions (NAMAs).

Intended Nationally Determined Contributions (INDCs)

In 2016, Jordan submitted its INDCs to the UNFCCC with the objective of reducing its greenhouse gas emissions. This INDCs Action Plan was formally approved by Jordan in August 2019. The INDCs include mitigation projects for the transport sector including: implementing a railway system, implementing the bus rapid transit (BRT) nationally, provision of electric car charging stations powered by renewable energy and ensuring the inclusion of energy efficiency considerations in purchase of vehicles. The aim of these projects is to increase the total number of commuters using public transport and reduce total vehicle kilometers travelled, fuel consumption, GHG emissions and emissions of other pollutants (More details can be found in Appendix B)

Highway Master Plan

The Ministry of Public Works and Housing (MoPWH) carried out its Highway Master Plan Study in 2011. This study provided a time-phased road sector development plan up to 2030, recommending roads and bridges in need of recovery maintenance, including implementation of identified safety measures, the major task identified was the rehabilitation of the Desert Highway. Several highways were also recommended for road widening to ease congestion. The study suggested that the network was sufficient, but recommended the implementation of a ring road for Amman.

A.2 Strategies, policies and plans at the sub-national level (within GAM)

As for Amman city, GAM's planning document is the 2010 Transport Mobility Master Plan (TMMP), which has been designed to guide development of the transport system within GAM up to 2025. The transport policies developed by GAM in the TMMP were based on providing a public Transport (PT) system which is accessible and affordable to all and encouraging a variety of mobility options while promoting public transport and walking. GAM strategies were developed related to public transport, road safety, pedestrian environment, parking, freight, intelligent transport systems (ITS), demand management and the road network. Strategies were also developed for the Downtown of Amman.

In the TMMP twelve scenarios were developed. These scenarios were basically based on the level of public transport to be provided (regular bus, BRT, light rail) combined with a range of demand management measures (soft, medium and hard). For GAM the preferred scenario included substantial investment in high quality public transport services, i.e. bus rapid transit (BRT) and light rail, but combined with soft demand management.

Transport and mobility projects have also been developed within Amman in documents seeking to encourage the city's development in a sustainable and environmentally friendly manner. These include:

Amman Resilience Strategy

This was developed with the guidance of the Rockefeller Institute's 100 resilient cities. As well as projects for an integrated mobility plan, BRT and metro. The report developed the following projects:

- Develop an urban mobility observatory, to enable a data-driven decision-making approach,
- Develop, review and update Amman's street manual to provide guidance to city planners to design safe, high standard streets that provide universal and inclusive accessibility and promote a walkable environment,
- Create a walking map to show routes between neighborhoods,
- Explore tactical urbanism opportunities i.e. creating opportunities for youth to participate in the redesign of spaces and temporarily reclaim spaces designated to cars,
- Organize a design competition for the area around Amman's Hejaz Railway, to increase access to green spaces in the city.

Amman Climate Plan, a Vision for 2050

This vision document, which was developed with the assistance of the World Bank, sets out a series of projects for transport and mobility. These include expansion of several of GAM's projects including more lanes of BRT, purchasing more electric vehicles to replace vehicles owned by GAM and taxis and providing buses with improved fuel specifications. In addition, they recommend enhancing the efficiency of the city bus network, to be addressed as part of the Feeder project.

Additionally, the plan recommends the following projects, many of which could be achieved in the short term:

- Implementation of a public transportation awareness plan to change perceptions and behavior,
- Coordination of transit-oriented planning with the planning and transportation departments,
- Installation of electric vehicle charging stations around the city,
- Implementation of benefits for zero/low emission vehicles, including fast lanes, parking discounts, and reduced fees,
- Installing bike paths and other bike safety measures.

The vision document also recommends the improvement of walkability through:

- Installation of new sidewalks,
- Maintenance and improvement of existing sidewalks,
- Increased green space and tree cover,
- Introduction of pedestrian safety measures.

Green City Action Plan

This project was launched in 2017 between EBRD and GAM to promote sector reforms and develop priority projects to modernise infrastructure and municipal services in Amman.

The report is still under development, but it will recommend projects based on the strategic objectives of:

- Increasing the modal share of public transportation,
- Developing a public realm strategy that supports pedestrian travel,
- Incorporating smart systems in transport planning.

B. Key Committed Projects

Amman Bus Rapid Transit (BRT) and Amman Zarqa BRT: In these projects, which are currently under construction, buses will be operated in their own dedicated lanes. The two systems will be operated as one integrated system and will form an important backbone for transport in the area.

The Amman BRT project will be supported by a study, to be implemented by GAM, concerning public transport in the area of the Amman BRT. The aim of this study is to advise how to rearrange and supplement current public transport services in order to support and make 'best use' of the BRT, by providing 'feeder' services to provide access from neighborhoods to BRT stations. Potential benefits of these combined projects are to improve the image of public transport and encourage a mode shift from private vehicles to BRT and public transport in general. This mode shift from private vehicles to public transport, is expected to produce a reduction in congestion, fuel use and emissions of greenhouse gases and other pollutants.

The fuel type of the buses to be purchased is still under consideration. The minimum standard, would be diesel Euro V or Euro VI, but electric buses are still under consideration.

The reorganization of the current public transport system for Amman based on the Feeder Study is expected to lead to a greater number of services being operated by new BRT buses. This would lead to a decrease in emissions, however is not possible to estimate the emissions savings until reorganization of public transport networks has been agreed.

Proposed Update of TMMP: A comprehensive list of proposed projects is laid out in the TMMP to support the strategies identified by GAM for transport in the city. However, it is considered that the next step for GAM should be to carry out an update of the TMMP, since the previous study is now 10 years old and there have been considerable changes in the city, in particular a large growth in population. This would enable the policies and strategies to be set out for mobility in GAM for the next 15 years, with the aim of guiding Amman city into development while considering energy efficiency and sustainability. One of the expected outcomes of the project is a roadmap for future growth in mobility in GAM with clear priorities given to proposed projects.

The Data Warehouse Project: this project is currently being implemented by MoT, with the purpose of collecting, storing, processing and distribution of data concerning the transport sector. This should motivate the use of data by decision makers at all levels. Potential benefits include the use of trends analysis to make estimates for the future and use of previous experience in future planning.

Public Transport Restructuring Project for Governorates: Projects are planned to restructure the urban public transport systems of Irbid, Zarqa and Madaba with the aim of developing reliable public transport systems and improving the level of services for citizens. Potential benefits are to promote a mode shift to public transport trips, from private vehicle trips, with a subsequent reduction in congestion, fuel use and emissions of greenhouse gases and other pollutants.

Intelligent Transport Systems Project (ITS): The aim of this project is to develop and operate ITS to monitor and control public transport services, and to provide an integrated electronic payment system. This has been implemented in GAM as a pilot project with the new buses for Amman Vision introduced in 2019. Potential benefit is in adding convenience for passengers, helping to promote mode shift from private vehicles to public transport.

Amman, Salt and Irbid Ring Roads: Salt and Irbid ring roads are currently under construction. Amman ring road, Phase 1, also known as Amman Development Corridor is already completed. Feasibility and Environmental Studies, as well as detailed designs have been carried out for the remaining sections. Potential benefits of these projects are to relieving traffic congestion in the cities, particularly from truck traffic and improve access to areas on the outskirts of the city.

Airport Projects: Air travel connections to Jordan are vital to Jordan's economic growth. Projects have been proposed to accommodate in future increasing passenger numbers, through expansion at Amman Civil Airport and King Hussein International Airport in Aqaba. Implementation of a further airport has also been suggested. Potential benefits of these projects are predominantly economic, but are also important for accessibility.

Projects concerning freight: In order to evaluate the GHG mitigation effect of freight projects, concerning use of different modes of transportation, emissions factors from the different modes published by Department of the Environment, Fisheries & Rural Affairs (Defra), UK have been compared. The lowest emissions from freight transport are for cargo ship, followed by freight rail services, and therefore these would be the best options for freight to and within the country. Transporting freight by air, either within the country or into the country has the largest emissions factors, and therefore road freight is to be preferred to air freight.

ASEZA Rail Freight Project: Feasibility and technical studies are being undertaken for the development of a railway connecting a planned land port at Ma'an with port facilities around Aqaba. Potential benefits are to encourage mode shift for freight between Aqaba and Ma'an from road to rail, leading to a reduction in congestion, and emissions of greenhouse gases and other pollutants.

MoT National Railway Project: The aim is to establish a freight railway network. The railway between Aqaba and Ma'an forms the first part of this plan. The remainder of the project is still in need of funding. Potential benefits are to encourage mode shift for freight around the country and to/from neighboring countries from trucks to railway with an expected reduction in congestion and emissions from greenhouse gases and other pollutants.

C. Future Trends in Transport Sector

In the short term (around 5 years) there are many projects being implemented, which will have a large effect on transport in Jordan. The BRT network for Amman and between Zarqa and Amman should be operational in 2021, with a modern comfortable bus fleet. The reorganization and restructuring of public transport services in Amman, Zarqa, Irbid and Madaba, should also have been carried out, with implementation of ITS technology on all buses. Additionally, walkability in Amman is already being improved, with the rehabilitation of areas along the BRT lines currently under construction by GAM.

These projects and improvements are expected to encourage a mode shift in trips from private vehicles to public transport as it is made more convenient and comfortable. This is expected to lead to a reduction in congestion and a decrease in fuel use, with a corresponding drop in emissions of greenhouse gases and other pollutants. These projects may additionally be copied by other governorates and within Amman, where there is potential for further lines of BRT and improvements in walking infrastructure. The data warehouse currently being implemented by MoT, would be a source of data and information concerning all transport projects, which could be made available to interested organisations.

The MoPWH is expected to have completed necessary rehabilitation of the Desert Highway, and carried out widening and rehabilitation of roads, as identified in the 2011 Highways Master Plan. This would lead to improved journey times and reduced congestion, which would lead to more efficient operations for road freight transport.

GAM's TMMP Update Project should have been completed providing important guidance concerning the priority for projects in the transport sector within the city.

It is expected to have more electric cars on the roads of Amman, purchased by GAM and by the public, as they are shown to be efficient for city-

use and as fuel stations and destinations in the city provide more charging stations.

In the medium term (around 10 years) larger infrastructure projects committed by the Government of Jordan should have been implemented. These are expected to include the pipeline project between Jordan and Iraq and the railway project between Aqaba and Ma'an. These two projects would remove a large number of truck vehicle kms from the network, since trips by oil trucks to Zarqa from Amman and Iraq, and trips by freight lorries between Amman and Aqaba are expected to be largely replaced by trips by pipeline or rail.

Work on Amman Civil Airport and King Hussein International Airport, are expected to have been completed, allowing greater passenger trips and boosting tourist numbers and economic growth in the country.

Ring roads around Amman, Salt and Irbid should have been completed, improving accessibility for areas around these cities and reducing congestion in the city centres. Stronger legislation will have been possible for trucks to keep them out of the urban areas of these cities, now suitable alternative routes have been provided, reducing congestion, GHG emissions and emissions of other pollutants.

Key projects for the longer term include the National Rail Network, which would connect with the railway from Aqaba at Ma'an. This is expected to carry a large proportion of the freight across Jordan, which would provide savings in terms of reducing Heavy Goods Vehicles (HGVs) on the road network, with a reduction in congestion, fuel use, GHG emissions and other pollutants. Metro for Amman could also have been implemented. Additionally, it is expected to have projects for GAM, as prioritized through the TMMP Update project. Potentially these could include a tram for Downtown Amman, and light rail from Amman to Queen Alia International Airport.

3.2.3 Baseline scenario for the industrial process sector

Industry is a significant contributor to Jordan's GDP, directly contributing about 24% to the national Gross Domestic Product (GDP), during 2017.

Industry in Jordan is divided into two main types; manufacturing sector, including the production of cement, lime, fertilizers and chemicals, and the mining and quarrying sector, including quarrying of limestone.

Jordan's industrial sector is increasingly affected by regional circumstances; exports to Iraq and Syria decreased because of the increasing difficulties of transportation and trade across the north-eastern and northern borders and the land routes to the Mediterranean. Moreover, the industrial sector is facing new challenges due to COVID-19 pandemic in 2020, i.e. Cement production has decreased due to Lockdown, and particularly periods of curfew that have slowed down operations significantly.

The government has focused on developing the industrial sector, through attracting foreign investment, privatization of public establishments and providing customs and tax exemptions for investment projects within the different sectors, particularly the mining sector. However, Government policies should take into account the afore-mentioned industry circumstances.

There are laws and regulations that encourage and protect the capital investment such as Jordan Investment Law No. 30 of 2014. However, current Jordanian laws and regulations do not directly control CO_2 and other GHG emissions from industrial processes. For example, the Jordanian legally binding standards (JS 1189/2006) concerning the quantity and quality of emissions from stationary sources such as the industrial processes has no specific threshold value for CO_2 and GHG emissions.

The following are the governmental policies, strategies and plans relevant to the industrial sector:

- The Ministry of Industry Trade and Supply developed an industrial policy (2017 – 2021) to enhance the competitiveness of the industrial sector, increase its contribution to economic development, enable it to increase its exports to traditional and new markets, and increase the investment through an effective partnership with the private sector,
- Jordan Economic Growth Plan (2018-2021) includes the establishment of a fund to support and finance industrial development in order to finance projects resulting from the industrial policy, reduce the operational costs on the industrial sector through motivating the use of alternative energy sources, providing technical and financial support to industrial companies, and developing infrastructure and regulatory procedures for the transport sector in all modes serving the industrial activities,
- The National Renaissance Plan (2019-2020) singled out a major thrust for the state of production which includes a number of national priorities and projects related to the industry and commerce sectors and small and medium enterprises. These priorities and projects aim to increase productivity, increase growth in Jordan's economy and generate decent job opportunities for Jordanians,
- Bylaw No. 13/2020 includes a set of standards and criteria that must be achieved for the industrial sector, including supporting the development of this sector, increasing its competitiveness in foreign markets and providing job opportunities for Jordanians.

Listed below are the main plans/activities of the government to improve the industrial performance of Jordan:

- Enhance the competitiveness of the industrial sector and increase its export potential to traditional and new markets,
- Improving the quality of local products and adapting them to international specifications.
- Providing job opportunities for all Jordanians, including female workers and people with disabilities,
- Increase confidence in the industrial sector and support the development of this sector to effectively contribute to economic development of the country,
- Allow the lease of treasury lands in the governorates for the purpose of establishing Small and Medium Enterprises (SMEs) by the governorates citizens, according to specific controls and standards,
- Reduce the operational costs of the industrial sector through motivating the use of alternative energy sources, providing technical and financial support to industrial companies, and developing infrastructure and regulatory procedures for the transport sector for all modes serving industrial activities,
- Improve the investment environment, in order to attract foreign investments to all the governorates,
- Improve the required infrastructure of services needed for industrial activities,
- Reduce the gap between the output of education and vocational training and the needs of the labor market and provide the necessary support, in order to build the capacities of workers in the industrial sector,
- Enhance the communication between technical research and development entities and industries in order to improve knowledge concerning use of new techniques/ technologies,
- Enhance the adoption of Best Available Technology (BAT) and Best Environmental Practices (BEP) in the industrial processes,
- Improve regulations and policies in order to encourage industrial investment,
- Enhance cooperation between the private and public sectors,

- Establish a national strategy to improve the export of local products to the international market,
- Improve the financial support mechanism to incentivise industrial investments,
- Provide technical support to the industries in order to comply with technical and environmental standards and enhance their participation in setting standards and decision-making.

3.2.4 Baseline scenario for the waste sector

Jordan is shifting towards more sustainable solid waste management systems and trying to introduce more innovative options to tackle the challenge of solid waste management, especially with the high pressure exerted on its system with the flux of refugees as a result of the Syrian crisis in recent years. Efforts made by the Ministry of Environment resulted in the adoption of The Solid Waste Framework Law, which aims at producing good governance in the waste sector. The Ministry of Local Administration also adopted the National Strategy in 2015, which diagnoses most of the problems the waste management system suffers from. Some of the problems and weaknesses identified by the strategy are: low operational efficiency of municipalities and Joint Services Councils, lack of information, low sanitation level at landfills (except Ghabawi), low level of recycling, few projects for waste to energy and composting activities.

The new solid waste management framework law which came into force in September 2020 will organise the solid waste sector in Jordan for the coming years and will provide the basis for better solid waste management.

The per capita solid waste generation rate is currently around 1kg/capita/day for urban areas in Jordan and is expected to continue increasing in the coming years with urbanization, reduction of family size and with increase in income. Waste in rural areas will mostly continue to increase but at a higher rate than in urban areas.

Funds from international agencies contributed to upgrading the solid waste infrastructure. The upgrade in solid waste infrastructure such as introduction of more solid waste transfer stations will improve the system capacity and will also improve the financial situation of municipalities especially medium and large ones.

Also, some donors have started waste management programs such as waste sorting facilities and composting at some landfills and within refugees camps. The unstable recyclables market still hinders the sustainability of the waste reduction and recycling programs as they still do not meet their monetary- economic feasibility. Composting will continue to be unfeasible unless it is adopted as governmental policy for waste reduction.

Private Public Partnership (PPP) in solid waste activities in Jordan is still weak and needs to be improved even though there are some good examples in Aqaba, Zarqa, and Petra. Awareness of public and vocational training of solid waste workers still needs to be improved more with focus on introducing key performance indicators for waste collection systems and workers at municipality level. Improvements expected in solid waste management will not be sustainable unless an information management system is adopted at all levels.

The economic success along with good governance in solid waste management are the most important. It is also important to achieve decoupling between GDP and waste generation which is not an easy task. Success in decoupling is ensured by effective awareness raising, waste reduction programs, waste recycling and reuse and application of resource efficiency and cleaner production principles in industry.

Climate change is expected to impact both waste generation rate and waste decomposition rate. Reduced cloud cover, as one of the climate change features, adversely impacts the life of exposed material resulting in more waste generation.

