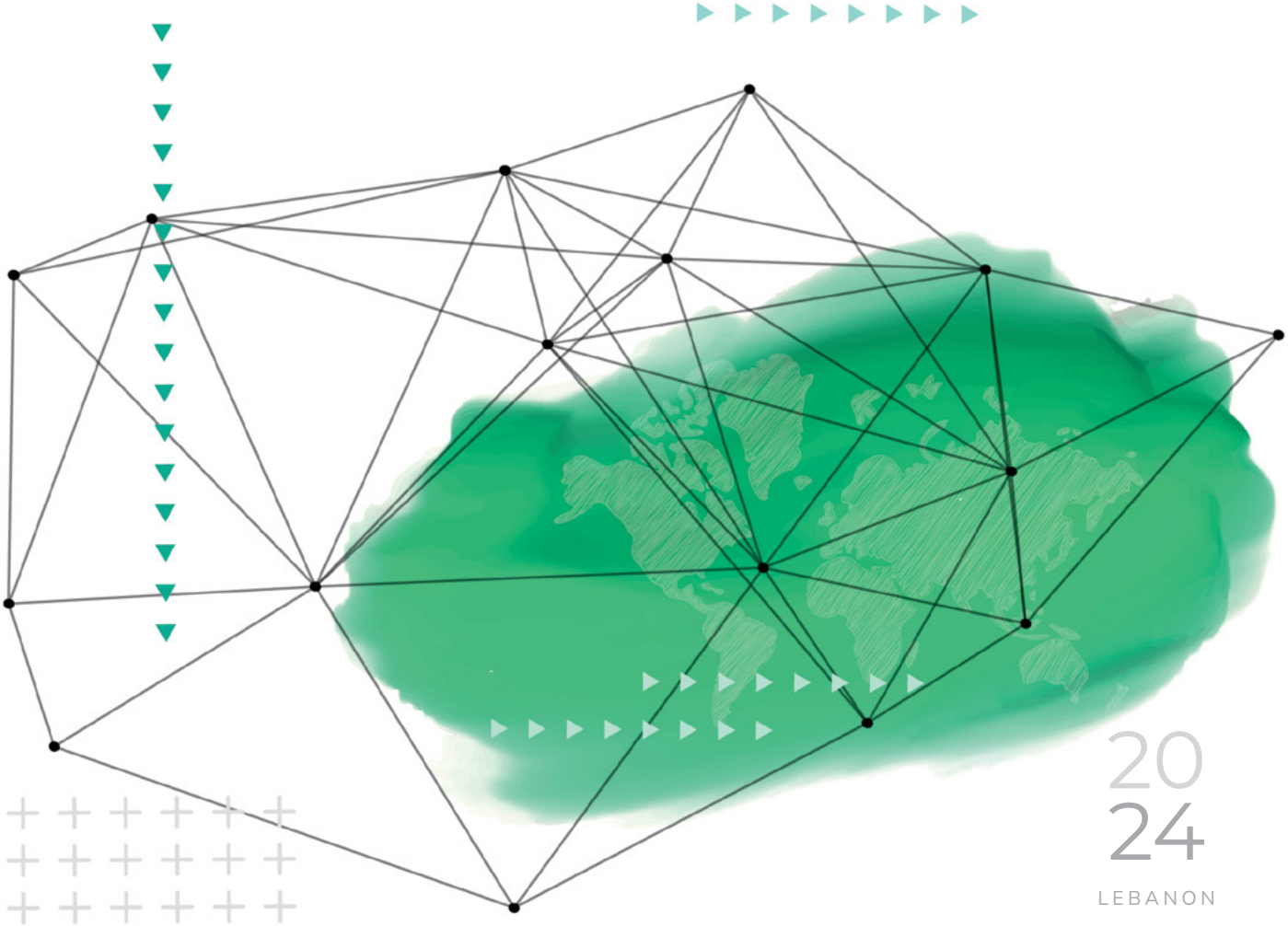
REPUBLIC OF LEBANON
MINISTRY OF ENVIRONMENT

LEBANON'S BIENNIAL TRANSPARENCY REPORT



2024

LEBANON

This document should be referenced as

MoE/UNDP/GEF (2024). Lebanon's First Biennial Transparency Report (BTR) on Climate Change. Beirut, Lebanon.

UNFCCC focal point

Hala Mounajjed . Acting Head of Environmental Technology Department . Ministry of Environment

For more information

http://climatechange.moe.gov.lb/
climatechange@moe.gov.lb
http://www.undp.org/lebanon

Executed by

Ministry of Environment, Lebanon

Funded by

Global Environment Facility

Implemented by

United Nations Development Programme, Lebanon

Main Authors

Lea Kai . Climate Change advisor . UNDP / MoE
Leya Zgheib . Project coordinator . UNDP/ MoE

Contributing Authors

Dr. Charbel Afif . Université Saint Joseph . Transport GHG inventory
Dr. Gihane Mansour Aboujaoude . Université Saint Joseph . Transport GHG inventory
Nader Hajj Chehadeh . OTB consult . Energy mitigation actions and support received
Dr. George Mitri . University of Balamand . LULUCF GHG inventory, mitigation actions and support received
Bassam Sabbagh . Ministry of Environment . Waste GHG inventory, mitigation actions and support received
Jacques Chahine . Waste consultant . EDESSA Waste GHG inventory, mitigation actions and support received

Technical Reviewers

Dr. Vahakn Kabakian . UNDP / MoE
Keltoum Ait Belhaj . CBIT GSP
Khetsiwe Khumalo . CBIT GSP
Moussa Diop . CBIT GSP
Fernando Farias . CBIT GSP

Acknowledgements

Energy and Transport

Khadija Noureddine . Ministry of Energy and Water
Dr. Sorina el Mortada . LCEC
Jihad Ghadieh . EDL
Rand Basha . Traffic and Vehicles Management Authority
Selim Saad . Association of Car Importers
Karim Osseiran . UNDP
Nabil Mneimne . UNDP
Marc Ayoub . AUB IFI
Dr. Toni Issa . IPT
Hasmig Khoury . IPT
Alexa Maria Al Hed . IPT
Nicolas Boukhater . ANB
Nada Doughan . AUB
Tala Kambriss . AUB
Noah Yaghmour . UB

Industrial Processes and Product Use
Jalil Darzi . Cimenterie Nationale
Grace el Azar . Holcim
Dr. Fouad Jaafar . Ciment de Sibline
Ghinwa Fayad . Ciment de Sibline

Agriculture, Forestry and Other Land Use
Dr. Chadi Mohanna . Ministry of Agriculture
Sawsan Bou Fakhreddine . AFDC
Maya Nehme . LRI

Waste and Wastewater
Jamila Al Hadi . Ministry of Environment
Talal Farhat . Council for Development and Reconstruction
Rita Gergi . OMSAR
Joseph Kassab . IBC Saida
Pierre Baaklini . Lebanese Waste Management and Drive-throw
Karim Haddad . SICOMO
Rami Nassif . UNDP
Joseph El Ghoul . LACECO
Assaad Zougheib . Zahleh Municipality
Ayman Dandash . Lebanese Eco-MovementUB

Cross Cutting
Marlene Ann Tomaszkiewicz – ESCWA - Climate projections
Marina Akl– UNDP – Gender mainstreaming
John Watterson – RICARDO – GHG inventory
Katherine Shabb . RICARDO . GHG inventory, NDC tracking indicators
Charis Evans . RICARDO . Adaptation, NDC tracking indicators
Sina Wartmann . RICARDO . GHG inventory, NDC tracking indicators
Ellie Voke . RICARDO . NDC tracking indicators
Nour Mucharafieh . ECODIT Liban . Adaptation and support received
Maria Mouzannar . ECODIT Liban . Adaptation and support received
Nada Doughan . ECODIT Liban . Adaptation and support received
Dana Halawani . ECODIT Liban . Adaptation and support received
Aya Akl . ECODIT Liban . Adaptation and support received

Editorial Reviewers

Danielle El Chemaly . UNDP / MoE
Wadih Maakaron . UNDP / MoE

Concept Design

Lead Designer: Joumana Samaha . UNDP / MoE
Graphic Designer: Hiba Kallas

FOREWORD

It is with great honor and responsibility that I present Lebanon's First Biennial Transparency Report (BTR1), marking a significant milestone in Lebanon's ongoing efforts to meet its climate commitments.

Lebanon has faced multiple crises, including economic instability, political turmoil, security disruptions, and military aggression, all compounded by the global climate crisis. Despite these difficulties, Lebanon remains committed to the Paris Agreement and has strived to meet its international obligations under Article 13, which governs the transparency framework of climate actions. This dedication to addressing climate change, even amid adversity, reflects the resilience and determination of the Lebanese people.

This report represents Lebanon's first opportunity to comprehensively take stock of its climate progress. It assesses the extent to which the country is meeting its Nationally Determined Contribution (NDC) targets and identifies key gaps that need to be addressed with the support of the international community. By providing a transparent account of Lebanon's climate actions, the BTR1 enables informed policy-making and prioritization for greater impact and accountability.

Moreover, it is crucial that the future outlook of Lebanon's climate policy is closely linked with its recovery and reconstruction plans. Integrating climate considerations into rebuilding efforts is essential to ensure long-term resilience, safeguard natural resources, and foster sustainable development.

I would like to express my deepest appreciation to the United Nations Development Programme (UNDP) and its Country Office and the Global Environment Facility (GEF) for their invaluable support and collaboration on this report. The expertise and leadership of the project's climate change team have been instrumental in navigating the complex processes of climate reporting and enhancing Lebanon's ability to address climate challenges.

Nasser Yassin, PhD
Minister of Environment

FOREWORD

Climate change stands as the defining crisis of our era, with its adverse impacts posing serious threats to the sustainable livelihoods, security, and well-being of the people in Lebanon. The United Nations Development Programme (UNDP) remains steadfast in its efforts to advocate for urgent action to address climate change and to rally the global community in strengthening its response through unwavering support for the Paris Agreement.

As a longstanding partner in Lebanon's climate action efforts, UNDP is proud to support the country in presenting its First Biennial Transparency Report (BTR1). This report marks a pivotal moment in Lebanon's ongoing commitment to enhancing transparency and accountability in climate actions. It reflects the government's dedication to fulfilling its obligations under the Paris Agreement and aligns with the Enhanced Transparency Framework, that empowers all parties to track progress, strengthen climate actions, and uphold global commitments.

Despite facing substantial and unprecedented challenges, the Lebanese Government has demonstrated perseverance and resilience in continuing its climate planning and reporting. BTR1 stands as a testament on how a country can strengthen its capacity to monitor, report, and verify climate actions, and align with global climate goals. Once again, Lebanon sets a strong example by leading the way in demonstrating determination and accountability in the face of adversity.

I would like to express my deepest gratitude to the Global Environment Facility (GEF) for their essential support, which not only facilitated the development of this report but also continues to serve as a vital financing mechanism to help countries deliver on their climate agendas.

The UNDP remains fully committed to supporting the Government of Lebanon despite the challenges that lie ahead. Guided by the Paris Agreement, UNDP recognizes that climate action not only combats climate change but also advances poverty eradication, gender equality, food security, and numerous other sustainable development goals, paving the way toward a low-emission, climate-resilient future.

Blerta Aliko

UNDP Resident Representative

Contents

List of Figures

List of Tables

List of Acronyms

AECID	Spanish Agency for International Development Cooperation
AF	Adaptation Fund
AFD	Agence Francaise de Development
AFDC	Association for Forests, Development and Conservation
AFOLU	Agriculture and Forestry and Other Land Uses
AICS	Italian Agency for Development Cooperation
BAU	Business as Usual
BIEEL	Business Innovation and Enhance Exports in Lebanon
BMZ	Federal Ministry for Economic Cooperation and Development
BTR	Biennial Transparency Report
BUR	Biennial Update Report
CBIT	Capacity Building Initiative on Transparency
CCA	Climate Change Adaptation
CDD	Consecutive Dry Days
CEDRO	Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon
CoM	Council of Ministers
CSP	Community Support Programme
CTF	Common Tabular Format
DB	Database
DRR	Disaster Risk Reduction
EbA	Ecosystem-based adaptation
EDL	Electricité du Liban
EM-DAT	Emergency Events Database
ERA	Electricity Regulatory Authority
ESCO	Energy Service Company
ESCWA	United Nations Economic and Social Commission for Western Asia
ESI	Evaporative stress Index
ETF	Enhanced Transparency Framework
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FOLU	Forestry and Other Land Use
FSRU	Floating Storage and Regasification Unit
FX	Flexibility
GBA	Greater Beirut Area
GCF	Green Climate Fund
GDP	Gross Domestic Product

GEF	Global Environment Facility
GFFO	German Federal Foreign Office
GHG	Greenhouse Gas
GIS	Geographic Information System
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit
GoL	Government of Lebanon
GSHP	Ground Source Heat Pump
GWP	Global Warming Potential
ICA	International Consultation and Analysis
ICARDA	International Center for Agricultural Research in the Dry Areas
IE	Included Elsewhere
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ITMOS	Internationally Transferred Mitigation Outcomes
KCA	Key Category Analysis
KFW	Kreditanstalt für Wiederaufbau
LA	Level Assessment
LAF	Lebanese Armed Forces
LCEC	Lebanese Center for Energy Conservation
LED	Light Emitting Diode
LEDS	Low Emission Development Strategy
LGIF	Lebanon's Green Investment Facility
LHSP	Lebanese Host Communities Support Program
LPA	Lebanese Petroleum Administration
LQPPP	Lake Qaraoun Pollution Prevention Project
LRA	Litani River Authority
LULUCF	Land Use, Land-Use Change, and Forestry
LWP	Lebanon Water Project
MEPI	Middle East Partnership Initiative
MISCAL	Management Information System for Climate Action in Lebanon
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoEW	Ministry of Energy and Water
MoF	Ministry of Finance
MoFA	Ministry of Foreign Affairs
MoPWT	Ministry of Public Works and Transport
MoU	Memoranda of Understanding
MPG	Modalities, Procedures and Guidelines
MRV	Measuring, Reporting and Verifying
NA	Not Applicable

NAP	National Adaptation Plan
NAS	National Adaptation Strategy
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communication
NCC	National Control Center
NDC	Nationally Determined Contribution
NDCSP	Nationally Determined Contribution Support Programme
NE	Not Estimated
NFCS	National Framework for Climate Services
NGO	Non-Governmental Organization
NIR	National Inventory Report
NMT	Non-Motorized Transport
NO	Not Occuring
NOP	No Objection Procedure
NP	Non-Principal
NSA	Non-State Actor
OECD	Organisation for Economic Co-operation and Development
OMSAR	Office of the Minister of State for Administrative Reform
P	Principal
PCM	Presidency of the Council of Ministers
PHES	Pumped Hydro Energy Storage
PPP	Public Private Partnership
PSAA	Private Sector Access to Assistance
PSL	Promoting Sustainable Livelihoods
PV	Photovoltaics
QA/QC	Quality Assurance/Quality Control
RE/EE	Renewable Energy/Energy Efficiency
RIH	Regional Innovation Hub
SALMA	Smart Adaptation of Forest Landscapes in Mountain Areas
SDG	Sustainable Development Goal
SME	Small and Medium-sized Enterprise
SWH	Solar Water Heaters
SWM	Solid Waste Management
TACCC	Transparency, Accuracy, Completeness, Comparability and Consistency
TF	Task Force
TNA	Technology Needs Assessment
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund

UNIDO	United Nations Industrial Development Organization
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
UNOPS	United Nations Office for Project Services
UPOPs	Unintentional Persistent Organic Pollutants
USAID	United States Agency for International Development
VFD	Variable Frequency Drive
WE4F	Water and Energy for Food Grand Challenge
WFP	World Food Programme

Executive Summary

Lebanon's national circumstances have undergone significant changes between 2019 and 2022 due to a combination of unprecedented economic, financial, and monetary crises, exacerbated by the global COVID-19 pandemic and regional instability. These crises have drastically altered Lebanon's socio-economic landscape, influencing the country's ability to meet its climate change commitments under the UNFCCC.

Lebanon is grappling with a severe economic and financial crisis, marked by a 67% drop in GDP per capita between 2018 and 2023. The crisis - exacerbated by the COVID-19 pandemic, Beirut Port explosion, and regional instability - have led to hyperinflation, collapsing infrastructure, and widespread poverty and unemployment. Public services, including electricity, water supply, and waste management, have deteriorated significantly, forcing reliance on private generators, informal water extraction, and unsafe waste disposal practices. These circumstances, compounded by hosting almost 1.5 million displaced Syrians and Palestinian refugees, have strained resources and intensified environmental pressures. Political gridlock and delayed reforms have further hindered effective climate adaptation and mitigation measures.

Lebanon's National Greenhouse Gas Inventory

Lebanon's First Biennial Transparency Report (BTR1) provides a comprehensive account of the country's Greenhouse Gas (GHG) emissions inventory for 2020–2022, highlighting the impact of its socio-economic and political crises on emissions trends and climate action.

In 2022, Lebanon emitted 20,519 Gg CO_2eq. of GHG emissions, reflecting a 32% decrease from 2019 due to the collapse of electricity production, reduced economic activity, and constrained fuel availability. The energy sector, including transport, contributed 77% of total emissions, driven by diesel oil combustion for electricity generation and gasoline consumption for transportation (Figure i and Figure ii).

Industrial processes accounted for 12.6%, primarily from cement production and F-gases, while the waste sector contributed 6.6% due to inadequate solid waste and wastewater management. Agricultural activities contributed to 3.8% of GHG emissions in 2022 while CO_2 removals from forestry, land use and land use change amounted to –3,243 Gg CO_2, bringing Lebanon's NET emissions to 17,274 Gg CO_2eq.

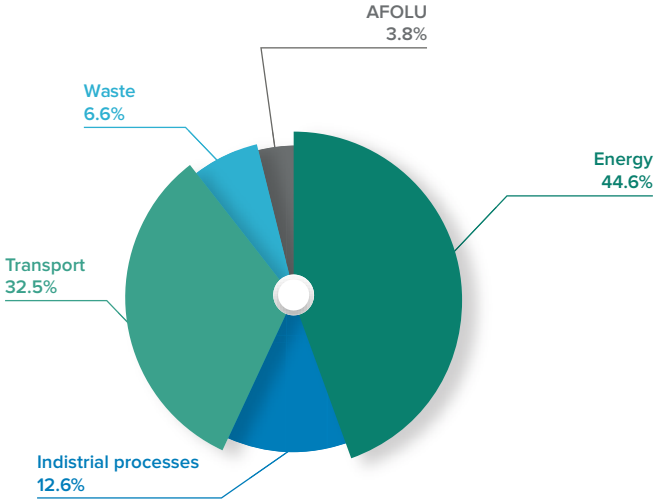


Figure i: Lebanon's national greenhouse gas inventory by category in 2022

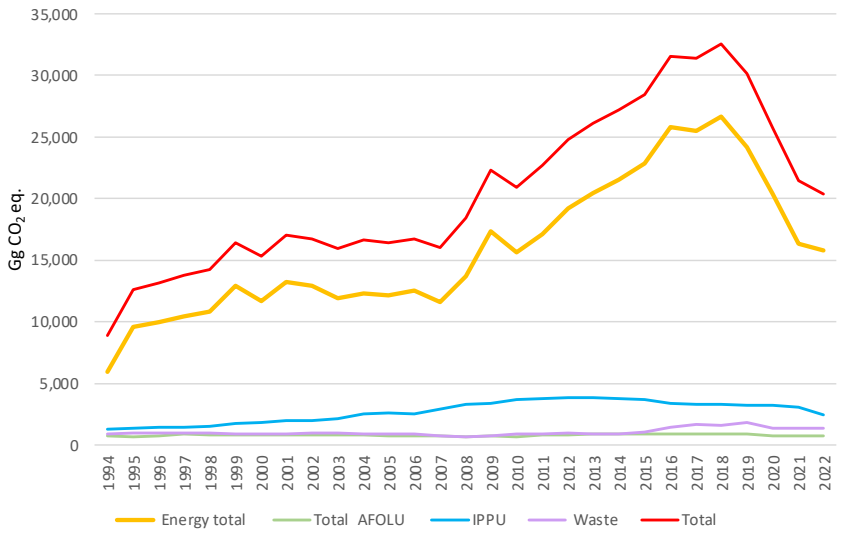


Figure ii: Trend in total and sectoral GHG emissions 1994-2022

Progress towards Lebanon's Updated Nationally Determined Contributions (NDCs)

In line with the Paris Agreement, Lebanon has committed to an unconditional target of 20% Greenhouse Gas reduction by 2030 under its updated Nationally Determined Contribution (NDC), with a focus of increasing the share of renewable energy to 18% from power demand and to 11% from hat demand in the building sector, in addition to a decrease in electricity demand by 3% by 2030. A conditional target of 31% emissions reduction, 30% share of renewable energy in power demand and 18.5 in heat demand and 10% reduction in power demand have also been included in the NDC.

For this BTR1 reporting, only indicators directly related to the unconditional targets have been used to report progress of the NDC. Lebanon is not reporting its progress compared to its conditional target, as achieving these goals remains contingent on receiving international support in the form of financial

assistance, technology transfer, and capacity building. To meet its conditional targets, Lebanon requires additional support for improving national legislation, regulatory and economic instruments, establishing appropriate financial and investment mechanisms, transitioning to innovative green technologies, and upscaling local skills and expertise.

The changes of Lebanon's national circumstances have resulted in a decrease of national GHG emissions by 33% compared to the BAU scenario, bringing Lebanon closer towards its NDC targets. Generation of electricity through renewable energy sources reached 1,913 GWh in 2022, accounting for 12% of total power demand for the same year. This share exceeded interim targets under the BAU scenario, demonstrating progress toward the 2030 NDC renewable energy target of 18%. Similarly, Lebanon's electricity demand of 16,380 GWh in 2022 is 38% lower than the demand projected under the BAU scenarios for 2022.

These reductions, while partly due to Lebanon's economic recession, were also influenced by global emission reductions during the COVID-19 pandemic. Nevertheless, the economic recovery prospects might result in increased emissions in the upcoming period. To that end, Lebanon will continue to make the needed efforts to reach its 2030 NDC targets.

Climate Change Impacts and Adaptation Efforts

Lebanon's climate projections underscore a rapidly evolving crisis with significant implications for key sectors and regions. By 2060, temperatures are expected to increase by up to 2.1°C in mountainous areas and between 1.8°C and 2.0°C in coastal and inland regions under high-emission scenarios (SSP5-8.5). Seasonal changes are anticipated, with winter temperatures rising by as much as 2.7°C, reducing snow accumulation which is critical for water resources and tourism. Summers are projected to experience increases of up to 2.3°C, extending heatwaves and straining energy systems. Inland and southern regions may face up to 19 additional very hot days exceeding 35°C annually by mid-century, intensifying risks to human health, agriculture, and infrastructure. Precipitation trends indicate a decline of up to 7 mm/month by 2041–2060, particularly in southern and inland areas already prone to drought. Seasonal rainfall shifts and reduced snowmelt will exacerbate water shortages, threatening agriculture and drinking water supplies. Coastal regions face dual challenges of rising sea levels, projected to increase by 30–80 cm by 2100, and saltwater intrusion into aquifers, jeopardizing infrastructure and livelihoods.

In response to these challenges, Lebanon has undertaken efforts through national strategies and sector-specific initiatives to adapt to climate risks. The National Adaptation Strategy (NAS) and National Adaptation Plan (NAP) currently under development will provide overarching frameworks for adaptation planning. However, priority sectors such as water resource management, agriculture, forestry, and disaster risk reduction are already being addressed through respective strategies. For example, the recent National Water strategy focuses on integrated water resource management, modernization of irrigation systems, and infrastructure rehabilitation, while the National Strategy to Reduce Forest Fire Risks emphasizes early warning systems, risk mapping, and community engagement to combat the increasing threat of wildfires. These sectoral strategies collectively aim to enhance Lebanon's resilience to the growing impacts of climate change.

Additionally, Non-State Actors (NSAs) such as local and international NGOs, communities and the private sector have been complementing these efforts, implementing 293 adaptation projects between 2020 and 2022. Most interventions are concentrated in agriculture, water and forestry sectors, targeting irrigation efficiency, sustainable farming practices, and community-based water and forest management. Other sectors, such as resilient cities, disaster risk reduction and health show comparatively lower engagement (Figure iii). Financing and institutional challenges hinder adaptation progress, with Lebanon's economic crisis and fragmented governance structures undermining public investment and coordination.

International support, particularly in capacity building and climate financing, remains crucial to addressing these gaps and ensuring Lebanon can effectively adapt to its escalating climate vulnerabilities.

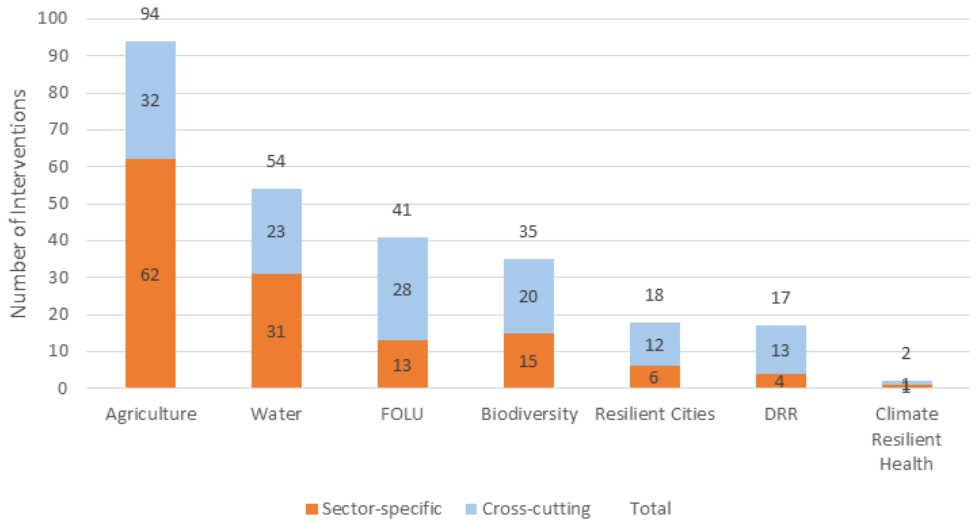


Figure iii: Distribution of climate adaptation interventions in adaptation in Lebanon (2020-2022)

Support needed and received to accelerate climate action

In terms of support received, the report emphasizes the critical role of international financial, technical, and capacity-building support under Articles 9–11 of the Paris Agreement. Between 2020 and 2022, Lebanon received approximately USD 227.5 million in climate finance, allocated across adaptation (USD 113.7 million), cross-cutting (USD 83.3 million), and mitigation projects (USD 30.4 million). Adaptation efforts, particularly in water and agriculture, received the highest funding, reflecting Lebanon's vulnerabilities in those sectors. However, mitigation efforts in renewable energy and transport remain underfunded, highlighting a gap in addressing emissions reductions (Figure iv).

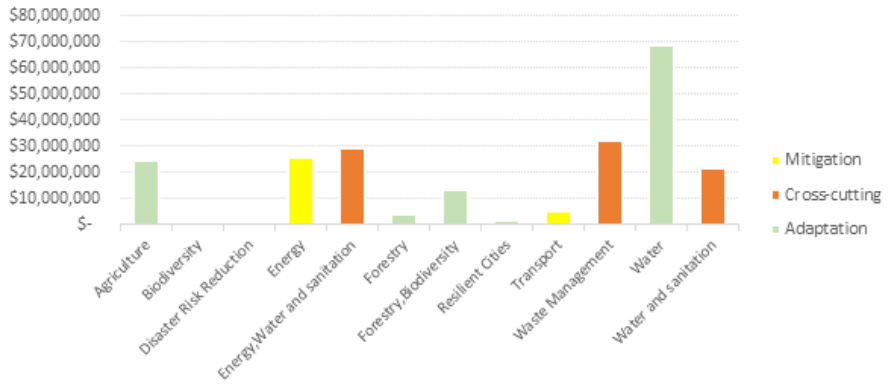


Figure iv: Sectoral allocation of climate funding in Lebanon

Lebanon's funding priorities show imbalances, with overemphasis on water and waste sectors, which are infrastructure-intensive requiring substantial investment, while forestry, biodiversity, transport, and urban resilience remain relatively underfunded. Funding targeted to energy and agriculture remains at a small pilot scale level, which underestimates their significant potential for efficient adaptation and emissions reduction leading to food and energy security.

The European Union (EU), with USD 53.4 million, stands out as the largest contributor, channeling extensive funds into projects focused on water governance, waste management, and agriculture, followed by USAID and the World Bank. Bilateral donors like Germany, Canada, Italy, Norway, also have a notable role in providing financial support across various adaptation and cross-cutting projects, further diversifying the donor landscape.

Despite the funding channeled to Lebanon to implement mitigation and adaptation projects, significantly more support is needed to accelerate the implementation of the NDC. Lebanon has identified a pipeline of projects under the GCF country programme seeking USD 327.5 million in grants, USD 50 million in loans, and USD 4 million in readiness support, targeting water, agriculture, energy and health. Additionally, the Long-Term Low-Emission Development Strategy (LEDS) estimates that USD 50 billion or 4% of GDP will be needed by 2050 as additional real investments to achieve ambitious low-emission development goals.

In addition to financial support, new and innovative technologies are critical to further advance mitigation and adaptation. Technologies prioritized for Lebanon include pumped hydro energy storage, smart grids and heat pumps to improve energy efficiency, electrification of freight vehicles and deploying e-bikes and scooters to transition to green mobility, in addition to technologies such as smart irrigation systems, crop yield monitors, water smart metering and leak detection applications to address inefficiencies in the agriculture and water sectors.

Barriers to deploying these technologies include high capital costs, lack of incentives, insufficient technical expertise, and limited market infrastructure. Regulatory gaps, weak institutional frameworks, and low public awareness exacerbate these challenges. Addressing these barriers requires targeted action plans, including regulatory reform, financial incentives, and capacity building.

Improvements in reporting over time

Although some improvements have been made throughout the preparation of Lebanon's climate change reports, the country has yet to enhance its institutional transparency mechanisms ensuring alignment with its commitments under the Paris Agreement. Strengthening transparency frameworks will also improve Lebanon's ability to access international climate finance by demonstrating accountability and facilitating clearer tracking of financial support received and needed.

To that end, significant improvements are planned in areas such as data collection, institutional coordination, and technical capacity. By integrating a centralized Monitoring, Reporting, and Verification (MRV) system, Lebanon aims to streamline data management and reporting processes across sectors. Progress made under CBIT has partially addressed these gaps, including defining roles and training technical staff. However, challenges persist, including limited disaggregated financial data, weak institutional arrangements, and the absence of donor coordination mechanisms.

Lebanon is also working to incorporate gender considerations into its climate policies. Efforts include gathering gender-disaggregated data and strengthening institutional capacities to ensure inclusive policy design. International support remains essential to advance Lebanon's transparency framework and reduce reliance on flexibility provisions.

1. National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

1.1 National circumstances and institutional arrangements

Lebanon's national circumstances significantly influence its approach to climate change mitigation and adaptation, in alignment with the requirements set forth by the UNFCCC. As a small, middle-income country with a complex political and socio-economic landscape, Lebanon faces unique challenges that impact its greenhouse gas emissions and its capacity to respond to climate change.

Lebanon's national circumstances have undergone significant changes between 2019 and 2022 due to a combination of unprecedented economic, financial, and monetary crises, exacerbated by the global COVID-19 pandemic. These crises have drastically altered Lebanon's socio-economic landscape, influencing the country's ability to meet its climate change commitments under the UNFCCC.

Since becoming a Party to the UNFCCC in 1994 and ratifying both the Kyoto Protocol in 2006 and the Paris Agreement in 2019, Lebanon has committed to ambitious climate goals, including an unconditional 20% reduction in Greenhouse Gas (GHG) emissions by 2030 as part of its updated Nationally Determined Contribution (NDC). The Ministry of Environment has been designated as the official coordinator of Lebanon's NDC, with an inter-ministerial NDC committee established in 2017 to oversee its implementation.

Lebanon's climate policies have also increasingly focused on gender responsiveness, with a gender Analysis conducted to assess the integration of gender considerations in climate governance. This analysis has prioritized sectors such as energy, waste, and water for gender mainstreaming activities.

Lebanon's First Biennial Transparency Report and National Inventory Report (NIR) which updates the country's GHG inventory for the period 2020-2022, reflect these national circumstances, including the impact of the Beirut port explosion in 2020, the COVID-19 pandemic, the economic crisis and the ongoing Syrian refugee crisis. The NIR also outlines the challenges and needs for improving GHG inventory preparation in Lebanon, considering the country's current socio-economic and political realities (MoE/UNDP/GEF, 2024).

Socio-Economic Overview

Lebanon has faced a severe economic and financial crisis, considered one of the worst since the mid-nineteenth century. Between 2018 and 2023, the GDP experienced a 67% drop per capita, effectively erasing over 22 years of development progress (World Bank, 2024a). The crisis, compounded by the COVID-19 pandemic, Beirut Port explosion, and geopolitical tensions, has led to the collapse of services, particularly in the electricity sector, where grid service in some areas has dropped to less than an hour per day. This has significantly impacted poverty rates, equitable access to energy, and recovery prospects. Wastewater treatment plants have become mostly non-operational, complicating responses to nationwide cholera outbreaks in areas with high rates of refugees. The transportation sector has struggled, with deteriorating public transport and road conditions hindering mobility, connectivity and trade. Water sector inefficiencies resulted in significant water loss and polluted rivers, posing health risks and reducing agricultural productivity. Poor urban air quality, primarily due to vehicle emissions and diesel generators,

added to the health risks (World Bank, 2024b). Increased fuel prices have led to illegal logging, endangering forests. The rising threat of wildfires and forest fires impacted tourism, a crucial socioeconomic safety net in rural areas. Additionally, with the majority of the population living in urban areas, particularly along the coastline, urban infrastructure is vulnerable to floods and storms due to inadequate development and increasing informal settlements from influxes of displaced population, which lack proper waste disposal, worsening environmental pollution and health hazards.

In 2022, Lebanon's population was estimated at approximately 5.48 million, characterized by high density per square kilometer, including foreign workers, Palestinian refugees, and an estimated 1.5 million displaced Syrians. The working-age population (15+ years) is about 3.6 million, with a labor force participation rate of 43.4%. There is a notable gender disparity, with men's participation at 67.2% and women's at 19.7%. The overall unemployment rate is alarmingly high at 29.6%, with women facing higher unemployment rates (32.7%) compared to men (28.4%). Youth unemployment (ages 15-24) is particularly severe, reaching 47.8%. These figures highlight the significant economic challenges Lebanon has been facing, further exacerbated by the severe economic and financial crisis, which has seen the GDP plummet from USD 55 billion in 2018 to USD 18 billion in 2023 (CAS, 2022; World Bank, 2024b).

The influx of around 1.5 million displaced Syrians since 2012, along with Palestinian and other refugees, has further strained basic services and economic opportunities, especially in regions like Akkar, Bekaa, and the South. Refugees, displaced populations, and Lebanese host communities (who are already suffering from the impacts of a worsening economic crisis) suffer from substandard housing and overcrowding, making them particularly susceptible to economic shocks and climate change impacts. Water scarcity, exacerbated by climate change, affects agriculture, energy, and tourism, with increased temperatures and rainfall variability reducing crop yields and threatening food security. The energy sector in Lebanon is heavily dependent on private and neighborhood diesel generators amid the public utility's inability to supply power commensurate with the demand.

GHG emissions inventory 2022

In 2022, Lebanon emitted 20,519 Gg CO_2eq. (as total emissions), which is a 32% decrease from 2019 (calculated as 30,189 Gg CO_2eq.), mainly due to a significant decrease in energy-related emissions. The economic crisis that started in 2019 exacerbated the problems of electricity supply, with extended power cuts due to the government's inability to secure fuel for power plants and ensure proper maintenance and upgrades of the already fragile infrastructure. An 85% decline in electricity production was observed between 2019 and 2022 with EDL electricity generation plummeting to 2,138 GWh in 2022 (EDL, 2023). This was mainly due to the halt of some power plants (i.e. Jiyeh and Zouk thermal power plants, Hrayche power plant), and gradual reduction in the reliance on power rental barges until complete halt in 2022.

Still, the main contributor to greenhouse gas emissions in Lebanon remains the energy sector (including transport) with 77% of GHG emissions, followed by industrial processes (12.6%) (Figure 1).

Transport emissions constitute around 32.5% of total emissions, remaining an important contributor to emissions with 6,662 Gg CO_2eq. in 2022, mainly due to the consumption of gasoline in passenger cars.

The industrial processes sector accounts for approximately 12.6% of total emissions with 2,584 Gg CO_2eq. in 2022. These emissions have seen fluctuations due to varying levels of industrial activity and changes in production processes. Key contributors include cement production and emissions from F-gases from refrigeration and air conditioning.

The AFOLU sector contributed to 3.8% of GHG emissions, with 777.94 Gg CO_2eq. in 2022. These emissions were from activities such as enteric fermentation in livestock, agricultural soil management, and deforestation. CO_2 removals from forestry, land use and land use change amounted to –3,243 Gg CO_2,

bringing Lebanon's NET emissions to 17,274 Gg CO_2eq. Emissions from this sector are influenced by agricultural practices, land-use changes, and forest management policies.

The waste sector contributes 6.6% of Lebanon's total GHG emissions, with emissions estimated at 1,347 Gg CO_2eq. in 2022. Emissions primarily result from solid waste disposal on land and wastewater treatment, due to the anaerobic decomposition of organic waste in landfills and the treatment of municipal and industrial wastewater.

Historically, Lebanon's GHG emissions steadily increased, nearly tripling since 1994, with an average annual growth of 6%. However, this trend shifted significantly following the events of 2019 and the subsequent financial/economic crisis. By 2022, total GHG emissions had decreased by 32% compared to 2019. Common reporting tables (CRT) for the electronic reporting of the national inventory report can be found in ANNEX I.

The time series of emissions in Figure 2 shows, since approximately 2008, a considerable growth in the total emissions, which are dominated by an increase in energy sector emissions. Between 1994 and 2022, the energy sector, including transport, remained the largest source of GHG emissions, contributing between 66% and 77% of the total.

Over time, emissions experienced periodic declines, notably in 2007, 2010, and after 2019. The 2007 drop was attributed to damage from the July 2006 war, which impaired the electricity distribution network and caused power plants to operate below capacity. In 2010, a shift to natural gas at the Deir Amar plant, along with increased hydropower production, further reduced emissions. However, the most significant decrease occurred after 2019 due to civil unrest and economic collapse that the country has been witnessing since.

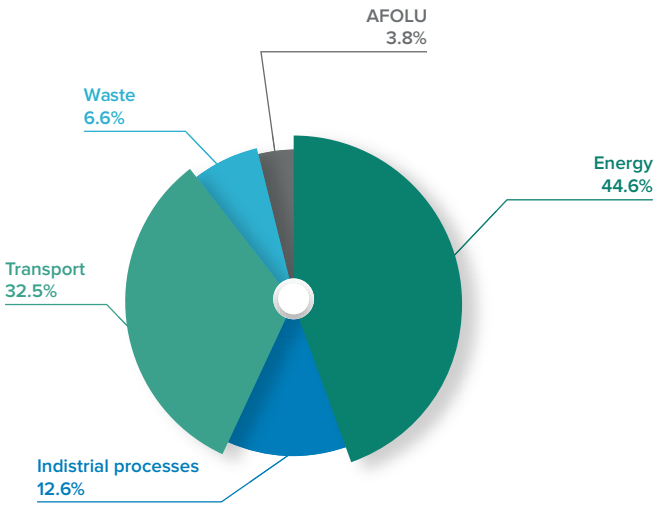


Figure 1: Lebanon's national greenhouse gas inventory by category in 2022

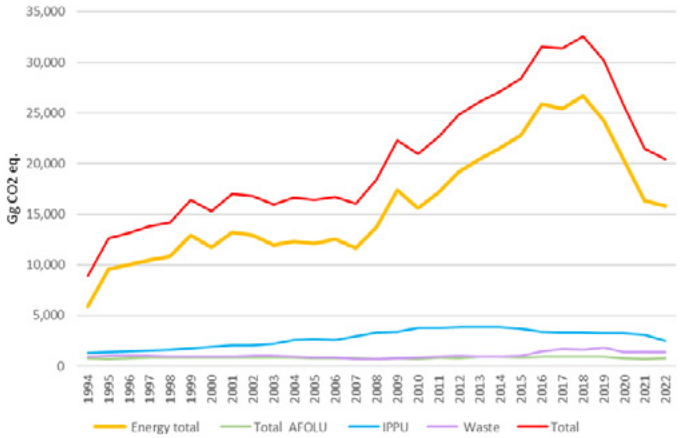


Figure 2: Trend in total and sectoral GHG emissions 1994-2022

Table 1 - Lebanon's GHG emissions and removals for 2022 per gas and category

Greenhouse gas source and sink categories (IPCC code)	CO_2 emissions/ removals	CH_4	N_2O	CH_4	N_2O	F-gases	Total emissions	Net emissions
	Gg	Gg	Gg	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.
Total National Emissions and Removals	13,283.3	63.92	2.06	1,789.64	544.77	1,656.51	20,519.78	17,274.22
1 - Energy	**15,613.08**	**2.39**	**0.49**	**66.99**	**129.95**		**15,810.02**	
1.A - Fuel Combustion Activities	15,613.08	2.39	0.49	66.99	129.95		15,810.02	
1.A.1 - Energy Industries	1,444.16	0.06	0.01	1.63	3.1		1,448.89	
1.A.2 - Manufacturing Industries and Construction	2,115.16	0.08	0.02	2.21	4.16		2,121.53	
1.A.3 - Transport	6,509.72	1.47	0.42	41.24	111.46		6,662.43	
1.A.4 - Other Sectors	5,544.04	0.78	0.04	21.90	11.23		5,577.17	
2 - Industrial Processes and Product Use	**900.61**		**0.10**	-	**27.16**	**1,656.51**	**2,584.28**	
2.A - Mineral Industry	900.29	NA	NA	NA	NA	NA	900.29	
2.A.1 - Cement production	898.88	NA	NA	NA	NA	NA	898.88	
2.A.2 - Lime production	0.75	NA	NA	NA	NA	NA	0.75	
2.A.3 - Glass Production	IE	IE	IE	NO	NO	NA		
2.A.4 - Other Process Uses of Carbonates	0.66	NA	NA	NA	NA		0.66	
2.B- Chemical Industry	NO	NO	NO	NO	NO	NA		
2.C - Metal Industry	NO	NO	NO	NO	NO	NA		
2.D - Non-Energy Products from Fuels and Solvent Use	0.32	NA	NA	NA	NA		0.32	
2.D.1 - Lubricant Use	IE	NA	NA	NA	NA			
2.D.2 - Paraffin Wax Use	0.32	NA	NA	NA	NA		0.32	
2.D.3 - Solvent Use	NE	NA	NA	NA	NA			
2.E- Electronics Industry	NO	NO	NO	NO	NO	NA		
2.F - Product Uses as Substitutes for ODS						1,656.51	1,656.51	
2.F.1 – Refrigeration/ Air Conditioning	NA	NA	NA	NA	NA	1,656.51	1,656.51	

Greenhouse gas source and sink categories (IPCC code)	CO_2 emissions/ removals	CH_4	N_2O	CH_4	N_2O	F-gases	Total emissions	Net emissions
	Gg	Gg	Gg	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.
2.F.2 - Foam Blowing	NO	NO	NO	NO	NO	NO		
2.F.3 - Fire Protection	NE	NE	NE	NE	NE	NE		
2.F.4 - Aerosols	NO	NO	NO	NO	NO	NO		
2.F.5 - Solvents	NO	NO	NO	NO	NO	NO		
2.G - Other Product Manufacture and Use			0.10		27.16		27.16	
2.G.1 - Electrical Equipment	NE	NE	NE	NE	NE	NE		
2.G.2 - SF_6 and PFCs from Other Product Uses	NE	NE	NE	NO	NO	NO		
2.G.3 - N_2O from Product Uses	NA	NA	0.10	NA		NA	27.16	
2.G.4 - Other	NE	NE	NE	NE	NE	NE		
3 - Agriculture, Forestry, and Other Land Use	**(3,243.27)**	**17.07**	**1.12**	**478.03**	**297.62**		**777.94**	
3.A - Livestock	-	17.06	0.38	477.68	100.97	-	578.65	
3.A.1 - Enteric Fermentation	NA	13.83	NA	387.21	NA		387.21	
3.A.2 - Manure anagement	NA	3.23	0.38	90.47	100.97		191.43	
3.B - Land	(3,245.55)	NA	NA	NA	NA		(3,245.55)	
3.B.1 - Forest land	(2,046.11)	NA	NA	NA	NA		(2,046.11)	
3.B.2 - Cropland	(1,218.69)	NA	NA	NA	NA		(1,218.69)	
3.B.3 - Grassland	NE	NE	NE	NE	NE			
3.B.4 - Wetlands	NE	NE	NE	NE	NE			
3.B.5 - Settlements	19.24	NA	NA	NA	NA		19.24	
3.B.6 - Other Land	NO	NO	NO	NO	NO		NO	
3.C - Aggregate sources and non-CO_2 emissions sources on land	2.29	0.01	0.74	0.35	196.66		199.30	
3.C.1 - Emissions from biomass burning		0.01	0.00	0.35	0.1		0.45	
3.C.2 - Liming	NO	NA	NA	NA	NA			
3.C.3 - Urea application	2.29	NA	NA	NA	NA		2.29	
3.C.4 - Direct N_2O Emissions from managed soils	NA	NA	0.57	NA	150.71		150.71	
3.C.5 - Indirect N_2O Emissions from managed soils	NA	NA	0.08	NA	21.02		21.02	
3.C.6 - Indirect N_2O Emissions from manure management	NA	NA	0.09	NA	24.83		24.83	
3.D Other								
3.D.1 - Harvested Wood Products	NE	NA	NA	NA	NA		NE	
4 - Waste	**12.87**	**44.45**	**0.34**	**1,244.62**	**90.03**		**1,347.53**	
4.A - Solid Waste Disposal	-	23.58	-	660.1	-		660.1	
4.B - Biological Treatment of Solid Waste	-	0.26	0.02	7.387	4.07		11.45	
4.C - Incineration and Open Burning of Waste	12.87	1.86	0.03	51.95	8.85		73.67	
4.D - Wastewater Treatment and Discharge	-	18.76	0.29	525.20	77.12		602.31	

Greenhouse gas source and sink categories (IPCC code)	CO_2 emissions/ removals	CH_4	N_2O	CH_4	N_2O	F-gases	Total emissions	Net emissions
	Gg	Gg	Gg	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.	Gg CO_2eq.
Memo Items								
International Bunkers	**815.42**	**0.02**	**0.02**	**0.45**	**5.83**		**821.70**	
1.A.3.a.i - International Aviation	694.54	0.01	0.02	0.14	5.04		699.72	
1.A.3.d.i - International water-borne navigation	120.88	0.01	0.00	0.31	0.80		121.98	
Information Items								
CO_2 from Biomass Combustion for Energy Production	34.79							

Climate policy Landscape

In 2021, and in accordance with Articles 4.9 and 4.11 of the Paris Agreement (and Law 115/2019, ratification of the Paris Agreement), Lebanon updated its Nationally Determined Contribution (NDC) to respond to the call for enhancement and to meet the goals of the Paris Agreement.

The NDC emphasizes that Lebanon's priority for the next decade is to spur sustainable economic growth through the creation of decent jobs and improve the well-being of its population through welfare programmes and protection of natural resources.

Lebanon's adaptation priorities aim to increase resilience to climate in tandem with enhancing resilience against economic shocks and other possible disasters. The updated NDC sets out 7 adaptation priorities, ranging from disaster risk reduction to ecosystem protection. Most of these priorities are embedded in existing national development strategies and plans.

The NDC update also puts forward an ambitious mitigation target of 20% emission reduction as an unconditional target by 2030 with clear sector- specific objectives. These targets are tied to mitigation principles, which involve green mobility, sustainable cities, sustainable production and energy security (MoE, 2021).

A full description of Lebanon's NDC is presented in section 2.2 of the BTR1.

In addition to the NDC, Lebanon prepared its Long-Term Low-Emission Development Strategy (LT-LEDS) in line with Article 4.19 of the Paris Agreement, to promote and integrate sustainable and resilient growth into economic planning. The strategy promotes investment in green technologies, renewable energy, and sustainable infrastructure, fostering innovation and creating new economic opportunities (MoE/ UNDP, 2025). As Lebanon prepares for its second NDC submission, the LT-LEDS will shape the country's development path and help achieve its climate goals.

The main targets of the LEDS include:

- Transition to full renewable energy, full electrification, and increased energy efficiency: This involves a comprehensive shift towards using renewable energy sources, electrifying various sectors, and improving energy efficiency. The goal is to reduce carbon emissions, enhance energy sustainability, and reduce overall energy consumption.
- Implementation of climate-smart agriculture and climate resilience measures: Climate-smart agriculture practices, such as precision farming and resilient crop varieties, are put in place to adapt to changing climate conditions. Additionally, climate resilience measures aim to protect agricultural systems from climate-related risks, ensuring food security and sustainable farming.

- Electrification of transport and shift in mobility towards NMT (Non-Motorized Transport): This initiative involves replacing traditional fossil fuel vehicles with electric vehicles and promoting non-motorized transport options like walking and cycling. These actions reduce greenhouse gas emissions, ease traffic congestion, and improve air quality in urban areas.
- Reforestation and restoration of forest areas: Reforestation and the restoration of forest areas are undertaken to enhance carbon sequestration, protect biodiversity, and mitigate the impacts of deforestation. This helps maintain healthy ecosystems and reduce carbon emissions.
- Implementation of climate resilience measures across various sectors: Climate resilience measures are applied across multiple sectors, including water resources, infrastructure, and public health, to minimize the impacts of climate change. These measures are tailored to each sector's specific vulnerabilities and include strategies to improve resilience and response to climate-related challenges

Box 1: Key result of the macro-economic analysis conducted for the LEDS-LTS using different simulations and scenarios

The LEDS is a competitive economic development strategy. It achieves a Benefit to Cost Ratio of 5.14 to 5.86 by 2050. It stands out as a competitive economic development strategy at the national level, it offers a unique approach to address the pressing issue of climate change. It recognizes that climate action and economic prosperity are not mutually exclusive but can, in fact, be mutually reinforcing.

The LEDS stimulates economic growth (GDP up to 53% higher than Business-As-Usual (BAU)by 2050) and job creation (28.1% higher than BAU, with 4 million people employed by 2050) both by reducing the costs of climate change (resilience) and by increasing productivity (transition).

The LEDS generates economic growth and job opportunities through a dual strategy. On one hand, it mitigates the economic burdens associated with adapting to climate change, reducing the costs incurred due to climate-related disasters. On the other hand, it enhances economic productivity by accelerating the transition to a green economy.

The LEDS, due to high ambitions for climate resilience, creates a strong synergy with transition investments. It distinguishes itself by setting ambitious targets for climate resilience, which creates a robust synergy with transition investments.

Investment levels are the highest for the LEDS scenario (close to 4% of GDP by 2030), as it envisions significant investments, making it a comprehensive and proactive strategy to address climate change. By earmarking substantial funds, the LEDS ensures that it has financial resources to make a significant impact.

The investments are economically viable (with USD 97.2 billion to USD 127.5 billion of net benefits between 2023 and 2050). The investments are not just ambitious but economically and financially viable as well. The LEDS stands as a credible and practical approach to climate prosperity, both from an investment and development point of view.

Funding options are available; a balance between public and private sources should be sought. While public funding plays a critical role, the LEDS also advocates for a balanced approach that leverages private sector investments.

Institutional arrangements and Inventory preparation process

In Lebanon, the Ministry of Environment (MoE) is the national focal point for climate change and is also the focal point of the many climate-change related international organizations, centers, initiatives and funding bodies.

Lebanon does not have major legislation directly addressing climate change, apart from its Nationally Determined Contribution (NDC). The most relevant law for data collection related to the national GHG inventory and climate transparency is the Lebanon Access to Information Law 28/2017, which allows public access to government-held information. Administrations subject to this law include government bodies, courts, public institutions, institutions that perform public functions, and private companies managing public services/facilities.

To support the implementation of the Law, the government of Lebanon developed a 'National Action Plan to Implement the Access to Information Law" which was adopted by the Ministerial Anti-corruption committee – an oversight body – in 2020. However, the law faces challenges with its implementation, one of the reasons being that state administrations lack the resources to digitize and publish government data and fulfil requests for information. The law also lacks provisions for enforcement measures or penalties for non-compliance, thereby impeding its effectiveness. In principle, the law provides a basis for data collection for Lebanon's national GHG inventory and NDC tracking progress. However, in absence of its full implementation, the law currently does not support such an exercise.

Other relevant legal texts include:

- The Environmental Compliance Decree 8471 of 2012, which mandates industries to conduct self-audits including energy consumption and emissions data, and the Air Quality Decision 16/1 of 2022, which requires periodic emission testing by industries. These decrees provide a framework for data collection to support the GHG inventory, but they are not fully implemented due to capacity limitations.
- MoE Air Quality Decision 16/1 of 2022, which requests industries to conduct emission testing at least twice per year by specialized companies and send the results to the MoE within 3 months of conducting the test.
- MoE Decision 191/1 of 1997 and MoE Letter to Cement Industries (registration no. 1112/B), under which cement industries are required to submit monthly electronic reports regarding air emissions to the MoE regarding air emissions. The reports include the results of the air emissions tests alongside average daily, weekly, and yearly emissions for the test parameters.
- MoE Decision 99/1 of 2013, which provides incentives to private enterprises to report their GHG emissions and related activity data to the MoE. In exchange for their cooperation, reporting companies are awarded with a certificate signed by the Minister. The report includes all activity data related to energy and transport activities of participating companies.

These decrees and legal texts present elements of a framework for regular data provision to support the data collection for the GHG inventory, however, the requirements of the decrees are not fully implemented due to capacity limitations.

Lebanon's national GHG inventories, national communications and biennial update/transparency reports are prepared by a small team at the Ministry of Environment, primarily funded through international projects. The retention of this team is contingent on securing ongoing external funding. The team has been working to improve data quality, engage other ministry staff, and establish sustainable data collection processes. The inventory is typically compiled in-house, with occasional assistance from national and international experts for specific sectors and quality assurance.

Data collection relies heavily on written requests to various ministries, a process that is often slow and dependent on personal relationships. Efforts to formalize data-sharing through Memoranda of Understanding (MoUs) with key ministries have been hindered by political instability and frequent changes in government officials.

During the inventory and BTR preparation process, delays in funding, data access, and political support have compromised adherence to a predefined GHG inventory cycle. This has led to ad-hoc data collection and reduced the time available for methodological improvements, data validation, and quality control.

Lebanon has been working to enhance its data collection efforts through the Capacity Building Initiative for Transparency (CBIT) project, which established sectoral task forces to improve the role and engagement of various ministries and agencies in GHG inventory preparation and other reporting requirements such as NDC progress tracking.

More details related to the institutional arrangement and sectoral national circumstances are available in the National Inventory Document (MoE/UNDP/GEF, 2024).

1.2 Methods

Methodologies, parameters, and data

The GHG inventory in this BTR1 covers the year 2022, with a time series for 2020-2022 and the baseline of 2011. The inventory was prepared based on the 2006 IPCC Guidelines, and using the IPCC software version 2.930, including analysis of key categories, uncertainties and generation of trends. One main challenge in the preparation of the BTR1 inventory was the migration of data from the IPCC software 2.69 to the new 2.930 version, which incurred significant loss of data. Due to time constraints, the whole time series of 1994-2022 was not completely transferred, with missing years for waste and LULUCF specifically.

The inventory is in line with Modalities, Procedures and Guidelines (MPGs) for the enhanced transparency framework as per UNFCCC Decisions 18/CMA.1 and 5/CMA.3.

The following sectors are covered: 1. Energy (including transport), 2. Industrial Processes and Product Use (IPPU), 3. Agriculture Forestry and Other Land Use (AFOLU) and 4. Waste (including wastewater).

To estimate the GHG emissions, Tier 1 methods were mostly applied using default emission factors, with activity data being derived from national sources, international organizations and other literature as identified in each sector. Proxy data, interpolations, extrapolations and estimations based on expert judgments were used in cases where data was unavailable.

Tier 2 methods were used to estimate emissions from energy industries, transport (for CH_4 and N_2O), cement manufacturing, product uses as substitutes for Ozone Depleting Substances (F-gases), solid waste disposal and wastewater treatment and discharge, while approach 3 was adopted for the representation of land use areas in some subcategories of AFOLU.

Key category analysis

Key categories for Lebanon are determined for both level and trend using Approach 1 from the 2006 IPCC Guidelines. The results from the KCA should be used to identify priorities for the improvement of the national GHG inventory. Emissions from key categories should be estimated using higher tier methods: Tier 2 or Tier 3. The key categories of 2022 are presented in the table below.

Table 2 - Key categories by level assessment (LA) for 2022 with LULUCF

IPCC Category code	IPCC Category	Greenhouse gas	2022 Ex,t (Gg CO_2eq.)	Ex,tl (Gg CO_2eq.)	Lx,t	Cumulative Total of Column F
1.A.3.b	Road Transportation - Liquid Fuels	CO_2	6,509.72	6,509.72	0.27	0.27
1.A.4	Other Sectors - Liquid Fuels	CO_2	5,544.04	5,544.04	0.23	0.50
3.B.1.a	Forest land Remaining Forest land	CO_2	(2,007.69)	2,116.62	0.09	0.59

1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	2,115.15	2,115.15	0.09	0.68
2.F.a	Refrigeration and Air Conditioning	FHC	1,656.50	1,656.50	0.07	0.75
1.A.1	Energy Industries - Liquid Fuels	CO_2	1,444.16	1,444.16	0.06	0.81
3.B.2.a	Cropland Remaining Cropland	CO_2	(1,233.31)	1,233.31	0.05	0.86
2.A.1	Cement production	CO_2	898.88	898.88	0.04	0.90
4.A	Solid Waste Disposal	CO_2	665.53	665.53	0.03	0.93
4.D	Wastewater Treatment and Discharge	CO_2	525.21	525.21	0.02	0.95
3.A.1	Enteric Fermentation	CO_2	387.22	387.22	0.02	0.96

Time-series consistency and recalculations

Lebanon applied flexibility for the time-series consistency, where instead of the of the mandatory requirement to report a consistent annual time series starting in 1990, Lebanon is reporting data covering the reference year (2011) of its NDC and, in addition, a consistent annual time series from 2020-2022. However, it should be noted that although historical data is available since 1994, time and technical constraints did not allow the migration of the whole time-series between the 2 versions of the IPCC software.

Uncertainty assessment

Uncertainty estimates have been done at different inventory levels (from inputs data to the national annual estimates of emissions or removals, and emissions or removals trends) using approach 1 for all the inventory except for transport activity data where the Monte Carlo/Approach 2 was used, as per the IPCC Good Practice Guidance (IPCC, 2000; IPCC, 2003), and the IPCC 2006 Guidelines (IPCC, 2006). Sectoral experts investigated the uncertainty parameters coming under their field of work, and uncertainties have been calculated for CO_2, CH_4 and N_2O (the analysis does not include the emissions of HFCs). The estimated overall uncertainty of the total inventory reached 8.5% in 2022, with the corresponding uncertainty in trend 1994-2022 estimated to 35%. Details of uncertainty calculation are presented in Lebanon's NIR.