In general, the rate of population growth in Jordan has been declining since the 1950's except during

exceptional circumstances, such as the Gulf War, where population increased by 10.3% and 6.72% in 1990 and 1991 respectively. The strategy suggests that the decrease in population growth rate will continue and may reach around 1.26 % in 2040. In reality, the growth rate will not continue to decrease, but would reach a fixed value of around 2.1% as the growth rate of population is greatly affected by religious belief, social circumstances and economic situation. As such, the solid waste quantities generated will continue to increase, but with a lower rate if only dependent on population increase, and disregarding other factors. This is in line with the assumption of the national strategy that assumes a 2.04% increase rate for urban areas and 1.02 % increase rate for rural areas. According to the strategy, by 2039 solid waste from urban areas will reach 1.64 and from rural areas 1.112 kg/capita/day.

However, in reality the waste generated per capita is not expected to continue increasing and it should reach some stagnant point (noting that Jordan is an upper middle income country according to World Bank classification and is not expected to become a high income country in the foreseeable future).

Waste composition is an important aspect for successful environmental policies and good waste management programs. Many solid waste composition studies have been performed in Jordan at different levels, most of them to analyse waste received at landfills and others based on samples at initial disposal points. It can be concluded from all the studies that organic waste seems to be the main component of the municipal solid waste, in addition to packaging waste, which seems to be significant mostly in urban areas. Waste composition is not fixed and could be changed based on different limiting factors such as socioeconomic conditions, urbanization, etc. As Jordan accepts waves of refugees from nearby countries, these incoming people may have different social behaviors that affect waste composition at country level, but no specific studies have been conducted to study this impact. Also, unforeseen events affect waste composition, such as the current COVID 19 crisis which immediately resulted in an increase in plastic waste in the form of gloves and masks. But this crisis may result in permanent changes in waste composition such as increasing packaging waste as a result of a change in social behavior, as people start ordering more online products.

In conclusion, waste quantities will continue to increase with time in Jordan in the short and medium term. To reach decoupling between waste generation and economic growth, robust policies need to be applied. Waste composition will continue to change as the urbanization rate increases, family size decreases, GDP increases and based on other related factors.

3.2.5 Baseline scenario for the AFOLU sector

Agriculture, Forestry, and Other Land Use (AFOLU) is unique among all sectors, since its mitigation potential is based on both an enhancement of removals of greenhouse gases (GHG), as well as reduction of emissions through management of land and livestock. The AFOLU sector is responsible for around a quarter of the annual GHG emissions resulting mainly from deforestation and agricultural emissions from livestock, soil and nutrient management. Opportunities for mitigation include both the supply-side and demand side options as well as forests which are considered important carbon pools.

Policies governing practices in agriculture and in forest conservation and management need to account for both mitigation and adaptation.

Anthropogenic land-use activities (e.g., management of croplands, forests, grasslands, wetlands), and changes in land use/cover (e.g., conversion of forest lands and grasslands to cropland and pasture, afforestation) cause changes superimposed on natural carbon fluxes.

Land is the critical resource for the AFOLU sector. It provides food and fodder and it provides livelihoods for people. Human economies and quality of life are directly dependent on the services and the resources provided by land.

In Jordan, the natural ecosystems support human activities in agriculture, forestry, animal husbandry, tourism, traditional and pharmaceutical health products, and traditional medicine, among others. According to the Ministry of Agriculture, less than 5% of the country's total area is arable land and 90% is grazing land with 100-200 mm annual rainfall. Natural and human-made forests cover around 1% of the country's area. The contribution of agriculture to the GDP in relative terms declined sharply from 40% in the 1950s to 4% in 2016. Irrespective of how humble the contribution of agriculture is to GDP and economic performance, farming remains important. The importance of the agricultural sector stems from the fact that it is not only a major source of food, particularly dairy products, fruits and vegetables, but it is also a source of livelihood for 25% of the total poor population (livestock keepers, smallholder farm households, and landless former agriculturalists) living in rural areas.

According to the Ministry of Agriculture (MoA) statistics 11% of the total country area is used as agriculture land and less than 1 % is forests (MoA, Annual Report, 2018). The country has three distinguished bioclimatic zones namely:

- The Jordan Valley, which forms a narrow strip that is situated below the mean sea level with warm winters and hot summers and where irrigation is practiced,
- The western highlands, where annual precipitation is in the range of 300 to 600 mm,
- The "Badia", which includes the arid and semi-arid areas in the eastern parts of the country, where the annual rainfall is below 200 mm. Badia is an Arabic word describing the open rangeland inhibited by Bedouins (nomads).

Available governmental plans, programs, policies, and strategies announced and published by the Ministry of Agriculture, the Directorate of Forests, and other relevant institutions were reviewed. The Ministry of Agriculture has just recently published the 2020-2025 National Agricultural Development Strategy focusing on the digitization and restructuring of the sector and boosting its productivity.

The strategy identified a total of 174 interventions and projects that will be financed through a host of channels, including the Treasury; from the Agricultural Credit Corporation and from foreign aid and grants.

The strategy has the following ambitious objectives:

- Increasing the agricultural GDP as a share of total GDP from 2.6 billion JD now to 3.66 billion JD by 2025 and boosting the added-value of agriculture to 2.48 billion JD from 1.6 billion JD,
- Increasing the forest area by 10% by 2025,
- Expanding pasture areas,
- Creating 65,000 jobs in the five-year period and replacing 21,000 foreign workers with Jordanians,
- Increase the number of farmers using digital government-run agricultural services by 30 per cent,
- Reducing export costs to facilitate a 15 per cent increase in agricultural exports,
- Increase the productivity of food and agricultural manufacturers by 18 per cent by 2025,
- The utilization of modern technology to enhance production and productivity, focusing on strategic crops,

The policy will address, as well, a number of challenges facing the agricultural sector, among which:

- The lack of comprehensive agricultural databases and poor utilization of modern technologies in agriculture that limited the agricultural producer's access to retailers and consumers,

- Marketing of products with the closure of neighboring markets due to regional conditions and the need to facilitate export of agricultural products through the Queen Alia International Airport (QAIA),
- Lack of refrigerator trucks to transport fruit and vegetables ready for exporting,
- Compensating farmers for the damage to crops because of frost,
- The high cost of electricity for the agricultural sector,
- The need to better manage the issue of non-Jordanian workers in the sector,
- The need to support livestock breeders with feed, medicine and vaccines,
- Increase in fodder prices due to delay and decrease of rainfall.

Consistent with these plans, the following is projected as the baseline for AFOLU:

- Field crops production: Increase productivity per unit area, promote water harvesting techniques to expand planting areas, and maintain productivity under predicted decrease in rainfall,
- Animal production: Promote high productive animal species, under increase in prices of fodder, and other production inputs
- Fodder production: Reclamation of rangelands and control of overgrazing of rangelands, introduce species with high productivity under drought conditions and promote wastewater reuse in fodder production,
- Forestry conservation: Maintain forests which are threatened by predicted drought cycles, urban and rural expansion, expected fire occurrences, and illegal deforestation.

3.3 Updates on the FBUR Mitigation Measures for Different Sectors

According to Annex III of Decision 2/CP.17 related to the guidelines for the preparation of national BURs, non-annex I parties should provide information, in a tabular format, on actions to mitigate climate change, by addressing anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol.

In the preparation of this chapter of Jordan's SBUR, all mitigation projects included in the FBUR have been reviewed and assessed to identify those options considered to be still valid and applicable. The cost-benefit analysis and the CO_2 emissions reduction have been updated for each valid mitigation project. Net present value was used in the financial calculations, by converting all present and future revenues and costs over the lifetime of the project to a base of today's cost. The same approach was followed in calculating CO_2 emissions reduction over the lifetime of the proposed projects. A discount rate of 8% was used in all calculations of cost and emissions reduction. The discounted unit cost of reduced emissions which is the quotient of the discounted cost to the discounted emissions reduction was also calculated.

The updated mitigation measures include GHG mitigation projects in the following areas:

- Primary energy,
- Renewable energy,
- Energy efficiency,
- Industrial processes,
- Waste,
- Agriculture and forestry.

The results of the mitigation measures update is presented in the following sub-sections.

3.3.1 Updates on the FBUR mitigation measures for primary energy

The GHG mitigation measures in the primary energy demand and supply that were considered in the FBUR have been reviewed and assessed. All information is presented in a tabular format in Appendix A, Table A.1. Table 3.4 is a summary of the FBUR mitigation projects and their current status.

Table 3.4: Status of the primary energy mitigation projects listed in the FBUR

Project Name	Status
Loss Reduction in Electricity Transmission and Distribution Network	Still valid and considered in this BUR.
Natural Gas Distribution Network in Amman, Zarqa and Aqaba	Still valid and considered in this BUR.
Demand Side Management	Canceled from NEPCO's implementation plan since the different components of the project will be implemented by JREEEF/MEMR through its Action Plan.
Adding a 100 MW Combined Cycle in Samra Power Plant	Implemented. It was modified to 70 MW instead of 100 MW and completely implemented by the year 2018. According to the modification, the total estimated GHG emission reduction is 2066 thousand tonnes CO_2eq (kt CO_2eq) during 25 years from 2018- 2043. The estimated emission reduction unit cost is - 33.77 JD/tonne of CO_2eq.

Thus, the following two primary energy projects are still valid and moved from FBUR to be updated and considered in this SBUR. The two mitigation projects are briefly described below.

- Loss Reduction in Electricity Transmission and Distribution (T&D) Network, This project seeks to reduce the transmission and distribution losses to 9% in 2027 compared to 13.3% in 2020. The project will be executed gradually over a period of 6 years starting in 2022. The main components of the project will be optimizing the utilization of distributed generation, improving the system power factor, upgrading or replacing existing conductors and insulators with lower-resistance equipment. The cost is estimated to be 48 Million USD. This project can lead to a significant reduction in fuel consumption and as a result a discounted emission reduction of 1,956 thousand tonnes of CO_2 through the 25 years, lifetime of the project (2022-2047),
- Natural Gas Distribution Network in Amman, Zarqa, and Aqaba, According to the energy strategy 2020-2030, Jordan will enhance the usage of natural gas in all sectors such as Industrial, Residential, Commercial and Transportation. This includes the use of natural gas instead of liquefied petroleum gas for cooking, diesel in central heating and water heating and gasoline for cars. In 2020, 86% of the electricity generation of the Kingdom is generated from imported natural gas. To deliver natural gas to smaller customers it will be necessary to construct new low-pressure gas distribution networks to connect customers to the new infrastructure.

  The project will be executed gradually over 10 years, starting in 2025 and with a capital cost of 110 million USD.

  Natural gas combustion emits 1.3 times less CO_2 than that of oil, which indicates that using natural gas in demand side sector as an alternative for diesel, fuel oil, LPG and gasoline, will mitigate a significant quantity of CO_2 emissions. Using the natural gas distribution networks in the main cities of Amman, Zarqa, and Aqaba will mitigate about 2,708 thousand tonnes of CO_2eq discounted emissions in the 25 years of the project lifetime (2025-2050).

The costs and CO_2 emissions reduction for the two valid projects have been analyzed. Table 3.5 shows a summary of the results.

Table 3.5: Emissions reduction (Gg of CO_2eq) and emissions reduction unit cost (JD/tonne CO_2eq) for the primary energy mitigation projects

Project Name	Total emission reductions (Gg of CO_2eq)	Reduction unit cost (JD/tonne of CO_2eq)
Loss Reduction in Electricity Transmission and Distribution Network	1,956	- 108.52
Natural Gas Distribution Network in Amman, Zarqa and Aqaba	2,708	-13.78

3.3.2 Updates on the FBUR mitigation measures for renewable energy (RE)

Renewable energy (RE) GHG mitigation measures that were considered in the FBUR have been reviewed and assessed. All information is presented in a tabular format in Appendix A, Table A.2. Table 3.6 is a summary of their current status.

Table 3.6: Status of RE mitigation projects listed in FBUR

Project Name	Status
100 MW Concentrated Solar Power (CSP)	Still valid and considered in this BUR. This project is postponed due to over commitment in the electricity capacity in terms of MW in the system and the decline in the electricity demand growth rate.
300 MW Concentrated Solar Power (CSP)	Still valid and considered in this BUR. This project is postponed due to over commitment in the electricity capacity in terms of MW in the system and the decline in the electricity demand growth rate.
Solar Water Heaters 2-30,000 Houses	Implemented in four stages by JREEEF/MEMR during the period 2017-2020.
Solar Water Heaters 3-30,000 Houses	Still valid and considered in this BUR. Postponed to start in the year 2022 instead of 2020.
120 MW PV – Wheeling and Net Metering	Implemented by MEMR during the period 2017-2020.

Thus, the following three renewable energy projects are still valid and moved from FBUR to be updated and considered in this SBUR. The three mitigation projects are briefly described below.

100 MW Concentrated Solar Power (CSP)

Concentrating solar power (CSP) systems work by concentrating the sun's rays using mirrors to create heat, then the created heat is transferred to a heat transfer fluid. Electricity is then generated in a steam cycle, using the heat transfer fluid to create steam and generate electricity as in conventional thermal power plants.

Concentrated solar plants today typically include low-cost thermal storage systems to decouple generation from the sun. Most commonly, a two-tank molten salt storage system is used. CSP systems are classified into line concentrating and focal concentrating systems referring to the arrangements of concentrating mirrors. The most widely deployed linear concentrating systems are parabolic trough collectors while solar towers are the most widely deployed focal

concentrating systems. It is expected that the concentrated technology will play a major role in producing electricity with an increasing use of thermal storage to utilize excess heat during night time to ensure the continuity of power production.

The capital cost of CSP represented by the unit cost of kW is decreasing with time. The reported global weighted- average cost of CSP commissioned in 2019 was USD 5,774/kW which is 36% lower than in 2010. Also, the capacity factor increased to reach 45% in 2019 with storage capacities from 4 to 8 hours. Operation and maintenance (O&M) costs that include insurance, and receivers and mirrors replacements are substantial compared to solar PV and onshore wind energy but these costs are also declining with time. The typical costs of O&M of plants in operation today are in the range of USD 0.02/kWh to USD 0.04/kWh (REVE magazine, 2020).

The proposed capacity of this project will be 100 MW and its capital cost, O&M costs, and capacity factor are assumed to be the same as those reported in 2019. The estimated annual electricity production is around 394,200,000 kWh and the capital cost is around 410 million JD. The estimated total discounted emission reduction is 1929.37 thousand tonnes CO_2eq during the 25 years of the project lifetime (2023-2047).

300 MW Concentrated Solar Power (CSP)

This project is expected to be constructed in 2028. In 2028, it is expected that the capital cost of CSP technology will decline by time and will reach 4,000 USD/kW while capacity factor will increase to reach 70%. O&M cost is assumed to decrease to 0.01 USD/kW. The proposed capacity of this project will be 300 MW with an estimated annual electricity production of around 1,708,200,000 kWh and a capital cost of around million JD 840. The estimated total discounted emission reduction is 9,003.71 thousand tonnes CO_2eq during the 25 years of the project lifetime (2028-2052).

Solar Water Heaters 3 – 30,000 houses

This mitigation project is similar to the previous solar water heaters (SWH) projects which were proposed earlier in TNC and FBUR and were successfully implemented by JREEEF/MEMR throughout 2017-2020. This proposed project is planned to be implemented over three years 2022- 2025 with a lifetime of 25 years 2022-2046.

SWH saves electric energy used to heat water for domestic use. It is assumed that SWH will replace electric heaters and every house requires a solar water heater of 4.6 m^2 and every m^2 can produce around 740 kWh/yr. This proposed project includes the installation of 30,000 solar water heaters; the cost of each is 500 JD. The installed capacity of this project will be 54 MW with an estimated annual electricity reduction of around 102 GWh. The estimated total discounted emission reduction is 457.53 thousand tonnes CO_2eq during the 25 years of the project lifetime (2022-2046).

The cost and the CO_2 emissions reduction for the three valid renewable energy projects have been analyzed. A summary of the results is shown in Table 3.7.

Table 3.7: Emissions reduction (Gg of CO_2eq) and emissions reduction unit cost (JD/tonne of CO_2eq) for renewable energy mitigation projects

Project Name	Total emissions reduction (Gg of CO_2eq)	Reduction unit cost (JD/tonne of CO_2eq)
100 MW Concentrated Solar Power (CSP)	1,929.37	118.68
300 MW Concentrated Solar Power (CSP)	9,003.71	- 7.18
Solar Water Heaters 3-30,000 Houses	457.51	-189.95

3.3.3 Updates on the FBUR mitigation measures for energy efficiency (EE)

Energy Efficiency (EE) GHG mitigation measures that were considered in the FBUR have been reviewed and assessed. All information is presented in a tabular format in Appendix A, Table A.3. Table 3.8 is a summary of their current status.

Table 3.8: Status of the energy efficiency (EE) mitigation projects listed in the FBUR

Project Name	Status
Replacing high thermal mass with low thermal mass (LTM) in ceramic factories	Not valid. This project was originally proposed to be implemented in 5 Ceramic companies, however, the main Ceramic company in Zarqa and most of other ceramic industries closed due to high competition of imported Ceramic especially from Egypt.
Returning un-returned condensate to the feed water tanks in food industry	Still valid and considered in this BUR. The project is assumed to be implemented in 2022.
Insulating the un-insulated pipes, fittings and tanks in food industries	Still valid and considered in this BUR. The project is assumed to be implemented in 2022.
Replacing fluorescent lamp fixtures with LED lamp fixtures in commercial buildings	Implemented by MEMR and concerned institutions during the period 2017-2020.
Insulating walls and roofs in 3,500 new houses	Still valid and considered in this BUR. The project is assumed to be implemented in 2022.
Street lighting: replacing 125 W Mercury lamps with 70 W high pressure Sodium lamps	Implemented by MEMR and concerned institutions such as GAM during the period 2017-2020.
Using regenerative burners instead of conventional burners in Steel Reheating	Still valid and considered in this BUR. The project is assumed to be implemented in 2022.
Using variable speed drives in the paper factories pumps	Not valid. This project was originally proposed to be implemented in paper factories that produce paper pulp, however, most of these factories are currently closed and ready paper pulp is imported for further processing.
LED lighting in public buildings	Implemented by MEMR and concerned institutions during the period 2017-2020.
Improving energy efficiency in small and medium size hotels	Under implementation by JREEEF/MEMR as planned, during the period 2017-2020, 16 small and medium hotels participated in this program
LED lighting in households	Implemented by MEMR and concerned institutions during the period 2017-2020.