Assessment of completeness

All sources of direct GHG gases included in the IPCC guidelines are covered by the inventory, as well as all the direct GHGs. The geographical coverage is complete.

For the notation keys, the following have been used in the 2022 inventory:

NO (not occurring): This notation key is used for activities in a particular source or sink category that do not occur in Lebanon. The highest number of source categories marked with NO is found in IPPU and agriculture sector.

NE (not estimated): Emissions of CO_2, CH_4 and N_2O from domestic aviation, glass production, non-energy products and solvent use, harvested wood products and changes in land use in wetlands and other lands

in addition to emissions of PFCs, SF_6 and NF_3, are not estimated because of lack of activity data and/or because their likely level of emissions is below 0.1 per cent of the national total GHG emissions (20.5 Gg CO_2eq.).

IE (included elsewhere): There are a few categories marked with IE because relevant data are not available on the reporting level and emissions are therefore included in some other categories. These sources include emissions from domestic navigation and lubricants.

NA (not applicable): This notation key is used for activities in a given source/sink category that do not result in emissions or removals of a specific gas.

FX (Flexibility): this notation key is used for activities where Lebanon has used the flexibility provisions provided by the MP.

More details on completeness is available in Lebanon's National Inventory Report.

Quality Assurance/Quality Control Procedures

Lebanon has elaborated a QA/QC plan for the preparation of its GHG inventory, which is implemented within each inventory cycles. The QA/QC plan includes procedures relevant to collection and computation of data, documentation, calculation, in addition to consistency and completeness checks. In addition, the inventory of BTR1 has been subject to review by international experts before its submissions, as a quality assurance measure.

A structured documentation and archiving system has been established, using standardized templates to ensure all data, methodologies, and recalculations are clearly documented and traceable. The information is stored in a cloud system accessible to authorized personnel, ensuring data integrity and availability.

The official consideration and approval of the GHG inventory are led by the Ministry of Environment, which coordinates stakeholder validation, external reviews, and final approvals. The completed inventory is then endorsed by the Minister of Environment and submitted to the UNFCCC, with the final report made publicly available to ensure transparency and public awareness.

More details on QA/QC are available in Lebanon's National Inventory Report (MoE/UNDP/GEF, 2024).

Metrics

Emissions of Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O) and F-gases (HFC) were estimated and reported in Gg CO_2eq. (1,000 tonnes) using the 100-year time-horizon global warming potential values of the IPCC Fifth Assessment Report, as referred to in decision 18/CMA.1.

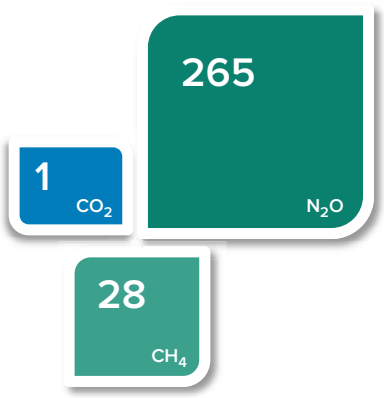


Figure 3: Global Warming Potential (IPCC, 2014)

2. Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

2.1 National circumstances and institutional arrangements

National circumstances affect a party's ability to implement and achieve its NDC under article 4 of the Paris agreement, including the government structure, population profile, geography, economy, climate and sector specific details and the political economy of a country. As described in section 1.1 of the BTR1 report, the drastic changes in Lebanon's socio-economic profile after 2019 had a significant impact on GHG emissions and climate change action in the country.

Lebanon's fiscal policy coupled with regional instability have restrained the country's economic activity as the public debt to GDP ratio stood at 171% in 2019, the largest budgetary shortfall of the decade. In addition, the country had been facing political instability with frequent changes in government and challenges in forming a stable and effective administration. The lack of political stability hindered decision-making processes, including those related to planning and implementation of policies, reforms and investments and resulted in a severely underfunded public sector.

These economic and political challenges in Lebanon had significant implications on the development of various sectors in Lebanon, hence impacting the country's ability to implement and achieve its NDC mitigation and adaptation targets. Specifically, the crisis has hindered the implementation of the main Climate Action Enablers referred to in the NDC (MoE, 2021) which are crucial to sustained and more ambitious actions to achieve the NDC, which include improved governance and institutional capacities, incentivized action and fiscal reform, strengthened partnerships, innovative research and development, comprehensive integration and enhanced monitoring and transparency. The accumulation of challenges listed in Table 3 has severely impeded government operations, the appetite for investment, and the provision of basic services.

Table 3 - Major challenges facing Lebanon since 2011

2011	▪ The conflict in Syria has significantly impacted Lebanon's social and economic growth, caused deepening poverty and humanitarian needs, and exacerbated pre-existing development constraints in the country. ▪ Government of Lebanon (GoL) estimates that the country hosts 1.5 million Syrians who have fled the conflict in Syria.
2019	▪ Civil protests erupt and demand reforms from government. ▪ Bank deposits are difficult to access, and banking institutions cease lending, which slows down economic activity.

2020	▪ The unemployment rate rises to nearly 30% since the outbreak of COVID-19 and related containment measures. ▪ Government defaulted on its Eurobond obligations. ▪ The 12-month inflation rate has risen steadily and sharply from 10% in January 2020, to 89.7% in June 2020, and 120% in August 2020. ▪ Lebanon experiences a devastating blast which resulted in over 200 deaths and 6,000 injuries, as well as damages estimated to be up to USD 4.6 million. ▪ Debt-to-GDP is estimated to have reached 174% by the end of 2020.
2021	▪ The sudden stop in capital inflows, coupled with a smaller but still large current account deficit, has steadily depleted the Central's Bank's foreign exchange reserves. ▪ Lebanon's GDP plummeted from close to USD 55 billion in 2018 to an estimated USD 23 billion in 2021, with USD GDP/ capita falling by around 55%.
2022	▪ The currency lost more than 95% of its pre-crisis value. This rapid devaluation, as well as supply-chain bottlenecks and fuel shortages have caused food prices to increase dramatically by 483% in January 2022 compared to the year before. ▪ As the Central Bank ran out of foreign reserves and lifted subsidies on the import of most vital goods, prices for electricity, water, and gas skyrocketed, increasing by 595% between June 2021 and June 2022.
2023	▪ Lebanon is hit by yet another crisis: the spillover effects of the conflict in the Middle East. ▪ The economy is able to find a temporary bottom following year of sharp contraction, thanks to tourism and sizeable remittances. ▪ Following the demarcation of the maritime border, exploration for oil and gas has started, but concluding results were negative.

The recent changes of national circumstances have resulted in a decrease of 32% in GHG emissions and removals from 2019 to 2022, with a major reduction reported in the energy sector, and has impacted the implementation of the NDC as summarized in Table 4.

Table 4 - Impact of national circumstances on NDC implementation

Impact of national circumstances	Description	Impact on NDC implementation
General		
Limited financial resources	The economic crisis had strained Lebanon's financial resources, making it challenging for the government not only to invest in and implement development projects and reforms but also in sustaining the already established good practices.	Lack of funding to invest in climate mitigation and adaptation.
Access to credit and financing	The economic crisis has limited access to credit and financing to industries, SMEs and farmers. Without adequate financial support, businesses and farmers are struggling to invest in modern clean technologies, purchase necessary equipment, or cover operational costs.	Lack of funding to invest in climate mitigation and adaptation.
Infrastructure deterioration	The prolonged economic crisis has contributed to the deterioration of critical infrastructure in the energy, transport, agriculture, water and waste sectors. Maintenance and upgrades of essential infrastructure were delayed or neglected, exacerbating the challenges in providing reliable and stable services.	Inadequate infrastructure to develop new mitigation and adaptation projects such as renewable energy projects, efficient irrigation systems, waste management facilities, etc.
Policy uncertainty and inconsistency	Political instability has led to policy uncertainty and inconsistency, hindering the implementation of long-term sectoral plans. This has also resulted in a fragmented approach to addressing climate change, making it challenging to develop and enforce effective regulations and incentives.	Climate action and NDC implementation de-prioritized in the national political agenda.

Re-shuffling of priorities	Social and economic priorities have taken precedence over longer-term climate change goals. The government is prioritizing issues such as poverty alleviation, job creation, and social welfare over investing in climate change measures.	Climate action and NDC implementation de-prioritized in the national political agenda.
Weakened institutional capacity	The crisis has weakened governmental institutions and their capacity to effectively address environmental issues, including climate mitigation and adaptation.	Weakened institutional frameworks for policy development, implementation, and enforcement to meeting climate change targets.
Lack of Regulation and Enforcement	The crisis has resulted in weakened governance and regulatory capacities. The absence of effective regulation and enforcement mechanisms has contributed to uncontrolled and illegal environmental practices such as illegal waste and wastewater dumping, groundwater overextraction, deforestation.	Compromised implementation of sector-specific measures and lack of public trust and engagement to foster community support for NDC implementation.
Energy and transport		
Fuel and Electricity Shortages	Lebanon has been experiencing severe shortages of fuel and electricity since 2019. The shortage of foreign currency made it difficult for the government to import sufficient fuel for power generation and transport. As a result, power outages have been widespread, pushing people to either rely on private generators, or invest in solar energy. Although fuel shortages did not significantly impede transportation in Lebanon (Afif, 2023), it contributed in fostering the growth of the market for hybrid and electric cars.	On one hand, decreased import and consumption of fuel with a concurrent expansion of decentralized solar PV in residential and commercial sectors and market penetration of hybrid and electric cars. On the other hand, the inability of a large section of the population to afford private generators or solar PV systems, forcing reliance on an underserving power supply, rising emissions from inefficient energy use, and limiting clean energy options. This has created a further gap and inequalities among the population (including access to energy), where the well-off have managed to install PVs and procure new hybrid and electric vehicles. The majority of the population is unable to secure the means for such purchases.
Removal of subsidies	Fuel subsidies have been gradually removed between 2021 and 2022, obliging users to pay the full price of petroleum products, which has led to a %379 increase in the price of gasoline and %682 increase in the price of diesel. A positive outcome is the correction of the electricity tariffs (removing the subsidies), which has been pegged to a price of oil barrel of USD 25/tonnes (in the mid1990-s).	Decreased electricity demand and fuel consumption. Decreased driving distances and gasoline consumption for commercial and trade vehicles. Expansion of decentralized solar PV in residential and commercial sectors and market penetration of hybrid and electric cars. With the correction of the electricity tariffs, the price of electricity has become unaffordable to most of the Lebanese – creating yet another disparity in equitable energy access.
Access to Natural Gas	National and regional political challenges have hindered the government plans to import natural gas to switch some oil-fired power plants. Discussions to transport Egyptian gas to Lebanon through the Arab Gas Pipeline which passes through Jordan and Syria have been halted. To date, no concrete plans and timeline were agreed upon to start the import and proceed with the fuel switch.	Continued reliance on high-emitting fossil fuels such as diesel oil and heavy fuel oil, jeopardizing the NDC emission reduction target.
Fuel smuggling	During 2020 and 2021, Lebanon experienced significant fuel smuggling across its borders, primarily into Syria, driven by the disparity between Lebanon's subsidized fuel prices and higher prices in neighboring countries. These activities worsened the country's energy crisis, contributing to power outages and limiting fuel availability for domestic needs.	Inability to accurately allocate national consumption of fuel and attribute emissions to Lebanon's GHG inventory, which might lead to overestimation of emissions.

Industrial production		
Disrupted industrial production	The currency devaluation increased the cost of importing raw materials and power generation to maintain operations and afford necessary inputs. In addition, the crisis affected trade and logistics and disrupted supply chains, hence affected the production and timely delivery of materials.	On the one hand, decreased industrial production, leading to lower energy consumption and lower production-related emissions. On the other hand, weakened ability to innovate and implement climate-friendly measures in industrial production.
Agriculture and forestry		
Disrupted agricultural production	The currency devaluation increased the cost of importing essential agricultural inputs, such as seeds, fertilizers, and equipment, making it challenging for farmers to maintain operations and productivity. Additionally, frequent electricity shortages impacted irrigation systems, limiting water access for crops.	Decreased use of synthetic fertilizers affecting N_2O emissions from the sectors. Decline in agricultural production impacting food security and local market supply. Weakened ability and incentive to shift to climate-smart agricultural techniques.
Impact on Livelihoods	The economic crisis has led to high unemployment rates and increased poverty levels, which affected the livelihoods of those engaged in agriculture, both as farmers and as laborers in the sector.	Weakened the capacity and willingness of stakeholders to invest in sustainable agricultural practices that align with NDC goals. Weakened ability and incentive to shift to climate-smart agricultural techniques.
Water Scarcity	The crisis has exacerbated existing infrastructure and operational challenges related to water scarcity affecting irrigation practices and the overall sustainability of agricultural activities.	Increased reliance on unsustainable practices, such as over-extraction of groundwater, further degrading water resources.
Waste and wastewater		
Lack of public funds	The economic crisis had caused budgetary constraints, which hindered the sector's ability to operate effectively and invest in necessary upgrades- especially that waste and wastewater management relies mainly on public funds for infrastructure development, waste/wastewater collection, and disposal and treatment facilities.	Continued unsustainable waste and wastewater discharge practices. Inability to invest, adopt and maintain new treatment measures, jeopardizing the NDC emission reduction target as well as adaptation measures.
Reduced Municipal Capacities	Municipalities, responsible for local waste management, are faced with energy, fuel, transportation, labor and financial challenges, that are impacting their ability to organize and manage waste collection services efficiently.	Continued unsustainable waste and wastewater discharge practices. Inability to invest, adopt and maintain new treatment measures, jeopardizing the NDC emission reduction target.
Increased informal waste disposal	Economic difficulties have led to an increase in informal waste disposal practices, such as illegal dumping or burning of waste.	Continued unsustainable waste and wastewater discharge practices. Weakened control over disposal and discharge practices.
Water		
Reduced water supply	The deterioration of critical infrastructure including water supply and distribution systems and the absence of maintenance and upgrades have led to leakages and disruption in water supply and a decline in overall supply of water. In addition, the energy crisis impacted on the operation of water pumping stations and treatment plants, leading to disruptions in overall services.	Reduced irrigation is affecting agricultural productivity and impacting food security. Reduced water availability for commercial, industrial and domestic use, compromising overall water security, and threatening livelihoods.
Over pumping of groundwater	Disruptions in public water supplies and lack of law enforcement has increased the tendency for private entities and individuals to over-pump groundwater.	Weakened ability to adapt to climate impacts as groundwater levels decline. Increased salinity and contamination, further complicating efforts to maintain food security and protect livelihoods.
Health		
Increased vulnerability of healthcare facilities	Rising operational costs, driven by currency devaluation and inflation, have strained healthcare providers, making it increasingly difficult to maintain adequate staffing, supplies, and equipment. Simultaneously, many people have faced financial hardship, resulting in an inability to pay for medical services or access to necessary treatments. This combination of increased costs and reduced patient affordability has led to significant declines in healthcare access and quality, exacerbating public health challenges during a critical time.	Weakened ability of healthcare institutions to adapt to climate-related health challenges and respond to climate disasters, such as floods or heatwaves. Weakened preparedness and resilience among healthcare institutions undermining Lebanon's ability to meet its NDC commitments related to public health.

Institutional structures for tracking and reporting NDC

Improved governance and institutional capacities are listed as the first of six climate action enablers in Lebanon's NDC. The NDC also states as a climate action enabler, enhanced monitoring and transparency through establishing a transparency framework to improve institutional arrangements, data availability and periodicity as well as monitoring and reporting.

After the submission of Lebanon's NDC in 2015, the Ministry of Environment (MoE) has been appointed as the official NDC coordinator and an inter-ministerial committee was formed in 2017 (Council of Ministers' decision 33/2017) to follow-up on the implementation of Lebanon's NDC. The committee is chaired by the MoE and includes nominated representatives from the Ministry of Energy and Water (MoEW), Presidency of the Council of Ministers (PCM), Electricité du Liban (EDL), Ministry of Public Works and Transport (MoPWT), Ministry of Agriculture (MoA), Lebanese Petroleum Administration (LPA), Ministry of Foreign Affairs (MoFA) and Ministry of Finance (MoF).

The main role of the NDC committee is to follow up the implementation of all NDC elements. The mandate of the committee also includes:

- Update on the progress of the ministries and institutions' plans and strategies that make up Lebanon's Nationally Determined Contribution.
- Implement the United Nations Framework Convention on Climate Change decisions related to the NDC and related transparency of action and support requirements.
- Assess gaps and needs related to the implementation of sectoral and cross-cutting activities under the NDC and related to the reporting of progress (needs could be financial support, capacity-building support, technology support or technical support).
- Update Lebanon's NDC to move to a more ambitious target every 5 years, with the first update in 2020.
- Find linkages and opportunities to better implement Lebanon's NDC and relevant Sustainable Development Goals (SDGs).
- Ensure that the implementation of Lebanon's NDC respects human rights and gender equality.
- Prepare the report on the NDC progress and communicate it to the Council of Ministers periodically.

The preparation of the NDC document and its update in 2020 was led by the Ministry of Environment in close coordination with the official NDC committee. The update was based on a series of meetings to ensure institutional ownership, public participation and engagement with local communities in a gender-responsive and inclusive manner. These included meetings with sectoral mitigation and adaptation experts from line ministries to assess where additional ambition in the NDC could be allocated and assess the enhanced adaptation targets, and their appropriateness considering Lebanon's special circumstances. Consultations were also organized with Non-State Actors, academic experts, youth, the private sector and civil society organizations. Finally, the results were presented to the official inter-ministerial NDC committee. Once feedback was received, the NDC was sent to the Council of Ministers for official approval and was submitted in January 2021 to the UNFCCC Secretariat.

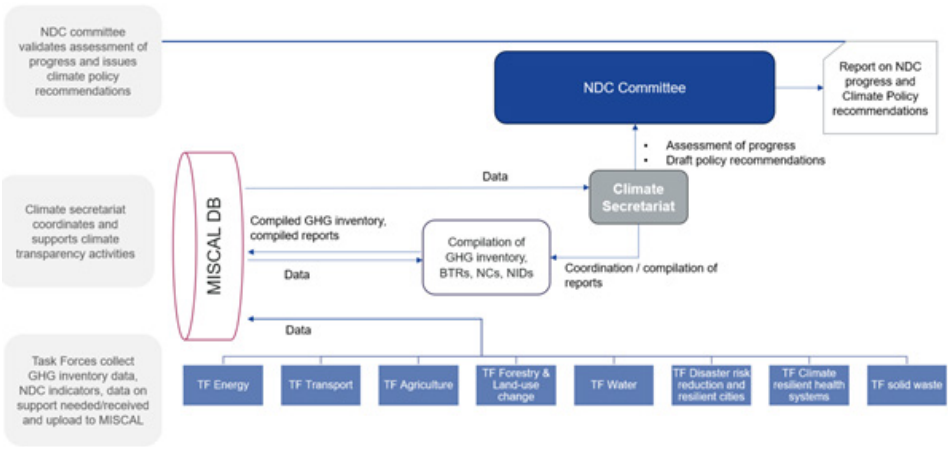
Currently, the MoE's climate change project team leads on the preparation of the mitigation and adaptation related content in the National Communications, Biennial Update Reports and Biennial Transparency Reports. For this purpose, information is requested from stakeholders, including ministries and other administrative institutions, local experts, international agencies working in Lebanon and the private sector, to capture an exhaustive map of national activities. However, the absence of proper institutional arrangements complicates the involvement of some institutions such as the Council of Development and Reconstruction, Ministry of Public Works and Transport, Ministry of Industry, Central Bank and Central Administration of Statistics and hinders the completeness and accuracy of the exercise. As there are no

formally established reporting channels yet, the data collection relies to some extent on the willingness of stakeholders to compile and/or provide such information.

To overcome institutional barriers, during the past 15 years, the Climate Change Projects at the Ministry of Environment has applied a number of approaches to improve data availability and data provision including training, creating awareness of reporting benefits with stakeholders, and putting in place Memoranda of Understandings. All these approaches were considered good international practice and were carefully prepared and implemented, however due to scarcity of resource and frequent staff turnovers, these approaches did not prove successful in the long-term. The political situation also played a part, making it difficult to generate regulation institutionalizing structures and processes. With Lebanon's current economic situation, staff resource has further deteriorated and staff with the relevant expertise are found mostly within donors. Good practice solutions, thus establishing sustainable reporting processes through focal points in relevant ministries and agencies, are thus not considered feasible in the current situation of staff resource scarcity.

Under the CBIT project, a more robust transparency framework was established, which includes the establishment of sectoral task forces to conduct work on NDC-related priorities with a clear deliverable (e.g. producing guidance) and timeline (e.g. six months) for each task force. Task forces are kept small, involving only the relevant stakeholders and experts per sector. A climate change secretariat at MoE oversees and coordinates the task force work, ensuring set timelines are met. A key enabling factor in the successful work of these task forces is the availability of resources in the form of donor staff and/or donor-funded staff.

Proposed basic institutional structures for Lebanon's Climate Transparency Framework are presented in Figure 4.



DB= Database TF=Task force

Figure 4: Suggested institutional framework for Lebanon's Climate Transparency Framework

These institutional structures cover data collection, compilation of indicators, compilation of greenhouse gas inventory and other UNFCCC reports as well as the evaluation of progress towards the NDC and development of policy recommendations. Data management and exchange is planned to happen through an online platform referred to as Management Information System for Climate Action in Lebanon (MISCAL) (Figure 5).

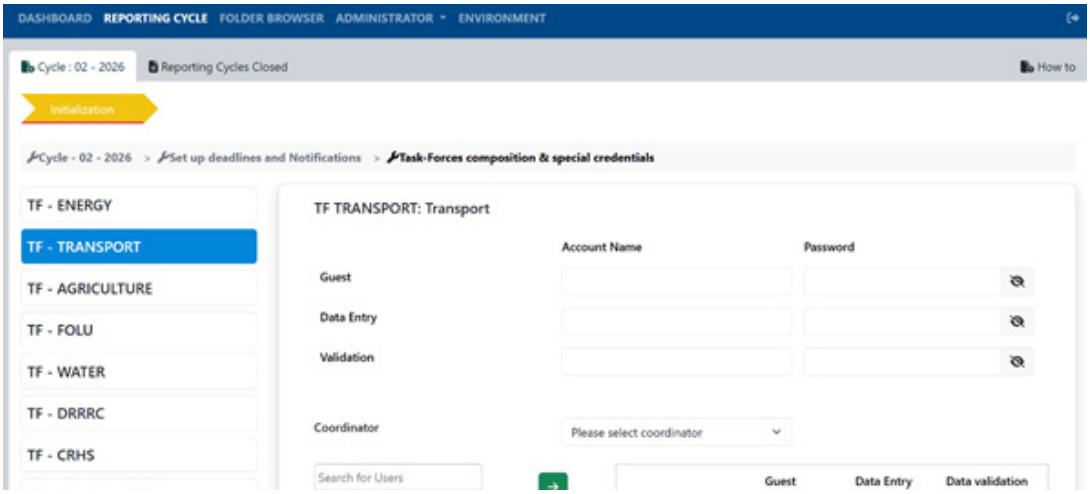


Figure 5: Management Information System for Climate Action in Lebanon (MISCAL) platform

Key entities involved in the Climate Transparency Framework include:

- **Task forces for data collection**, consisting of a small number of experts related to the task forces scope, including ministry, agency, donor, and NGO staff, academic and experts. Each task force has a specific Terms of Reference and work is organized and validated by a volunteer task force coordinator from within the group.
- **Lebanon's existing NDC Committee**, discussing progress towards the NDC and issuing policy recommendations to decision-makers in climate planning and implementation.
- **A Climate Secretariat to the NDC Committee**, coordinating the processes under the climate transparency framework, providing inputs and further support to the NDC Committee, and compiling selected reports to the UNFCCC. This entity is the engine of Lebanon's Climate Transparency Framework. It consists of a small number of staff members at MoE with broad experience in climate transparency under the UNFCCC including NDC drafting, implementation and tracking, GHG inventory compilation and UNFCCC reporting. At present, the most feasible option is to be staffing the Secretariat using resources at the Climate Change Project at the MoE.

2.2 Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates

In compliance with the provisions of the Paris Agreement, Lebanon published its Nationally Determined contribution (NDC) in 2015 and an update in 2021 with an ambitious mitigation target of 20% emission reduction as an unconditional target by 2030 with clear sector- specific objectives (Table 5 and Table 6). Common tabular format (CTF) tables, as per 5/CMA.3- Annex II, reporting on NDC tracking can be found in annex II.

Additionally, as per paragraph 11 of Article 7 of the Paris Agreement and paragraph 11 of Decision 9/CMA.1, the adaptation priorities in the updated NDC correspond to (c) National adaptation priorities, strategies, policies, plans, goals and actions of the Annex of Decision 9/CMA.1 (Further guidance in relation to the adaptation communication, including, inter alia, as a component of nationally determined contributions, referred to in Article 7, paragraphs 10 and 11, of the Paris Agreement and Law 115/2019). Therefore, the adaptation priorities reported in the updated NDC have constituted part of Lebanon's first Adaptation Communication in accordance with paragraph 10 of Article 7 of the Paris Agreement and Law 115/2019 (MoE, 2021). Lebanon's latest NDC is available at the NDC registry.

Table 5 - Overview of Lebanon 2020 NDC, including mitigation targets and adaptation priorities

Mitigation Targets
Unconditional targets 2020[1]
• A GHG emission reduction of 20% compared to the Business-As-Usual (BAU) scenario in 2030, (amounting to 7,790 Gg. CO_2eq.). • 18% of the power demand (i.e. electricity demand) and 11% of the heat demand (in the building sector) in 2030 is generated by renewable energy sources. • A 3% reduction in power demand through energy-efficiency measures in 2030 compared to the demand under the BAU scenario.
Conditional targets 2020[2]
• A GHG emission reduction of 31% compared to the Business-As-Usual (BAU) scenario in 2030 (amounting to 12,075 Gg. CO_2eq.). • 30% of the power demand (i.e. electricity demand) and 16.5% of the heat demand (in the building sector) in 2030 is generated by renewable energy sources. • A 10% reduction in power demand through energy-efficiency in 2030 compared to the demand under the BAU scenario.
[1] The unconditional mitigation scenario includes the impacts of mitigation actions which Lebanon can nationally implement, and through international support in the form of loans or other repayable instruments. *[2] The conditional mitigation scenario covers the mitigation actions under the unconditional scenario, as well as further mitigation actions which can be implemented upon the provision of additional international support in the form of grants.*
Adaptation guiding principles
1. Achieve food and water security through the sustainable management of resources. 2. Enhance the resilience of the infrastructure, urban and rural areas to subsist climate-related disasters. 3. Ensure and protect public health, well-being and safety of all communities through climate-resilient systems. 4. Incorporate Nature-Based Solutions as a first line of defense from adverse impacts of climate change. 5. Combat desertification and land degradation by achieving Land Degradation Neutrality. 6. Substantially reduce the risk of climate and non-climate related disasters to protect lives, the economy and physical and natural assets.
Adaptation priorities
1. Strengthen the agricultural sector's resilience to enhance Lebanon's agricultural output in a climate-smart manner. 2. Promote the sustainable use of natural resources, restore degraded landscapes, and increase Lebanon's forest cover while meeting the ecological, social and economic needs of sustainable forest management 3. Structure and develop sustainable water services, including irrigation, in order to improve people's living conditions. 4. Value and sustainably manage Lebanon's terrestrial and marine biodiversity for the preservation and conservation of its ecosystems and habitats and the species they harbor in order to adequately respond to anthropogenic and natural pressures and to ensure Lebanese citizens equal access to ecosystem goods and services. 5. Reduce the vulnerability of climate change impacts on coastal zones, especially in cities. 6. Ensure overall public health and safety through climate-resilient health systems. 7. Reduce disaster risk and minimize damage by mitigating and adapting to climate-related natural hazards and extreme weather.