Thus, the following four energy efficiency projects are still valid and moved from FBUR to be updated and considered in this SBUR. The four mitigation projects are briefly described below.

- Returning un-returned condensate to the feed water tanks in food industry.

  This proposed project will be implemented in 2022 with a lifetime of 25 years. In some food factories, condensate resulting from the

condensation of steam is drained without the utilization of its heat. Therefore, returning this condensate to the boiler feed water tank will save energy represented by the saved heavy fuel oil to operate the boiler in addition to saving in the cost of water treatment and water itself. It is assumed that 10 food factories will implement this energy efficiency measure with a discounted emission reduction of 7,433.38 tonne CO_2 over the lifetime of the project (2022-2046).

- Insulating un-insulated pipes, fitting and tanks in food industries.

  This proposed project will be implemented in 2022 with a lifetime of 25 years. In some food factories, the steam and condensate pipes and valves, and feed water tank are uninsulated. Insulating them will save energy in the form of saved fuel used to power the steam boiler. It is assumed that 10 food factories will implement this energy efficiency measure with a discounted emission reduction of 8,243.32 tonnes CO_2 over the lifetime of the project (2022-2046).

- Insulating walls and roofs in 3,500 new houses.

  This proposed project will be implemented in three years starting from 2022 with a lifetime of 30 years. It is assumed that 80% of new residential houses are not insulated, so out of 3,500 checked houses it is assumed that the insulation of walls and roofs will have been implemented for 2,800 houses. It is also assumed that the saving from this measure is about 50% of the annual heating and cooling bills in these houses. It is estimated that this energy efficiency measure will result in a discounted emission reduction of 69,792.85 tonnes CO_2 over the lifetime of the project (2022-2051).

- Using Regenerative Burners Instead of Conventional Burners in Steel Reheating Industry.

  This proposed project will be implemented in 2022 with a lifetime of 20 years. In steel factories, the reheating furnace uses heavy fuel oil to reheat the steel billets, usually to form the steel into construction steel rods. High speed pressure jet burners are used for this purpose. Using regenerative burners instead of these conventional burners will result in energy saving of around 10%. It is estimated that implementing this energy efficiency measure in 5 steel factories will result in a discounted emission reduction of 72,093.67 tonnes CO_2 over the lifetime of the project (2022-2041).

The costs and the CO_2 emissions reduction for the proposed EE projects have been analyzed. A summary of the results is shown in Table 3.9.

Table 3.9: Emissions reduction (Gg of CO_2eq) and emissions reduction unit cost (JD/tonne of CO_2eq) for the energy efficiency mitigation projects

Project Name	Total emissions reduction (Gg of CO_2eq)	Reduction unit cost (JD/tonne of CO_2eq)
Returning un-returned condensate to the feed water tanks in food industries	7.43	-108.04
Insulating un-insulated pipes, fittings, and tanks in food industries	8.24	-215.16
Insulating walls and roofs in 3500 new houses	69.79	-183.64
Using regenerative burners instead of conventional burners in steel reheating industries	72.09	-110.03

3.3.4 Updates on the FBUR mitigation measures for IPPU sector

GHG mitigation options in the IPPU sector that were considered in the FBUR report have been reviewed and assessed. Relevant information is presented in a tabular format in Appendix A, Table A.4. Table 3.10 is a summary of their status.

Table 3.10: Status of the IPPU mitigation projects listed in the FBUR

Project Name	Status
Use of steel slag and/or fly ash to substitute the raw materials needed to produce clinker	Still valid and considered in this BUR.
Increase the percentage of Pozzolana in CEM II cement	Still valid and considered in this BUR.
Produce new cement product CEM IV with 45% of Pozzolana	Still valid and considered in this BUR.
Use of biomass (MSW or/and Sewage Sludge) as alternative fuels	Still valid and considered in this BUR.
Catalytic reduction of N_2O inside the ammonia burner of the nitric acid plant	Still valid and considered in this BUR.

Thus, all the five FBUR mitigation projects for IPPU are still valid and moved from FBUR to be updated and considered in this SBUR. These mitigation projects are briefly described below.

- Use of steel slag and/or fly ash to substitute the raw materials needed to produce clinker at the selected cement plant

Certain steel slag and fly ash materials (de-carbonated kiln feedstock) could be added to the raw material feed to reduce the amount of raw material needed to produce a given amount of clinker. Jordan has more than 5 steel melting and galvanizing factories, therefore there is an available stock of steel slag and fly ash to be used in the cement industry.

In this mitigation project, it is suggested to produce a new type of cement CEM V (Composite Cement) at one of the cement industries; mainly the one that has a neighboring steel manufacturing company and can try the production of this type of cement with minor additional costs in comparison to other existing companies. The percentages of blast-furnace slag and natural Pozzolana range between 31-49% each, to produce CEM V/B. A 40% substitution of steel slag/fly ash and a 10% production of new CEM V/B will be assumed at this company.

The price of steel slag and/or fly ash is estimated to be 42.3 JD/tonne. The cost of energy and raw materials reach 61% of total cost and based on the assumption of a production cost of 89.7 JD/tonne of cement. This option will reduce the cost by 54.7 JD/tonne of cement. No annual increase in the production costs will be assumed for the project lifetime. Investment cost to grind the steel slag will be estimated as 2,442,928 JD (based on the maximum produced tonnes of CEM II in 2046) based on the estimated cost of 1.37 USD/tonne cement.

It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 250,000 tonnes of CO_2 over the lifetime of the project (2022 - 2046)

- Increase the percentage of Pozzolana in CEM II

Blended cement is a mixture of clinker and additives containing less than 95% clinker. Blended cement types are distinct products with different uses that have different additives and different shares of clinker. More than 90% of cement produced at the local cement companies is CEM II (Portland–Pozzolana Cement) with a percentage of Pozzolana

ranges between 21-32%. Therefore; there is an area to increase the percentage of Pozzolana in CEM II by improving the reactivity of the produced clinker and the raw mix to produce CEM II/B-P to achieve the required strength of 42.5N that cause the use of Pozzolana of less than 32% (the 3% is substituted by gypsum). A reasonable 2% more substitution could be assumed on average and so a reduction of CO_2 emissions by 2% could be assumed as well.

Since all local cement companies produce CEM II, there is no need for investment to procure the equipment needed to receive, store, grind and meter.

Pozzolana to the cement product. The operational cost includes the price of extraction of Pozzolana, paid to MEMR (previously payment was to the Natural Resources Authority) and transportation. However, this option will reduce the cost of raw materials (mainly limestone) and energy needed to produce the saved clinker that will be substituted by Pozzolana.

The price of Pozzolana is estimated to be 36.6 JD/tonne. As mentioned above, this option will reduce the cost by 54.7 JD/tonne cement to save both energy and raw materials and no extra investment cost is needed.

To have time for the experimental trials, it is expected to start the implementation of this project in 2022. The project lifetime is assumed to be 25 years.

It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 367,000 tonnes of CO_2 over the lifetime of the project (2022-2046)

- Produce new cement product CEM IV with 45% of Pozzolana

It is estimated that 10% of currently produced CEM II/B-P will be changed to CEM IV, strength 22.5X in which the Pozzolana substitution will reach 45% (at least 13% more (starting from approximately 32%). CO_2 reduction will be calculated by multiplying the annual CO_2 emissions by the reduced percentage of 13%, this percentage will also be multiplied by the percentage of the products that will be converted from CEM II/B-P to CEM IV which is assumed to be 10% of CEM II/B-P. Therefore; annual CO_2 emissions from producing CEM II/B-P will be multiplied by 1.3% to calculate the CO_2 emissions reduction as a result of implementing this option.

To allow time for the experimental trials, marketing the new product, and setting the legally binding regulations and enforcement measures to control its use, it is expected to start the implementation of this project in 2022. The project lifetime is estimated to be 25 years. The price of Pozzolana is estimated to be 36.6 JD/tonne and also this option will reduce the cost by 54.7 JD/tonne cement by savings in both energy and raw materials, and with no extra investment. It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 238,000 tonne CO_2 over the lifetime of the project (2022 – 2046).

- Use of biomass (MSW and/or Sewage Sludge) as alternative fuels

A potential reduction of CO_2 emissions in the cement industry could be achieved by switching from traditional fossil fuel to a biomass fuel.

Since most local cement factories are licensed to burn coal, petcoke, oil shale and alternative fuels such as waste tires and used oil, to replace the expensive heavy fuel oil, they are equipped with multi-purpose burners which reduce the investment costs for using biomass as alternative fuels. However, the required capital cost depends on the needed storage, segregation, handling, grinding and metering as well as environmental pollution control measures. A value of 27.5 JOD/tonne of alternative fuel is used to estimate the investment cost based on the maximum estimated tonnes needed in 2046. So, the investment cost for this option is estimated at 129,942,957 JD.

To allow time for the experimental trials, studies of the maximum percentage of MSW and dried sewage sludge to be used, availability of stocks in the market, testing the emissions, conduct EIA study and getting the environmental clearance; it is expected to start the implementation of this project in 2022. The project lifetime is estimated

to be 25 years. It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 814,000 tonne CO_2 over the lifetime of the project (2022 – 2046).

- Catalytic reduction of N_2O inside the ammonia burner of the Nitric Acid plant

This project involves the installation of a new N_2O abatement technology that is not commonly used in nitric acid plants. The abatement technology is a pelleted catalyst that will be installed inside the ammonia burner just underneath the precious metal gauzes. This technology is capable of reducing approximately 75% to 80% of the N_2O formed at the precious metal gauzes inside the ammonia burner to atmospheric N_2 and O_2 (through communication with KEMAPCO).

The selected N_2O abatement technology depends on replacing some of the Al_2O_3 balls that support the platinum-rhodium catalyst by a base metal secondary catalyst, which is capable of reducing N_2O by at least 75%.

This project will only be implemented for the sake of GHG emissions reduction; there are no other direct benefits. Therefore, its implementation is strongly dependent on the provision of economic incentives. The project is assumed to start in 2022 and its lifetime is estimated to be the same as the lifetime of the KEMAPCO plant, which is estimated to be 25 years (till the year 2046). It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 1,659,000 tonnes CO_2 over the lifetime of the project (2022 – 2046).

The costs and the CO_2 emissions reduction for the proposed IPPU mitigation projects have been analyzed. A summary of the results is shown in Table 3.11.

Table 3.11: Emissions reduction (Gg of CO_2eq) and emissions reduction unit cost (JD/tonne of CO_2eq) for the IPPU mitigation projects

Project Name	Total reduction for the project lifetime (Gg of CO_2eq)	Mitigation cost (JD/tonne of CO_2eq)
Use of steel slag and/or fly ash to substitute the raw materials needed to produce clinker	250	-22.9
Increase the percentage of Pozzolana in CEM II cement	367	-32.1
Produce new cement product CEM IV with 45% Pozzolana	238	-32.0
Use of biomass (MSW and/ or Sewage Sludge) as alternative fuels	814	-69.3
Catalytic reduction of N_2O inside the ammonia burner of the nitric acid plant	1,659	0.37

3.3.5 Updates on the FBUR mitigation measures for AFOLU sector

The main mitigation options within AFOLU mainly involve one or more of three strategies:

- Reduction/prevention of emissions to the atmosphere by conserving existing carbon pools in soils or vegetation that would otherwise be lost, or by reducing emissions of CH_4 and N_2O,
- Sequestration—enhancing the uptake of carbon in terrestrial reservoirs, and thereby removing CO_2 from the atmosphere,

- Reducing CO_2 emissions by introducing changes within demand-side options (e.g., by lifestyle changes, reducing losses and waste of food, changes in human diet, changes in wood consumption).

GHG mitigation options in the AFOLU sector that were considered in the FBUR report have been reviewed and updated. Relevant information is presented in a tabular format in Appendix A, Table A.5. Table 3.12 is a summary of their status.

Table 3.12: Status of the AFOLU mitigation projects listed in FBUR

Project Name	Status
Forestry- Introduce new plantations in urban areas	Still valid and considered in this BUR.
Forestry- Introduce new plantations in northern area	Still valid and considered in this BUR.
Rangeland 1- Restoration of rangeland areas	Still valid and considered in this BUR.
Rangeland 2- New protected rangeland area as natural reserve	Still valid and considered in this BUR.
Promoting for climate-smart agricultural practices in the Jordan Valley	Still valid and considered in this BUR.

Thus, all the five FBUR mitigation projects for AFOLU are still valid. The projects will be modified and updated to be considered in this SBUR. These mitigation projects are briefly described below.

- Introduce new trees plantation in Urban Areas

Losses in urban trees are a continuous concern either due to snow storms, or from burning, and cutting due to land use change. No official numbers have been published, but it was assumed that an average loss of around 2,500 trees within Greater Amman Municipality area will be compensated for, mostly by planting pine and coniferous trees.

A medium growth coniferous tree, planted in an urban setting and allowed to grow for 10 years, sequesters 0.060-tonnes CO_2 per planted tree**.** It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 1,502 tonnes CO_2 over the lifetime of the project (2022 – 2042).

- Forestry- Introduce new plantations in Northern Area

Losses in forest trees are a continuous concern, either due to snow storms, burning or illegal cutting. No official numbers have been published regarding the loss, but it was assumed that an average loss of around 30,000 trees within the Northern Area will be compensated for, mostly by planting pine and coniferous trees. A medium growth coniferous tree, planted in an urban setting and allowed to grow for 10 years, sequesters 0.060-tonne CO_2 per planted tree**.** It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 11,923 tonne CO_2 over the lifetime of the project (2022 – 2042).

- Rangeland restoration and increase in forage production Projects

The projects suggest that the Ministry of Agriculture establish a public corporation responsible for forage production and sales to livestock owners. The corporation will be responsible for buying the plants and for hiring labor for cultivation.

Two areas for production will be considered:

- Rangelands Project 1: Restoration of Rangeland Areas and Rangelands

  50,000 dunums in the Badia (Al Jafr and Al Husseinieh) sub-districts within the Ma'an Governorate. It is assumed that the productivity of these area will be 50 kg/ dunum of dry matter (in areas with 100-200 mm rainfall). Suggested plant types are perennial fodder shrubs. It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 888,140 tonne CO2 over the lifetime of the project (2022 – 2036).

- Project 2: New Protected Rangeland Area as Natural Reserve combined

100,000 dunums in the wide desert valleys of south Badia. The average annual dry matter production is 4 kg/dunum in normal years and with good restoration practices, the productivity can be increased to 15 kg/dunum.

The project will harness direct benefits for protection of floral biodiversity through controlling the grazing of the indigenous *Atriplex halimus* shrubs. Much of this area is covered with chert and an underlying thin layer of fine textured soil. *Artemisia herba-alba, Retama raetam, Achillea fragrantissima, Atriplex halimus* and *Poa bulbosa* are common in the wadi beds. Despite its deterioration this region is known to be the main grazing land in Jordan.

It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 1,776,280 tonnes CO_2 over the lifetime of the project (2022 – 2036).

The projects will achieve reductions through CO_2 emissions offset from natural soil carbon release caused by rangeland deterioration. The project will harness direct benefit for soil resources through rain harvest techniques as well as soil erosion control techniques (erosion is caused by flow from flash floods). It is assumed to have an average of 35 average sized shrub/dunum and the sequestration rate is 5.57 tonnes SOC/ha/year and a lifetime of 15 years will be assumed for calculation purposes.

- Promoting climate-smart agricultural practices in the Jordan Valley

Climate smart agriculture is not a new agricultural system, nor is it a set of practices. It is a new approach, a way to guide the needed changes of agricultural systems, given the necessity to jointly address food security and climate change. It contributes to the achievement of sustainable development goals and integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars: Sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; reducing and/or removing greenhouse gases emissions, where possible.

Sustainable crop production, controlled grazing and maintained forest systems can sequester substantial and variable amounts of carbon from the atmosphere and store it in soils and vegetation. Carbon sequestration will not only stabilize climate but will also increase the overall resilience of the agro-ecosystems. Widespread adoption of climate-smart practices has the potential to make major contributions to the achievement of national food security and development goals. It is estimated that implementing this mitigation measure will result in a discounted emission reduction of 13,057 tonnes CO_2 over the lifetime of the project (2022 – 2026).

The costs and the CO_2 emissions reduction for the proposed AFOLU mitigation projects have been analyzed. A summary of the results is shown in Table 3.13.

Table 3.13: Emissions reduction (Gg of CO_2eq) and emissions reduction unit cost (JD/tonne of CO_2eq) for the AFOLU mitigation projects

Project Name	Total reduction for the project lifetime (Gg of CO_2eq)	Mitigation cost (JD/tonne of CO_2eq)
Forestry- Introduce new plantations in Urban Areas	0.15	40
Forestry- Introduce new plantations in Northern Area	11.92	14.5
Rangeland 1- Restoration of rangeland areas	1,776.28	18
Rangeland 2- New protected rangeland area as natural reserve	888.14	10
Promoting for Climate-smart agricultural practices in the Jordan Valley	13.06	-1333

3.3.6 Updates on the FBUR mitigation measures for the waste sector

GHG mitigation options in the waste sector that were considered in the FBUR report have been reviewed and assessed. Relevant information is presented in a tabular format in Appendix A, Table A.6. Table 3.14 shows a summary of their status.