Table 6 - Reporting Format for the description of a Party's nationally determined contribution under article 4 of the Paris Agreement, including updates (Appendix)

Description	
Target(s) and description, including target type(s) as applicable	1. Lebanon commits to unconditionally reduce its greenhouse gas emissions by 20% below its Business-As-Usual (BAU) scenario (amounting to 7,790 Gg. CO_2eq.) and to conditionally reduce its greenhouse gas emissions by 31% below its Business-As-Usual (BAU) scenario in 2030 (amounting to 12,075 Gg. CO_2eq.). 2. Lebanon commits to unconditionally generate 18% of its power demand (i.e. electricity demand) and 11% of its heat demand (in the building sector) by renewable energy sources and to conditionally generate 30% (i.e. electricity demand) of its power demand and 16.5% of its heat demand (in the building sector) by renewable energy sources in 2030. 3. Lebanon commits to unconditionally reduce power demand through energy efficiency measures by 3% under the Business-As-Usual (BAU) scenario and to conditionally reduce power demand through energy efficiency measures by 10% under the Business-As-Usual (BAU) scenario in 2030.
Target year(s) or period(s) and whether they are single year or multiyear target(s), as applicable	2030, 2011-2030, Single-year target.
Reference point(s), level(s), baseline(s), base year(s), or starting point(s) and their respective value(s), as applicable	*Base year: 2011, same for the BAU.* *1. Base year emissions: 19,194 Gg CO_2eq., same for the BAU.* *BAU GHG emissions by 2030: 38,948 Gg CO_2eq. (projected).* *GHG Emissions by 2030 under unconditional scenario: 31,159 Gg CO_2eq.* *% reduction of GHG emissions by 2030 compared with BAU emissions by 2030= 20% (BAU GHG emissions by 2030 – GHG Emissions by 2030)/ BAU GHG Emissions by 2030*100.* *Reduction of GHG emissions by 2030 compared with BAU emissions by 2030= 7,790 Gg CO_2eq. (BAU GHG emissions by 2030 – GHG Emissions by 2030).* *2. 2.1) Base year % electricity demand by renewable energy sources: 5% % electricity demand by renewable energy sources by 2030 under unconditional scenario: 18%* *2.2) Base year% heat demand in the building sector by renewable sources: 0%* *% heat demand in the building sector by 2030 from renewable sources: 11%* *3. Base year power demand: 16,564 GWh* *BAU power demand by 2030: 34,742 GWh (projected).* *Power demand by 2030 under unconditional scenario : 33,700 GWh* *% reduction power demand through energy efficiency measures by 2030 = 3%: (BAU power demand by 2030 – Power demand through energy efficiency measures by 2030)/ BAU power demand by 2030*100* *The BAU scenario does not take into account mitigation actions implemented after 2011.*
Time frame (s) and/or periods for implementation, as applicable	*2021 to 2030.*

Scope and coverage including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	*Lebanon's NDC is an economy wide absolute GHG emissions target. Information provided in Lebanon's inventory as part of its Biennial Transparency Report (BTR) will be consistent with the IPCC guidelines.* *Sectors* *Energy, industrial processes and product use, agriculture, forestry and land-use, and waste.* *Gases* *Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).* *Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) are not included in Lebanon's NDC.* *For agriculture, forestry and land-use, emissions and removals the following reporting categories are included: forest land, cropland, grassland, and wetland (wetland remaining wetland only from 2026), including land use changes between the categories, and between these categories and settlements and other land. The five carbon pools above-ground biomass, below-ground biomass, litter, dead wood and soil organic matters are included. In addition, the carbon pool harvested wood products is included.*
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	*While at present, the use of Article 6 mechanisms is not envisaged, Lebanon does not exclude the possibility of making use of international market mechanisms to achieve its NDC targets.*
Any update or clarifications of previously reported information, as applicable.	*Lebanon started to calculate emissions of F-gases (HFC from refrigeration and Air Conditioning) since 2019 only, which means that emissions of F-gases were not part of the NDC BAU scenario emission projections.* *Therefore, the total GHG emission indicator does not include F-gases in the Total GHG emissions of the current year (2022).*

2.3 Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

Lebanon's NDC has emission reduction targets compared to a Business-as-Usual level, which commits Lebanon to limit emissions to a level below that projected under the BAU trajectory, as described in section 2.2. Indicators determined by Lebanon to track the implementation and achievement of its NDC have been developed under the CBIT project, as part of Lebanon's transparency strategy. **For this BTR1, only the indicators directly related to the unconditional NDC targets only have been used to report progress of the NDC.**

Lebanon is not reporting its progress compared to its conditional target, which is contingent to receiving international support for financial assistance, technology transfer and capacity building. To achieve its conditional targets goals, additional support is needed for the improvement of national legislation, regulatory and economic instruments, the establishment of appropriate financial and investment, the gradual transition to more innovative and green technologies and the continuous upscaling of local skills and expertise.

Emissions of gases covered by Lebanon's NDC are calculated on the basis of the 2006 IPCC guidelines, the methodological tier employed depends on the availability of data for the different sectors. Emissions of the covered gases are aggregated in terms of the 100-year time horizon global warming potential based on the values stipulated in the 5th assessment report of the IPCC.

Due to the unprecedented economic and financial crisis that Lebanon is witnessing since 2019 which led to a significant reduction in GDP, economic, industrial and agricultural activity in additional to drastic reduction in energy production, national GHG Lebanon total emissions in 2022 have gradually decreased reaching a total of 20,519 Gg CO_2eq. When compared to the NDC scenarios and targets, the adjusted total of **18,863** Gg CO_2eq. (without LULUCF and F-gases in line with the NDC scenarios) is **33%** less than what Lebanon would have emitted in 2022 under a Business-as-usual scenario (28,362 Gg CO_2eq.). This decrease, attributed partially to the economic recession, but also the emission reduction witnessed globally pursuant to the COVID-19 pandemic, has brought closer Lebanon towards its NDC targets. Nevertheless, the economic recovery prospects (both from the economic recession and the post-COVID-9 pandemic), might result in increased emissions in the upcoming period. To that end, Lebanon will continue to make the needed efforts to reach its 2030 NDC targets.

In terms of renewable energy, Lebanon generated **1,913 GWh** from renewable energy sources in 2022, constituting **12%** of the total power demand. The share of renewable energy is above the expected shares under the BAU scenario, demonstrating progress toward meeting the renewable energy target (18% in 2030).

In comparison to the 3rd NDC target of a reduction of 3% of Lebanon's electricity demand in 2030, the 2022 estimation shows a demand of **16,380** GWh, which is **38%** lower that the demand projected for 2022 under the BAU scenario.

Table 7 to Table 10 present a summary of the progress, according to the CTF tables as per 5/CMA.3-annex II.

Table 7 - Structured summary: Description of selected indicators (CTF Table 1)

Indicator(s) selected to track progress	Description
1. Total greenhouse gas emissions (without LULUCF and F-gases)	**Economy wide national total GHG emissions and removals in Gg CO_2eq. (excluding LULUCF and F-gases).** Note: this indicator is only used to assess **the NDC unconditional scenario**.
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate	The reference level in the BAU scenario in 2022 is 28,362 Gg CO_2eq. The baseline and reference level in the base year (2011) is 19,194 Gg CO_2eq.
Updates in accordance with any recalculation of the GHG inventory, as appropriate	The current GHG inventory published in the BTR1 includes F-gases with a recalculation for the period 2015-2019. This recalculation is not reflected in the NDC BAU scenario. Therefore, the indicator does not include F-gases in the total GHG emissions.
Relation to NDC	The indicator is defined in the same metric and unit as the targets at the NDC.
2.1 Percentage of renewable energy in electricity/power demand	In Lebanon, the total electricity generation and the electricity generated by renewable energy sources is estimated in GWh by the Ministry of Energy and Water. In Lebanon, the renewable energy sources include hydropower, solar power and landfill gas.
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate	The reference level in the base year is 5% share of renewables from the electricity/power demand. The reference level in the BAU scenario in 2022 is 5% share of renewable energy from the electricity/power demand.
Updates in accordance with any recalculation of the GHG inventory, as appropriate	*No updates have been made.*

Relation to NDC	The indicator is defined in the same metric and unit as the energy related target at the NDC. Lebanon's NDC has a specific renewable energy target under the unconditional scenario. Therefore, the percentage of renewable energy in the energy/demand is the most appropriate indicator for this target.
2.2 Percentage of heat demand in the building sector by renewable energy sources	In Lebanon, the total heat generation in the building sector and the heat generation in the building sector produced by renewable energy sources is estimated from the Ministry of Energy and Water. In Lebanon, the renewable energy sources in the building sector are mainly defined as solar energy.
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate	NA
Updates in accordance with any recalculation of the GHG inventory, as appropriate	NA
Relation to NDC	So far, no indicator has been identified to track this NDC commitment.
3.Percentage reduction in power demand through energy efficiency measures	**The percentage reduction (%) in power demand in 2030 compared to the BAU estimated power demand.**
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate	Power demand is the estimated demand in GWh by the Ministry of Energy and Water in any given year. The level in the BAU scenario is 26,383 GWh in 2022 and the baseline level in 2011 (base year) is 16,564 GWh.
Updates in accordance with any recalculation of the GHG inventory, as appropriate	No updates have been made.
Relation to NDC	The indicator is defined in the same metric and unit as the energy related target at the NDC. Lebanon's NDC has a specific power demand reduction under the unconditional scenario. Therefore, the percentage reduction in the demand is the most appropriate indicator for this target.

Table 8 - Structured summary: Definitions needed to understand NDC (CTF Table 2)

Definition needed to understand each indicator:	Definitions
1. Total greenhouse gas emissions (without LULUCF and F-gases)	The total GHG emissions selected as an indicator are the economy-wide national total GHG emissions, excluding LULUCF and F-gases. The national total GHG emissions correspond to total GHG emissions in units of Gg CO_2eq. as reported in the most recent national GHG inventory, presented in the BTR1 (excluding LULUCF and F-gases to align with the NDC BAU and unconditional scenarios).
2.1. Percentage of renewable energy in electricity/power demand	The percentage of renewable energy in electricity power demand as an indicator is the amount in GWH of electricity produced from renewables (including hydropower, solar power and landfill gas) in a given year as a share of the total national electricity/power demand in the same year.
2.2 Percentage of heat demand in the building sector by renewable energy sources	NA
3. Percentage reduction in power demand through energy efficiency measures	The percentage reduction on power demand as an indicator is the amount in GWH of electricity needed in a given year as compared to the power demand estimated under the BAU scenario..

Table 9 - Structured summary – methodologies and accounting approaches (CTF Table 3)

Reporting requirement	Description or reference to the relevant section of the BTR
For the first NDC under Article 4	
Accounting approach, including how it is consistent with Article 4, paragraphs 13–14, of the Paris Agreement (para. 71 of the MPGs)	Lebanon is accounting for its anthropogenic GHG emissions and removals using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, and 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (collectively, the "2006 IPCC Guidelines"). Global Warming Potentials (GWP) for a 100-year time horizon from the IPCC's fifth Assessment Report (AR5) is being used to calculate CO_2eq. Lebanon's NDC seeks to ensure that its emissions reduction targets contribute to real global climate action, without relying on market mechanisms that could lead to double counting or overestimation of emissions reductions, hence ensuring environmental integrity of actions. In order to avoid of duplication/double counting, Lebanon's NDC includes clear boundaries on sectors and types of actions according to the IPCC guidelines. In addition, through coordination with international organizations, Lebanon ensures that its contributions are not counted by other countries or projects. The NDC is consistent the TACCC framework through: Transparency: Lebanon's NDC reporting is clear and open to international review, allowing external parties to track its progress. Accuracy: Emission reductions are calculated using IPCC 2006 guidelines. Completeness: Lebanon's NDC covers the main IPCC sectors including energy, IPPU, agriculture, forestry, and waste ensuring all relevant emissions and actions are accounted for. Comparability: Lebanon uses reporting metrics aligned the IPCC AR5 and the IPCC 2006 Guidelines which allows its efforts to be easily compared and assessed. Consistency: The methodologies Lebanon uses for reporting emissions are consistent with those used in prior reports, except for F-gases where it was not accounted for in the BAU GHG emission scenario of the NDC.
For each NDC under Article 4 *Accounting for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (para. 12(a) of decision 4/CMA.1 and para 1 of its annex II)*	
Each methodology and/or accounting approach used to assess the implementation and achievement of the target(s), as applicable (para. 74(a) of the MPGs)	Lebanon will compare the results of the selected indicators, including the use of the results of the National GHG inventory and the use of other energy related data sources, with the targets established in the NDC, taking as much as possible into account the 2006 IPCC guidelines. As indicated above, the results will only consider the three main GH gases and excluding the data from the LULUCF sector.
Ensuring methodological consistency, including on baselines, between the communication and implementation of NDCs (para. 12(b) of the decision 4/CMA.1 and para 1 of its annex II)	
Explain how consistency has been maintained in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches including on baselines, between the communication and implementation of NDCs (para. 2(a) of annex II to decision 4/CMA.1)	The construction of the current baseline (BAU) is methodologically consistent with the NDC of Lebanon and with the selected indicators to be used for tracking purposes by the country. Using 2006 IPCC guidelines, same sectors, same scope same gases except for F-gases so: IPCC categories included in GHG inventory : 1.A, 2.A, C, D, E 3 A, B, C and 4. A, B, C, D UNFCCC categories includes in Accounting of NDC: 1.A, 2.A, C, D, E 3 A, B, C and 4. A, B, C, D Therefore categories excluded from accounting: 2.E which includes F-gases from refrigeration and air conditioning. Consistency is maintained through using total annual emissions calculated in the NIRs without the F-gases emission values in order to compare them to BAU, unconditional and conditional scenarios.
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) and explain methodological inconsistencies with the Party's most recent national inventory report, if applicable (para. 76(c) of the MPGs)	Using 2006 IPCC guidelines in calculating GHG inventories and NDC targets, including the same sectors, emission factors, parameters and assumptions, expect for F-gases estimations, which were not included in NDC targets but included in the 2020-2022 inventories. Consistency is maintained through using total annual emissions calculated in the NIRs without the F-gases emission values in order to compare them to BAU, unconditional and conditional scenarios.

Table 10 - Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement (CTF Table 4)

	Unit, as applicable	Reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate (paras. 67 and 77(a)(i) of the MPGs)	Implementation period of the NDC covering information for previous reporting years, as applicable, and the most recent year, including the end year or end of period (paras. 68 and 77(a)(ii–iii) of the MPGs)			Target level	Target year or period	Progress made towards the NDC, as determined by comparing the most recent information for each selected indicator, including for the end year or end of period, with the reference point(s), level(s), baseline(s), base year(s) or starting point(s) (paras. 69–70 of the MPGs)
		2011	2020	2021	2022			
Indicator(s) selected to track progress of the NDC or portion of NDC under Article 4 of the Paris Agreement (paras. 65 and 77(a) of the MPGs)								
1. Total greenhouse gas emissions (without LULUCF and F-gases)	kt CO_2eq.	19,194	23,488.24	19,545.84	18,863.20	31,159.91	2030	Lebanon total emissions in 2022 (excluding LULUCF and F-gases) is 18,863 Gg CO_2eq., which is 33% under the reference BAU level in 2022 (28,362 Gg CO_2eq.).
BAU emissions baseline scenario (measured as kt CO_2 equivalent)	kt CO_2eq.	26,669.35	27,401.73	28,362.69	26,669.35			
Difference: BAU emissions baseline scenario - Total greenhouse gas emissions	kt CO_2eq.	3,181.11	7,855.89	9,499.49	3,181.11			
BAU emissions baseline scenario (measured as kt CO_2 equivalent)	%	12.00	29.00	33.00	12.00			
Where applicable, total GHG emissions and removals consistent with the coverage of the NDC (para. 77(b) of the MPGs)	kt CO_2eq.		23,488.24	19,545.84	18,863.20			
Contribution from the LULUCF sector for each year of the target period or target year, if not included in the inventory time series of total net GHG emissions and removals, as applicable (para. 77(c) of the MPGs)	kt CO_2eq.		-2,896.00	-3,018.00	-3,243.00			
2.1 Percentage of renewable energy in Electricity/power demand	%	5	5.00	4.00	12.00	18.00	2030	In 2022, 12% renewable energy as share of total electricity demand.
Renewable energy generated	GWh		1,163.00	902.00	1,913.00			
2.2 Percentage of heat demand in the building sector by RE sources	%		NA	NA	NA			
3. Percentage reduction in power demand	%	0	-1.00	-14.00	-38.00	3.00	2030	38% reduction in 2022, compared to the BAU 2022 demand.

Additional NDC tracking indicators

In addition to the development of national indicators under the CBIT project, sectoral headline and supporting indicators have been developed for mitigation and adaptation priorities, all validated by task force members.

The **national indicators** have been used in this BTR1, as they focus on simply tracking and reporting the overarching unconditional mitigation target from Lebanon's updated NDC – such as a GHG emission reduction of 20% compared to the Business-As-Usual (BAU) scenario in 2030.

The **headline indicators** and associated supporting indicators are sector-specific to facilitate the collection of data and consequently, track the progress of each NDC priority to better inform national policy making. Headline indicators are intended to show a trend in GHG emissions or strongly relate to the defined priorities and will be the primary element to track progress of the NDC commitments. The **supporting indicators** then present supplementary information to understand the drivers behind the trends as identified by the headline indicator or additional indicators which relate to the mitigation activities defined under the NDC priorities. These indicators will be mostly used for national tracking.

This hierarchical approach aims to help comprehensively consolidate progress across GHG inventory sectors and priorities by tracking not only the developments related to targets (e.g., sectoral GHG trends), but also the drivers influencing these developments (e.g., increased shares of renewables in power generation) as well as activities influencing these drivers (e.g., programmes supporting renewable energy use). These indicators have not been used to track progress of NDC in Lebanon's BTR1 however institutional arrangements are being put in place to allow a more efficient tracking in subsequent BTRs.

Table 11 presents the headline indicators for NDC priority mitigation sector. Adaptation indicators are presented in section 3.5 of this report. Supporting indicators are presented in Annex III.

Table 11 - Headline indicators to track the progress of Lebanon's NDC

#	Sector	Indicator	Unit
E.H1	Energy	Difference in emissions from energy generation compared to BAU	Gg CO_2eq. and %
E.H2	Energy	GHG emissions trend from energy generation since [2015]	Gg CO_2eq. and %
E.H3	Energy	Total emissions energy generation in year X	Gg CO_2eq.
E.H4	Energy	Share of renewables in generation in year X	%
E.H5	Energy	Difference in emissions in 1.A.1 energy industries compared to BAU	Gg CO_2eq.
E.H6	Energy	Emissions trend in power demand since [2015]	Gg CO_2eq.
E.H7	Energy	Difference in emissions from 1.A.2 Manufacturing Industries and Construction compared to BAU	Gg CO_2eq. and %
E.H8	Energy	GHG emissions trend in 1.A.2 Manufacturing Industries and Construction since [2015]	Gg CO_2eq. and %
E.H9	Energy	Total emissions 1.A.2 Manufacturing Industries and Construction in year X	Gg CO_2eq.
E.H10	Energy	Difference in emissions from 1.A.4 Other Sectors compared to BAU	Gg CO_2eq.
E.H11	Energy	GHG emissions trend in 1.A.4 Other Sectors since [2015]	Gg CO_2eq.
E.H12	Energy	Total emissions 1.A.4 Other Sectors in year X	Gg CO_2eq.
T.H1	Transport	Difference in emissions from 1.A.3 Transport compared to BAU	Gg CO_2eq. and %
T.H2	Transport	GHG emissions trend in 1.A.3 Transport since [2015]	Gg CO_2eq. and %

T.H3	Transport	Total emissions transport sector in year X	Gg CO_2eq.
Ag.H1	Agriculture	Difference in agricultural emissions compared to BAU	Gg CO_2eq. and %
Ag.H2	Agriculture	GHG emissions trend in agriculture since [2015]	Gg CO_2eq. and %
Ag.AP1	Agriculture	Agricultural production by key crop type	Tonnes
F.H1	Forestry	Difference in net land use emissions compared to BAU	Gg CO_2eq. and %
F.H2	Forestry	GHG emissions trend in net land use since [2015]	Gg CO_2 and %
F.AP2.H1	Forestry	Lebanon's forest cover in Year X	Hectares (ha) and %
F.AP2.H2	Forestry	Number of management plans for forest systems	#
F.AP2.H3	Forestry	Hectares of burned lands	Ha
W.H1	Waste	Difference in emissions from waste compared to BAU data	Gg CO_2eq. and %
W.H2	Waste	GHG emissions trend in waste since [2015]	Gg CO_2eq. and %
Wt.H1	Waste	Difference in emissions from wastewater compared to BAU data	Gg CO_2eq. and %
Wt.H2	Waste	GHG emissions trend in wastewater since [2015]	Gg CO_2eq. and %

2.4 Mitigation policies and measures, actions, and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

As part of the Paris Agreement requirement for Parties to undertake ambitious efforts as part of their NDC, Article 4 paragraph 2 requires parties to pursue domestic mitigation measures and provide necessary information to track progress of these measures. These include policies, plans or decision made by the government to achieve specific objectives, or actions or measures to reduce emissions with potential co-benefits.

In this section, Lebanon is quantitatively reporting actions, policies and measures only related to the energy sector, as these could be directly linked to the implementation and achievement of NDC targets, as presented in Table 12. Mitigation policies related to other sectors, such as transport, waste, and forestry, are presented qualitatively since emission reduction estimations or direct links to the NDC targets could not be established. These narratives highlight the progress and efforts in these sectors, while acknowledging the need for improved data collection and analysis to enable more comprehensive reporting in future submissions.

Due to time limitations and data unavailability, Lebanon is using the flexibility provision for not reporting emission reduction achieved or expected for some of the measures, as presented in section 5 of this BTR.

Table 12 - Mitigation policies and measures, actions and plans (CTF Table 5)

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2eq.)	
									2022 Achieved	2030 Expected
Energy-CEDRO-LHSP	The Lebanon Host Communities Support Program (LHSP) involves the installation of 10 commercial-scale solar PV systems with capacities ranging from 25 to 600 kWp each.	Improving PV supply and Biomass briquetting	Economic instrument	Implemented	Energy	CO_2	2019	UNDP	FX	FX
Energy-UNOPS-Japan	The installation of a solar photovoltaic (PV) system at the Rafik Hariri University Hospital aims to reduce electricity costs by approximately USD 160,000 annually.	Supplying continuous energy to the main public hospital in Beirut through renewable energy	Economic instrument	Implemented	Energy	CO_2	2022	UNOPS	FX	3.67
Energy-Private Sector-Qaa	This project involves installing solar photovoltaic (PV) pumping systems for irrigation in grape and fruit farms, providing a sustainable solution for water supply. By replacing diesel-powered pumps, the system saves 6,000 liters of diesel per day, significantly reducing fuel costs and carbon emissions while promoting environmental sustainability in agricultural practices.	Supplying energy for water pumping for irrigation.	Economic instrument	Implemented	Energy	CO_2	2022	Private Sector	FX	35.39
Energy-Private Sector-Teir Dibba	The project installed PV plant for water pumping.	Ensuring water availability for domestic use.	Economic instrument	Implemented	Energy	CO_2	2022	Private Sector	FX	0.96
Energy-CEDRO-SE4S	The project focuses on installing renewable energy solutions and enhancing energy efficiency at Lebanese Armed Forces (LAF) facilities	Increasing LAF personal comfort and security through various sustainable interventions.	Economic instrument	Implemented	Energy	CO_2	2019	UNDP	FX	10.51
Energy-CEDRO-V	The project focuses on advancing solar pilot initiatives, providing policy and startup support, and fostering innovative solutions to drive energy efficiency (EE) and renewable energy (RE) adoption.	Creating new value chains for biogas, solar and concentrated solar thermal technologies, industrial energy efficiency, and solar PV.	Economic instrument	Implemented	Energy	CO_2	2019	UNDP	FX	1.33
Energy-CEDRO-Post Blast Karantina	The project involves supporting affected households by providing 200 solar water heaters, 80 electric boilers, and 14 solar street lights, to improve access to hot water and sustainable energy	Supplying energy – efficient equipment to damaged houses.	Economic instrument	Implemented	Energy	CO_2	2021	UNDP	FX	FX
Energy-CEDRO-S4H	The project involves the installation of solar photovoltaic panels, solar water heaters LED lighting, and variable frequency drives at public hospitals to enhance energy efficiency and promote renewable energy use.	Improving access to healthcare and support healthcare facilities	Economic instrument	Implemented	Energy	CO_2	2021	UNDP	FX	29.69
Energy-CEDRO-Solarization of GT School	The Solarize Gebran Tueini School project involves installing a 41 kWp photovoltaic system with 80 kWh lithium-ion storage at the Gebran Tueini Public School in Karantina, Lebanon, to provide a reliable and sustainable electricity source for the school's operations.	Supplying energy through renewable sources	Economic instrument	Implemented	Energy	CO_2	2022	UNDP	FX	FX

Energy-CEDRO-Norway	The project involves installing photovoltaic systems at the Lebanese Agricultural Research Institute (LARI) in Tal Amara and selected public schools to enhance energy sustainability. Implementing PV systems in schools can lead to significant cost savings	Reducing tensions and ensuring critical services continue to operate given the extensive power cuts	Economic instrument	Implemented	Energy	CO_2	2022	UNDP	FX	FX
Energy-REESTART Project	The project conducts energy audits and implements energy efficiency measures while providing training for engineers to obtain ESCO (Energy Service Company) certifications.	Energy Audits and Energy Efficiency Implementation	Economic instrument	Implemented	Energy	CO_2	2019	ICU	FX	9.03
Energy-Japan Emergency Grant Aid to Lebanon	The project provided a full solar photovoltaic (PV) system to 122 public schools across Lebanon, funded by the Japanese Emergency Grant Aid. The systems, ranging from 6 kWp to 20 kWp, were installed in five regional lots, ensuring sustainable energy for the schools.	Improving and sustain access to energy for education	Economic instrument	Implemented	Energy	CO_2	2020	ECOSys	FX	12.42
Energy-NCA Solar Pumping Projects	Norwegian Church Aid (NCA) has implemented solar-powered water pumping projects in Lebanon, including the installation of a 137-kW solar water pumping system with a car spot structure in Koura, North Lebanon.	Providing solar PV plants to run water pumps	Economic instrument	Implemented	Energy	CO_2	2016	IOCC	FX	13.05
Energy-MoEW Financed Solar Projects	The Ministry of Energy and Water finances solar projects aimed at expanding renewable energy capacity and reducing reliance on traditional power sources.	Solarize public buildings as pilot projects	Economic instrument	Implemented	Energy	CO_2	2019	LCEC	FX	4.23

Mitigation policies and plans

Electricity sector:

Lebanon's energy sector plays a pivotal role in achieving the country's climate mitigation goals outlined in its NDC. Recognizing the sector's centrality to emission reductions, the Ministry of Energy and Water (MoEW) has emphasized that climate action must be integrated with comprehensive electricity sector reform. The key policies described below aim to modernize Lebanon's energy infrastructure, diversify its energy mix, and enhance financial sustainability, further highlighting the critical role of regulatory reforms in supporting a just and sustainable energy transition.

MoEW policy statement (2022) explicitly states that climate mitigation efforts in the energy sector go hand in hand with the reform of the electricity sector, which builds on the Least Cost Generation Plan (MoEW/EDL/WB, 2021), on Lebanon Power Sector Emergency Action Plan (World Bank, 2020) and on policy papers and plans previously approved by the Council of Ministers. The Policy statement includes the following activities:

- Increasing supply hours while preparing to increase generation capacity on the grid through electricity imports from Jordan and natural gas imports from Egypt and supplying gas to Zahrani and Deir Amar power plant through a floating storage and regasification unit (FSRU)
- Increasing generation by commissioning three new power plants, a nominal capacity of 825 MW each, with the participation of the private sector and the decommissioning of the old Zouk and Jieh power plants. In addition, it entails building renewable energy power plants using PPPs and ensuring a 15% share of the energy mix from renewable energy sources by the end of 2026, with the aim of reaching 30% by 2030.
- Improving performance of the network, reducing losses and enhancing collection through a comprehensive plan covering installation of smart meters and restoring illegal connections. The plan also entails transitioning to a new and advanced PPP model for the distribution sector.
- Achieving financial sustainability through implementing a new tariff, indexed to international oil price and USD exchange rate. The new tariff will take effect in a gradual manner once daily supply hours are increased to 8-10 hours while ensuring cost recovery.
- Addressing the regulatory and legislative frameworks including the recruitment process of the Electricity Regulatory Authority (ERA) commissioners.

However, the implementation of the policy paper is conditional to several factors internal and external factors such as securing the arrival of gas from Egypt and electricity from Jordan through Syria, efficient electricity bill collection, metering energy consumption of displaced Syrians and Palestinian refugees, provision of public and private finance for the investments and the commitment of all stakeholders to support the implementation of the plan.

Transport sector

Since 2019, no major mitigation measure has targeted the transport sector and lead to significant emission reductions from the sector. The majority of the government-lead projects have focused on roadway and parking construction which are not considered sustainable solutions for the state of transportation in Lebanon and are therefore not covered in this section. In addition, the progress toward implementing the National Transport Policy issued in 2014 has been slowed down, especially after the compounded crises that Lebanon has been facing since 2019 that has reshuffled the government's priorities.

A tax incentive scheme (2018-2024) has been issued by the Government in the budget Law 79/2018 (article 55) and renewed in the 2019-2024 budget laws, providing cuts on customs and registration fees for the purchase of hybrid and electric vehicles in Lebanon. This has created momentum in the market with the deployment of new lines of fuel-efficient vehicles across car importers. It has also increased the

interest of the public, academic and private sector to explore research investment opportunities in the infrastructure for electric mobility. Since no disaggregated data is available on the increase penetration rate of hybrid and electric car in the Lebanese market as a result of this measure, no emission reduction was estimated from the implementation of this financial measure.

Forestry sector

Lebanon's forests play a critical role in the country's climate action efforts, contributing to both mitigation and adaptation goals under its NDC. Since 2019, Lebanon has implemented a series of strategic programs aimed at enhancing forest management, promoting reforestation, and mitigating wildfire risks, further demonstrating the country's commitment to sustainable land use and climate resilience.

The National Forest Program (2015–2025) provides a comprehensive framework for the development of the forestry sector, aligning national goals with international agreements, modernizing existing forestry laws, and outlining Lebanon's long-term vision for forest and rangeland management. It emphasizes active community participation, engaging local stakeholders in forest conservation while integrating scientific and traditional knowledge (MoA, 2015).

The National Afforestation and Reforestation Program (2014-2018) is a cornerstone of Lebanon's forest sector strategy, implementing the ambitious "40 Million Trees Campaign." The programme which is still ongoing, strengthens cross-sector collaboration to promote sustainable land-use planning and contributes significantly to Lebanon's climate goals by enhancing forest cover and carbon sequestration.

In response to the increasing frequency and severity of wildfires, Lebanon developed **the National Forest Fire Management Strategy** in 2009, which was updated in 2023 (MoE, 2023a). Successful implementation of the strategy relies on the establishment of an interagency coordination among the Ministry of Agriculture, Ministry of Environment, and Disaster Risk Management Unit at the Prime Minister's Office, developing a centralized system for fire data collection and management and developing adequate funding to secure appropriate national budget allocations for effective implementation.

Lebanon's reforestation and wildfire prevention efforts play a crucial role in achieving its NDC targets by sequestering atmospheric carbon and avoiding emissions. Between 2019 and 2022, reduced forest fires and reforestation efforts increased the carbon removal capacity of forests, contributing a cumulative -30.705 Gg of CO_2eq. (Figure 6). This demonstrates a consistent annual increase in carbon sequestration, highlighting the importance of well-managed reforestation in meeting NDC goals.