Table 3.14: Status of the waste sector mitigation projects listed in FBUR

Project Name	Status
Biogas collection and utilization from Al-Dhulil domestic solid waste landfill	Still valid and considered in this BUR.
Biogas collection and utilization from Al-Salt (Homra) domestic solid waste landfill	Not valid. The biogas capture rate is limited and also there is no infrastructure for biogas collection.
Biogas collection and utilization from Al-Karak domestic solid waste landfill	Not valid. The biogas capture rate is limited and also there is no infrastructure for biogas collection.
Biogas collection and utilization from Madaba domestic solid waste landfill	Not valid. The biogas capture rate is limited and also there is no infrastructure for biogas collection.
Biogas generation by utilizing the sludge generated from Ramtha domestic wastewater treatment plant	Not valid. The biogas capture rate is limited and also there is no infrastructure for biogas collection.
Biogas generation by utilizing the sludge generated from Wadi Arab domestic wastewater treatment plant	Still valid and considered in this BUR.
Biogas generation by utilizing the sludge generated from Baqa'a tertiary domestic wastewater treatment plant	Still valid and considered in this BUR.
Biogas generation by utilizing the sludge generated from Salt domestic wastewater treatment plant	Not valid. The biogas capture rate is limited and also there is no infrastructure for biogas collection.
Biogas generation by utilizing the sludge generated from Madaba domestic wastewater treatment plant	Still valid and considered in this BUR.

Thus, the following mitigation projects are still valid and moved from FBUR to be updated and considered in this SBUR. These mitigation projects are briefly described below.

- Biogas collection and utilization from Al-Dhulil domestic solid waste landfill. A considerable amount of biogas could only be generated from Al-Dulail landfill while Al-Karak, Al-Salt and Madaba domestic solid waste landfill sites were considered not valid due to low production of gas in those sites.

  The proposed project aims at collecting the generated biogas, treating it for impurities, generating electricity using biogas generator and connecting the generated electricity to the national electricity grid. The suggested project will contribute to reducing the amount of fuel used for electricity generation. The starting year for implementing this project is 2022 and construction activities, commissioning, and testing will take 1 year, so the actual operation for the proposed project will be in 2023. The lifetime of the project is 25 years (2022 – 2047).

- Biogas generation by utilizing the sludge generated from the domestic wastewater treatment plants. The project was considered to be valid for Wadi Arab, Baqa'a, and Madaba domestic wastewater treatment plants and thus emission reductions were recalculated while it was considered invalid for Ramtha and Salt due to decreased inflow of wastewater to these treatment plants.

  The proposed projects aim at generating biogas from the sludge and connecting the generated electricity to the national electricity grid. These projects will contribute to reducing the amount of fuel used for electricity generation, taking into consideration that a considerable amount of sludge produced from the wastewater treatment plants without any utilization. In the three projects of Wadi Arab, Baqa'a, and Madaba the construction activities, commissioning, and testing will take 1 year so the actual operation for the proposed projects will be the next year. The starting year for implementing the proposed projects in Madaba and Wadi Al Arab is 2021 for a lifetime of 25 years (2021 to 2046) while the project in Baqa'a will be implemented in 2025 for a lifetime of 25 years (2025 to 2049).

The following assumptions were used during the update of waste projects:

- Total amount of organic material generated is assumed to increase annually by 2.2%,
- Density of methane is 0.717 kg/m^3,
- The captured methane from all landfills is calculated according to the PRIF study (Environment and use of methane from municipal waste in Amman, 1993), where the average value is used,
- Electricity grid emission factor is considered to be 0.4585 kgCO_2/KWh,
- The calculation of generated electricity in MW is based on 8,000 working hours per year,
- The generated electricity from utilization of sludge produced at wastewater treatment plants is assumed to be sold at a fixed price of 0.094 JD/kWh (each kW produced is assumed to replace 1kw sold from the electricity grid),
- The generated electricity from utilization of biogas produced from landfills is assumed to be sold at a fixed price of 0.06 JD/kWh,
- The cost of a 1 MW biogas electricity generation landfill system (generator, wells, piping, etc.) is 1.5 million JD, according to the International Renewable Energy Agency (IRENA),
- The cost of 1 MW biogas electricity generation from biogas system (digester, WWTP generator, piping, etc.) is 4 million JD (Jordan biogas project),
- The fixed annual cost is the sum of maintenance, operation, overheads and supervision costs (3% of capital cost) in wastewater treatment plant systems,

- The fixed annual cost is the sum of maintenance, operation, overheads, and supervision costs in biogas projects in landfills (5% of capital investment, according to IRENA).

All mitigation options under the waste sector were considered as energy measures because the biogas will be used for electric power generation. The cost and the CO_2 emission reductions are analyzed for the 5 proposed projects. A summary of the results is shown in the following table 3.15.

Table 3.15: Emissions reduction (Gg of CO_2eq) and emissions reduction unit cost (JD/tonne of CO_2eq) for the waste mitigation projects

Project Name	Total reduction for the project lifetime (Gg of CO_2eq)	Mitigation cost (JD/ tonne of CO_2eq)
Biogas collection and utilization from Al-Dhulil domestic solid waste landfill	1,003.66	- 0.50
Biogas generation by utilizing the sludge generated from Wadi Arab domestic wastewater treatment plant	280.30	- 4.00
Biogas generation by utilizing the sludge generated from Baqa'a tertiary domestic wastewater treatment plant	188.03	4.48
Biogas generation by utilizing the sludge generated from Maddaba domestic wastewater treatment plant	188.23	4.54

3.3.7 Main results of updating the FBUR mitigation measures

3.3.7.1 GHG emissions reduction of the updated measures

Twenty three GHG mitigation projects out of the 39 projects that were proposed previously in the FBUR are still valid. The yearly GHG emission reductions were recalculated for each mitigation measure over its lifetime. Table 3.16, shows the total GHG emission reductions of the 23 measures for selected years.

Table 3.16: GHG total emissions reductions (Gg of CO_2eq) from the updated measures for selected years

Year	Total GHG Emissions Reductions of the 23 updated measures (Gg of CO_2eq)
2025	1,511.45
2030	2,487.75
2035	2,591.57
2040	2,400.42
2045	3,228.82
2050	1,220.47

3.3.7.2 GHG abatement cost analysis for the updated projects

GHG abatement cost was recalculated for the 23 projects in addition to the yearly and reduced emission reductions. These projects belong to several sectors and subsectors including primary energy, renewable energy, energy efficiency, waste, and agriculture.

It is concluded from the abatement cost analysis for the updated FBUR valid projects that the most feasible options are the energy mitigation projects. The findings indicated that in particular the energy efficiency should receive the most attention. Table 3.17 shows the abatement marginal cost for all mitigation measures ranked from the highest to the lowest and figure 3.1 shows the updated mitigation projects grouped by sector.

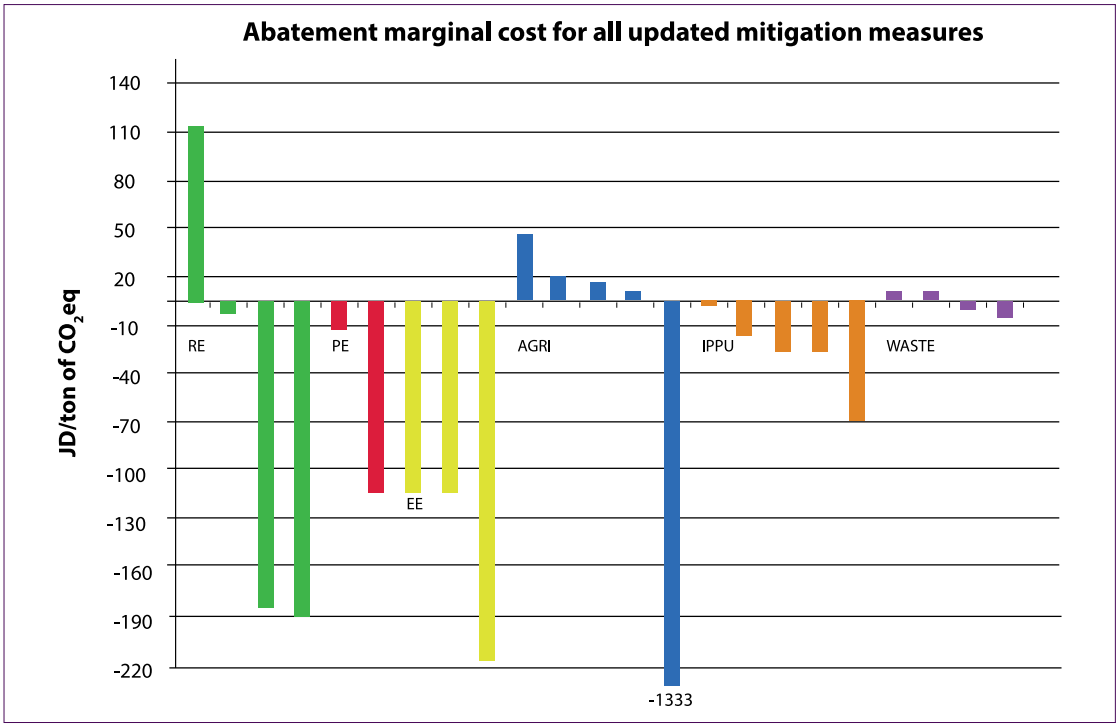

Figure 3.1 Abatement marginal cost (JD/tonne of CO_2eq) for all updated mitigation measures grouped by sector

Legend: AGRI- AFOLU projects, waste- waste projects, IPPU- Industrial Processes projects, RE- Renewable Energy Projects, EE- Energy Efficiency Projects and PE-Primary Energy Projects)

Table 3.17: All updated mitigation projects ranked from the highest GHG reduction cost (JD/tonne CO_2eq) to the lowest cost

	Project Name	Emissions Reduction Unit Cost (JD/tonne of CO_2eq)
1	100 MW Concentrated Solar Power (CSP 1)	118.68
2	Forestry- Introduction of new plantations in Urban Areas	40.00
3	Rangeland 1- Restoration of Rangeland Areas	18.00
4	Forestry- Introduce new plantations in Northern Area	14.50
5	Rangeland 2- New Protected Rangeland Area as Natural Reserve	10.00
6	Biogas generation by utilizing the sludge generated from Madaba domestic wastewater treatment plant	4.54
7	Biogas generation by utilizing the sludge generated from Baqa'a tertiary domestic wastewater treatment plant	4.48
8	Catalytic Reduction of N_2O inside the Ammonia Burner of the Nitric Acid Plant	0.37
9	Biogas collection and utilization from Al-Dhulil domestic solid waste landfill	-0.50
10	Biogas generation by utilizing the sludge generated from Wadi Arab domestic wastewater treatment plant	-4.00
11	300 MW Concentrated Solar Power (CSP 2)	-7.18
12	Natural gas distribution network in Amman, Zarqa and Aqaba	-13.78
13	Use of steel slag and/or fly ash to substitute the raw materials needed to produce clinker	-22.90
14	Produce new cement product CEM IV with 45% of Pozzolana	-32.00
15	Increase the percentage of Pozzolana in CEM II	-32.10
16	Use of biomass (domestic solid waste or/and sewage sludge) as alternative fuels in cement plants	-69.30
17	Returning un-returned condensate to the feed water tanks in food industry	-108.04
18	Loss reduction in transmission and distribution	-108.52
19	Using regenerative burners instead of conventional burners in steel industry	-110.03
20	Insulating walls and roofs in 3,500 houses	-183.64
21	Solar water heaters 3- 30,000 houses	-189.95
22	Insulating pipes, fittings and tanks in food industries	-215.16
23	Promoting climate-smart agricultural practices in the Jordan valley	-1333.00

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Petra

4 DOMESTIC MEASUREMENT, REPORTING, AND VERIFICATION

4.1 Overview

The UNFCCC framework on Measurement, Reporting and Verification (MRV) consists of several elements, which have been put in place gradually through a set of COP decisions since 2004. Some of these elements are implemented at the international level and others at the national level.

At the international level, the MRV framework for developing countries includes:

- Guidance on reporting through National Communications (NCs) and Biennial Update Reports (BURs),
- Guidance on setting up domestic MRV frameworks,
- A process for consideration of information submitted by developing countries in their BURs through an International Consultant and Analysis (ICA),
- International guidance on MRV for those developing countries that voluntarily implement reforestation and avoided deforestation activities and wish to take the opportunity of a results-based payment.

At the national level, Parties to the UNFCCC are expected to implement these international guidance and to prepare and report information every two years through their NCs and BURs. The list of information elements to be reported includes annual GHG emissions inventories, mitigation actions and their estimated effects, as well as technical and financial support needed and received. Jordan was among the first developing countries to submit its first NC under the UNFCCC in 1997.

MRV is central to effectively implement the NDCs, which describes countries mitigation goals and policies submitted under the Paris Agreement.

Measurement is needed to identify emissions trends, determine where to focus Green House Gas (GHG) emissions reduction efforts, track mitigation-related support, assess whether mitigation actions planned under the NDCs are effective, evaluate the impact of support received, and monitor progress achieved in reducing emissions. Reporting and verification are important for ensuring transparency, good governance, accountability, and credibility of results, and for building confidence that resources are being utilized effectively.

At COP 13, through the Bali Action Plan, Parties agreed on the principle of applying MRV for developing country Parties, which laid the foundation for the subsequent elaboration of the existing comprehensive MRV framework for developing country Parties. MRV occurs at the international level, but can also be voluntary at the national level.

4.2 Jordan's multi-tiered MRV system

During 2016, Jordan with the support of the World Bank has submitted its Market Readiness Proposal (MRP) to the Partnership for Market Readiness (PMR) initiative. Jordan's MRP outlined a plan for implementing the market readiness components that will be necessary to support the development of appropriate market based instruments.

The PMR initiative in Jordan is led by the Ministry of Environment, in collaboration with an inter-ministerial technical working group. At the current phase, the PMR initiative, has identified the energy and water sectors as priority sectors for mitigation actions (with energy efficiency (EE) and renewable energy (RE) identified as pilot cross-sector interventions). The initiative aimed at fulfilling three components:

- A national MRV system and registry for climate mitigation measures,
- Designing a platform for private sector financing in EE and RE,
- Exploring the potential for market based instruments for climate mitigation measures.

In February 2018, the first milestone was achieved with developing a multi-tiered integrated MRV system. The first version of the system - still in the experimental phase - covers the public sector energy projects (RE and EE); adding GHG data and support data at sectoral and national level from different sectors and will serve in tracking progress towards Nationally Determined Contribution (NDC) commitments.

The main functions of the system are shown in the figure below (adopted from PMR initiative brochure, 2018), and they are described briefly in the subsequent sections.

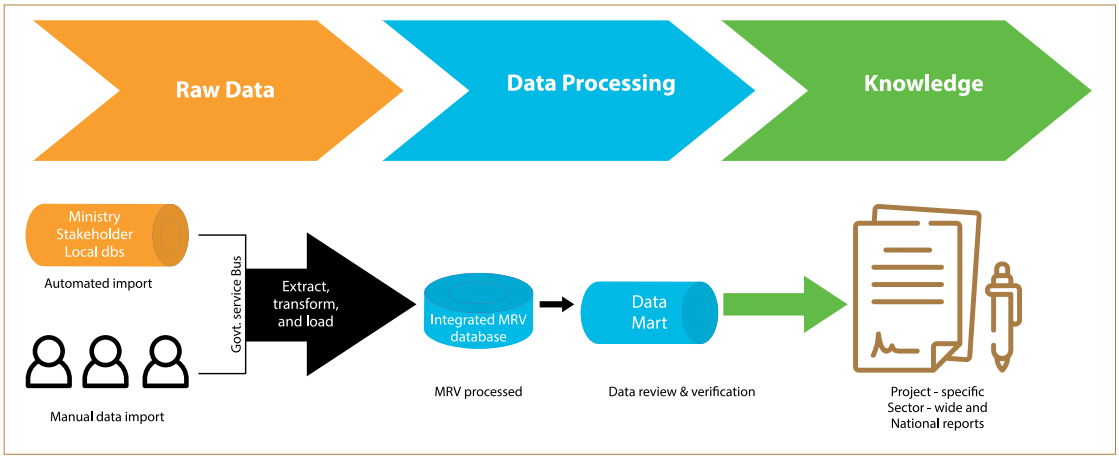

Figure 4.1: The main functions of the MRV system (adopted from PMR initiative Brochure, 2018).

Data Extracting, Transforming & Loading: the system acts as database for GHG emissions at project, ministry, sectoral and national levels, with main functions of; metadata[1] viewing and editing, reference[2] data monitoring, emissions data monitoring and uploading data in a standard format or automatically importing data.

Data Processing: the system provides a database of validated emissions and reduction, with main functions of pre-determined calculations of data compared to previous years and calculation of GHGs and emission reduction based on proxy data[3] and modelled scenarios.

Data Review and Verification: the system provides approved GHG emissions database:

- Validated GHG emissions and emission reductions data based on reviews and verification (by third party, if applicable),
- Status of emissions and GHG emission reductions and browse/change data values.

Data Reporting: the system provides a database for final GHG emissions.

Data are reported and shared in a standard format available in graphics and tables.

1. A set of data that describes and gives information about other data.
2. Data used to classify or categorize other data
3. Data that measures the cause and effect relationship between two variables indirectly.

The following figures (Figure 4.2 and Figure 4.3) illustrates the designed MRV system. The key stakeholders listed below have several roles and functions and are engaged at different levels with various access levels granted according to their role at the national level:

- Ministry of Environment (MoEnv),
- Ministry of Energy and Mineral Resources (MEMR),
- Ministry of Water and Irrigation (MWI),
- Ministry of Local Administration(MoLA),
- Ministry of Finance (MoF),
- Ministry of Planning and International Cooperation (MoPIC),
- The Greater Amman Municipality (GAM),
- Jordan Renewable Energy & Energy Efficiency Fund (JREEEF),
- Department of Statistics (DOS).

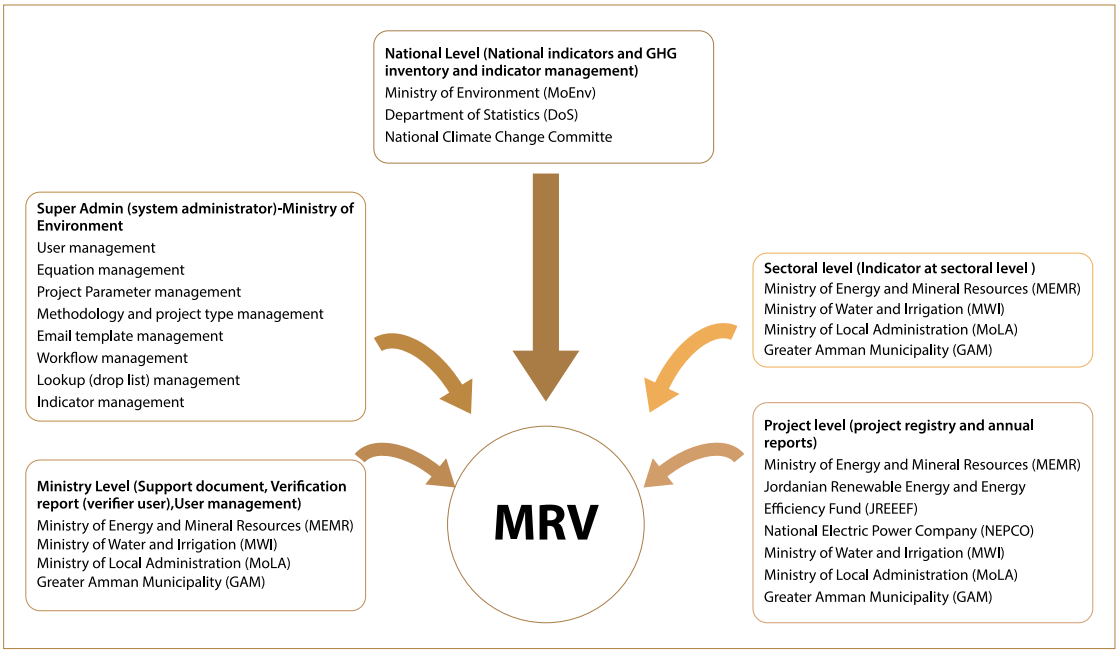

Figure 4.2: key stakeholders involved in Jordan's MRV system

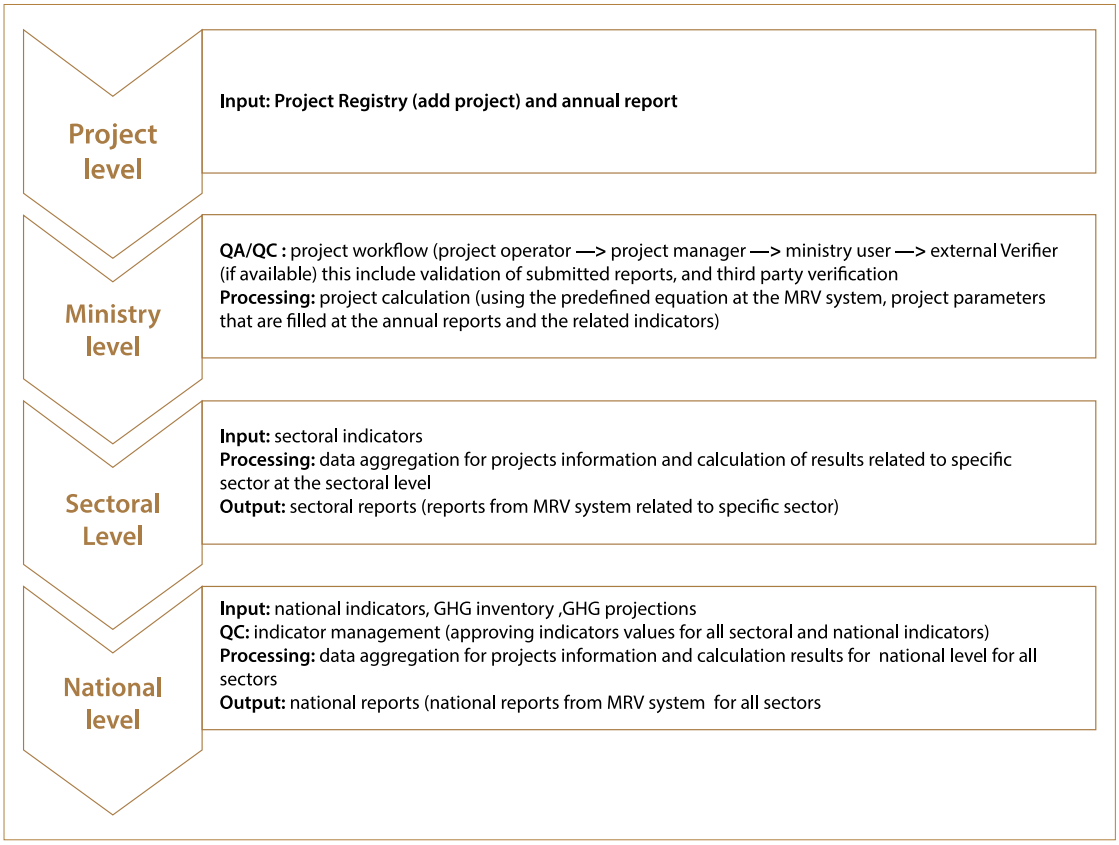

Figure 4.3: Roles and functions of stakeholders at different levels

4.3 Jordan's MRV future plans

It was planned that Jordan's National MRV system and the registry of climate mitigation measures to be fully functional by the end of the year 2020 covering transport and waste sectors in addition to the energy sector. However, this was not done mainly because of COVID-19 pandemic.

References

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Wadi Rum

5 UPDATED GAPS AND CONSTRAINTS, AND RELATED NEEDS

5.1 Introduction

COP 17 adopted the UNFCCC biennial update reporting guidelines for non-Annex I Parties to the Convention in annex III of decision 2/CP.17.

According to article 5 of Annex III; non-Annex I parties should provide updated information on constraints and gaps, and related financial, technical and capacity-building needs. Also, non-Annex I parties should provide updated information on financial resources, technology transfer, capacity-building and technical support received from the Global Environment Facility, Parties included in Annex II to the Convention and other developed country Parties, the Green Climate Fund and multilateral institutions for activities relating to climate change, including for the preparation of the current biennial update report.

With regard to the development and transfer of technology, non-Annex I Parties should provide information on technology needs, which must be nationally determined, and on technology support received.

Accordingly, this chapter aims at providing a brief description of the constraints and gaps identified in previous national climate change communications and the First Biennial Update Report (FBUR). It will also identify newly arising constraints and gaps, and needed actions and resources required to overcome them.

5.2 Institutional Constraints and Gaps and Policy Mainstreaming

5.2.1 Current institutional arrangements

Climate change (CC) Directorate, Environment Law No. 6/2017 and CC bylaw No.79/2019.

The Directorate of Climate Change was established at the MoEnv in 2014 to act as the institutional hub for coordinating and developing all climate change activities in Jordan in relation to the UNFCCC and the global climate change governance system and initiatives.

Jordan has issued in May 2017 a new Environmental Protection Law (No.6/2017) that mandates the MoEnv to "coordinate national efforts to project Climate Change impacts, identify the sectors affected, and limit and mitigate greenhouse gas emissions by means such as funding, technology transfer and reallocation of available funding and its distribution to Climate Change activities". Another significant milestone, is the issuance of the Climate Change Bylaw No. 79 in 2019 which was adopted pursuant to article no. 30(a) of the Environmental Protection Law No. 6/2017. The Bylaw came as a response to the need to define a framework that establishes a clear institutional setting to address climate change challenges and ensure full engagement of all partners and stakeholders including both the technical experts and the decision makers.

Under the provisions of this bylaw, a National Climate Change Committee (NCCC) has been formed. This Committee is chaired by the Minister of Environment and consists of the secretary generals and high level members from the related institutions.

The bylaw identified the responsibility of the MoEnv as UNFCCC focal point to:

a. Seek approval from the NCCC on proposed policies and strategies to adapt to the negative impacts of climate change, and to reduce greenhouse gas emissions, to be submitted to the Cabinet for adoption and inclusion in sectoral policies and strategies,

b. Prepare nationally determined contributions, national communication reports, biennial update reports, national adaptation plans and other climate change relevant documents and update them according to international conventions and obligations,

c. Represent the Kingdom in international climate change commissions and conferences,

d. Create and manage a national inventory database to document emissions data, mitigation and adaptation measures and climate finance data,

e. Authorize accredited entities to verify the results of national inventory reports according to a criteria that will be set for this purpose,

f. Provide technical support to scientific research centres through opening up channels of communication with equivalent international climate research centres,

g. Coordinate with national stakeholders to develop a national climate finance plan, that identifies projects, programmes and plans of priority,

h. Coordinate with national stakeholders with regard to climate change market mechanisms.

In addition to the NCCC, technical teams are nominated according to specific needs; consisting of experts and specialists from governmental organizations, scientific research institutions, civil society organizations, and other related entities identified in the bylaw.

Also, the bylaw set a group of entities mandated to support the MoEnv with providing data, available at their entities, needed for GHG inventory estimation, NDCs and financial support tracking.

Establishment of Green Economy Unit

A Green Economy Unit was established at the MoEnv in 2014, with the purpose of coordinating the national efforts regarding developing and updating the green economy national strategies and legislation in accordance with the sectoral needs. This unit works hand in hand with the Climate Change Directorate (CCD) to support environmental and climate action in Jordan, while also achieving sustainable economic green growth objectives.

In 2017 and with the support of Global Green Growth Institute (GGGI) and UNEP, a National Green Growth strategy, was published, it has identified green growth as a top national priority. Then, recently in 2020, the Green Growth National Action Plans for (2021-2025) was launched for six main sectors (energy, waste, water, transport, agriculture and tourism).

NDC Partnership

In March 2017, Jordan through the MoEnv joined the NDC Partnership as a member country, Jordan became a part of the global coalition of 130 countries and institutions working together to mobilize support and achieve ambitious climate goals. As a global coalition emerging from the Paris Agreement, the NDC Partnership works with Jordan to shift the NDC's focus from commitment to implementation, supporting fast-tracked, enhanced NDC implementation. By facilitating and coordinating the delivery of technical and financial support and knowledge services, the Partnership aims to bridge Jordan's NDC implementation needs with Partnership resources.

To accelerate the implementation of its NDC, the Government of Jordan (GoJ) unveiled its NDC Action Plan in April 2019. Jordan's NDC Action Plan is a detailed statement of measures aligned with the mitigation and adaptation objectives stated in its NDC. It offers a concrete roadmap for transitioning to a low-emissions and climate resilient economy by increasing the share of renewables in the energy mix and scaling up energy efficiency measures; adapting to the impacts of climate change in water, agricultural and health sectors; and strengthening the resilience of vulnerable groups and ecosystems. The measures listed in the Action Plan are at different stages of development and require different types of support, including technical support for feasibility studies, developing financing strategies, monitoring and evaluation services, and financial support for implementation of the investment ready measures.

Mainstreaming climate change at the national level

On the national level many institutions made considerable progress in including climate change in their entities mandates. Many national institutions established climate change directorates or units to follow up with Ministry of Environment, such as the ministries of Agriculture, Water and Irrigation, Transport, The National

Agriculture Research Centre, and The Royal Jordanian Geographic Centre.

Also, recently the Ministry of Environment signed an agreement with King Abdullah II Centre for Excellence to update the Environment Sustainability Award for industries to enhance their commitments towards environment protection including the reduction of GHGs.

The private sector is engaging as well, with a unit for energy and environmental sustainability established in Jordan Chamber of Industry, through which they work with the industries and the government to encourage low emission technologies.

One of the most recent strategies that was recently launched, is the National Energy Strategy 2020 – 2030. This strategy aims to reduce the CO_2 emissions by 10% by 2030. Also the Agriculture Development National Strategy 2020-2025 focused on adaptation and the impacts of climate change on biodiversity and land degradation. At the city level, Greater Amman Municipality in cooperation with Ministry of Environment and World Bank launched in 2018 "Amman Climate Plan - A Vision for 2050 Amman". This inaugural plan sets an interim target of a 40% reduction of greenhouse gas emissions by 2030. This plan sets out a shared vision for collaboration among the government, private sector, development partners and residents of Amman. This plan is a living, evolving document that the city will continue to build on until reaching a carbon-neutral city in 2050.

5.2.2 Identified gaps and constraints and recommendations to address them

The CCD at Ministry of Environment, as UNFCCC focal point, plays a pivotal role in climate change activities at the national level. However, the directorate needs strengthening in term of human resources and sustainability. It is recommended to increase the number of the staff and enhance their capacity to be able to carry out their huge responsibilities in the long term.

Although the climate change bylaw was issued in 2019, it is not fully functioning yet. Up to date, the number of meetings, between the NCCC and the technical teams is not sufficient and no major decisions have been taken on the ground. Also, there are entities identified in Annex (3) of the bylaw who are responsible for providing needed data for the greenhouse gas (GHG) inventory estimation, however, only a slight improvement was detected in providing and facilitating collection of data and still more collaboration is needed.

The following are some recommendations to enact and activate the bylaw, its committee and technical groups:

- It is recommended that MoEnv as chair of the NCCC highlights continually the role of different ministries and institutions in the area of climate change and the need for cooperation to fulfil Jordan's commitments,
- Seek support from international capacity building programs to enable and strengthen the committee and technical groups formed according to the climate change bylaw, in areas relevant to their roles,
- It is recommended to invest in building the capacities of the focal points acting in the technical groups and appoint them to their positions for a sufficient period of time (at least 3 years) to be able to strengthen their work and it's highly recommended to prepare their successors in advance,
- CCDs at different ministries and institutions are important vehicles to mainstream climate change into the strategies and policies of their respective institutions. As such, it is recommend that the MoEnv coordinates continuously with these departments and supports them in identifying their capacity building needs.

5.3 Technical and Capacity Building Needs

5.3.1 Identified gaps and capacity building needs through the Technical Analysis- ICA process

Jordan's First Biennial Update Report (BUR) to the UNFCCC was prepared and submitted in late 2017. After its submission, a Team of Technical Experts (TTE) were formed by the UNFCCC secretariat to perform review. These experts were trained to conduct reviews as part of the ICA according to Decision 2/CP.17, Annex IV.

Following the TTE review and during COP24, Jordan's first BUR was subjected to the Facilitative Sharing of Views (FSV) during the 49th Subsidiary Body for Implementation (SBI 49). The FSV objective is to identify capacity-building needs of developing countries in order to enhance transparency of mitigation actions. The following are the identified capacity-building needs related to the facilitation of the preparation of subsequent BURs and the NCs:

a. Enhance technical capacity on using surrogate data and other splicing techniques from the 2006 IPCC Guidelines that can help fill gaps of historical data and generate a consistent time series;

b. Develop technical capacity for data collection and estimation of emissions of HFCs on a gas-by-gas basis, particularly capacity-building needs related to collecting data from equipment, disposal and processing raw data from the custom departments and other national and/or international sources;

c. Develop technical capacity to perform key source category analysis, particularly capacity-building needs for executing level and trend analysis, and to use the outcomes of the key category analysis;

d. Develop technical capacity to perform uncertainty analysis, particularly capacity-building needs for the quantification of uncertainties of activity data and Emission Factors (EFs) and other parameters of each source/sink category, and to use the outcomes of uncertainty analysis;

e. Enhance technical capacity to conduct ongoing surveys to provide accurate data and to integrate climate change questions in existing energy surveys that mainly focus on energy,

f. Enhance capacity for data collection, project labelling and tracking information for reporting the technology support received,

g. Enhance technical capacity for developing national emission factors and using higher tier methods in the categories defined as key and particularly in the AFOLU and waste sectors,

h. Enhance technical capacity to report on mitigation actions that are already implemented or ongoing across all sectors,

i. Enhance technical capacity for establishing a verification and tracking system of GHG reductions for various mitigation actions across all sectors,

j. Enhance capacity in reporting progress and the underlying steps envisaged for the planned mitigation actions and when they will be implemented,

k. Enhance capacity for analysing emission reductions during the implementation period for each mitigation action.

5.3.2 Reported capacity-building needs in Jordan's FBUR

The following capacity-building needs were reported in the FBUR (most of them are still valid) covering the following areas:

GHG inventory preparation, including:

- There is a need to build capacity in the use of the 2006 IPCC Guidelines and Software.
- The National GHG Inventories of 2010 and 2012 did not provide emission estimates for indirect GHGs such as CO, NOx, NMVOC, and other gases not controlled by the Montreal Protocol, such as SOx because the 2006 IPCC Software does not support the estimation of those gases,

- The National GHG Inventories of 2010 and 2012 have been estimated using the 2006 IPCC Guidelines, which have structural and methodological differences with the Revised 1996 IPCC Guidelines used in estimating GHG emissions inventories for earlier NCs, which made it difficult to provide a consistent time series,
- In preparing all GHG inventories so far, default emission factors were used since there are no available studies to develop national emission factors. The use of national emission factors is highly vital, particularly for key categories within the inventory.

GHG mitigation measures, including:

- Stakeholders had limited expertise and knowledge capacity for conducting mitigation analysis for the transportation, IPPU, AFOLU, and waste sectors,
- The complex nature of mitigation actions and initiatives that are being developed and implemented within the UNFCCC had been a challenge. The various potentials and features of Clean Development Mechanism (CDM), Nationally Appropriate Mitigation Actions (NAMAs), Low Emission Development (LED), Intended Nationally Determined Contributions (INDCs), and other mitigation tools make it difficult for a holistic planning perspective in climate change mitigation,
- Data quality, completeness, and accuracy are of a primary concern when it comes to establishing the baseline and mitigation analysis. Data are not up to date, nor are they readily available in one place.

5.3.3 Capacity building needs and recommendations to fulfill commitments under the Paris Agreement (PA)

The Paris Agreement's Enhanced Transparency Framework (ETF) places new and more strict requirements on developing countries. To implement these new requirements capacity-building support is vital. Article 11 of the PA emphasizes the importance of building the capacity of developing country Parties. The objective is to allow them to take effective climate change actions, particularly via the implementation of adaptation and mitigation actions, so as to facilitate *"technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness and the transparent, timely and accurate communication of information".*

Also, capacity building is essential to drive climate transparency. The 2015 PA outlines an "Enhanced Transparency Framework" including greater requirements for developing countries. Some developing countries have struggled to fulfill pre-Paris Agreement transparency requirements and will need capacity-building support to implement the PA's more stringent requirements (WRI Working paper, 2019).