In addition to reforestation, Lebanon's avoided emissions in 2022 amount to 220.86 Gg of CO_2eq. as a result of implementing coordinated and successful forest fire mitigation measures. This one-time reduction helps to decrease overall emissions and should be seen as complementary to ongoing efforts such as reforestation that have annual benefits.

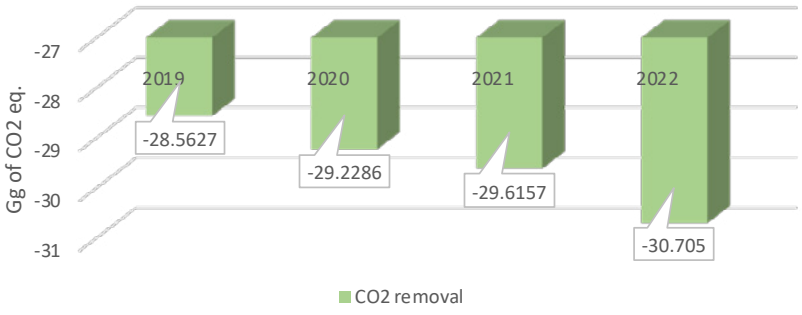


Figure 6: Cumulative GHG removal from re-afforestation

Waste sector

Effective waste management also contributes to Lebanon's climate mitigation efforts, particularly in reducing methane emissions from solid waste. While challenges remain, recent advancements in solid waste management policies signal important steps toward improving the sector's sustainability and aligning it with the NDC. The key developments presented below reflect the potential to significantly reduce GHG emissions, enhance resource efficiency, and contribute to a more sustainable and climate-resilient waste management system.

- The Solid Waste Management (SWM) Law 80 was issued in 2018, constituting the new backbone of the legal framework for the sector.
- The National SWM Authority (as per article 13 of law 80/2018) was approved by the Council of Ministers (CoM) (decision No 28 dated 12/01/2024) but still needs the appointment of its members to make it operational.
- The Cost recovery draft law (decree No 12526 dated 2/11/2023): A draft law was approved by the CoM as per the decree 12526 and sent to Parliament for endorsement. This is a very critical law that will allow to resolve one of the main weaknesses of the sector, namely the ability to provide sustainable financing of SWM solutions, on a national and subnational levels.
- The National SWM strategy (MoE, 2023b): The strategy document is being finalized and awaits final approval by the CoM. The strategy will put in place several strategic and realistic objectives which the government will aim to achieve in the short, medium and long term.

The Cost Recovery Law and the National SWM Strategy are urgently required in order to allow the implementation of the required reforms of the sector. These two regulations will organize the sector from the institutional and financial aspects where the authority will be responsible for controlling and monitoring SWM facilities. As for the municipalities, they will be able to sustainably finance the private sector for SWM services, allowing the government to take the sector to another level where many open dumps will be closed. In addition, these regulations will incentivize the private sector to invest and to upgrade the quality of the operation and maintenance of the sector.

In addition, Lebanon was divided into 17 service areas where local and regional master plans are under preparation at the moment by different international agencies as support to the MoE. These master plans will pave the road for the implementation plans in each service area once the necessary legal and institutional documents are issued.

2.5 Summary of greenhouse gas emissions and removals

The summary of greenhouse gas emissions and removals has been included in CTF table 6 on the UNFCCC ETF platform, as presented in Table 13.

Table 13 - Summary of greenhouse gas emissions and removals in accordance with the common reporting table 10 emission trends – summary (CTF Table 6)

GREENHOUSE GAS EMISSIONS AND REMOVALS	Reference year/period for NDC	2011	2020	2021	2022	Change from reference Year to latest reported year
	CO2 equivalents (kt)					(%)
CO_2 emissions without net CO_2 from LULUCF	20,384.51	20,384.51	21,043.45	17,211.87	16,528.85	-18.91
CO_2 emissions with net CO_2 from LULUCF	17,325.84	17,325.84	18,121.12	14,174.65	13,277.67	-23.36
CH_4 emissions without CH_4 from LULUCF	1,351.46	1,351.46	1,847.02	1,788.68	1,788.96	32.37
CH_4 emissions with CH_4 from LULUCF	1,351.92	1,351.92	1,850.34	1,791.76	1,789.27	32.35

N_2O emissions without N_2O from LULUCF	556.58	556.58	585.21	535.70	544.70	-2.14
N_2O emissions with N_2O from LULUCF	556.84	556.84	586.95	537.32	544.86	-2.15
HFCs	1,100.97	1,100.97	1,830.81	1,716.35	1,656.53	50.46
PFCs	FX	FX	FX	FX	FX	-
Unspecified mix of HFCs and PFCs	FX	FX	FX	FX	FX	-
SF_6	FX	FX	FX	FX	FX	-
NF_3	FX	FX	FX	FX	FX	-
Total (without LULUCF)	23,393.53	23,393.53	25,306.48	21,252.60	20,519.04	-12.29
Total (with LULUCF)	20,335.57	20,335.57	22,389.22	18,220.07	17,268.33	-15.08
Total (without LULUCF, with indirect)	23,393.53	23,393.53	25,306.48	21,252.60	20,519.04	-12.29
Total (with LULUCF, with indirect)	20,335.57	20,335.57	22,389.22	18,220.07	17,268.33	-15.08
1. Energy	17,955.25	17,955.25	20,346.81	16,314.69	15,809.96	-11.95
2. Industrial processes and product use	3,685.63	3,685.63	2,715.80	2,796.22	2,584.30	-29.88
3. Agriculture	678.23	678.23	855.38	793.24	777.23	14.60
4. Land use, land-use change and forestry	-3,057.95	-3,057.95	-2,917.26	-3,032.52	-3,250.71	6.30
5. Waste	1,074.42	1,074.42	1,388.49	1,348.44	1,347.54	25.42
6. Other	FX,NE	FX,NE	FX,NE	FX,NE	FX,NE	–
Total (with LULUCF)	**20,335.57**	**20,335.57**	**22,389.22**	**18,220.07**	**17,268.33**	**-15.08**

2.6 Projections of greenhouse gas emissions and removals, as applicable

In its NDC target of 2030, Lebanon has used projections using 2011 as a base year to 2030 as a reference in setting the baseline of its targets to 2030, that is, its commitment to reduce emissions related to a projected baseline emissions scenario known as Business-As-Usual scenario. However, given national circumstances and capacities, Lebanon is applying flexibility provision in not reporting GHG emissions projections under BTR1, in line with para 92 of 18/CMA1. Therefore, Lebanon is not reporting in in its first BTR projections “with measures” of all GHG emissions and removals (para 94), starting the most recent year in the national inventory (2022) and extending at least 15 years beyond the next year ending in zero or five (para 95), and is not including information related to methodology used to develop projections (para 96) and key indicators (para 97).

3. Information related to climate change impacts and adaptation under Article 7 of the Paris Agreement

This section constitutes Lebanon's adaptation communication as a component of the BTR1, providing comprehensive information on climate change impacts, vulnerabilities, and the adaptation measures being implemented to enhance resilience.

3.1 National circumstances and institutional arrangements

Lebanon is located in the Eastern Mediterranean basin, covering an area of 10,452 km^2, home to 5.48 million people as of 2022, with women accounting for 51.5% of the population. Its diverse geography, comprising coastal plains, the Lebanon and Anti-Lebanon mountain ranges, and the Beqaa Valley, creates distinct climatic zones that necessitate tailored approaches to managing environmental challenges, particularly in water resources and agriculture. These varied landscapes are vital to Lebanon's economic and social systems.

The country's Mediterranean climate is characterized by hot, dry summers and cool, wet winters. Coastal areas experience summer temperatures exceeding 35°C, while inland regions, like the Beqaa Valley, endure harsher extremes due to the rain shadow effect of the mountains. Annual rainfall ranges from 700 to 1,000 mm, primarily between November and March, though precipitation patterns are becoming increasingly erratic. Prolonged droughts, irregular rainfall, and higher temperatures are compounding challenges for agriculture, water availability, and ecosystem resilience (MoE/UNDP/GEF, 2022).

Climate change is amplifying these vulnerabilities. Sea levels are projected to rise by 37–90 cm by the end of the century, threatening urban centers like Beirut, Tyre, and Tripoli with flooding, erosion, and seawater intrusion into aquifers. In mountainous regions, snowmelts are becoming less predictable, jeopardizing seasonal water supply and impacting winter tourism. The frequency and intensity of extreme weather events such as heatwaves, floods, and wildfires are also on the rise. In 2021 alone, Lebanon experienced over 1,000 wildfire incidents, compared to just 343 in 2019, causing significant damage to ecosystems and threatening livelihoods (MoE/UNDP/GEF, 2022).

Socio-economic context and climate adaptation

Lebanon's economic collapse has significantly heightened the country's vulnerability to climate change and diminished its adaptive capacity. Between 2018 and 2023, Lebanon's GDP plummeted by 68% representing one of the most severe non-conflict-related economic contractions globally. This collapse has led to hyperinflation and a devalued currency, pushing over 80% of the population into multidimensional poverty. These economic challenges has limited the resources available for climate adaptation, reducing Lebanon's ability to invest in sustainable infrastructure, climate-resilient technologies, and adaptive social systems.

The deterioration of critical infrastructure, including water supply, electricity, and waste management systems, further amplified climate risks. Decades of underinvestment, compounded by increased demand, have weakened the country's resilience to climate-related impacts such as extreme weather events, water scarcity, and public health crises. Additionally, the presence of approximately 1.5 million Syrian

refugees—28% of Lebanon's population—has placed immense pressure on public services, exacerbating competition for resources and intensifying social tensions. This fragile context underscores the urgent need for equitable, inclusive, and sustainable adaptation strategies to mitigate the compound effects of economic and climate crises.

Despite these difficulties, Lebanon has taken steps to enhance resilience. The Daem platform supported approximately 60% of households by providing adaptive social protection during economic and environmental shocks. Additionally, a new agricultural registry has been established aiming to improve farmers' access to resources and services, fostering agricultural resilience. However, these measures remain limited in scope and effectiveness, constrained by financial and institutional capacity challenges (MoE/UNDP, 2025)

Institutional arrangements and legal frameworks

Lebanon's commitments to addressing climate change are reflected in Lebanon's updated Nationally Determined Contribution (NDC), which emphasizes adaptation priorities in agriculture, water management, energy, and health. The Ministry of Environment leads Lebanon's climate change agenda, coordinating National Communications and Biennial Update Reports while overseeing adaptation planning. However, the country lacks a comprehensive national adaptation policy, limiting the integration of adaptation measures into broader development strategies.

Existing legal frameworks in Lebanon provide a foundation for climate action but expose significant gaps that hinder effective implementation. While Lebanon's updated NDC prioritizes key adaptation areas, progress remains constrained by fragmented governance structures, insufficient inter-ministerial coordination, and limited financial resources. The lack of integrated approaches often results in ministries operating in silos, leading to inefficiencies, overlapping responsibilities, and missed opportunities for cohesive action.

The NDC Committee in Lebanon, chaired by the Minister of Environment is responsible for overseeing the implementation of the country's Nationally Determined Contributions (NDCs) including its adaptation components. Its mandate includes integrating climate change into national and local policies, setting targets, coordinating actions to build resilience, ensuring inter-ministerial collaboration, and reporting progress to national and international stakeholders. The committee aims to streamline efforts, reduce governance fragmentation, and align climate actions with Lebanon's development and international commitments.

The Ministry of Environment, as the principal leading agency of the government on national climate change actions, and delivery of operational coordination, shall report to the Council of Ministers through the NDC committee the progress of NDC implementation. Among the specific duties are to set targets and coordinate actions for building resilience to climate change and enhancing adaptive capacity.

Development of Lebanon's National Adaptation Strategy and National Adaptation Plan

Lebanon's National Adaptation Strategy (NAS) and National Adaptation Plan (NAP), currently under development under the GCF NAP readiness project, represent a critical opportunity towards developing an adaptation framework which would better guide the implementation of adaptation action nationally. The NAS aims to establish a clear governance structure for adaptation, improve coordination across sectors, and align national efforts with Lebanon's international commitments under the Paris Agreement. Strategic priorities include enhancing data collection systems, defining sector-specific adaptation goals, and fostering community resilience, particularly in vulnerable regions and among marginalized groups, such as refugees.

The NAP is expected to translate the NAS into actionable measures. This includes implementing region-specific adaptation projects, promoting ecosystem-based solutions, and developing infrastructure resilient to climate risks. Together, these frameworks aim to create a comprehensive roadmap for building Lebanon's capacity to adapt to climate change while supporting sustainable development.

The implementation of Lebanon's National Adaptation Plan (NAP) will necessitate establishing a conducive enabling environment to support its rollout. This includes transitional arrangements to leverage the expertise and institutional knowledge accumulated by current coordinating bodies. The successful implementation of the NAP will require collaborative contributions from stakeholders across various sectors and levels of governance.

Figure 7 reflects Lebanon's updated NDC adaptation priorities highlighting sectoral actions and the responsible ministries, reflecting the collaborative framework necessary for implementing the National Adaptation Strategy (NAS) and National Adaptation Plan (NAP).

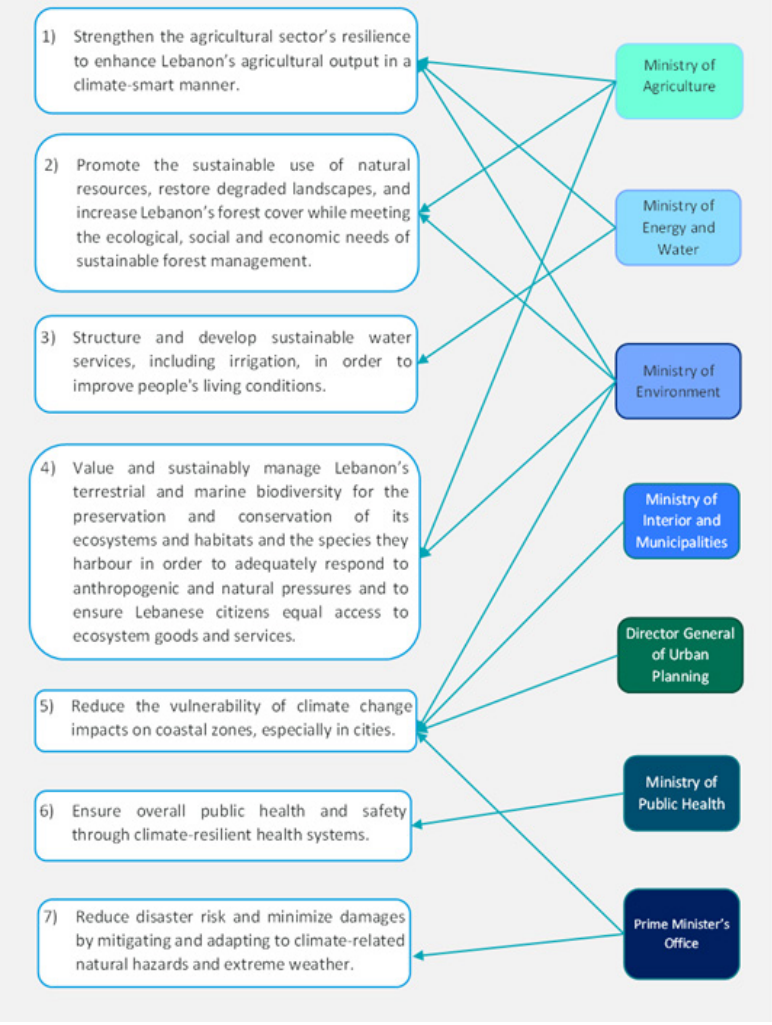


Figure 7: Key governmental stakeholders per adaptation priority reflected in Lebanon's NDC

In addition, the Capacity-Building Initiative for Transparency (CBIT) project in Lebanon has played a critical role in establishing institutional structures to support climate transparency efforts, with a focus on both mitigation and adaptation. The project identified institutional gaps, based on which, task forces were formed, and their roles were clearly defined, each dedicated to specific sectors such as agriculture, water,

health, and disaster risk reduction. These task forces were designed to address gaps in data collection, coordination, and reporting under the Enhanced Transparency Framework (ETF) requirements of the Paris Agreement. The process involved extensive stakeholder consultations, drawing expertise from ministries, agencies, NGOs, and academic institutions to ensure broad representation and technical capacity. For example, the agriculture task force collects data on greenhouse gas emissions related to farming while also tracking progress on adaptation priorities like resilient agriculture. This integrated approach ensures a holistic evaluation of climate action.

Through CBIT, Lebanon also established a transparency baseline by developing indicators to monitor adaptation and mitigation actions, tracking the progress of its NDC implementation efforts. These indicators were prioritized based on their relevance to NDC commitments and data availability. The project introduced mechanisms for data validation, including peer reviews within task forces, to ensure accuracy and reliability. This structure has enabled Lebanon to meet its ETF reporting requirements more effectively while creating a foundation for continuous improvement in climate governance. More details is included in section 3.5 of this BTR.

Climate finance for adaptation and institutional challenges

Financing adaptation efforts remains a significant challenge for Lebanon. Hyperinflation, fiscal instability, and the collapse of the banking sector have severely constrained domestic funding. The country relies heavily on international climate finance, with multilateral institutions like the Global Environment Facility (GEF), the Green Climate Fund (GCF) and the Adaptation Fund (AF) playing key roles.

The Ministry of Environment, as Lebanon's National Designated Authority to the GCF and the AF and the focal point of GEF, has facilitated access to key funding streams. The GCF Readiness Projects, strengthened Lebanon's institutional arrangements, developed a No Objection Procedure for project approvals and are establishing the NAP framework. Additionally, technical assistance from the NDC Partnership has helped in accelerating the implementation of adaptation measures. However, political instability, high borrowing costs, and unimplemented reforms continue to restrict Lebanon's access to multilateral funding.

Institutional fragmentation further complicates climate finance management. Weak coordination among ministries and the absence of a unified tracking system reduces transparency and hinder Lebanon's ability to align funding with national priorities. Addressing these challenges will require comprehensive reforms, including the establishment of a centralized climate fund and capacity-building initiatives to improve governance and financial management.

3.2 Impacts, risks, and vulnerabilities, as appropriate

3.2.1 Current climate trends and impacts for Lebanon

Lebanon's Mediterranean climate, with its hot, dry summers and cool, rainy winters, has experienced profound disruptions due to climate change. Historically, the country's average annual temperature was 15°C, with most rainfall concentrated from November to March. However, rising temperatures, declining precipitation, and increasing frequency of extreme weather events are clear indicators of a shifting climate. Between 1950 and 2020, Lebanon's mean annual temperature rose by 1.6°C, with sharper increases observed in recent decades, particularly from 1991 to 2020. Summers have become hotter and longer, with temperatures frequently exceeding 40°C, intensifying heat stress in urban areas and heightening energy demands (MoE/UNDP/GEF, 2022).

Box 2: Climate Change Trends in Lebanon (1950-2020)

Temperature Rise

- Annual mean temperature increased by 1.6°C (1950-2020)
- Faster warming in 1991-2020; coastal areas warmed slower due to sea breezes

Precipitation Decline

- Decrease of 0.53 mm/decade (1950-2020), reduced to 0.35 mm/decade (1990-2020)
- Annual precipitation fluctuated between <500 mm (e.g., 1960-61, 2010) and ~900 mm (e.g., 1968-70, 2004)

Dry Days

- South-to-north gradient of Consecutive Dry Days (CDD); southern Lebanon experiences significantly more CDDs

Extreme Events

- Flood incidents tripled in 2015

Source: MoE/UNDP/GEF, 2022

Precipitation patterns have also changed dramatically, with annual rainfall showing a declining trend since 1950. This decline is uneven across the country, reflecting spatial variability from the relatively moist coastal plains to the arid mountain regions. Seasonal irregularities are also evident, with prolonged dry periods interspersed by erratic heavy rainfall during winter months. Such shifts have strained water resources, disrupted snowmelt patterns, and exacerbated water scarcity, which is critical for agriculture and rural livelihoods. For example, the period from 2010 to 2020 saw irregular precipitation surpluses in winter but also notable droughts during spring and summer, further destabilizing the agricultural sector.

The impacts of these climatic shifts are compounded by the country's socio-economic and political challenges. The ongoing economic crisis, combined with the destruction caused by the 2020 Beirut Port explosion and the strain of the COVID-19 pandemic, has left Lebanon with limited capacity to respond to environmental crises. Political gridlock and delayed reforms further hinder effective climate adaptation and mitigation measures. Hostilities in vulnerable regions have disrupted agricultural production and damaged critical infrastructure, deepening the socio-economic crisis.

Lebanon's climate-related hazards

Lebanon's vulnerability to climate change is compounded by its exposure to a wide range of natural and technological hazards. Over recent decades, recurrent climate-related disasters, such as floods, droughts, wildfires, and extreme temperatures, have inflicted substantial socio-economic and environmental costs. Between 1955 and 2023, Lebanon experienced 26 major disasters, affecting over 5.4 million people and resulting in significant human and economic losses. The heatwaves of 2007 and 2010 caused temperatures to spike above 40°C for extended periods, leading to widespread forest fires and agricultural losses. Severe flooding events, such as those in 2009 and 2019, caused significant damage to infrastructure and displaced communities, while snowstorms and heavy rains in 2018 brought further destruction, including landslides and road closures. These events highlight Lebanon's growing vulnerability to climate extremes (MoE/UNDP/GEF, 2022).

The impacts of these disasters vary geographically. Coastal regions, including Beirut, Saida, and Tripoli, are particularly susceptible to flooding, coastal erosion, and seawater intrusion, while inland regions like

the Bekaa Valley and Baalbek-Hermel face increased drought severity and flash floods. Mount Lebanon and Akkar are at heightened risk of wildfires due to warming, drying, and more frequent heatwaves. The frequency of extreme weather events, such as intense storms and floods, is projected to rise, with flash flooding expected to increase in urban and low-lying coastal areas due to reduced soil infiltration and more intense rainfall events.

Hydrometeorological hazards are the most common disaster types in Lebanon, often affecting critical regions such as Beirut, Bekaa, and Mount Lebanon. Recent records show a significant increase in the occurrence of wildfires, rising from 343 events in 2019 to over 1,000 in 2021, exacerbated by prolonged droughts and mismanagement of natural resources. These disasters have had cascading effects, including displacement, loss of livelihoods, and damage to critical infrastructure, further straining Lebanon's fragile socio-economic context.

Table 14 provides a detailed overview of major disasters recorded in Lebanon between 1955-2024, highlighting their periods, affected locations, and impacts, as documented on the EM-DAT platform. The Emergency Events Database (EM-DAT) is a global disaster database that records human and economic losses at the country level for disasters that meet at least one of the following criteria: 10 fatalities, 100 affected people, a declaration of a state of emergency, or a call for international assistance (EM-DAT, 2024).

Table 14 - Profile of climatic and non-climatic disasters in Lebanon, 1955-2024

Disaster Type	Location	Year	Total Deaths	No. Injured	No. Affected	Total Affected
1. Extreme temperature	Bekaa, Mount Lebanon, North, South	2024			2,975,000	2,975,000
2. Extreme temperature	Bekaa Valley, Beirut, Mount Lebanon	2023			1,024,200	1,024,200
3. Epidemic	Akkar Governorate	2022		803		803
4. Explosion (Industrial)	Akkar region	2021	32	80		80
5. Wildfire	Chouf, Akkar regions	2020				
6. Explosion (Industrial)	Beirut	2020	206	6,000		306,000
7. Storm	Spears, Gemmayzeh (Beirut); Jbeil, Jounieh, Antelias, Chouf (Mount Lebanon); Halba, Tripoli (North); Saida, Nabatiyeh, Tyre (South); Zahleh, Rashaya (Bekaa)	2019	3	9	11,000	11,009
8. Storm	Near Masnaa	2018	15			
9. Storm	Saida, Sour districts (South province), Tripoli, Akkar districts (North province)	2015	2		1,000,000	1,000,000
10. Storm	Beirut, Bekaa, Mount Lebanon, Nabatiyeh, North, South provinces	2015			942	942
11. Storm	Baalbek, Temnine towns (Baalbek district, Bekaa province)	2015	3	750		750
12. Air	Beirut	2010	90			
13. Water	Banyas, Jabli, Lattakia	2009	44		39	39
14. Wildfire	Bekaa, Mount Lebanon, North provinces	2007	1	15		15
15. Flood	Baalbek,, Hermel, West Bekaa, Zahleh districts (Bekaa province), Akkar district (North province)	2003			17,000	17,000
16. Fire (Industrial)	Brummana	2003	14			
17. Road	Masnaa (Lebanon - Syria border)	2003	14	15		15
18. Road	Qalmoun	2003	10	13		13
19. Storm	Beirut, Bekaa, Mount Lebanon, Nabatiyeh, North, South provinces	2002			500	500
20. Collapse (Miscellaneous)	Naamé (near Beirut)	2000	10	27		27
21. Storm	South Bekaa and South Lebanon	1992	25	75	100,000	104,075
22. Fire (Miscellaneous)	Beirut	1990	45			

23. Flood	Northern Bekaa Region	1987			1,500	1,500
24. Mass movement (dry)	Bekaa valley	1983	20			
25. Earthquake	Bekaa, Litani	1956	136	200		200
26. Flood		1955	440			
Total			**1,110**	**7,987**	**5,129,681**	**5,441,668**

Source: EM-DAT Platform - EM-DAT, 2024

Lebanon's disaster preparedness and adaptation capacity remain insufficient to address the growing risks. According to the 2024 ND-GAIN Country Index (ND-GAIN, 2024), Lebanon is ranked as the 108th most vulnerable country to climate change, with a vulnerability score of 0.402. While Lebanon's readiness score has improved slightly, moving from 158th to 156th out of 187 countries, it remains one of the least prepared nations for adapting to climate impacts. Enhancing Lebanon's resilience requires urgent investments in infrastructure, policy reforms, and resource management to mitigate the escalating impacts of climate change and disasters.

The intersection of rising climate risks, socio-economic instability, and limited readiness underscores the urgency of implementing robust mitigation and adaptation strategies. Lebanon's position in the ND-GAIN Index highlights a critical need to prioritize climate resilience across sectors, focusing on water management, agricultural sustainability, and urban infrastructure to safeguard communities and ecosystems against future climate shocks.

3.2.2 Projected Impacts

Temperature Projections

Based on the RICCAR projections for the Mashreq Area (ESCWA, 2024), this section examines the projected impacts of climate change in Lebanon using the SSP2-4.5 (intermediate scenario) and SSP5-8.5 (fossil-fueled development) scenarios , focusing on annual changes in temperature, precipitation, and hydrological indicators for the periods 2021–2040 and 2041–2060, compared to the 1995-2014 reference period.

Annual Mean Temperature

As presented in in Figure 8, the increase in temperature compared to 1995-2014 is more pronounced for the mid-term period (2041-2060), especially under the SSP5-8.5 scenario, where warming exceeds 2.1°C in the Lebanese mountainous areas. Coastal areas and inland plains are projected to experience more modest temperature increases, ranging from 1.8 to 2.0 °C by 2060 under SSP5-8.5. Mountainous regions show relatively lower increases, highlighting their role as temperature buffers. These changes have significant implications for biodiversity, water resources, and human health.

As for seasonal changes, winter temperatures show increases of 1.8–2.7°C by the mid-term period under SSP5-8.5, with higher values in the mountainous regions. These shifts may lead to reduced snow accumulation and earlier snowmelt, impacting water resources and winter tourism. In addition, summer shows increase of up to 1.7-2.3°C under SSP5-8.5 by 2041–2060. Inland areas are particularly vulnerable, with extended heatwaves expected to stress water resources and increase energy demand for cooling.

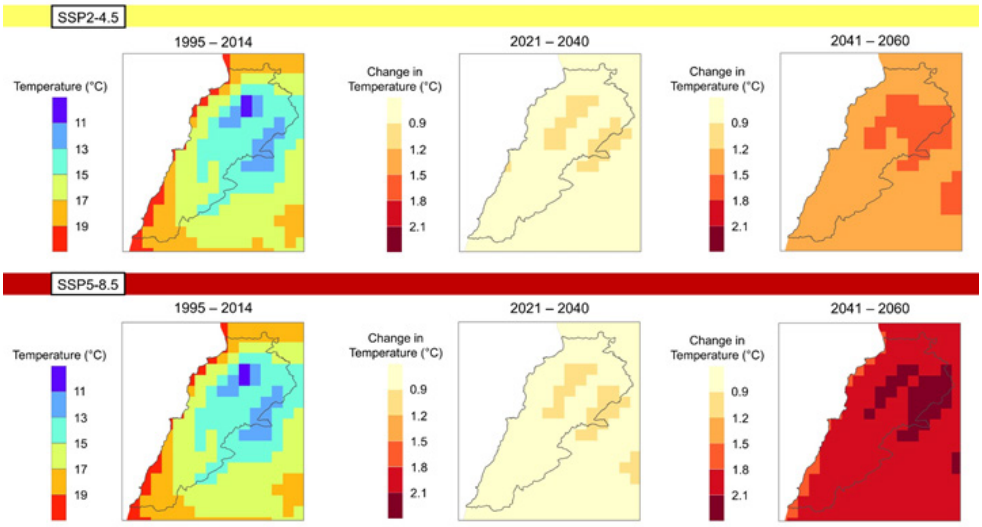


Figure 8: Change in Annual Mean Temperature projections from 2021-2040 and 2041-2060 compared to 1995-2014 (ESCWA, 2024)

Extreme Heat Events:

Very Hot Days (SU40): In Figure 9, the annual frequency of days exceeding 40°C is shown. Under SSP5-8.5, the number of very hot days is projected to increase to approximately 1-1.5 days annually by mid-century (2041–2060), with further increases toward the end of the century. This trend highlights growing risks of heat-related challenges for health and agriculture, particularly in vulnerable regions like southern and eastern Lebanon.