The new requirements for the PA's enhanced transparency framework have shown that these requirements represent greater efforts to communicate on climate change action and support. Countries agreed on the guidelines for the enhanced transparency framework in December 2018. However, new efforts to build capacity for the transparency framework need not "start from scratch" but should build on and learn from the history of transparency and capacity building under the UNFCCC.

The processes under the PA, including the technical expert review and the facilitative, multilateral consideration of progress under Article 13, the global stock take under Article 14, and the mechanism to facilitate implementation and promote compliance under Article 15 are excellent capacity-building instruments since they help countries improve their transparency-related governance systems and improve data and information needs for reporting. Building or developing capacity is a process that takes time and requires Jordan to "learn by doing", and by leveraging national experiences, lessons learned, and emerging tools or approaches developed over the past 20 years.

Capacity for transparency can be strengthened through enhanced governance and institutional structures and supported by the right participatory

approach. Jordan must organize institutional and governance structures able to collect, report, and use data for decision-making. Governments' ability to engage effectively with key stakeholders is critical to obtaining data of quality and in turn providing the right signals and guidance to convince stakeholders to support government's efforts.

Lasting systems and knowledge are critical to building capacity. More effort is required to build the critical knowledge within key national institutions, by looking at the educational channels and exploring further pedagogical approaches, including twinning programs, to produce active national and regional peer and professional communities. National capacity-building centres—national universities and training centres—need to play a central role in the building of more durable processes for collecting and managing better data, while creating sustainable skills and jobs.

Jordan has already started the capacity building process by taking part in the BUR ICA (as mentioned previously).

As for the implementation of Article 6 (A6) under the PA, Jordan has recently started the work of preparing a roadmap to promote and facilitate Jordan's engagement in A6. A working committee has been formed, aiming at raising awareness and building the capacity of the national stakeholders.

Article 6 has three operative paragraphs, two of which relate to carbon markets: (1) Article 6.2 provides an accounting framework for international cooperation, such as linking the emissions-trading schemes of two or more countries. It also allows for the international transfer of carbon credits between countries, (2) Article 6.4 establishes a central UN mechanism to trade credits from emissions reductions generated through specific projects, (3) Article 6.8 establishes a work program for non-market approaches, such as applying taxes to discourage emissions.

While A6 established these concepts in broad strokes and countries achieved some progress on defining the rules over the years, their final shape remains yet to be agreed.

5.4 Technology Needs Assessment and Technology Transfer

The Ministry of Environment, with Global Environment Facility (GEF)-UNDP support, has previously published a Technology Needs Assessment (TNA) and technology transfer report for 2004-2005. More recently, the Ministry has completed a climate change technology needs assessment for Jordan for the period 2015-2017, where three reports have been published by this project. The first report is for the selection of priority mitigation and adaptation sectors for TNA activities in Jordan. The second report presented a list of the main barriers and an enabling framework, while the third report, which was published in August 2017, offered a technology action plan for two priority mitigation sectors (energy and transport) and two priority adaptation sectors (water and agriculture).

The following TNA analysis is extracted from the three published reports.

The top three mitigation technologies for the energy sector were:

(1) Solar thermal,

(2) PV for electrification, and

(3) PV for water pumping.

The three top-ranked priority mitigation technologies for the transportation sector were:

(1) Bus Rapid Transit,

(2) Improving pedestrian infrastructure, and

(3) Ticketing systems to improve the quality and the attractiveness of public transport services.

The final results for the water sector's top three priority adaptation technologies were:

(1) Roof-top rainwater harvesting,

(2) Augmenting and expansion of Water Users Association (WUAs), and

(3) Desalination and brackish water treatment and re-use.

The results for the agricultural sector's top three priority adaptation technologies were:

(1) Water saving technologies, such as drip or subsurface irrigation,

(2) Farm-level water harvesting, and

(3) Plant varieties resistant to climate change.

Also recently, in April 2020, the Green Growth Action Plan (GGAP) was published by MoEnv, identifying clearly the relation between the green growth and the climate change. The GGAP focused on many interventions related to technology and knowledge transfer in the six sectors; the below are selected technologies that were identified:

Energy

- Improve energy demand management through development of a smart electricity grid,
- Implement electric vehicle charging stations and services provision in Greater Amman Municipality through a public-private partnership,
- Develop and implement a national energy storage action plan and investment pipeline,
- Increase public investment in energy sector research and development,
- Improve the enabling environment and capacity development support for the growth of the Energy Services Companies (ESCOs) market.

Transport

- Support the deployment of Intelligent Transportation Systems (ITS) to allow a modal and fair integration of the public and private transport systems in the city of Amman,
- Establish a national centre of excellence and capacity building program for sustainable transport,
- Develop a national electric mobility strategy and action plan,
- Design and implement a public transport electric mobility pilot and capacity building program in Amman.

Waste

- Establish a national centre for excellence on waste management and circular economy to promote innovation, training, R&D, investment, and policy work,
- Conduct market assessment and feasibility study to identify potential projects and programs to divert organic waste from municipal solid waste streams.

Water

- Technical Assistance to support water efficiency in businesses, industries, and commercial activities (Based on SwitchMed[1] Experience),
- Expand the Samra Wastewater Treatment Plant (Phase III),
- Undertake Desalination of Seawater at the Gulf of Aqaba through Renewable Energy Sources.

Agriculture

- Map and optimize research to impact pathways to improve relevance of innovation efforts in the agriculture sector,
- Develop a flexible crop planning and variety selection methodology and decision-making process based on crop-per-drop and economic competitiveness,
- Design and implement program to support demonstration resource efficiency projects in the olive cultivation and oil production sector,
- Develop and implement pipeline of projects (all sizes) and policy recommendations to increase use of aquaponics and hydroponics in urban and rural areas,
- Upgrade packaging, scaling, storage and cooling of fruits and vegetables managed by the private sector,
- Promote the development of organic agriculture through knowledge exchange and market development.

1. EU initiative aiming at enabling the switch to resource-efficient and circular economies in the Southern Mediterranean region

Tourism

- Develop a roadmap for increasing resource efficiency in the tourism sector,
- Establish a tourism sector centre of excellence to promote innovation and market development.

5.5 Financial Resources Needs

According to NDCs, the Government of Jordan has proposed sectoral mitigation policies and programs to achieve a 14% reduction in GHG emissions by 2030 compared to the baseline scenario. The 14% reduction of GHG emissions is divided into two parts. The first part seeks to achieve a 1.5% reduction in GHG emissions through unilateral actions, while the remaining 12.5% reduction is contingent and conditional on receiving international financial support. In its NDCs, Jordan put the estimate of reducing GHG emissions by 14% at USD 5.7 billion. To finance mitigation measures in the energy sector, Jordan will require USD 5,158 million to meet its conditional mitigation targets.

While a significant proportion of this is likely to come from international sources of finance, one of the key sectoral actions for the energy sector is attracting private sector finance and reducing administrative obstacles in order to enable JREEEF to support investments at early stages.

In Jordan, the role of the private sector is crucial and essential in achieving our NDC, the very high ratio of (Debt: GDP) makes it difficult for the Government to obtain loans. Therefore, the government is considering the role that the mobilization of private investment can play a role in implementing and achieving our NDC.

The key challenges in financing climate change projects are summarized as follows:

- Due to the COVID-19 pandemic and its negative effects on health, the economy and society, it is expected that financial support from donors will be directed to the health sector to mitigate the effects of this pandemic, and this may negatively affect the availability of the required support from international bodies or public budgets at the national level to implement projects to protect the environment in general and climate change projects in particular,
- Lack of Climate Finance Framework (policy or strategy),
- Banks in Jordan, in general, are interested in providing finance to RE and EE projects. Banks prefer financing RE projects, particularly those which are of a larger size and linked to their existing client base. EE and smaller sized projects are less preferred,
- To minimize risks, financiers need access to an independent, credible reference body for the accreditation of climate change projects, particularly RE and EE projects. However, technical verifiers are unavailable, and financiers lack technical capacity,
- There is a lack of appropriate financial products,
- Project developers lack technical capacity.

The work of public financing institutions, such as JREEEF and Jordan Environment Fund (JEF), although small scale, could play a crucial role in promoting early stage investments, particularly for public Private Partnership (PPP) projects, and for Projects with co-financing. For JEF to fund mitigation activities will require a widening of its current role to include a specific focus on mitigation activity, and the development of project selection criteria including an assessment of projects' impact on GHG emissions. In addition, JEF currently lacks adequate human, technical, and financial capability to perform its current role, it needs strengthening at various levels to have an expanded role.

JREEEF now is active and has full and adequate institutional, technical, and financial capacity to manage the fund, supported by a management committee, supportive legislation (JREEEF By-

Law), a transparent and effective governance structure, a strategic business plan, and financial support windows.

The majority of financial resources pumped into environmental sectors in Jordan come from donor countries through bilateral agreements that focus on fiscal and developmental challenges in the country. Framework agreements and strategies with major donors like UNDP, United States Agency for International Development (USAID), UNEP, EU, GIZ, UNIDO, and other agencies have been developed and they address a variety of sustainable development objectives. The donor community is supportive of a public registry of projects which would allow transparency and coordination of ongoing activities, as well as the assessment of their cost effectiveness. In addition, these donors are particularly supportive of developing strong GHG MRV frameworks, believed to be key to demonstrating the effectiveness of climate financing (details about the current MRV can be found in section 4). Financial institutions and banks are interested in entering this new sector. Several green loans and programs are being established and green suppliers and manufacturers are growing in number. However, the market lacks proactive marketing and public outreach.

Previously an amount of 112 million JD were made available for RE and EE financing in Jordan; 76 million JD of the total were made available through the four commercial banks using the Central Bank of Jordan's window for RE and EE, and 36 million JD was made available through the Agence Français de Development (AFD) facility. This experience was not successful, key challenges in disbursing these funds included the lack of credible market references and short credit history. Another challenge for banks was the lack of sufficient knowledge to verify project assumptions, technologies, or risks. They need access to an independent, credible reference body for the accreditation of RE and EE projects.

The following are suggested actions and recommendations to address those gaps and needs:

- Expansion of the framework for the MRV system for Received Support that addresses most of the above gaps, constraints, and needs by establishing a dedicated entity to oversee collecting and verifying received support information related to climate change,
- Strengthen the ability to develop bankable and evidence-based projects,
- It is recommended to raise the capacities of stakeholders to produce bankable viable projects,
- It is recommended to raise the awareness of bankers of technical projects evaluation and assessment,
- Enhance the partnership between the public and private sector.

5.6 Financial and Technical Support Provided by GEF Related to Climate Change

GEF supported Jordan financially in executing the following climate change activities during the period 2015-2020:

- Enabling Activities for the Preparation of Jordan's Third National Communication to the UNFCCC, implemented by MoEnv, 2012-2015,
- Enabling Activities for the Preparation of Jordan's First Biennial Update Report to the UNFCCC, implemented by MoEnv, 2015-2017,
- Mainstreaming Rio Convention into National Sectoral Polices, 2015-2018,
- A systematic approach to Sustainable Urbanization and Resource Efficiency (SURE) in GAM, 2018-2022,
- Enabling Activities for the Preparation of Jordan's Fourth National Communication and Second Biennial Update Report to the UNFCCC, implemented by MoEnv, 2019-present.

The above projects have been implemented with UNDP support, and with technical support from other United Nations organizations including UNEP and UNFCCC. In addition, the UNDP-UNEP Global Support Program (GSP) have provided technical support for the preparation of Jordan's National Communications and the FBUR on climate change through training workshops, provision of guidelines and guidance materials, review of studies and reports and provision of online support and teleconference calls.

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- Climate change technology needs assessment for Jordan (2015-2017). United Nations Environment Program (UNEP) / UNEP-DTU Partnership.
- Developing an Action Plan (2015-2018) for CCD in the Ministry of Environment, GIZ, 2015.
- Jordan's Third National Communication (TNC) to UNFCCC, 2014.
- Jordan's Intended Nationally Determined Contribution (INDCs) to UNFCCC, 2015.
- Market Readiness Proposal (MRP) of Jordan to World Banks' Partnership for Market Readiness' PA, 2015.
- National Environmental and Economic Development Study for Climate Change (NEEDS) Submitted to the United Nation Framework Convention on Climate Change, 2010.
- Roadmap for a national MRV system for GHG inventory, GIZ, 2015.

Dead Sea

6 INFORMATION ON SUPPORT RECEIVED

According to decision 2/CP.17, non-Annex I Parties should provide updated information on constraints and gaps, and related financial, technical, and capacity-building needs. Also, non-Annex I Parties should provide updated information on financial resources, technology transfer, capacity building, and technical support received from the Global Environment Facility.

With regard to the development and transfer of technology, non-Annex I Parties should provide information on technology needs, which must be nationally determined, and on technology support received.

The data on support received and financial flows was requested through traditional channels by sending official letters and formal emails and follow up calls by the Ministry of Environment to all relevant entities (public and private organizations, UN agencies, etc.)

Improvement was witnessed in collecting the needed data due to the increased level of engagement of the national entities in the national climate change profile over the last 2 years, and due to the issuance of the Climate Change Bylaw in 2019, which helped to institutionalize and strengthen the cooperation between relevant entities.

Nevertheless, there is still a need for well-established systems for tracking data and a well-defined process for the data flow from these organizations into the MRV system. To date some data are still present only at one entity and can't be tracked from other sources (the same difficulties as in the First BUR of 2017).

The Tables below (6.1-6.7) provide information on the support received from national, bilateral, and multilateral sources for the period 2015-2020 including funding, technology transfer, capacity building, and technical assistance. The data also describe the different types of support: Grant, Own budget, Loans, Technical Assistant, or Private Investment Corporation.

Types of support are defined as follows:

Climate finance: refers to local, national or transnational financing—drawn from public, private and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change (UNFCCC[2], 2020).

Technology Transfer; "a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organizations (NGOs) and research/education institutions". (CDM-UNFCCC, 2010[3])

Capacity-building: should "assist developing countries to build, develop, strengthen, enhance, and improve their capabilities to achieve the objective of the Convention through the implementation of the provisions of the Convention". (Capacity building framework established by Marrakesh Accord (Decision 2/CP.7).

Technical Support: is defined here as the support which brought together national experts with experts from international organizations, private sector and civil society to facilitate sharing of experiences, lessons learned and best practices in the process of preparation and implementation of the provisions of the convention.

Table 6.1: Support received to fulfil the national climate change commitments (2015-2020)

Support received to fulfil the national climate change commitments (Inventory, Communications, NDCs)					
Timeframe	Project	Donor/ Implementing Entity	Total Budget	Type of Support[1]	Project Objective
2015-2021	Policy dialogue and knowledge management on low emissions development strategies in the MENA region "DIAPOL-CE"	BMU- GIZ/ MoEnv	Grant: Euros 460,000	CB, TS	To support strategies that reduce greenhouse gas emissions in countries of the MENA region. The project provides policy dialogue and supports the implementation of low-emission development in Jordan.
2015-2019	CCAC SNAP- Supporting National Action and Planning on Short-Lived Climate Pollutants (SLCPs)	CCAC/MoEnv	Grant: USD 125,550	CB, TS	Strengthening the institutional capacity dedicated to promoting SLCP mitigation and integrating SLCPs into relevant national planning processes in Jordan.
2015-2016	Partnership for Market Readiness (PMR)	PMR/ MoEnv	Grant: USD 350,000	TS	Preparing the Jordanian Proposal for Market Readiness.
2016-2020	Implementing the activities included in Market Readiness Proposal of Jordan	PMR/ MoEnv	Grant: USD 3,000,000	CB,TS, TT	To enhance the capacity of public agencies and private sector towards the design of future market based instruments. The readiness activities include: 1. Fully Implemented Multi-level MRV 2. Identification of market-based instruments through private sector engagement
2016-2017	Development of Jordan`s first Biennial Update Report to the UNFCCC	GEF-UNDP/ MoEnv	Grant: USD 352,000	CB, TS	To prepare and submit of Jordan's FBUR to the Conference of the Parties to the UNFCCC.
2017	Developing a concept note to seek support on solar water pumping	Clima-South initiative-EU Commission/ MoEnv	Grant	TS	The concept note aims to introduce 10,000 solar water pumps for farmers in Jordan

1. CB= Capacity Building, TS= Technical Support, TT= Technology Transfer, F= Finance

Support received to fulfil the national climate change commitments (Inventory, Communications, NDCs)					
Timeframe	Project	Donor/ Implementing Entity	Total Budget	Type of Support	Project Objective
2017-2019	Mainstreaming Rio Convention Provisions into National Sectoral Policies	GEF-UNDP/ MoEnv	Grant: GEF: USD 950,000 UNDP: USD 25,000	CB, TS	Mainstreaming Rio convention provisions into key national sectoral policies and/or legislation in Jordan.
2017-2019	Development of the National Adaptation Plan process in Jordan to support the implementation of the Paris Agreement and Jordan's NDC	BMU- GIZ/ MoEnv	Grant: Euros 400,000	CB, TS	To develop first NAP in 2020 through a national consultation process based on international guidelines and best practices related to UNFCCC and Paris Agreement.
2018-2020	Supporting effective governance for NDC review and implementation in Jordan (IKI- NDCs)	BMU- GIZ/ MoEnv	Grant: Euros 2,000,000	TS, CB	To advise MoEnv and national partners on the key elements of: 1. Reviewing and updating the first NDC document and development of a new NDC document by 2020 2. Developing a framework for enhanced transparency in Jordan. 3. Localization of NDC through developing three local climate action plans.
2018-2020	Development of Fourth National Communication and Second Biennial Update Report under the UNFCCC	GEF-UNDP/ MoEnv	Grant: USD 852,000	TS, CB	To prepare and submit Jordan's 4thNC and Second BUR to the Conference of the Parties to UNFCCC.
2018-2020	Strengthening National Designated Authority (NDA) of Jordan to deliver on Green Climate Fund (GCF) Investment Framework	GCF/ MoEnv	Grant: USD 220,000	CB, TS	To strengthen and enable Jordan NDA to effectively engage with the GCF.

Support received to fulfil the national climate change commitments (Inventory, Communications, NDCs)					
Timeframe	Project	Donor/ Implementing Entity	Total Budget	Type of Support	Project Objective
2018-2020	GCF Readiness for Accreditation	GCF/ MoEnv	Grant: USD 660,000	CB, TS	To support a national entity to get accreditation for Direct Access Entity. Pipeline development. Private sector engagement
2018-2021	CLIMA- MED project	EU Commission/ MoEnv	Grant	CB, TS	Technical assistance task for the Southern Neighbourhood region, including Jordan, to enhance municipalities to develop sustainable energy and climate action plans, to support climate action
2019-2023	NDC Action Program (IKI), Regional program.	BMU /UN-Environment/ MoEnv	Grant: Euros 1,000,000	CB, TS	This program is being implemented in selected countries. The project outcome is to apply a systematic approach to using policies and economic instruments that accelerate public and private investment in NDC implementation
2020	Green Growth Action Plan Implementation	GGGI/ MoEnv	USD 183,000	CB, TS	Complete the implementation arrangements for the Green Growth National Action Plan (GGNAP). Support MoEnv to establish an internal climate and green growth Project Management Unit.
2020-2021	GCF Readiness	GCF/ MoEnv	Grant: USD 1,000,000	CB, TS	- National Climate Finance Needs Assessment & Strategy - Pipeline Development. - Private Sector Mobilization

Table 6.2: Support Received for Energy Sector (2015-2020)

Support Received for Energy Sector					
Timeframe	Project	Donor/Implementing Entity	Total budget	Type of Support[2]	Project objective
2015	Wind Energy- Tafilah, 117 MW	IFC/Private company: Jordan Wind Project Company (JWPC)	Commercial Loan: USD 290,000,000	F, CB, TT	Generating clean energy, and diversification of energy sources.
2015	Solar energy- Azraq, 2.17 MW	Bilateral Spanish-Jordan Debt Swap mechanism/ MEMR	Grant: USD 5,000,000	TT	Generating clean energy, and diversification of energy sources.
2015	Solar energy- Azraq, 3 MW	Spanish Loan/ MEMR	Grant: USD 6,000,000	TT	Generating clean energy, and diversification of energy sources.
2016-2017	Solar Energy Round I, 200 MW	Private lenders/ Private companies	Commercial Loan: USD 400,000,000	TT	Generating clean energy, and diversification of energy sources.
2016-2019	Renewable Energy and Energy Efficiency Program REEE II.	EU Commission/ Private company	Grant (General Budget Support): Euro 90,000,000	CB, TS, TT	To support government of Jordan in enhancing the clean energy and energy efficiency practices.
2017	Wind energy- Ma'an, 80 MW	Gulf Grant/ MEMR	Grant: USD 150,000,000	TT	Generating clean energy, and diversification of energy sources.
2017	Solar energy - Zaatari	KFW/ MEMR	Grant: Euros 15,000,000	TT	Generating clean energy, and diversification of energy sources.
2017	Solar energy (round II) - Mafraq, 50 MW	EBRD/ Private company	Loan: USD 86,000,000	TT	Generating clean energy, and diversification of energy sources.
2017	Solar energy- Mafraq, 50MW	EBRD/ Private company	Loan: USD 80,000,000	TT	Generating clean energy, and diversification of energy sources.

2. CB= Capacity Building, TS= Technical Support, TT= Technology Transfer, F= Finance

Support Received for Energy Sector					
Timeframe	Project	Donor/Implementing Entity	Total budget	Type of Support	Project objective
2017	Solar energy-Alsafawi, 50MW	EBRD/ Private company	Loan: USD 80,000,000	TT	Generating clean energy, and diversification of energy sources.
2018	Solar energy-Quwera, 103MW	Abu Dhabi Fund/ MEMR	Grant: USD 150,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy-Rajef/ Ma'an, 86 MW	EBRD/ Private company	Loan: USD 183,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy-Fujij/ Shobak, 90MW	Private sector/ Private company	Loan: USD 182,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy-Tafila, 50MW	Private sector/ Private company	Loan: USD 113,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy-Tafila, 100MW	Private sector/ Private company	Loan: USD 201,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy-Irbid, 45MW	Private sector/ Private company	Loan: USD 100,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy-AlShobak , 45MW	EBRD and Islamic Cooperation for the Development of Private Sector/ Private company	Loan: USD 100,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Solar energy, Azraq, 5MW	EU commission/ MEMR	Grant: USD 5,000,000	TT	Generating clean energy, and diversification of energy sources.

Support Received for Energy Sector					
Timeframe	Project	Donor/Implementing Entity	Total budget	Type of Support	Project objective
2019	Solar energy- East of Amman, 40MW	- Overseas Private Investment Corporation/ Private company - Sumitomo Mitsui Banking Corporation/ Private company	Loan: USD 50,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Solar Energy – Risha, 50MW	- EBRD - DEG - Arab Bank - Implementing: - Private company	Loan: USD 75,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Solar Energy in South Amman, 46.33 MW	- KFW/ MEMR	Grant: USD 51,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy- Fujij/ Shobak, 90MW	- The Export-Import Bank of Korea (KEXIM) - Sumitomo Mitsui Banking Corporation (SMBC) - MIZOHO/ Private company	Loan: USD 182,000,000	TT	Generating clean energy, and diversification of energy sources.
2019	Wind energy- Tafila, 50MW	- IFC - Standard Chartered Bank - Shinhan Bank/ Private company	Loan: USD 113,000,000	TT	Generating clean energy, and diversification of energy sources.
2018	Solar energy- Muwaqer, 200MW	- Japan International Cooperation Agency - DEG, Deutsche Investitions Und entwicklungs gesellschaftsmbh - Open Fund for International Development/ Private company	Loan: USD 200,000,000	TT	Generating clean energy, and diversification of energy sources.
2020	Solar energy- Round III, 150MW	- Private sector/ Private company	Loan: USD 250,000,000	TT	Generating clean energy, and diversification of energy sources.

Table 6.3: Support Received for Waste Sector (2015-2020)

Support Received for Solid Waste Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support[3]	Project objective
2015-2018	Comprehensive Landfill Gas Recovery program at Ghabawi landfill	EBRD/GAM	Loan: USD 18,000,000	CB, TS, TT	Design, build and operate Landfill Gas to Energy in Ghabawi Landfill
2016-2020	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Grant: GBP 4,900,000	TS, TT	To mitigate the effects of the increasing number of refugees by providing more sustainable and long term solutions in the solid waste sector.
2017-2019	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Loan: JD 3,250,000 Grant: GBP 4,165,000	TS,TT	Construction of new cell in Ghabawi Landfill
2017-2021	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Grant: USD 396,412.	CB, TS	Supervision on the implementation of Biogas project
2017-2023	Support the implementation of the National Solid waste Strategy in Jordan	EU/GAM	Grant: Euro 120,000,000	CB, TS, TT	General support to Government of Jordan to enhance the implementation of the NSWMS with focus on northern area.
2018-2020	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Loan: JD 11,100,000 Grant: GBP 5,630,000 Grant: USD 7,400,000	TS, TT	Improving the machinery and infrastructure at Ghabawi landfill.

3. CB= Capacity Building, TS= Technical Support, TT= Technology Transfer, F= Finance

Support Received for Solid Waste Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support	Project objective
2018-2020	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Loan: USD 3,100,000 Grant: Euro 3,700,000	CB, TS, TT	Installations of LFG recovery for power generation
2018-2020	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Grant: USD 689,784	CB	Developing the Environmental and Social Action Plan (ESAP) for GAM, and ESIA for Ghabawi Landfill
2018-2020	Solid Waste Crisis Response Program to Syrian Refugees Influx / GAM	EBRD/GAM	Grant: Euro 578,450	CB	Support GAM to complete a mapping exercise on mapping all current waste related activities
2018-2020	Climate and Response Protection through Circular Economy (CIRCLE)	BMZ- GIZ/ GAM	Grant: Euro 4,000,000	CB, TS	Improving the solid waste management system in the city of Amman
2019-2021	The rehabilitation and expansion of Al-Shaer Waste Transfer Station (WTS)	EBRD/GAM	Loan: JD 2,500,000 Grant: Euro 3,000,000	TS, TT	To rehabilitate and expand Al-Shaer Waste Transfer Station
2019	The purchase of 25 sweepers to be used in the City of Amman for solid waste services	EBRD/GAM	Loan: JD 2,400,000 Grant: Euro 3,000,000	TS, TT	To improve the solid waste services in the City of Amman
2020	Awareness raising on solid waste management practices	EBRD/GAM	Grant: EUR 500,000	CB	Capacity building and awareness raising on solid waste management practices.

Table 6.4: Support Received for Transport Sector (2015-2020)

Support Received for Transport Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support	Project objective
2010/2015-2021	Amman Bus Rapid Transit	AFD/GAM	Loan: USD 166,000,000	CB, TS, TT	To provide high-quality public transport by encouraging mode shift from private cars to public transport.

Table 6.5: Support Received for Industrial Sector (2015-2020)

Support Received for Industrial Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support	Project objective
2015-2020	Mediterranean Transfer of Environmentally Sound Technology III (MED TEST)	EU Commission/ MIT &	Grant: Euro 1,500,000	CB, TS, TT	The project is part of the EU Switch-MED program on enhancing sustainable consumption and production /circular economy themes with coordination of the Jordanian industries.

Table 6.6: Support Received for Water and Wastewater Sector (2015-2020)

Support Received for Water and Wastewater Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support[4]	Project objective
2012-2018	Climate Adaptation: Hydrological Monitoring System	KFW/MWI	Loan: Euro 6,400,000	TS, TT	Strengthening of the hydrological and meteorological monitoring system
2013-2019	Climate Change Mitigation in the Wastewater Sector	KFW/ MWI	Loan: Euro 20,000,000	TT	Mono landfill at Samra WWTPs and sludge management in part of the WWTP in the north: biogas digester in two WWTPs
2014-2020	Adaptation to Climate Change in Water Sector	KFW/ MWI	Loan: Euro 20,000,000	TT	

4. CB= Capacity Building, TS= Technical Support, TT= Technology Transfer, F= Finance

Support Received for Water and Wastewater Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support	Project objective
2014-2020	Measures to Adaptation to Climate Change in Water Sector	KFW/ MWI	Grant: Euro 1,500,000	TS	
2014-2017	ACCBAT-Adaptation to climate change through improved water demand management in irrigated agriculture by introduction of new technologies and best agricultural practices.	ENPI CBC Med Program/MWI	Grant: Euro 829,000	TS, CB	The project aimed to promote balance between supply and demand by stabilizing water demand through the reduction of water losses and promoting development and sustainable use of non-conventional water resources mainly in agriculture.
2014-2019	Improved Water Resources Security for Low Income Rural and Urban Communities	EU Commission / MWI	Grant: Euro 6,500,000	CB, TS, TT	Enhance re-use of treated wastewater for farmers.
2015-2020	Reduce vulnerability in Jordan in the context of water scarcity and increasing food-energy demand	Swiss Agency for Development and Cooperation (SDC)/ MWI	Grant: Euro 2,216,267	CB, TS, TT	Reduce vulnerability of the rural Jordanian in the context of water scarcity for agriculture, increased demand for food and livelihood provision from growing population and increasing energy demand.
2016-2020	Improved access to water, water distribution performance and related sewerage disposal in Irbid Governorate for host communities and Syrian refugees	EU Commission / MWI	Grant: Euro 40,000,000	CB, TS, TT	Develop water and wastewater services in host communities.

Support Received for Water and Wastewater Sector					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support	Project objective
2017-2019	Resilience and Water Optimization in Communities Hosting Syrian Refugees and Vulnerable Jordanians	SDC/ MWI	Grant: Euro 1,300,000	CB, TS	This project aimed to increase water use efficiency as a response to scarce water resources through rehabilitation and upgrade of water networks in two villages and of water and sanitation facilities in households.
2017-2020	Climate Protection in the wastewater sector- ACC measures	KFW/ MWI	Loan: Euro 3,000,000	TS	Support to Yarmouk Water Company (YWC) in operation of WWTP
2018-2019	Aqaba Flash Flood Mitigation Measures and Early Warning System	SDC/ MWI	Grant: Euro 420,000	CB, TS	To support ASEZA and their operational arm Aqaba Development Cooperation (ADC) in mitigating the threat of flash floods.
2019-2022	Water Companies for Climate Mitigation, WaCCliM	BMU- GIZ/ MWI	Grant: Euro 400,000	CB, TS, TT	Working with water utilities to reduce their carbon emissions throughout the whole cycle (abstraction, distribution, collection and wastewater treatment).
2019	Climate Resilient Water Safety Plan in Wadi Heidan	UNICEF/ MWI	Grant: Euro 200,000	CB, TS	To support Miyahuna Company on implementing the Climate Resilient Water Safety Plan in Wadi Heidan
2019-2024	Adaptation to climate change in the water sector II	KFW MWI	Loan: Euro 25,000,000	TT	Irrigation infrastructure rehabilitation i.e. irrigation networks, reservoirs and water conveyors.
2019-2024	Measure to Adaptation to Climate Change in Water Sector II	KFW/ MWI	Grant: Euro 1,500,000	TS	Consulting measures for the Adaptation to Climate Change in the Water Sector Project II.

Table 6.7: Support Received for Vulnerable Communities (2015-2020)

Support Received for to Support Vulnerable Communities					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support[5]	Project objective
2014-2018	Irrigation technology pilot project to adapt to climate change in Jordan	GEF/ NARC	Grant: USD 2,000,000	CB, TS, TT	Reducing the vulnerability of the agricultural system to climate change by testing innovative and efficient water-use technologies.
2015-2025	Special Fund for Emergency and Rehabilitation (SFERA) Revolving Fund Component- Needs Assessment and Program Development Window	Multilateral/ FAO	300,000 USD	CB, TS, TT	Building the resilience and livelihood of Syrian refugees and Jordanian host community in climate smart agricultural practices to achieve food security
2017	Improving household food security and access to livelihoods. Food production and processing by Syrian refugees and vulnerable host community households.	FAO/FAO	270,000 USD	CB, TS, TT	Building resilience of Syrian Refugees and Jordanian host community in climate smart agricultural practices to achieve food security.

5. CB= Capacity Building, TS= Technical Support, TT= Technology Transfer, F= Finance

Table 6.8: Support Received for Urban Planning (2015-2020)

Support Received for Urban Planning					
Timeframe	Project	Donor/ Implementing Entity	Total budget	Type of Support[6]	Project objective
2018-2022	A Systematic Approach to Sustainable Urbanization and Resource Efficiency in Greater Amman Municipality (SURE)	GEF-UNDP/ GAM	Grant: USD 2,640,000 UNDP: USD 100,000	CB, TS, TT	To assist GAM to improve the quality of life for its citizens and comply with the National Energy Efficiency Action Plan (NEEAP) by targeting low-carbon interventions related to municipal buildings and street lighting.
2018-2021	Sustainable Inclusive, Evidence Based National Urban Policies in Selected Arab Countries.	United Nations Department of Economic and Social Affairs (UNDESA)/ UN-Habitat	Grant: USD 451,000	CB, TS	To strengthen capacities of policy makers for more informed, sustainable and inclusive National Urban Policies (NUP) leading to mainstreaming of climate change. .
2020-2021	Strengthening the social stability and resilience of vulnerable Jordanian communities and Syrian refugees in Amman against flash flood	Government of Japan/ UN-Habitat	Grant USD 978,709	CB, TS, TT	To strengthen the government and the community resilience to better manage flash flood including infrastructure.

6. CB= Capacity Building, TS= Technical Support, TT= Technology Transfer, F= Finance

Kufranja Dam

7 APPENDICES

Appendix A: Mitigation Projects Tabular Updates

Table A.1: Primary energy projects

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Project Duration	Discounted Emission reduction during project lifetime (Gg CO_2eq)
Loss Reduction in Electricity T&D Network	Electricity (CO_2, N_2O, CH_4)	NEPCO and Distribution Companies	Planned	Reduce the T&D losses to 9% in 2027 compared to 13.3% in 2020	2022-2047	1,956
Natural Gas Distribution Network in Amman, Zarqa, Aqaba	Supply (CO_2, N_2O, CH_4)	MEMR and Private Sector	Planned	Replace the Oil products with NG in demand sectors	2025-2050	2,708
Demand Side Management	Electricity (CO_2, N_2O, CH_4)	NEPCO	Canceled from NEPCO's implementation plan. Different components of the project will be implemented by JREEEF/MEMR	-	-	-
Adding a 100 MW Combined Cycle in Samra Power Plant	Electricity (CO_2, N_2O, CH_4)	CEGCO	Implemented in 2018	Utilization of waste heat		Actual emissions reduction needs to be estimated
OBJECTIVE OF THE MITIGATION ACTION						
The objective of these mitigation actions is to reduce emissions by: • Reducing electricity consumption which will result in reduced quantity of fuels used for electricity generation. • Replacing usage of fuel oil products with natural gas. • Utilizing the waste heat from electricity generation.						

Table A.2: Renewable energy projects

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/invalid]	Main assumptions used in the mitigation analysis	Duration	Discounted Emission reduction during project lifetime (Gg CO_2eq)
100 MW Concentrated Solar Power (CSP)	Renewable energy sub-sector (CO_2)	Ministry of Energy and Mineral Resources	Proposed idea	- Annual average solar energy yield is 1,520 KWhe/KWp. - Grid emission factor of 0.4585 kg CO_2/KWh. - Capacity factor for CSP technology in 2023 is 45%. - Discount rate is 8%.	2023-2047	1,929.37
300 MW Concentrated solar power (CSP)	Renewable energy sub-sector (CO_2)	Ministry of Energy and Mineral Resources	Proposed idea	- Annual average solar energy yield is 1,520 kWhe/kWp. - Grid emission factor of 0.4585 kg CO_2/kWh. - Capacity factor for CSP technology in 2028 is 70%. - Discount rate is 8%.	2028-2052	9003.71
Solar water heaters (2)- 30,000 houses	Renewable energy sub-sector Residential sector (CO_2)	JREEEF / MEMR	Implemented in four stages- during 2017-2020	-		Monitoring is needed to estimate actual emission reduction.