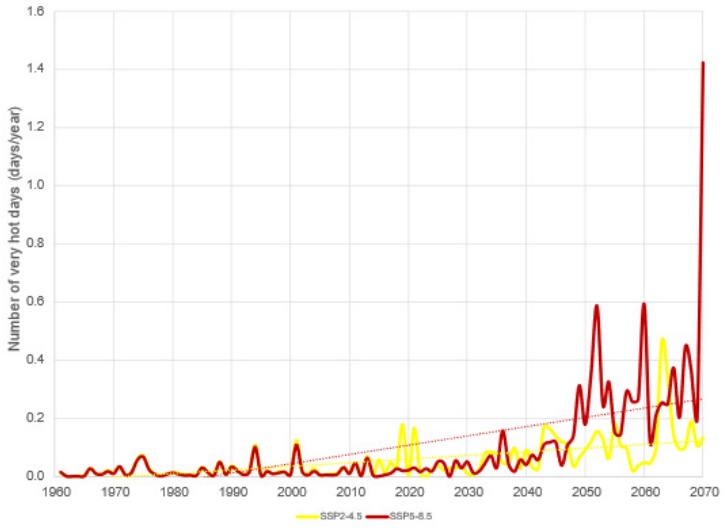


Figure 9: Change in Annual frequency of days exceeding 40°C (SU40) projections from 2021-2040 and 2041-2060 compared to 1995-2014 (ESCWA, 2024)

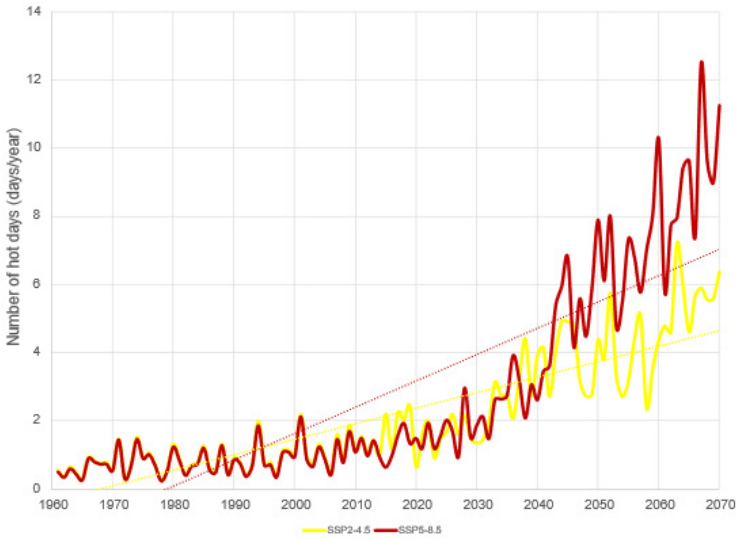


Figure 10: Change in Annual frequency of days exceeding 35°C (SU35) projections from 2021-2040 and 2041-2060 compared to 1995-2014 (ESCWA, 2024)

Hot Days (SU35): Figure 10 shows an increasing trend in the number of days exceeding 35°C under both SSP2-4.5 and SSP5-8.5 scenarios. The SSP5-8.5 scenario projects a sharper rise, with up to 12–13 additional hot days annually by mid-century. These trends underscore the importance of urban cooling strategies, such as increasing vegetation cover and promoting energy-efficient infrastructure.

Annual Precipitation:

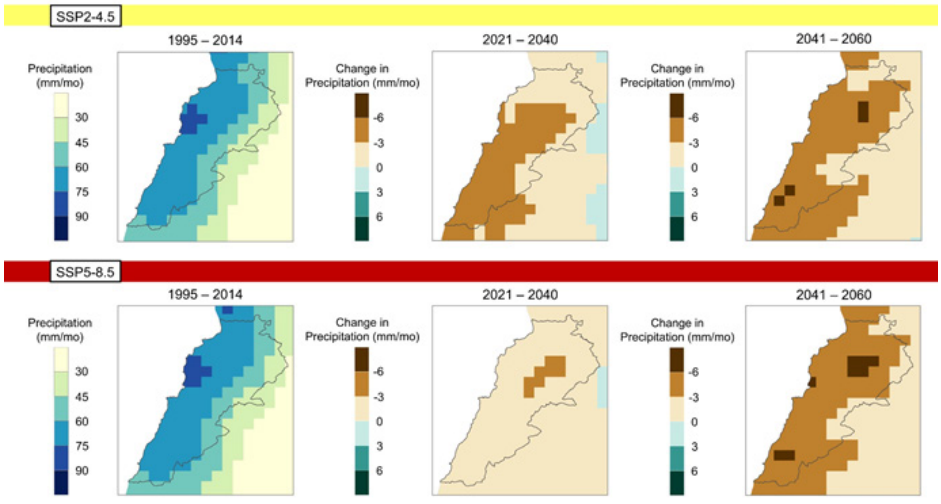


Figure 11: Change in Annual Mean precipitation projections from 2021-2040 and 2041-2060 compared to 1995-2014 (ESCWA, 2024)

As presented in Figure 11, the analysis of projected precipitation reveals a clear and concerning trend of generally declining precipitation across the country, with the severity of reductions varying by emissions scenario and geographic region. Under the SSP2-4.5 scenario, precipitation reductions range from 0.7 to 6.4 mm/month by the mid-term period, intensifying water stress in already vulnerable regions. More extensively, SSP5-8.5 projects sharper declines of 1.5 to 7.1 mm/month, particularly in southern and inland areas, exacerbating drought conditions and water scarcity. While northern Lebanon retains comparatively

higher precipitation levels, reductions are still significant under SSP5-8.5, highlighting widespread impacts. Temporal trends show more pronounced declines by 2041–2060, particularly under SSP5-8.5, with reductions of up to 6 mm per month in precipitation in certain areas, threatening groundwater recharge, river flows, and agricultural productivity. These changes will compound existing challenges in water management, irrigation inefficiencies, and over-reliance on groundwater, heightening socio-economic pressures and regional disparities across Lebanon.

Winter, Lebanon's wettest season, is projected to experience a 3–14% decrease in precipitation by 2041–2060 under the SSP5-8.5 scenario, with northern and eastern regions showing greater decreases. This reduction is particularly alarming given that winter precipitation (including snowfall) is vital for recharging aquifers, sustaining river flows, and supporting agricultural activities during the dry season. Opposingly, summer is projected to see an increase in precipitation of up to 1.6 mm/month by 2041–2060 in the mountains but a decrease of 0.8 mm/month along the coast. However, these annual increases are modest, while annual precipitation is generally decreasing.

Due to rising temperatures, evapotranspiration will also increase and any increase in precipitation will likely evaporate. This shift in the hydrological cycle is particularly significant given the already limited water availability during summer, heightening risks for groundwater recharge, irrigation, and water supply systems. These changes suggest a growing need for adaptation measures to mitigate the impacts of reduced summer rainfall on agriculture and water resources.

Spring precipitation, essential for crop planting and early growth, is projected to decrease by up to 12.1 mm/month in northern and inland regions under SSP5-8.5 by mid-century. This decline jeopardizes soil moisture levels critical for germination and early-stage crop development. Similarly, autumn precipitation, which plays a key role in replenishing soil moisture after the dry summer months, projects a decline up to 5.1 mm/month for the same time period and scenario. These seasonal decreases exacerbate the challenges for agriculture, increasing irrigation demands and heightening competition for water resources.

Under SSP2-4.5, notable changes still occur, indicating that even moderate emissions scenarios will result in significant challenges to water availability during these critical agricultural periods. Regional variability is evident, with southern and inland regions, already characterized by heightened vulnerability to drought, projected to experience the most substantial impacts. These projections underscore the need for adaptive measures, including enhanced irrigation systems, drought-resistant crop varieties, and improved water management strategies, to mitigate the adverse impacts on agricultural productivity and rural livelihoods.

In terms of precipitation intensity, heavy precipitation days (R20) are projected to decrease by up to by 2041–2060 under the SSP5-8.5 scenario (Figure 12). While fewer very heavy precipitation events may reduce the total volume of precipitation available for storage, these changes also increase the likelihood of short duration but intense rainfall events. Such events, though less frequent, can lead to flash floods and exacerbate soil erosion, especially in areas with steep topography or degraded vegetation. Under SSP2-4.5, the declines are less severe but remain significant, underscoring the need for adaptive water management and flood mitigation strategies to address these evolving risks.

However, rainfall intensity (SDII) records slight changes under both scenarios with some areas projecting marginal increase and other areas signaling a small drop (Figure 13). Increasing rainfall intensity limits soil infiltration, worsening runoff and increasing erosion risks. A reduction poses challenges for effective water infiltration into the soil, as lower intensity rainfall reduces the rate at which water permeates the ground, limiting aquifer recharge and increasing surface runoff. The maps indicate spatial variability, with increasing intensity more likely in the mountainous region, giving rise due to flood and erosion risk due to the terrain.

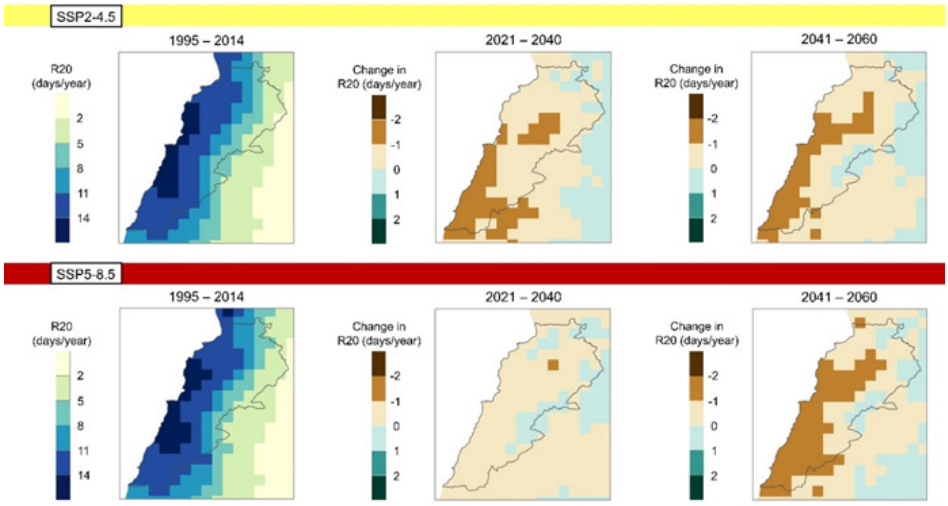


Figure 12: Annual Mean Very Heavy Precipitation Days (R20) projections from 2021-2040 and 2041 2060 (ESCWA, 2024)

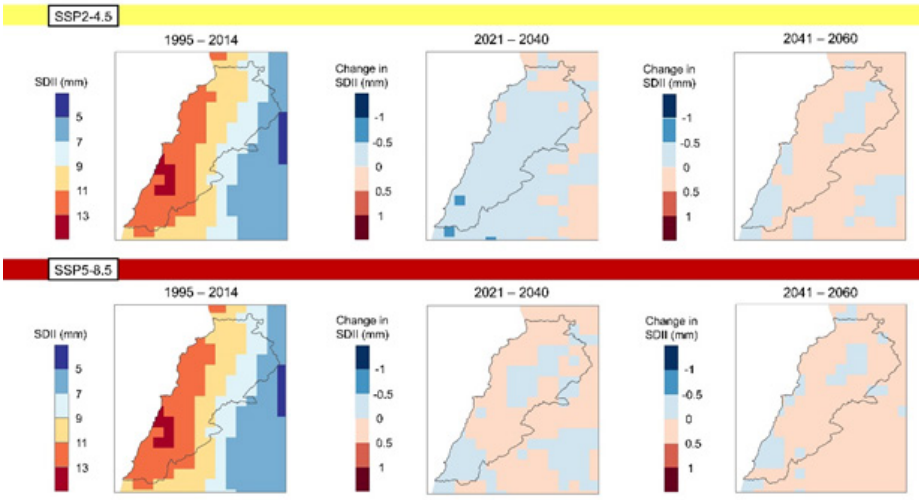


Figure 13: Rainfall Intensity (SDII) projections from 2021-2040 and 2041-2060 (ESCWA, 2024)

Hydrological Impacts

Runoff, a critical component of the hydrological cycle, is projected to decline by up to 16.3 mm/month by 2041–2060 under both scenarios, particularly in mountainous areas (Figure 14). This decrease is largely attributed to diminished winter snowfall. These reductions are critical, as runoff contributes to surface water availability, directly supporting agriculture, hydropower, and drinking water supplies.

Regional variability further underscores the challenge, exacerbating water scarcity. Reduced runoff also compromises groundwater recharge, increasing reliance on over-extracted aquifers. The findings emphasize the urgency of implementing sustainable water management practices, including enhanced watershed management and improved storage infrastructure, to mitigate the projected impacts on water availability.

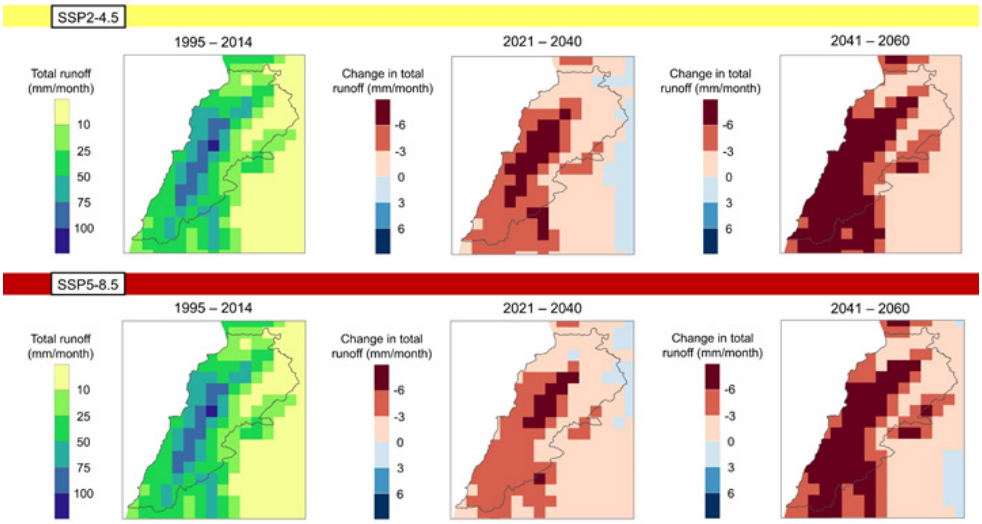


Figure 14: Change in Total runoff projections from 2021-2040 and 2041-2060 compared to 1995-2014 (ESCWA, 2024)

Figure 15 reveals changes and spatial variability in consecutive dry days (CDD). CDD is a critical indicator of drought conditions, which projects an increase up to 6 days annually in southern regions by 2041–2060 under the high-emissions scenario. This trend significantly increases drought risks, particularly in areas already prone to water scarcity, and undermines agricultural productivity by reducing soil moisture and increasing the need for irrigation. Under SSP2-4.5, the increases are less pronounced but remain significant, suggesting that even moderate emissions scenarios will lead to longer dry periods.

Regional disparities are evident, with southern and eastern Lebanon facing the most pronounced impacts. The extended duration of dry periods exacerbates challenges for water resource management, disrupts rain-fed agriculture, and increases reliance on groundwater extraction. These findings underscore the urgency of implementing adaptive measures, such as water conservation practices and drought-resistant crop varieties, to mitigate the effects of prolonged dry periods on Lebanon's agricultural and water systems.

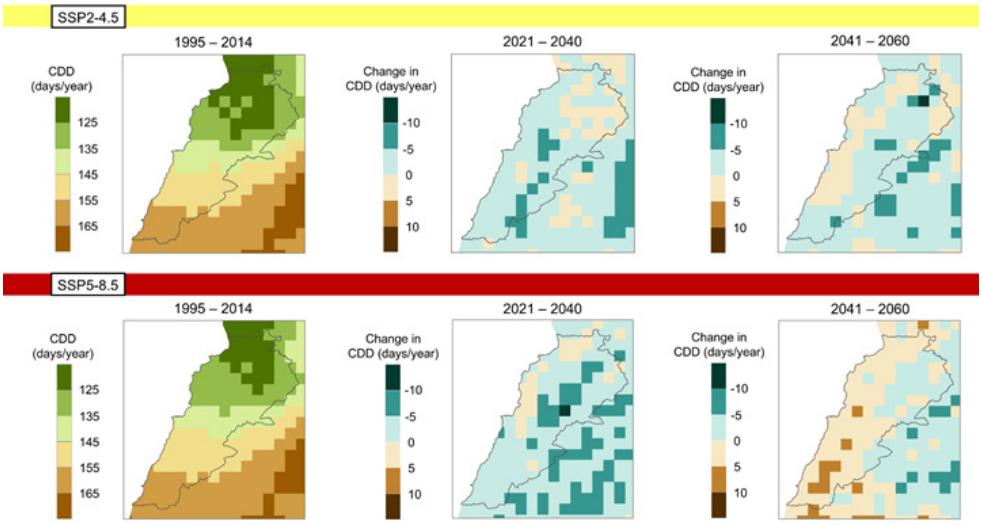


Figure 15: Change in Consecutive dry days (CDD) projections from 2021-2040 and 2041-2060 compared to 1995-2014 (ESCWA, 2024)

3.2.3 Summary of Projected Impacts

The geographical distribution of climate impacts in Lebanon reveals significant variations across regions, which amplify existing vulnerabilities and create diverse risks to critical sectors. Rising temperatures, as projected under SSP2-4.5 and SSP5-8.5 scenarios, show the most significant increases in southern and inland regions, with temperature anomalies exceeding 2.1°C by mid-century under SSP5-8.5. These changes are most pronounced in summer and autumn, leading to amplified drought conditions, heightened heat stress, and reduced agricultural productivity in urban centers such as Beirut, Saida, and Tripoli. Mountainous regions, although less affected by extreme warming, face threats to biodiversity and reduced snow cover, which jeopardize downstream water availability and ecosystem health.

Precipitation patterns exhibit a clear north-south gradient, with southern and coastal plains experiencing the most pronounced reductions under SSP5-8.5. By mid-century, annual precipitation is expected to decline by up to 7 mm/month, with the wettest season (DJF) seeing reductions of up to 14%. These changes will exacerbate water scarcity, reduce groundwater recharge, and threaten agricultural livelihoods in critical regions like the Bekaa Valley and Akkar plains. Shorter wet seasons, coupled with longer consecutive dry periods, will intensify drought risks, heighten soil erosion, and increase the likelihood of rain-fed agriculture failures, particularly in southern and eastern Lebanon.

Hydrological risks are further compounded by decreasing runoff and heightened variability in wet and dry periods. Projected increases in consecutive dry days (CDD) up to 6 days annually under SSP5-8.5 pose severe threats to rain-fed agricultural systems and water supply networks. Coastal areas face dual challenges of reduced precipitation and rising sea levels, which threaten infrastructure, livelihoods, and aquifers with saltwater intrusion. Cities such as Tyre, Beirut, and Tripoli are particularly vulnerable to coastal flooding and infrastructure degradation, disrupting economic activities concentrated along the coast.

The frequency and intensity of extreme weather events, including heatwaves, floods, and wildfires, are expected to increase significantly. Inland areas, such as Baalbek-Hermel, are highly susceptible to flash flooding due to short-duration, heavy rainfall events. Prolonged droughts and heatwaves will heighten wildfire risks in regions such as Chouf, Akkar, and Mount Lebanon, leading to widespread crop failures, reduced livestock productivity, and disrupted food security. These compounded hazards will likely further challenge Lebanon's capacity to maintain sustainable agriculture and protect natural ecosystems.

Lebanon's coastal and mountainous geography intensifies its vulnerability to climate change. Rising sea levels, projected to increase by 30–80 cm by the end of the century, endanger densely populated coastal areas, where much of Lebanon's economic activity is concentrated. Coastal flooding, erosion, and seawater intrusion into aquifers pose severe risks to water quality and critical infrastructure in cities like Beirut, Tripoli, and Tyre. Meanwhile, mountainous regions, which function as vital water catchments, face diminishing snow accumulation and earlier snowmelt, jeopardizing water supplies downstream and reducing biodiversity.

Extreme heat events are projected to increase substantially. Days exceeding 35°C (SU35) and 40°C (SU40) will become more frequent, with southern and inland areas experiencing up to 19 additional SU35 days annually and 2–3 more SU40 days under SSP5-8.5 by mid-century. These trends pose severe risks to human health, exacerbate energy demands for cooling, and reduce agricultural productivity. Wildfires, driven by prolonged droughts and higher temperatures, are expected to become more frequent and severe, particularly in Chouf, Akkar, and Mount Lebanon, creating ideal conditions for fire weather and threatening both human livelihoods and natural ecosystems.

3. 2.4 Climate Change Impacts on Sectors and Vulnerability Factors

These projected climate change impacts amplify vulnerabilities and create new risks across key sectors. Rising temperatures, altered precipitation patterns, and intensifying extreme weather events are disrupting agriculture, water resources, biodiversity, urban areas, public health, and disaster risk management. These changes are compounding existing challenges, straining resources, and undermining resilience.

Agriculture

Agriculture, a cornerstone of Lebanon's economy and rural livelihoods, is under significant strain due to climate change. Water scarcity, inefficient irrigation systems, and outdated water management practices exacerbate vulnerabilities in this sector. Increased competition for water resources, driven by urbanization, population growth, and migration, is creating significant pressure on agricultural water use. Coastal regions face an added challenge of seawater intrusion caused by over-extraction of groundwater, which degrades water quality and adversely affects agricultural productivity.

The impacts on crop yields are already evident, with reductions ranging from 0.3% to 8.7% for irrigated crops and 3.5% to 7.5% for rain-fed crops. Temperature increases, heatwaves, and droughts have disrupted critical growth stages for crops such as wheat, potatoes, tomatoes, and fruits, including apples, cherries, grapes, citrus, and olives. Projections indicate that rising temperatures and extended dry periods will further exacerbate these losses, with significant economic repercussions for farmers and national food security.

Certain regions, such as Baalbek, Akkar, Hasbaya, Rachaya, and the coastal plains, face heightened vulnerability due to their dependence on agriculture and limited adaptive capacity. Hotspots of agricultural vulnerability, including southeastern Akkar and areas in Zahleh, Zgharta, and Bcharre, suffer from a combination of steep slopes, soil erosion, limited groundwater resources, and poorly integrated land use planning. Weak governance, incomplete land surveys, and fragmented land ownership further hinder sustainable agricultural practices.

The livestock sector is similarly vulnerable, with insufficient monitoring of animal health, overuse of antibiotics, and poor pasture management, reducing productivity. Extreme weather events, including heatwaves, floods, and wildfires, have become more frequent and damaging. For instance, heavy winds and floods regularly destroy crops, greenhouses, and livestock infrastructure. Economic losses in the agricultural sector reached an estimated USD 605 million in 2018, with floods being the most damaging hazard. Annual financial losses from changing rainfall patterns and higher temperatures are projected to reach USD 250 million, with regions like Baalbek-Hermel, Akkar, and Bekaa experiencing the greatest economic damage (Abdallah, C., & Serhal, A., 2019).

Water Resources

Water resources in Lebanon are increasingly stressed by the twin pressures of climate change and human activity. Reduced precipitation, rising temperatures, and declining snow cover have led to decreased surface and groundwater availability. Annual precipitation declines of up to 7 mm/month by 2041–2060 under SSP5-8.5 threaten critical water systems. Key river basins, including Nahr El Kabir, Nahr Ibrahim, and the Upper Litani Basin, face reduced flows due to diminished snowmelt and earlier peak flows (ESCWA, 2024a). These changes not only lower water availability during critical dry months but also heighten flood risks during the wet season. By 2050, the Upper Litani Basin is projected to experience a significant water deficit, driven by increased demand and climate-related reductions in water availability (ESCWA, 2024a).

Groundwater resources, which are vital for domestic and agricultural use, are also under severe pressure. Over-extraction, particularly in coastal areas, has led to a decline in groundwater levels by 30–35 meters over the past four decades and a 35–40% reduction in total groundwater volume (UNDP, 2014). This over-reliance on groundwater has intensified saltwater intrusion, further degrading water quality and threatening coastal agriculture.

Snow cover, a crucial source of seasonal water storage, is declining due to rising temperatures and reduced precipitation. Snowmelt floods, which traditionally provide critical water supply during spring and early summer, are increasingly being replaced by rainfall floods. This shift contributes to earlier drought periods and exacerbates water scarcity during the dry months. Droughts are projected to become more frequent and severe, particularly in southern and coastal regions, where the number of Consecutive Dry Days (CDD) is expected to increase up to 6 days annually by 2041–2060 under SSP5-8.5. These droughts will strain river flows, reduce aquifer recharge, and increase demand for irrigation, particularly in agriculture. Simultaneously, the frequency and magnitude of floods in river basins such as Nahr El Kabir are expected to increase, posing risks to infrastructure and further complicating water resource management (ESCWA, 2024a).

Governance challenges exacerbate these issues. Overlapping laws and fragmented institutional responsibilities hinder effective water resource management. A lack of reliable data on water availability and quality complicates planning and investment prioritization, while limited coordination between ministries and institutions reduces accountability and transparency.

Terrestrial and Marine Biodiversity

Lebanon's rich biodiversity, encompassing terrestrial, marine, and forest ecosystems, is under significant threat from climate change. Rising temperatures, altered precipitation patterns, and human pressures are accelerating habitat loss and ecosystem degradation.

The Mediterranean Sea, home to a high number of endemic species, is particularly vulnerable to warming, acidification, and pollution. These changes are projected to reduce marine productivity, alter species distribution, and threaten commercially valuable fish and invertebrates. By 2050, up to 20% of exploited marine species could face local extinction (MedECC, 2020). Changes in plankton ecology, reductions in fish stocks, and the spread of invasive species are expected to disrupt marine ecosystems, negatively affecting fisheries and tourism.

Lebanon's forests, including iconic species such as Cedrus libani and Juniperus excelsa, are at risk from higher temperatures, prolonged droughts, and pest outbreaks. Forest productivity is expected to decline, with higher mortality rates and dieback in water-limited environments. Climate change also exacerbates forest fragmentation, overexploitation, and grazing pressures, further endangering forest health. Forest fires, already a significant threat, are projected to become more frequent and intense, particularly in regions like Chouf, Akkar, and Mount Lebanon. The risk of extreme fire-weather conditions could more than double by the end of the century.

Coastal Cities, Societies, and Tourism

Lebanon's coastal areas, where most of the population resides, face heightened vulnerability to climate change impacts. Rising sea levels (projected to increase by 30–80 cm by 2100), reduced precipitation, and increasing temperatures are compounding the risks of coastal flooding, erosion, and seawater intrusion. Cities like Beirut, Tyre, and Batroun are particularly at risk, with impacts on infrastructure, fisheries, and local economies (MoE/UNDP/GEF, 2022).

The tourism sector, a vital contributor to Lebanon's economy, is especially vulnerable. Rising temperatures, extreme weather events, and coastal erosion threaten tourist destinations, infrastructure, and natural

attractions. Increased heat stress and damage to beach ecosystems are likely to reduce tourism demand, leading to economic losses and job cuts.

3.3 Adaptation strategies, policies, plans, goals, actions and barriers to integrate adaptation into national policies and strategies

Lebanon has developed several adaptation strategies, policies, and plans across key sectors, reflecting its commitment to addressing climate change impacts. These include government-led efforts in agriculture, water management, forestry, coastal zone protection, and disaster risk reduction, which outline goals and actions to enhance resilience and integrate adaptation into national planning. However, their implementation has been slow, hindered by the country's ongoing political instability, weak institutional frameworks, and severe financial constraints. Despite these barriers, non-state actors, including NGOs, private sector entities, and community-based organizations—have played a significant role in driving adaptation efforts on the ground. Guided by government strategies, these actors have initiated localized and sectoral interventions, highlighting the critical role of collaborative efforts in bridging implementation gaps and advancing Lebanon's adaptation agenda. The below section presents an overview of both the government and non-state actors' policies and actions related directly or indirectly to climate adaptation.

Government-lead adaptation policies

Lebanon has undertaken efforts to integrate climate change considerations into its national plans and strategies, aligning these efforts with its Nationally Determined Contributions (NDCs) and the Sustainable Development Goals (SDGs). Key national plans have been developed to address climate challenges through targeted policies and actions across critical adaptation areas, as highlighted by the following sector-specific actions:

1. **Agriculture**: The Ministry of Agriculture's 2020-2025 strategy (MoA, 2020) prioritizes strengthening Lebanon's agricultural resilience to climate change through targeted interventions. In water management and irrigation, efforts focus on modernizing irrigation systems, reducing non-revenue water losses, and expanding networks to reach vulnerable agricultural zones. Innovative techniques such as hill lakes, reservoirs, and rainwater harvesting are being promoted to ensure water availability during dry periods. Crop diversification and resilience are also key areas, with initiatives encouraging drought-tolerant crops, low-chilling cultivars, and adaptive planting techniques to address the impacts of heatwaves and prolonged droughts. Conservation agriculture practices, such as no-tillage and crop rotation, are increasingly adopted to preserve soil health and productivity. Additionally, capacity building and investment initiatives, including farmer training programs and incentives for private sector involvement in the agri-food value chain, aim to enhance the competitiveness and resilience of the sector in the face of climate challenges.

2. **Public Health**: The Ministry of Public Health has endorsed a regional strategy that integrates climate impact assessments into health system response plans, ensuring climate considerations are incorporated into the national health strategy. The strategy underscores the importance of addressing healthcare disparities by increasing access to services in vulnerable regions like Baalbek and Akkar, where infrastructure and resources are currently inadequate.