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/invalid]	Main assumptions used in the mitigation analysis	Duration	Discounted Emission reduction during project lifetime (Gg CO_2eq)
Solar water heaters (3) 30,000 houses	Renewable energy sub-sector Residential sector (CO_2)	JREEEF / MEMR	Planned	- Grid emission factor of 0.4585 kg CO_2/KWh - Annual energy production for one m2 of solar water heater is 740 KWh. - Discount rate is 8%.	2022-2046	457.51
120 MW PV – Wheeling and Net Metering	Renewable energy sub-sector	MEMR	Implemented 2017-2020	-		Monitoring is needed to estimate actual emission reduction.
OBJECTIVE OF THE MITIGATION ACTION						
The objective of these mitigation actions is to increase the share of RE in the energy mix and to enhance energy security. Using clean RE replaces electricity generated from carbon intense sources.						

Table A.3: Energy efficiency projects

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/invalid]	Main assumptions used in the mitigation analysis	Duration	Emissions reduction (Gg)
Replacing high thermal mass with low thermal mass (LTM) in ceramic factories	Energy efficiency sub-sector (CO_2)	Jordan Chamber of Industry can lead/initiate the implementation of this action or the Ceramic Plants	Invalid- The main Ceramic company in Zarka and most of the other ceramic industries have closed due to high competition from imported Ceramic		-	-
Returning unreturned condensate to the feed water tanks in food processing	Energy efficiency sub-sector (CO_2)	Jordan Chamber of Industry can lead/initiate the implementation of this action.	Proposed idea	- The measure is assumed to be implemented in 10 food industries - Grid emission factor of 0.4585 kg CO_2/KWh - Discount rate is 8%.	2022-2046	7.43
Insulating un-insulated pipes, fittings, and tanks in food processing	Energy efficiency sub-sector (CO_2)	Jordan Chamber of Industry can lead/initiate the implementation of this action.	Proposed idea	- The measure is assumed to be implemented in 10 food industries - Grid emission factor of 0.4585 kg CO2/KWh - Discount rate is 8%.	2022-2046	8.24

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/invalid]	Main assumptions used in the mitigation analysis	Duration	Emissions reduction (Gg)
Replacing fluorescent lamp fixtures with LED lamp fixtures in commercial buildings	Energy efficiency sub-sector (CO_2)	MEMR	Implemented by MEMR and concerned institutions during 2017-2020	-	-	Monitoring is needed to estimate actual emission reduction
Insulating walls and roofs in 3,500 new houses	Energy efficiency sub-sector (CO_2)	Ministry of Public Works and Housing can lead the implementation of this action in cooperation with municipalities.	Proposed idea	- This project is assumed to be implemented in 80% of the targeted 3500 new houses (i.e 2800 houses) - The area of each house is 150 m^2. - Grid emission factor of 0.4585 kg CO_2/KWh - Discount rate is 8%.	2022-2051	69.79
Street lighting replacing 125 W Mercury lamps with 70 W high pressure sodium lamps	Energy efficiency sub-sector (CO_2)	Ministry of Public Works and Housing, MEMR and GAM	Implemented	-	-	Monitoring is needed to estimate actual emission reduction.

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/invalid]	Main assumptions used in the mitigation analysis	Duration	Emissions reduction (Gg)
Using regenerative burners instead of conventional burners in steel reheating.	Energy efficiency sub-sector (CO_2)	Jordan Chamber of Industry can lead/initiate the implementation of this action.	Proposed idea	- Grid emission factor of 0.4585 kg CO_2/KWh - Discount rate is 8%. - It is assumed that this measure is to be implemented in 5 steel factories	2022-2041	72.09
Using variable speed drives in the paper factories pumps	Energy efficiency sub-sector (CO_2)	Jordan Chamber of Industry can lead/initiate the implementation of this action.	Invalid- Most of the paper pulp factories are currently closed.			
LED lighting in public buildings	Energy efficiency sub-sector (CO_2)	MEMR	Implemented during 2017-2020	-	--	Monitoring is needed to estimate actual emissions reduction

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/invalid]	Main assumptions used in the mitigation analysis	Duration	Emissions reduction (Gg)
Improving energy efficiency in small and medium size hotels	Energy efficiency sub-sector (CO_2)	MEMR/JREEEF	Under implementation	- Up until the end of 2020 measures were implemented in 16 hotels	2017-2021	Monitoring is needed to estimate actual emission reduction
LED lighting in households	Energy efficiency sub-sector (CO_2)	MEMR	Implemented during 2017-2020	-		Monitoring is needed to estimate actual emission reduction
OBJECTIVE OF THE MITIGATION ACTION						
The objective of these mitigation actions is to increase EE in different sectors: residential, commercial and industrial. Introducing EE measures will result in substantial reduction of consumption of electricity generated and fossil fuels.						

Table A.4: IPPU Projects

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Use of steel slag and/ or fly ash to substitute the raw materials needed to produce clinker	Mineral Industry/ Cement production CO_2	Cement manufacturing companies	Proposed idea	- 40% of limestone is replaced by steel slag/ fly ash. - 10% of CEM II/B-P (Portland-Pozzolana Cement) will be converted to a new product CEM V/B. - The annual CO_2 emissions from producing CEM II/B-P is multiplied by 4% to calculate the CO_2 emissions reduction. - The price of steel slag and/or fly ash is estimated to be 42.3 JD/tonne. - Investment cost to grind the steel slag is estimated to be $0.1.37/tonne of cement. - The production cost will be reduced by 54.7 JD/tonne of cement.	2022 - 2046	250
Increase the percentage of Pozzolana in CEM II	Mineral Industry/ Cement production CO_2	Cement manufacturing companies	Proposed idea	- A reduction of CO_2 emissions by 2% is assumed. - The price of Pozzolana is estimated to be 36.6 JD/tonne. - The production cost will be reduced by 54.7 JD/tonne of cement.	2022-2046	367

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Produce new cement product CEM IV with 45% of Pozzolana	Mineral Industry/ Cement production CO_2	Cement manufacturing companies	Proposed idea	- 10% of produced CEM II/B-P will be changed to CEM IV. - The annual CO_2 emissions from producing CEM II/B-P is multiplied by 1.3% to calculate CO_2 emissions reduction. - The price of Pozzolana is estimated to be 36.6 JD/tonne. - The production cost will be reduced by 54.7 JD/tonne of cement.	2022 - 2046	238

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Use of biomass (MSW or/ and Sewage Sludge) as alternative fuels	Mineral Industry/ Cement production CO_2	Cement manufacturing companies	Proposed idea	- A reduction factor of 0.0231 tonnes CO_2/ tonne cement is used to estimate the average use of MSW or dried sewage sludge. - The price of coal is estimated to be 344 JD/ tonne. - The estimated average distance between the cement plants and Ghabawi Landfill is 100 km. - The estimated fuel cost is 0.2 JD/km. - The estimated transport fees are 1.5 JD/km. - An additional cost of 10 JD/tonne of MSW or/and sewage sludge is assumed to manage any required mitigation before use. - 0.175 tonnes of dry MSW is required to produce 1 tonne of cement. - 0.233 tonne of dry sludge is required to produce 1 tonne of cement. - 0.098 tonne of coal is required to produce 1 tonne of cement. - 20% of coal is replaced. - A value of 27.5 JD/tonne of alternative fuel is to estimate the investment cost.	2022 – 2046	814

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Catalytic Reduction of N2O inside the Ammonia Burner of The Nitric Acid Plant	Mineral Industry/ Nitric Acid Production N_2O	Arab fertilizers and Chemicals Industries LTD (KEMAPCO)	Proposed idea	- The capital cost for an integrated secondary abatement project is estimated to be around 2.78 Euro/tonne of nitric acid produced. - The operational cost is estimated to be around 1 Euro/tonne of nitric acid produced. - This abatement technology is capable of reducing the N_2O produced inside the ammonia burner, by about 75%	2022 – 2046	1,659
OBJECTIVE OF THE MITIGATION ACTION						
The objective of these measures is to change the raw material inputs, in order to save energy, whilst continuing to produce high quality products. In addition, to introduce new technologies in industrial companies with the aim of reducing GHG emissions from industrial processes.						

Table A.5: AFOLU Projects

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Forestry- Introduce new plantations in Urban Areas	Agriculture/ Land use	Ministry of Agriculture	Proposed Idea	- Planting 2,500 trees in urban areas - A medium growth coniferous tree, planted in an urban setting and allowed to grow for 10- 20 years, sequesters 0.06 tonne CO_2 per planted tree.	2022-2042	0.1502
Forestry- Introduce new plantations in Northern Area	Agriculture/ Land use	Ministry of Agriculture	Proposed Idea	- Planting 30,000 Trees (Jerash and Ajloun) - A medium growth coniferous tree allowed to grow for 10- 20 years, sequesters 0.06 tonne CO_2 per planted tree.	2022-2042	11.92
Rangeland 1- Restoration of rangeland areas	Agriculture/ Land use	Ministry of Agriculture	Proposed Idea	- Restoring 50,000 dunums of rangeland and introducing perennial shrubs will enhance and conserve carbon within the soil. - It is assumed that within an area of annual rainfall of 100-200 mm, the average annual production of dry matter per dunum is 50 kg. - It is assumed to have an average sequestration rate of 0.567 tonnes/ha/year.	2022-2036	888.14

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Rangeland 2- New protected rangeland area as natural reserve	Agriculture/ Land use	Ministry of Agriculture	Proposed Idea	- Restoring 100,000 dunums of rangeland and introducing perennial shrubs will enhance and conserve carbon within the soil. - It is assumed that within an area of annual rainfall of 100-200 mm, it is expected to increase the average annual production of dry matter per dunum from 4 kg to 15 kg - It is assumed to have an average sequestration rate of 0.567 tonnes/ha/year.	2022-2036	1,776.28
Promoting for Climate-smart agricultural practices in the Jordan Valley	Agriculture/ Land use	Ministry of Agriculture	Proposed Idea	- The project suggests two main best practices of the climate smart agriculture to be promoted, namely: Minimal mechanical soil disturbance (i.e. low tillage practices and direct seeding) and replacing 50 % of the Synthetic fertilizer by compost (organic fertilizer). This would decrease emissions and will improve soil health in terms of structure, productivity and water holding.	2022-2026	13.06

OBJECTIVE OF THE MITIGATION ACTION

The main mitigation options within AFOLU mainly involve two objectives:

- Reduction/prevention of emissions to the atmosphere by conserving existing carbon pools in soils or vegetation that would otherwise be lost or by reducing emissions of CH_4 and N_2O;
- Sequestration—enhancing the uptake of carbon in terrestrial reservoirs, and thereby removing CO_2 from the atmosphere.

Table A.6: Waste Projects

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Utilization of biogas produced from Al-Dhulil Landfill in electricity production	Waste- Solid waste	Ministry of Local Administration	Planned	- Density of methane = 0.717 kg/m^3 (Clean Energy Emission Reduction (CLEER) protocol , ICF, 2019) - The captured methane is calculated according to PRIF study, Amman, 1993 where the average value is used. - Assuming every 1 MW produced needs 300 m^3 CH_4/hr to be burned - Electricity grid emission factories 0.4585 $kgCO_2$/KWh - The generated electricity will be sold at a fixed price of 0.06 JD/kWh - The cost of 1 MW biogas electricity generation system (generator, wells, piping, ….etc) is 2,940,000 JD (According to International Renewable Energy Agency ARENA) - The fixed annual cost is the sum of maintenance, operation, overhead and supervision costs (5% of capital investment)	2022-2047	1003.66

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Biogas collection and utilization from Al-Salt (Homra) domestic solid waste landfill	Waste- Solid waste	Ministry of Local Administration	Invalid- the biogas generation rate is limited	-	-	-
Biogas collection and utilization from Al-Karak domestic solid waste landfill	Waste- Solid waste	Ministry of Local Administration	Invalid- the biogas generation rate is limited	-	-	-
Biogas collection and utilization from Madaba domestic solid waste landfill	Waste- Solid waste	Ministry of Local Administration	Invalid- the biogas generation rate is limited	-	-	-

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Biogas generation by utilizing the sludge generated from Ramtha domestic wastewater treatment plant	Waste-Wastewater	Ministry of Water and Irrigation	Invalid- the biogas generation rate is limited	-	--	
Utilization of sludge produced form Wadi Al Arab wastewater treatment plant	Waste-Wastewater	Ministry of Water and Irrigation	Planned	- The captured methane is assumed to be 100% - Assuming every 1 MW produced needs 300 m^3CH_4/hr to be burned - Electricity grid emission factor is 0.4585 $kgCO_2$/KWh - The generated electricity will be sold at a fixed price of 0.094 JD/kWh - The cost of 1 MW biogas electricity generation system (generator, digester, piping, ….etc) is 4 MJD - The fixed annual cost is the sum of maintenance, operation, overhead and supervision costs (3% of capital cost)	2021-2046	280.30

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Utilization of sludge produced from Baqa'a wastewater treatment plant	Waste- Wastewater	Ministry of Water and Irrigation	Planned	- The captured methane is assumed to be 100% - Assuming every 1 MW produced needs 300 m^3CH_4/hr to be burned - Electricity grid emission factor is 0.4585 $kgCO_2$/KWh - The generated electricity will be sold at fixed price of 0.094 JD/kWh - The cost of 1 MW biogas electricity generation system (generator, digester, piping, ….etc) is 4 M JD - The fixed annual cost is the sum of maintenance, operation, overhead and supervision costs (3% of capital cost)	2025-2049	188.03
Biogas generation by utilizing the sludge generated from Salt domestic wastewater treatment plant	Waste- Wastewater	Ministry of Water and Irrigation	Invalid- the biogas generation rate is limited	-	-	

Name and brief description of the mitigation action	Sector and subsector (and GHG reduced)	Implementing institution	Status [Proposed idea, planned, implemented, under implementation, cancelled/ invalid]	Main assumptions used in the mitigation analysis	Duration	Emission reductions (Gg)
Utilization of sludge produced by Madaba wastewater treatment plant	Waste-Wastewater	Ministry of Water and Irrigation	Planned	- The captured methane is assumed to be 100% - Assuming every 1 MW produced needs 300 m^3CH_4/hr to be burned - Electricity grid emission factor is 0.4585 $kgCO_2$/KWh - The generated electricity will be sold at fixed price of 0.094 JD/kWh - The cost of 1 MW biogas electricity generation system (generator, digester, piping, ….etc) is 4 M JD - The fixed annual cost is the sum of maintenance, operation, overhead and supervision costs (3% of capital cost)	2021-2046	188.23
OBJECTIVE OF THE MITIGATION ACTION						
The objective of the mitigation action is to reduce methane emitted by anaerobic decomposition of waste at landfills and to use captured methane to produce electricity. This will directly subsidize part of the electricity already produced by combustion of fuel including natural gas and HFO.						

Appendix B: Jordan's INDC's- Transport Projects

Jordan's INDC's- Transport Projects (MoEnv and MoPIC), 2016

Proposed Mitigation Project	Status of Project
Launching the MoT's long term national transport strategy in 2014	Achieved
Increasing the percentage of commuters using public transport to 25 % by 2025;	GAM and MoT are working towards this with implementation of the BRT systems for Amman and Amman –Zarqa. 135 new buses have been added to GAM fleet, with more in planning stage. Additionally, improvements to the PT networks in other Jordanian cities will help achieve this action.
Introduction of the Zero Emission Electric Vehicle (ZEV) in Jordan will be implemented in various phases with the eventual deployment of 3,000 charging stations (on grid & off grid) to support 10,000 ZEVs by the private sector. The ZEV charging stations will be powered by renewable energy. The programme will be implemented through a partnership between the Greater Amman Municipality and the Ministry of Environment and the private sector within a Public Private Partnership (PPP) agreement. The outcomes of the initial phase will guide the upscaling of this programme in a wider context that goes beyond 2020. The Jordanian government in coordination with the private sector will develop the supporting legislation needed to ensure a secure and transparent introduction of the ZEV in the kingdom	One of the strategies from the National Transport Strategy. However, there has been limited uptake of electric and hybrid cars, and few implemented charging stations. Government action is needed to push this forward. It should be noted that the value of using electric vehicles depends on the energy mix of the country. This action can therefore only be achieved in conjunction with the Ministry of Energy and Mineral Resources (MEMR)
Reducing all emissions from transport sector (i.e. CO_2, CO, PM_x, NO_x expressed in tonnes per day);	Related to uptake of electric and hybrid vehicles.
Reducing fuel consumption (in tonnes per day) achieved through the implementation of the transport strategy;	Related to implementation of the BRT, but more action needed
Reduction in vehicle kilometers travelled (VKT)*at national level and in densely populated areas by type of vehicle (i.e. car, HGV, LGV and expressed in VKT per day);	Related to implementation of the BRT, but more action needed
Implementing the national BRT system;	Strategy for national BRT has not been developed. Amman and Amman Zarqa BRT in implementation. No other BRT schemes have been proposed.

Implementing the railway system, which would be a cornerstone of the planned multimodal network that would play a major role in the ease of the transport of goods within the country and the surrounding region. With such system in place, the reductions of emissions from these activities are obvious;	In need of funding
Increasing transport sector ride-ability through adopting and implementing policies related to fleet characteristics to enhance efficiency and reduce emissions thus yielding positive effect on energy consumptions and reducing CO_2 and other greenhouse gases emissions;	135 Euro V buses purchased for GAM in 2019. Planning for more buses to be added to the fleet in the future (Euro V or Euro VI) BRT buses to be purchased for operation in 2021 (Fuel type to be decided)
Ensuring the inclusion of energy efficiency considerations when buying transport models	Considered for bus purchases, for other vehicles strategy needs to be developed
*VKT - a unit of measure of traffic flow, determined by multiplying the number of vehicles on the traffic network by the average length of their trips (measured in kilometers).	


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