3. **Water Sector**: The National Water Sector Strategy (2024-2030) addresses the impacts of climate change on water resources. It includes measures such as constructing dams and reservoirs, implementing aquifer recharge projects, and promoting the reuse of treated wastewater. Infrastructure modernization is a central focus, with plans to rehabilitate outdated systems, reduce leakage in irrigation and supply networks, and upgrade public water services for consistent delivery. Sustainable groundwater management is also prioritized to address aquifer depletion and mitigate saltwater intrusion in coastal

areas. Additionally, watershed management plans are being developed for drought-prone regions, integrating water considerations into urban and rural land-use planning. Community engagement and awareness initiatives further support these efforts by promoting water conservation practices and fostering community-based water management, thereby enhancing local adaptive capacity to climate-related water challenges (MoEW, 2024).

4. **Forestry**: The 2023 National Strategy to Reduce Forest Fire Risks in Lebanon (MoE, 2023a) focuses on tackling the challenges posed by frequent and intense fires, which annually affect an average of 1,449 hectares over a fire season lasting around 200 days. Key actions include prevention, preparedness, response, recovery, and strengthening local capacities. Measures such as early warning systems and risk mapping are designed to protect fire-prone regions, where an average of 167 fires occur each year. The strategy emphasizes updating legal frameworks, improving coordination among agencies, and involving local communities in fire management. By addressing issues like prolonged dry seasons and extreme weather conditions, the strategy aims to reduce environmental and economic impacts while supporting sustainable forest management.

In addition, the National Forest Program (2015-2025) integrates climate change adaptation into forestry management, promoting ecosystem resilience and sustainable forest management practices to mitigate the effects of climate change (MoA, 2015).

5. **Disaster risk reduction**: the draft National Strategy for Disaster Risk Reduction (2021-2030) strategy emphasizes understanding disaster risk, strengthening governance, and investing in risk reduction, particularly for climate-related hazards such as floods, droughts, and wildfires. The strategy aligns with climate adaptation efforts by integrating risk assessments, enhancing early warning systems, and promoting resilient infrastructure. It highlights the importance of linking disaster risk management with climate change adaptation to reducing vulnerabilities across sectors.

6. **Biodiversity**: Lebanon's National Biodiversity Strategy and Action Plan (NBSAP) 2016-2030 integrates ecosystem-based adaptation (EbA) to address climate vulnerabilities by leveraging natural ecosystems to reduce risks from floods, droughts, and wildfires. The NBSAP is currently being updated with an alignment of targets with the post-2020 Global Biodiversity Framework target. NBSAP aligns with national climate adaptation goals, emphasizing nature-based solutions to enhance resilience across sectors and reduce vulnerabilities effectively (MoE/UNDP/GEF, 2016).

Non-state actors (NSA)-lead adaptation actions

Between 2020 and 2022, Non-State Actors (NSAs) in Lebanon have played a pivotal role in implementing climate adaptation actions across various sectors, addressing vulnerabilities exacerbated by climate change. This section highlights the distribution and focus of these interventions, emphasizing their critical contributions to Lebanon's adaptation landscape. Most of the interventions are implemented by local and international NGOs. There is limited involvement of industries and commercial establishments in adaptation action in Lebanon, highlighting the need for increased private sector participation in climate action (Figure 16).

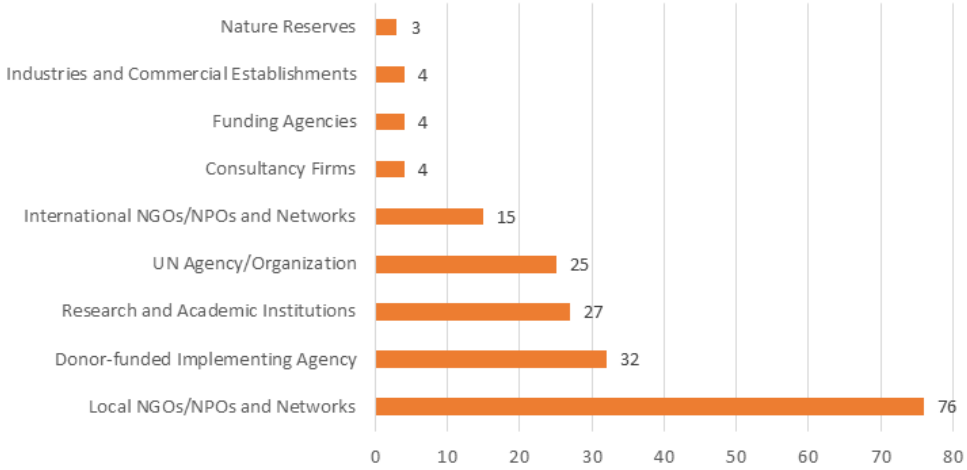


Figure 16: Count of Stakeholder Categories Across All Sectors in Lebanon (2020-2022)

Sectoral Distribution of NSA-lead Adaptation Actions

Adaptation interventions in Lebanon are distributed across 7 priority sectors as illustrated Figure 17 The agriculture sector emerges as the most targeted, with 94 interventions, followed by water (54 interventions) and Forests, Other Land Uses (FOLU) (41 interventions). Other sectors, such as resilient cities (18 interventions) and disaster risk reduction (DRR) (17 interventions), show comparatively lower engagement, while the climate-resilient health sector records only 2 interventions.

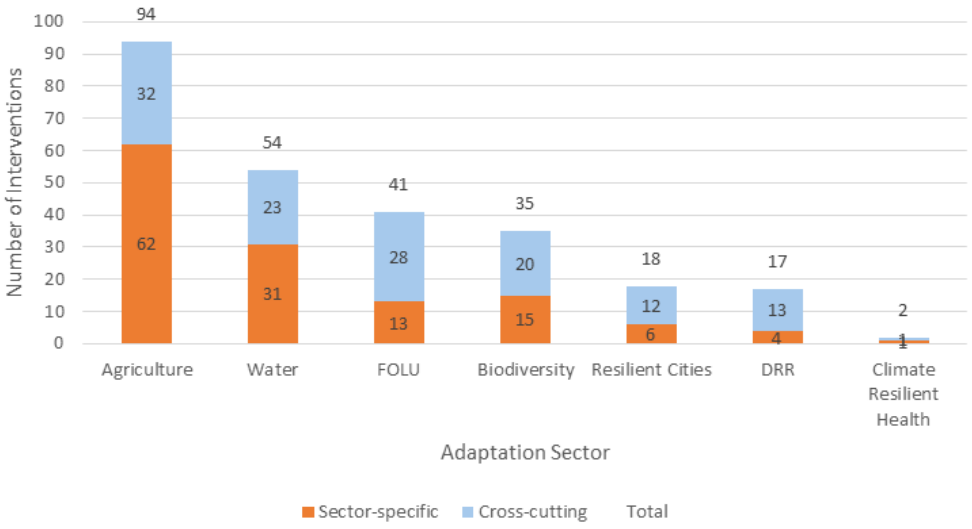


Figure 17: Distribution of climate adaptation interventions in adaptation in Lebanon (2020-2022)

Agriculture leads with 94 interventions, split into 62 sector-specific and 32 cross-cutting initiatives. The sector's appeal to NSAs likely reflects its economic importance; although agriculture accounts for only 3–5% of Lebanon's GDP, it engages 20–25% of the workforce, contributing up to 80% of economic output in some rural areas (FAO, 2024a; ILO/FAO, 2020; Maddah & Darwish, 2023; World Bank, 2017). Among all seven climate adaptation sectors, agriculture has the highest number of sector-specific interventions. Furthermore, the substantial linkages between agriculture and the water sector in cross-cutting initiatives highlight the critical role of water management in the agricultural sector sustainability.

The water sector, with 54 interventions (31 sector-specific and 23 cross-cutting), is pivotal to Lebanon's climate resilience. Despite abundant water resources and unique regional rainfall patterns, Lebanon's poor water management has led to scarcity, pollution, and uneven access, with around 2.8 million people facing challenges in safe water access (Yared, 2023). Aging infrastructure contributes to high water losses, and disparities of water access between various regions in Lebanon. Additionally, changing precipitation patterns are projected to significantly reduce water availability, with a decrease of up to 30% anticipated by 2080 under high-emission scenarios (MoE/UNDP/GEF, 2022). This likely explains the finding that water supply interventions are the highest intervention area under the water sector. Water is one of the only 2 adaptation sectors, alongside Agriculture, with more sector-specific than cross-cutting interventions.

Forests and Other Land Use (FOLU) comprises of 41 interventions (13 sector-specific and 28 cross-cutting) conducted by NSAs in Lebanon in 2020-2022. The focus on forestry may stem from the fact that Lebanon's forests, despite their economic and environmental value, face multiple threats, including forest fires, unsustainable practices, urbanization, and demographic pressures (FAO, 2024b). Efforts in the forestry sector play a crucial role in addressing climate risks such as desertification, a growing concern as temperatures rise and rainfall patterns shift (Al-Sayah et al., 2022). While sector-specific interventions are fewer, the high number of cross-cutting interventions reflects the integration of forest and land management into broader biodiversity, urban resilience, agricultural, and DRR strategies - essential for preserving Lebanon's forests and enhancing rural community resilience.

Host to 4,486 known fauna species, Lebanon has one of the highest densities of floral diversity in the Mediterranean basin, a region globally recognized for its significant biological diversity (CBD, 2024). Despite Lebanon's rich biodiversity and its vulnerability to climate and human pressures, there is only a total of 35 interventions in the biodiversity sector (15 sector-specific and 20 cross-cutting), suggesting that biodiversity conservation was either not highly prioritized by NSAs or other non-climate related funds were approached for biodiversity initiatives.

Despite Lebanon's coastline of approximately 225 km and the vulnerability of its coastal cities to rising sea levels and storm surges, the resilient cities sector (aiming to enhance urban resilience and disaster preparedness), ranks relatively lower with 18 interventions (6 sector-specific and 12 cross-cutting). In Lebanon, where nearly 90% of the population lives in urban areas, strengthening cities like Beirut, Tripoli, Saida, and Tyre is essential to uphold human rights to housing, water, sanitation, and other critical services (UN-Habitat, 2024). Beirut faces challenges such as shrinking green spaces, rapid urbanization, and increased vulnerability to flooding and extreme heat events. Considering the large coastal population, the limited focus on resilient cities may raise concerns. Therefore, it is essential to increase efforts to protect urban communities, infrastructure, and tourism – all vital to the Lebanese economy.

Disaster Risk Reduction (DRR) in Lebanon is among the weakest, with only 17 interventions (4 sector-specific and 13 cross-cutting) in 2020-2022. The relatively low number of interventions might reflect Lebanon's reactive approach to disasters, often prioritizing immediate needs, leading to gaps in long-term planning and resilience against climate risks. While disaster strategies and regulations exist, implementation suffers from poor coordination, inadequate funding, weak infrastructure, and a lack of political will (El Murr, 2023; Nuwayhid et al., 2022).

The health sector in Lebanon has only 2 interventions (1 sector-specific and 1 cross-cutting), revealing the urgent need for a proactive approach to integrating climate resilience into health systems. Recent studies indicate that the preparedness of Lebanese healthcare facilities to climate shocks remains alarmingly low, with minimal improvements made to date (MoE/UNDP/GEF, 2022a). This low readiness is especially concerning given the ways climate change worsens existing health challenges; exacerbating air pollution,

and hence increasing hospital admissions for respiratory issues like asthma and chronic obstructive pulmonary disease (D'Amato et al., 2015; Zhang et al., 2015). The current underinvestment in health adaptation efforts represents a significant gap that must be addressed in future planning. The vulnerabilities highlighted by Lebanon's reactive approach to the COVID-19 pandemic, the Beirut blast, and ongoing conflicts reveals that Lebanon's healthcare system is ill-prepared for shocks and crises, making it essential to enhance its resilience against future health emergencies, heatwaves, and climate-related diseases.

Despite progress in designing and implementing adaptation policies, significant barriers remain that hinder their effective execution across key sectors. In agriculture, challenges persist in addressing livestock sector vulnerabilities, with limited focus on improved pasture management, disease control, and sustainable livestock systems. Localized interventions in high-risk areas such as Baalbek and Akkar are crucial to tackling region-specific challenges. In the water sector, disparities in availability, particularly in semi-arid regions and river basins, call for real-time groundwater monitoring and tailored adaptation plans. For ecosystems, expanding measures to address marine biodiversity challenges, such as the spread of non-indigenous species, alongside legislative reforms to integrate biodiversity into urban planning, would enhance ecosystem resilience. Coastal zones and cities require localized adaptation strategies for vulnerable cities coupled with improved institutional coordination and public awareness. Finally, effective disaster risk reduction (DRR) necessitates cross-sectoral collaboration, integration into national planning, enhanced governance, and mobilization of international funding to address Lebanon's growing climate risks and build resilience against disasters.

3.4 Progress on implementation of adaptation

Tracking the progress of adaptation actions in Lebanon remains a significant challenge due to fragmented reporting systems, limited data availability, and the absence of a unified monitoring and evaluation framework. The lack of coordination among various stakeholders, coupled with insufficient financial and technical resources, further complicates efforts to measure and assess the effectiveness of adaptation initiatives. However, some progress is being made to improve data collection, enhance institutional collaboration, and develop mechanisms for more comprehensive reporting and monitoring. These steps aim to establish a clearer understanding of adaptation progress, inform policy adjustments, and align implementation efforts with Lebanon's climate resilience goals.

Development of Lebanon's National Adaptation Strategy (NAS) and National Adaptation Plan (NAP)

The development of Lebanon's National Adaptation Strategy (NAS) and National Adaptation Plan (NAP) under the GCF NAP readiness project is contributing to advancing analysis of progress through the assessment of existing national and sectoral strategies, identifying critical gaps in adaptation planning and implementation while aligning actions with Lebanon's broader development priorities and commitments under its Nationally Determined Contributions (NDC).

Through this work, 148 adaptation actions have been identified, reflecting Lebanon's sectoral vulnerabilities, such as water scarcity exacerbated by inefficient irrigation, public health risks linked to climate-induced diseases, and declining agricultural productivity. The assessment of the progress of these actions revealed that existing strategies often lack coordination and sufficient focus on climate-specific vulnerabilities. Many proposed actions overlap or remain underdeveloped, indicating the need for more cohesive planning to ensure resources are directed effectively. Identifying these shortcomings is critical in framing a structured approach for adaptation, but the integration and operationalization of these actions remain challenging. The development of the NAP roadmap will build on the assessment results and stakeholder feedback to validate barriers and build consensus on implementation priorities and mechanisms.

Lebanon's Long-Term Low Emission Development Strategy (LT-LEDS)

Lebanon's Long-Term Low-Emission Development Strategy (LT-LEDS) places significant emphasis on adaptation, recognizing the urgent need to build resilience across critical sectors. For water resources, the strategy prioritizes integrated water resource management, rehabilitation of aging infrastructure, expansion of rainwater harvesting, sustainable groundwater use, and wastewater treatment to address water scarcity and quality issues. In agriculture, it advocates for climate-smart practices, the introduction of resilient crop varieties, efficient irrigation systems, and support for smallholder farmers through capacity-building and access to financing. Infrastructure adaptation focuses on incorporating climate risk assessments into urban planning, developing climate-resilient construction standards, expanding green zones to mitigate urban heat, and improving drainage systems to manage flooding. Health system adaptation includes strengthening emergency preparedness by integrating climate risks into disease surveillance, public health planning, and raising awareness about climate-induced health impacts like heat stress, vector-borne diseases, and waterborne illnesses. Nature-based solutions, such as reforestation and wetland restoration, are central to enhancing ecosystem resilience and providing co-benefits for adaptation and mitigation. Cross-sectoral measures emphasize adaptive governance, improved inter-ministerial coordination, stakeholder engagement, and robust data systems to support evidence-based decision-making. Financing adaptation is also a critical component, with the LT-LEDS stressing the importance of mobilizing international climate finance, establishing dedicated adaptation funds, and leveraging public-private partnerships to support region-specific projects and vulnerable communities. Despite its comprehensive approach, the strategy acknowledges significant challenges, including financial constraints, fragmented governance, and insufficient local capacity, highlighting the need for stronger institutional frameworks and alignment with ongoing initiatives like the NAS and NAP to ensure effective implementation and long-term resilience (MoE/UNDP, 2025).

3.5 Monitoring and evaluation of adaptation actions and processes

Lebanon has taken significant steps to establish a framework for monitoring and evaluating adaptation progress to better tracks its NDC implementation progress. This process involves the development of a comprehensive set of indicators, categorized into headline and supporting indicators, to track adaptation priorities outlined in the Nationally Determined Contributions (NDCs). The indicators were developed through a systematic six-step process that included consultations with the Ministry of Environment's Climate Change Project, reviews of sectoral strategies, lessons from other countries, and the application of a theory of change to ensure alignment with national adaptation goals. These indicators are designed to measure trends in adaptation efforts and provide insights into the drivers and outcomes of associated actions, ensuring they remain relevant to Lebanon's context and data availability.

Headline indicators focus on key adaptation priorities such as resilient agriculture, water management, biodiversity conservation, disaster risk reduction, and climate-resilient health systems. Supporting indicators provide supplementary data to contextualize the trends observed and evaluate the enabling factors for adaptation activities. This double-tiered approach ensures a comprehensive assessment of adaptation progress and helps identify areas requiring further action.

Table 15 presents the headline indicators for adaptation priority sectors and Annex III presents the corresponding supporting indicators.

Table 15 - Headline indicators to track the progress of Lebanon's NDC

Indicator #	Sector	Indicator	Unit
Ag.AP1.H1	Agriculture	Agricultural production by key crop type	Tonnes
Ag.AP1.H2	Agriculture	Increase of agricultural productivity of key crop types	%
Ag.AP1.H3	Agriculture	Percentage of agricultural land using climate-smart practices	%
Ag.AP3.H1.	Agriculture	% increase in total irrigated area under modern irrigation system	%
F.AP2.H1	Forestry	Lebanon's forest cover in Year X	Hectares (ha) and %
F.AP2.H2	Forestry	Number of management plans for forest systems	#
F.AP2.H3	Forestry	Hectares of burned lands	Ha
Wt.H1	Water	Difference in emissions from wastewater compared to BAU data	t CO_2eq. and %
Wt.H2	Water	GHG emissions trend in wastewater since [2015]	t CO_2eq. and %
Wt.AP3.H1	Water	Share of population with access to safely managed drinking water	%
DRR.AP4.H1	Disaster Risk Reduction	areas dedicated to ecosystem preservation and conservation across Lebanon	Ha and %
DRR.AP5.H1	Disaster Risk Reduction	Frequency and severity of coastal flooding events	# / Severity scale
DRR.AP5.H2	Disaster Risk Reduction	Rate of coastal erosion	cm/year
CRH.AP6.H1	Health	Number of annual climate-related illnesses (e.g., heatstroke, respiratory problems due to air quality, and water-borne diseases)	#

To facilitate the collection, validation, and analysis of these indicators, Lebanon is developing the Management Information System for Climate Action in Lebanon (MISCAL). This platform will serve as a centralized system to track NDC implementation, with a particular focus on adaptation. Task forces established under the Capacity-Building Initiative for Transparency (CBIT) project will play a critical role in populating this platform with validated data. MISCAL is designed to integrate sectoral data, support peer validation processes within task forces, and enable the Climate Secretariat to generate reports and policy recommendations for the NDC Committee.

As Lebanon continues to refine its monitoring and evaluation framework, these tools and processes will be essential in ensuring transparent and accountable tracking of adaptation progress, addressing gaps in data availability, and enhancing the country's capacity to meet its adaptation commitments.

3.6 Cooperation, good practice, experience, and lessons learned, International Cooperation

Lebanon recognizes that international cooperation is fundamental to advancing its National Adaptation Plan (NAP) and enhancing its resilience to climate change. A significant aspect of Lebanon's adaptation planning has been its collaboration with the NAP Global Network, which has provided invaluable technical assistance, knowledge sharing, and capacity-building support. This collaboration enabled Lebanon to draw on successful examples and good practices from other countries with similar challenges, helping to shape a robust and context-sensitive NAP framework.

Through the NAP Global Network's guidance, Lebanon adopted innovative approaches to institutional coordination and adaptation planning, leveraging lessons learned from countries such as Albania,

Moldova, and Bosnia and Herzegovina. These efforts included integrating participatory vulnerability assessments and climate risk mapping into the planning process, ensuring that adaptation measures were informed by comprehensive and localized data. The collaboration also facilitated capacity building for Lebanese institutions, enhancing their ability to manage and implement adaptation actions effectively.

Beyond the NAP Global Network, Lebanon has engaged in regional and global partnerships to address cross-border climate risks, particularly in shared water resources, biodiversity conservation, and sustainable agriculture. Lebanon has also benefited from international climate finance, including the Green Climate Fund (GCF), to support the development of readiness proposals and adaptation projects. These initiatives have empowered Lebanon to align its adaptation strategies with global best practices while addressing local vulnerabilities and needs.

Strengthening Scientific Research and Knowledge

Lebanon has prioritized strengthening its scientific foundation as part of its adaptation planning. Collaborations with international organizations and academic institutions have enabled Lebanon to conduct climate risk mapping, vulnerability assessments, and scenario analysis tailored to its unique context. These efforts have enhanced Lebanon's ability to integrate scientific insights into decision-making and ensure that adaptation strategies address both current and projected climate risks.

The country's partnership with international stakeholders has also improved its climate information systems, enabling the development of early warning systems and climate projection models. These tools have supported Lebanon in identifying critical risks and implementing targeted adaptation actions, particularly in vulnerable sectors such as agriculture, water, and coastal zones. Through ongoing collaboration, Lebanon has benefited from access to cutting-edge research and methodologies, ensuring that its adaptation planning is grounded in robust and actionable data.

Lebanon's experience in developing its NAP underscores the importance of international collaboration and the use of successful examples to inform national processes. Working with the NAP Global Network highlighted the value of adopting tailored approaches that align with the country's specific socio-economic and environmental challenges. Engaging stakeholders early and continuously throughout the planning process has strengthened ownership and alignment of adaptation actions with local priorities.

Key lessons include the necessity of capacity-building programs to address institutional and technical gaps, as well as the importance of leveraging innovative financing mechanisms that blend domestic resources with international support. Establishing budget tracking systems for climate adaptation expenditures has also been instrumental in enhancing accountability and mobilizing resources effectively. Additionally, embedding adaptation within sectoral and national development plans has reinforced coherence, ensuring that adaptation actions are part of a comprehensive, long-term strategy.

By continuing to build on these collaborations and lessons learned, Lebanon remains committed to advancing its adaptation agenda, protecting its people and ecosystems from climate impacts, and contributing to global climate resilience goals.

4. Information on financial, technology development and transfer and capacity-building support needed and received under Articles 9–11 of the Paris Agreement

4.1 National circumstances, institutional arrangements and country-driven strategies

In Lebanon, climate-related finance and technical support come from a variety of sources, including international donor agencies, foreign governments, and to limited extend national budget. These funds are used to design and implement numerous mitigation and adaptation projects and policies. While the Ministry of Environment hosts and implements many of those projects, many more are carried out by other public institutions or NGOs.

Despite this financial and technical support, Lebanon lacks a centralized system for tracking and reporting on climate change projects and related expenditures. No single entity is currently responsible for overseeing and monitoring climate-related support received, and there are no designated focal points within government institutions with specific mandates for this task. This fragmented approach often leads to inefficiencies and underestimation of the support that the country is receiving for climate action, as there might be an incomplete understanding of the financial climate landscape.

The Ministry of Environment has made efforts during the years to identify and track climate change related activities and associated support over the years, but the information available for estimating the overall support that Lebanon is receiving for climate action is limited. Under the CBIT project, a transparency framework was established with its institutional arrangements, with the aim to facilitate the tracking of financial and technical support received related to climate action. Under this framework, sectoral task forces have been established for priority mitigation and adaptation sectors and an information sharing platform (MISCAL) have been designed with clear indicators to track activities (see section 2.1 of BTR1). However, due to lack of time resources, no finance indicators were agreed upon with relevant stakeholders and such an exercise was postponed to future opportunities.

However, it is worth noting that information on support received for capacity-building and technical assistance was not explicitly differentiated due to the lack of disaggregated information in addition to time, budget and personnel limitations. Lebanon was not able to dedicate resources to comprehensive disaggregation for identifying capacity-building activities or technical support received during this period.

Similarly, information on technology support received was not reported in this BTR1 due to lack of disaggregated data. Lebanon plans to undertake a specific exercise to devise a national methodology for tracking technology transfer including selecting criteria for defining a project under technology support and monetizing technology transfer, and accordingly track such support received in its subsequent BTRs.

4.2 Underlying assumptions, definitions, and methodologies

Based on ICA's recommendations to enhance data collection on financial support received, especially in

adaptation, the Ministry of Environment has launched an extensive mapping exercise to identify NSAs involved in climate adaptation in Lebanon and their related initiatives during the 2020-2022 period. Mapping Non-State Actors (NSA) initiatives is crucial to improve national planning, fulfill reporting obligations under Article 13, and enhance policy and Nationally Determined Contributions (NDCs) implementation under Article 4 of the Paris Agreement.

Accordingly, a database of 293 adaptation projects conducted by NSAs in Lebanon was compiled and firsthand insights were gathered from stakeholders about their climate adaptation priorities, challenges, and lessons learned from implementing adaptation interventions.

To effectively map climate change adaptation interventions in Lebanon, it was essential to establish a clear definition of activities that qualify as climate adaptation. A variety of resources informed this definition, including the NDCs, the OECD Rio Markers for Climate Handbook, and a comprehensive literature review of international reports, UNFCCC documents, national strategies, academic articles, and relevant legal frameworks. Accordingly, seven key adaptation sectors were identified—Water, Agriculture, Biodiversity, Forests, Disaster Risk Reduction (DRR), Resilient Cities, and Health.

The mapping exercise combined two primary approaches: desk review and stakeholder engagement.

1. **Desk Review**: A systematic review of climate change reports, academic literature, donor progress reports, and social media provided an initial understanding of adaptation efforts in Lebanon. The desk review remained open throughout the stakeholder engagement phase to maximize data coverage and ensure continuous updates.

2. **Stakeholder Engagement**: Building on the desk review, a snowball sampling method was employed to identify stakeholders actively engaged in adaptation activities. Stakeholders meeting predefined criteria—including sectoral focus, geographic relevance, organizational type, and activity timelines—were invited to participate. Meetings were held to collect data, which was refined through Excel templates aligned with the UNFCCC Common Tabular Format (CTF) tables.

Data collection tools such as online surveys were used to gather stakeholder insights on adaptation challenges, lessons learned, and ongoing or future priorities. The process ensured the development of a robust interventions database covering adaptation projects from 2020–2022. Data analysis, performed using SPSS software, focused on two areas: the analysis of the adaptation interventions database and stakeholder inputs to inform the development of Lebanon's climate adaptation reporting under the BTR.

As for mitigation projects, the collection of information was done through desk reviews and intensive stakeholder consultations to capture financial support received for energy, transport, waste and forestry measures. Although this exercise was not specifically focused on NSAs, it allowed to collect most of the information available within ministries and international organizations which are leading on the implementation of mitigation measures in Lebanon.

The analysis of the collected information focused on understanding key aspects of climate mitigation and adaptation projects implemented in 2020-2022. The following areas were examined:

- Sectoral Distribution: Projects were categorized by mitigation and adaptation sector to reveal the engagement of stakeholders per sector.
- Sub-sectoral Activities: Within each sector, interventions were further classified into sub-sectoral activities (i.e., irrigation under the agriculture sector, or renewable energy under energy).
- Budgets and Financial Information: The analysis of project budgets, funding sources, and budget distribution was performed. Budgets were analyzed along multiple variables, such as sectors, intervention types, and funding sources, offering insights into resource allocation priorities and potential funding gaps. To analyze the budget of the identified interventions and effectively classify and report the budget allocations for climate action in Lebanon, the Rio Markers Scoring System developed by the OECD was adopted.

The Rio Markers system assesses financial allocations for environmental and climate objectives by categorizing projects as either “Principal” (P) or “Non-Principal” (NP) based on their climate focus. The classification was done by examining each project’s objectives and descriptions, searching for specific terms from the lexical field of climate adaptation and mitigation. Key terms included: climate, mitigation, emission reductions, adaptation, adaptive capacity, resilience, and vulnerability. Projects containing those climate-focused terms (in their objectives, description, or outcomes) were classified as “Principal,” with 100% of their budget counted toward climate finance. Projects that provided some climate benefits but did not explicitly prioritize it were categorized as “Non-Principal,” with 40% of their budget allocated toward climate finance, reflecting the proportion of benefits tied to climate action.

Currency Conversion: Project budgets, reported in United States Dollars (USD), Euros (EUR), and Great British Pounds (GBP), were standardized to USD using exchange rates from the United States Federal Reserve as of October 24, 2024 (1 GBP = 1.3022 USD, 1 EUR = 1.0854 USD). This conversion provided consistency across projects, allowing for straightforward budget comparisons.

To improve transparency, Lebanon prioritized detailed project documentation, highlighting the connection between activities and climate action objectives. This approach ensures that stakeholders can trace financial allocations to specific outcomes, enhancing accountability and alignment with Paris Agreement goals. Key sectors such as energy, agriculture, and water demonstrated substantial engagement with mitigation and adaptation priorities, underscoring the relevance of the Rio Marker framework for strategic planning and reporting.

The information presented in the BTR does not include any double counting given that 1) none of reported finance has been mobilized by public interventions where transactions have mobilized private financial resources, 2) none of the support is related to Internationally Transferred Mitigation Outcomes (ITMOs) payments.

4.3 Information on financial support needed by developing country Parties under Article 9 of the Paris Agreement

Achieving the NDC target of reducing Lebanon’s emissions by 20% by 2030 will require significant investment in key sectors of energy generation, waste management and transport. Additional investments will be needed to increase the resilience and adaptive capacity of the country’s most vulnerable sectors such as water, agriculture, forest and health.

Although a quantified accurate amount of the support required for climate priorities is not available, various policy documents outline areas in which support is needed to transform ambition into action, build resilience and meet the country’s low-emission development goals.

Lebanon’s Country Programme to the GCF (MoE, 2024), updated in 2024, has identified a list of pipeline projects 9 full project ideas and 2 readiness projects, collectively seeking funding amounting to USD 327.5 million in grants, USD 50 million in loans and USD 4 million for Readiness to contribute to the NDC implementation. The majority of these projects have been proposed as grants, specifically targeting vulnerable sectors such as water and food security and health, with emission reduction potentials from the use of renewable energy and energy efficiency measures. The proposed projects, presented in Table 16, are aligned with NDC mitigation targets and adaptation priorities and the objectives of the LEDS, underscoring Lebanon’s commitment to supporting the most affected communities, ensuring sustainable and resilient development in the face of a changing climate (MoE, 2024).

Table 16 - Pipeline priority projects and programmes GCF (2024-2027) (MoE, 2024)

Sector	Accredited entity	Title and overview	Estimated Budget
Full projects			
Early Warning systems	UNEP	**Enhancing Climate Information Services and Impact-Based Multi-Hazard Early Warning in Lebanon.** Climate Services (NFCS), climate observation and hazard forecasting systems, improve warning dissemination systems, disaster preparedness and response.	USD 20 Million Grant
Agriculture, Irrigation	WFP	**Building Climate Resilient Inclusive Food System in Lebanon.** Irrigation, rehabilitation/upgrade processing facilities, use Renewable Energy, promotion of hydroponics, soil and water conservation, hillakes, agribusiness planning, upgrade meteo/ weather stations.	USD 50 Million Grant
Health	AFD	**Assessing and Enhancing the Climate Resilience of Lebanon's Healthcare System.** Develop vulnerability and adaptation plans for health care facilities, promote and implement green resilient health facilities, including waste management and energy efficiency.	USD 65 Million Grant EUR 15 Million from AFD grant
Finance	Cedar Oxygen (PSAA)	**Catalyzing Climate Finance through the Lebanon Green Investment Facility (LGIF).** Mobilize and improve availability and access to green investment and climate finance for various sectors.	USD 7 Million grant USD 50 Million loan USD 65 Million Private Sector
Water	FAO	**Strengthening resilience to climate change risks through integrated watershed management in Lebanon.** Develop watershed management plans for Beirut and EL Assi, Urban/ territorial master plans, implementation of adaptation such as solarization of water, hill lakes, industrial wastewater, circular economy, reforestation, agriculture.	USD 76 Million Grant
Agriculture, forestry	FAO	**Enhancing climate resilience in Lebanon through improved territorial development and landscape management.** Institutional measures for climate-resilient productive ecosystems, territorial development and integrated landscape management in key areas.	USD 40 Million Grant
Energy	UNIDO	**Promoting renewable energy, energy efficiency and circular resource efficiency solutions for the sustainable recovery of Lebanon's industrial sector.** Demonstration of suitable technologies and financial business models, demonstration of RE/EE projects and circular projects, Finance strategy, project pipeline.	USD 19.5 Million Grant 1:2 to 2:3 co-financing
Water	UNICEF	**Localized climate-appropriate full-cycle water systems in remote locations.** Access to safe public water suppose and wastewater management services, efficiency of service provision, Installation and maintenance of water supply and services.	USD 30 Million Grant
Energy	TBD	**Expanding the Beirut River Solar Snake to increase renewable energy integration in electricity provision.** Build solar panels over Beirut River and rehabilitate the national control center of EDL.	USD 20 Million Grant
Readiness Projects			
Water and Energy	GWP	**Strengthening national technical and institutional capacities in planning and resource mobilization for water climate resilience and energy transition.** Climate-resilient planning in the energy water and wastewater sectors, climate-proofing wastewater management plans, urban climate action, 3 concept notes for water and energy.	USD 3 Million
NDC	UNDP	**Support the Development of Lebanon's NDC 3.0 by strengthening implementation and financial investment strategies and enhancing national climate governance framework.** Develop Lebanon's NDC 3.0 through enhancing institutional capacities, improving available information and providing tools for key public and private institutions to enhance planning processes and strategic frameworks for mobilizing climate investment for the country.	USD 1 Million

In addition, under the Lebanon's Climate promise 2.0 project, Lebanon's Green Investment Facility (LGIF) was established to support the development of a private sector-oriented investment mechanism for NDC financing and implementation. The initial assessment of LGIF's pipeline is estimated at around USD 150 million to implement NDC-related mitigation and adaptation projects with the private sector.

Complementarily, Lebanon is currently in the process of securing GCF readiness funds to prepare its NDC 3.0. The "Support the Development of Lebanon's NDC 3.0 by strengthening implementation and financial investment strategies, and enhancing the national climate governance framework" project will include the development of an NDC implementation strategy and a finance and investment strategy which will identify specific financial needs for Lebanon to achieve its NDC targets. The project will also develop a comprehensive private sector engagement strategy, technical assessments, and robust bankable project pipeline, leveraging the LGIF to mobilize resources, aligned with international financial standards and frameworks.

Beyond the NDC targets of 2030, Lebanon's 2050 Low-Emission Development Strategy (LEDS) has estimated that around USD 50 billion or 4% of GDP will be needed as additional real investments to further implement climate policies and activities and reach ambitious low emission development targets (MoE/UNDP, 2025). Such investments will rely on one hand on annual public investments of USD 64 to 73 billion over the period from 2022 to 2050 in areas like power generation, flood-proof buildings, waste management, electric vehicle charging networks, urban greening, and electric buses. On the other hand, private investments needed will reach USD 390 to 418 million per year over the same period, contributing to the overall investment effort.

Lebanon already has a set of development-oriented potential projects identified, which are aligned with the objectives of the NDC and LT-LEDS. These potential projects cover sectors such as renewable energy, water and waste management, sustainable agriculture, forestry, and biodiversity conservation with 53 transition projects at a value of USD 8.77 billion and 40 resilience projects, representing a value of USD 7.19 billion (MoE/UNDP, 2025).

4.4 Information on financial support received by developing country Parties under Article 9 of the Paris Agreement

Climate finance from multilateral and bilateral sources plays an important role in advancing climate action in Lebanon. Over the years, it has contributed to the implementation of sectoral policies and programs and supported initiatives from governmental and non-governmental institutions to reduce GHG emissions and increase the resilience of vulnerable sectors. Therefore, having a clear understanding of these finance flows is crucial to assess the outcomes of support received and optimize available and future climate resources.

Financial support tracking is done through the collection of information from multilateral funds or bilateral cooperation thus tracing the source of the funds, the type of activities, the sector covered, and the budget allocated. Identified interventions include internationally funded projects that begun as early as 2015 and are still ongoing or have been completed by 2022, as well as projects that have been approved and committed in 2022 and will be completed by 2028. Validation of information is then done through meetings with donors and with beneficiaries, in addition to alignment with the relevant ministry for each sector. Then Rio markers are used to allocate a specific portion of the budget to climate activities and is reported in the BTR. Common tabular format (CTF) tables, as per 5/CMA.3- annex II, reporting on support received can be found in Annex II.

Under the CBIT project, a new transparency framework has been developed to concurrently collect information related to support with the collection of NDC tracking indicators and the assessment of

mitigation and adaptation measures. The transparency framework, as explained in section 2, includes institutional arrangements related to the sectoral task forces which will have the mandate to collect, analyze and validate information on support received, and the NDC committee which will receive and validate the data to be included in the BTR.

No domestic funding is reported in this section due to the limited data availability of the national budget allocated for climate-related projects. Only one project has been identified (QuoDePro project GoL/UNDP) where funding from the national budget has been earmarked as co-financing to implement the project. It is worth noting that this section does not reflect the full and actual finance support received, as some activities that have been implemented by private sector entities and sub-national entities may not have been recorded.

Between 2020 and 2022, Lebanon received approximately USD 227.5 million in climate finance, with the largest share, USD 113.7 million, allocated to adaptation projects reflecting significant efforts to build resilience in vulnerable sectors such as water and agriculture. Cross-cutting projects received USD 83.3 million, addressing both adaptation and mitigation objectives such as initiatives tackling simultaneously energy, water and sanitation, forestry and biodiversity, waste and wastewater whereas mitigation projects received USD 30.4 million mainly targeted to renewable energy and transport (Figure 18). Records show that energy projects attracted much less funding during 2020-20222 compared to previously reported periods, mainly due to Lebanon's economic constraints, absence of reforms, lack of large-scale mitigation insufficient private sector engagement and the absence of a comprehensive policy framework have hindered the development of new mitigation projects.

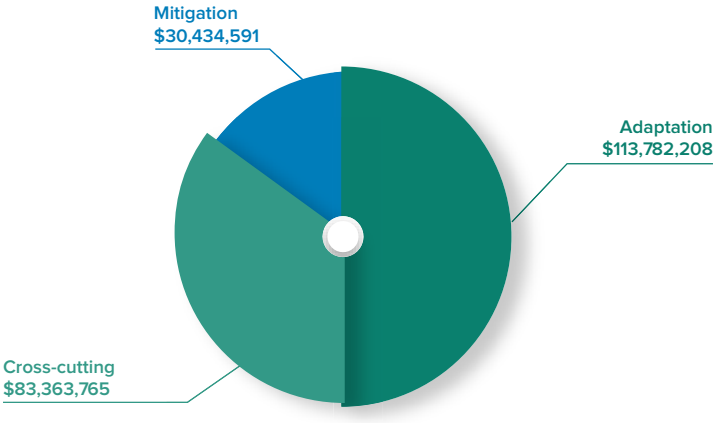


Figure 18: Support received distribution by measure type

The observed trend of adaptation projects receiving more funding compared to mitigation projects does not necessarily reflect a greater interest in adaptation from donors. Instead, it can be the result of the more comprehensive assessment conducted for adaptation within this BTR1 and not for mitigation. This detailed assessment enabled the identification and reporting of a broader range of adaptation projects, especially from non-state actors, in contrast to mitigation efforts, which were not as thoroughly evaluated in this cycle. Moving forward, ensuring a balanced and comprehensive assessment of both adaptation and mitigation efforts will provide a more accurate representation of climate finance flows and donor priorities, allowing for improved planning and resource allocation across sectors.

The sectoral allocation of climate funding in Lebanon (Figure 18) highlights a strategic alignment with the country's vulnerabilities, focusing predominantly on water, waste management, energy, and agriculture

sectors. These allocations are indicative of Lebanon's efforts to address critical climate-induced challenges while optimizing available resources for resilience and sustainability.

The distribution of mitigation interventions across 5 key sectors shows waste management and energy sectors receiving the highest levels of funding while sectors such as transport remain notably underprioritized. As for adaptation interventions, it shows a focus on water, agriculture and forestry. These findings underscore the need for a more balanced allocation of efforts to address Lebanon's mitigation and adaptation objectives more effectively.

During the period 2020-2022, the **water sector** received the highest allocation with USD 68.9 million in funding, emphasizing the importance in addressing water scarcity, inefficient management, and aging infrastructure, all of which are exacerbated by climate change. The higher budgets for water interventions, compared to lower budgets for sectors like agriculture or biodiversity, are mainly related to the intervention types. Most water-related interventions are infrastructure-related, which require substantial investment with projects such as the Greater Beirut Water Supply Project (USD 36.8 million), and the Hawkamaa EU WASH Project (USD 11.2 million) aiming at improving water access, infrastructure, and governance.

The **waste management sector** followed closely with, with USD 32.1 million addressing challenges such as environmental pollution, landfill overflows, the development of sustainable recycling infrastructure, and strengthening governance systems. Initiatives such as the TaDWIR Project (USD 20.7 million), and the DAWERR Project (USD 15 million) highlight the sector's reliance on high-budget infrastructural investments, underscoring the discrepancies between the number of interventions with the allocated funding.

Combined projects in **energy/water/sanitation** mobilized USD 29.4 million, and water/sanitation with USD 21.8 million, indicating a positive increase in the integration of these interconnected systems into broader mitigation and adaptation strategies.

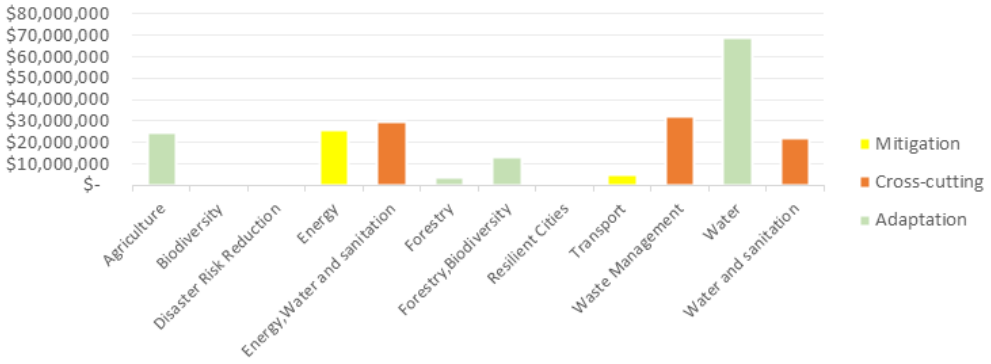


Figure 19: Sectoral allocation of climate funding in Lebanon

The **energy** sector received USD 25.5 million targeting small-scale pilot renewable energy projects and energy efficiency measures aimed at mitigating greenhouse gas emissions and enhancing national energy security. Despite the relatively high number of interventions, the overall funding for energy remains limited relative to its potential for emissions reduction and energy security improvements.

Despite the high level of intervention recorded at the national level (see section 3.3), the **agriculture sector** received a modest USD 24.5 million, primarily supporting improved irrigation and resilient crop practices. The disparity between the number of projects and allocated funding can be attributed to the smaller-scale, localized nature of agricultural projects, which typically require less financial investment per intervention. Examples such as the Water and Energy for Food Grand Challenge (USD 2.35 million)

and the Income Generation through Support to Irrigation Infrastructure in Lebanon (USD 400,000) demonstrate targeted efforts to enhance irrigation and crop resilience. These interventions, while numerous, reflect the sector's focus on building localized capacity and resilience rather than undertaking large infrastructural developments. In addition, the predominance of non-principal interventions in agriculture (based on OECD Markers) could suggest that many initiatives are more focused on enhancing agricultural productivity, supporting rural livelihoods. While these goals align with climate adaptation, they may not explicitly target climate action as a primary aim.

Forestry and biodiversity sectors have been allocated USD 13.4 million of funding tackling mainly deforestation, forest fire risks and restoration of degraded lands. While forestry received focused interventions contributing to carbon sequestration and ecosystem restoration, the overall funding levels do not match the sector's potential to address broader climate risks, with initiatives like the Smart Adaptation of Forest Landscapes in Mountain Areas (SALMA) (USD 7.1 million) and the Food for Asset Project (USD 1.85 million) who have been limited to small-scale interventions. This might imply that conservation and ecosystem protection are often seen as complementary to climate change rather than primary. Numbers of combined forestry and biodiversity projects are witnessing an increase, maintaining and interconnected approach to preserving ecosystems, protecting flora and fauna while sequestering carbon. Forestry-focused projects and biodiversity-specific initiatives have secured funding of USD 3.6 million and USD 1.1 million, respectively. This highlights the limited integration of such projects with climate change objectives, despite Lebanon's status as a biodiversity hotspot experiencing substantial pressures from climate change-induced habitat loss and fire risks. Projects such as the BIOCONNECT Project (USD 1 million) and the STEPping up Nature Reserves Capacity Project (USD 3.37 million) demonstrate efforts to integrate biodiversity conservation into broader climate strategies, but these remain insufficient given the sector's critical importance.

The **transport** sector, with USD 4.9 million, exhibits a significant underrepresentation, despite its role as a major contributor to emissions. The Lebanon Sustainable Low Emission Transport Systems Project, funded at USD 3.7 million, and the EU Zahleh Public Transport Project, funded at USD 1.2 million, reflect limited progress in transitioning to sustainable transport systems.

Resilient cities were allocated USD 1.47 million, indicating insufficient focus on protecting infrastructure and populations in urban areas vulnerable to extreme weather events and flooding.

Similarly, **disaster risk reduction** projects related to climate change recorded a modest funding of USD 703,000, highlighting significant gaps in synergizing disaster and climate-related interventions. This might be linked to donors perception and preference to separate funding between climate and humanitarian projects, as Lebanon's reactive approach to disasters often prioritizing immediate needs rather than long-term planning.

In terms of **disaggregation of funding per funding entity** as presented in Figure 20, the European Union (EU), with USD 53.4 million, stands out as the largest contributor, channeling extensive funds into projects focused on water governance, waste management, and agriculture. Notable projects include the Hawkamaa WASH Project and the TaDWIR Project, emphasizing the EU's critical role in supporting cross-cutting mitigation and adaptation efforts.

USAID follows as a support provider, with funding of USD 55.5 million directed toward water and agricultural resilience projects. Key examples include the Lebanon Water Project, which received USD 16 million, and the DAWERR Project, funded with USD 15 million, both aimed at improving resource management and supporting climate adaptation and mitigation strategies.

The World Bank Group also emerges as a significant contributor, with over USD 50 million allocated to large-scale initiatives such as the Greater Beirut Water Supply Project and the Lake Qaraoun Pollution Project. However, it is important to note that some World Bank funding is provided as non-concessional loans, which adds to Lebanon's debt burden and raises concerns about financial sustainability in the context of its ongoing economic challenges.

Bilateral donors like Germany, Canada, Italy, Norway, also have a notable role in providing financial support across various adaptation and cross-cutting projects, further diversifying the donor landscape. Other entities, such as the Global Environment Facility (GEF) and United Nations agencies, also contribute significantly to Lebanon's climate action framework.

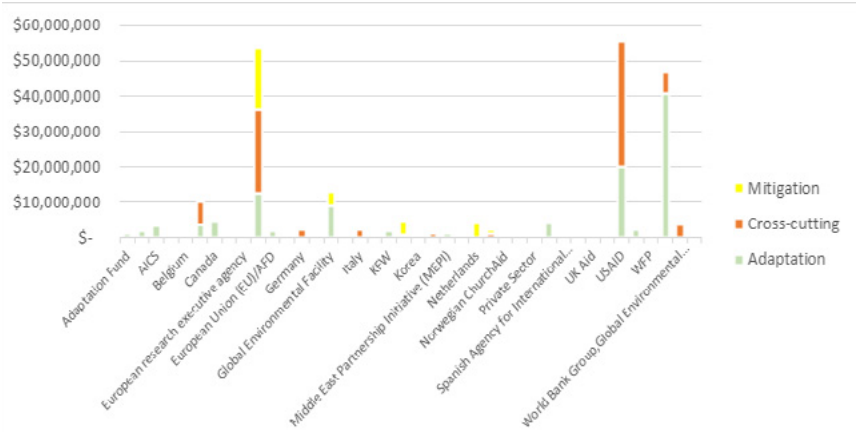


Figure 20: Distribution of support received by funding source

While these contributions reflect strong international partnerships, the data reveals a heavy reliance on multilateral and bilateral donors, with limited evidence of local institutional ownership. This dependence raises concerns about the long-term sustainability of climate initiatives, especially in the absence of robust local frameworks and capacity-building efforts.

Additionally, the funding distribution highlights disparities in sectoral funding, with water governance and waste management receiving substantial investment, while sectors like transport, biodiversity, and dedicated mitigation projects remain underfunded. Addressing these imbalances is crucial to ensuring a more equitable allocation of resources that aligns with Lebanon's national priorities and climate commitments. Strengthening local institutional capacity is essential for reducing reliance on external funding and achieving sustainable climate action in the long term.

Figure 19 presents the financial support received to Lebanon during the period 2020-2022 as per 5/CMA.3 for CTF table III.7 and following the methodology and assumptions described in section 4.2. It is worth noting that projects whose budgets exceed USD 100,000 have been included in the CTF table III.7 due to the high numbers and low impact of the smaller scale projects.

Table 17 - Information on financial support received by developing country Parties under Article 9 of the Paris Agreement (CTF table III.7)

Title of activity, programme, project or other	Channel	Recipient entity	Implementing entity	Amount received (climate-specific) (USD)	Time frame	Financial instrument	Type of support	Sector	Status of activity
Agriculture Farmers Development and Livelihoods – Afdal III	Bilateral	BMZ	WFP	212,346	2022-2024	Grant	Adaptation	Agriculture	Ongoing
Appui aux populations vulnerables en milieu rural a travers la mise en œuvre d'activites de reboisement	Bilateral	AFD	Horsh Ehden Nature Reserve	203,526	2021-2024	Grant	Adaptation	Forestry	Ongoing
Beirut Environment Recovery and Waste Management (LFF/ ENV)	Bilateral	World Bank Group	UNDP	4,000,000	2022-2027	Grant	Cross-cutting	Waste Management	Ongoing
BIOCONNECT Project	Bilateral	European Union (EU)	ACE	1,000,000	2022-2025	Grant	Adaptation	Forestry, Biodiversity	Ongoing
Building a Resilient Food System in Lebanon	Bilateral	AFD	Mada Association	337,160	2018-2022	Grant	Adaptation	Agriculture	Completed
Capacity Building for the Fruits and Vegetables Market in Al-Qalaa Uom	Bilateral	UK Aid	UNDP	105,017	2021-2022	Grant	Adaptation	Agriculture	Completed
CEDRO - Public Schools	Bilateral	Norway	UNDP	1,189,073	2022		Mitigation	Energy	Ongoing
CEDRO-LHSP	Bilateral	Netherlands	UNDP	4,000,000	2017-2019	Grant	Mitigation	Energy	Completed
CEDRO-Post Blast Karantina	Bilateral	European Union (EU)	UNDP	500,000	2019-2023	Grant	Mitigation	Energy	Completed
CEDRO-S4H	Bilateral	KFW, Germany	UNDP	4,000,000	2021-2022	Grant	Mitigation	Energy	Completed
CEDRO-SE4S	Bilateral	European Union (EU)	UNDP	4,000,000	2019-2021	Grant	Mitigation	Energy	Completed
CEDRO-Solarization of GT School	Bilateral	Spanish Agency for International Development Cooperation (AECID)	UNDP	106,120	2022	NA	Mitigation	Energy	Ongoing
CEDRO-V	Bilateral	European Union (EU)	UNDP	8,700,000	2019-2023	Grant	Mitigation	Energy	Completed
CLIMAT2	Bilateral	WFP	ESDU AUB	334,898	2021-2022	Grant	Adaptation	Agriculture	Completed
Community Support Programme (CSP)	Bilateral	USAID	Chemonics Beirut	1,042,984	2015-2025	Grant	Adaptation	Water	Ongoing
Conducting an evidence-based national Non-State Actors Campaign on Marine Protected Areas Network	Bilateral	European Union (EU)	University of Balamand	249,365	2022-2024	Grant	Adaptation	Biodiversity	Ongoing
Contribute to the resilience of vulnerable communities through provision of solar energy systems for water points	Bilateral	UNOCHA	Rene Moawad Foundation	174,435	2022-2023	Grant	Adaptation	Water	Completed
Diverting Waste by Encouraging Reuse and Recycling (DAWERR) Project	Bilateral	USAID	ECODIT	6,000,000	2020-2025	Grant	Cross-cutting	Waste Management	Ongoing
EIIP: Employment creation and enhanced agricultural productivity through construction and rehabilitation of farms	Bilateral	KFW	ILO	1,600,000	2022-2022	UA	Adaptation	Agriculture	Completed

Emergency support to vulnerable smallholder farming households affected by the ongoing economic crisis in Lebanon	Bilateral	Belgium	FAO	200,000	2022-2024	Grant	Adaptation	Agriculture	Ongoing
Employment Promotion Lebanon Project	Bilateral	Germany	Fair Trade Lebanon	144,302	2022-2024	Grant	Adaptation	Agriculture	Completed
Endorse Sustainable Livelihood Development in Vulnerable Communities	Bilateral	BMZ	AFDC	399,431	2022-2022	Grant	Adaptation	Agriculture	Completed
Enhance national food security and support sustainable food systems by increasing the resilience of wheat value chain	Bilateral	Japan	FAO	296,296	2022-2026	Grant	Adaptation	Agriculture	Ongoing
Enhance the use of evidence and science in environmental policy-making and regulation	Bilateral	European Commission	University of Balamand	249,365	2022-2026	Grant	Adaptation	Biodiversity	Ongoing
Enhancing regional climate change adaptation in the Mediterranean Marine and Coastal Areas	Multilateral	Global Environment Facility	UNEP, MAP	144,000	2021-2024	Grant	Adaptation	Resilient Cities	Ongoing
Enhancing the resilience of vulnerable refugee communities	Bilateral	Korea	FAO	500,000	2019-2021	Grant	Adaptation	Forestry	Completed
Enhancing Water Resource Management WAMA	Bilateral	BMZ	GIZ	6,316,155	2022-2025	Grant	Cross-cutting	Water and sanitation	Ongoing
Environmental Rehabilitation through the enhancement Of Integrated waste management - EROI	Bilateral	AICS	UNDP	760,000	2020-2023	Grant	Cross-cutting	Waste Management	Completed
EU Zahleh public transport	Bilateral	European Union (EU)	Economic and Social Fund for Development (ESFD)	1,200,000	2022	Grant	Mitigation	Transport	Completed
Food for Akkar	Bilateral	Monaco	Fair Trade Lebanon, La Coopération monégasque	141,932	2022-2025	Grant	Adaptation	Agriculture	Ongoing
Food For Asset - project to Improve marginalized communities through reforestation and forest management activities	Bilateral	BMZ	AFDC	1,854,343	2019-2021	Grant	Adaptation	Forestry	Completed
Gender-Sensitive Value Chain Analysis of Agri-Food Sector in Lebanon	Bilateral	Canada	FAO	108,688	2020-2021	Grant	Adaptation	Agriculture	Completed
Global Hunger Response	Bilateral	World Vision United States	World Vision Lebanon	119,000	2022-2023	Grant	Adaptation	Agriculture	Completed
Greater Beirut Water Supply Project for Lebanon	Bilateral	World Bank Group	CDR	36,800,000	2010-2025	Non-concessional loan	Adaptation	Water	Ongoing
Hawkamaa-EU WASH assistance to support water governance and public water and wastewater services in Lebanon	Bilateral	European Union (EU)	ACTED	11,201,000	2021-2025	Grant	Adaptation	Water	Ongoing
Implementing the 2030 Agenda for Water Efficiency/Productivity and Water Sustainability in NENA	Bilateral	Sida	FAO	4,000,000	2018-2022	Grant	Adaptation	Agriculture	Completed

Income Generation through Support to Irrigation Infrastructure in Lebanon	Bilateral	KFW	UNDP	400,000	2020-2024	Grant	Adaptation	Water	Completed
Increasing the resilience of displaced persons and host communities to climate change related water challenges	Multilateral	Adaptation Fund	UN Habitat	1,326,460	2021-2025	Grant	Adaptation	Resilient Cities	Ongoing
Labor Intensive Forest Activities with Vulnerable Communities in Lebanon	Bilateral	UK Aid	UNDP	398,784	2020-2021	Grant	Adaptation	Forestry	Completed
Labour Intensive Forest Activities with Vulnerable Communities in Lebanon	Bilateral	UK Aid	UNDP	119,917	2022-2022	Grant	Adaptation	Agriculture	Completed
Lake Qaraoun Pollution Prevention Project (LQPPP)	Bilateral	World Bank Group	CDR	2,000,000	2016-2024	Non-concessional loan	Cross-cutting	Water and sanitation	Ongoing
Land Degradation Neutrality for Mountain Landscapes in Lebanon	Multilateral	Global Environment Facility	UNDP	1,880,000	2020-2025	Grant	Adaptation	Forestry, Biodiversity	Ongoing
Lebanon Sustainable Low-Emission Transport Systems Project	Multilateral	Global Environment Facility	UNDP	3,700,000	2022-2027	Grant	Mitigation	Transport	Ongoing
Lebanon Water Project (LWP)	Bilateral	USAID	DAI Global LLC	16,000,000	2015-2021	Grant	Adaptation	Water	Completed
MENAdrought	Bilateral	USAID	USAID	703,000	2018-2022	UA	Adaptation	Disaster Risk Reduction	Completed
MoEW Financed Solar Projects	Bilateral	Government of Lebanon	LCEC	209,398	2019-2019	UA	Mitigation	Energy	Completed
Operationalize 11 WWTP in Lebanon	Bilateral	European Union (EU)	UNICEF	12,636,600	2021-2026	Grant	Cross-cutting	Water and sanitation	Ongoing
PARSIFAL Project	Bilateral	AFD	University of Balamand	182,600	2021-2025	Grant	Adaptation	Forestry	Ongoing
Prevention of Agrochemical Pollution in the Upper Litani Basin	Bilateral	Norway	FAO	271,287	2019-2023	Grant	Adaptation	Agriculture	Completed
Promoting Sustainable Livelihoods (PSL)	Bilateral	USAID	Rene Moawad Foundation	2,400,000	2020-2025	Grant	Adaptation	Agriculture	Ongoing
Protection and sustainable development of maritime resources (PROMARE) Project	Multilateral	European Union (EU)	European Union (EU)	2,707,248	2020-2024	Grant	Cross-cutting	Waste Management	Ongoing
Provision of Direct Support to Farmer's Cooperative in Qaa	Bilateral	UK Aid	UNDP	105,017	2022-2023	Grant	Adaptation	Agriculture	Completed
Provision of Four Capacity Building Training Packages - Marketing in Various Agri-Food Sectors	Bilateral	Canada	FAO	151,928	2020-2022	Grant	Adaptation	Agriculture	Completed
Qaraoun Depollution Programme (QoDePro)	Bilateral	Government of Lebanon	UNDP	800,000	2022-2024	Grant	Cross-cutting	Waste Management	Ongoing
Recovery of affected marine ecosystems and development of marine and coastal biodiversity	Bilateral	European Union (EU)	University of Balamand	177,399	2018-2021	Grant	Adaptation	Biodiversity	Completed

Reducing Marine Litter in the Mediterranean Through Waste Wise Cities Lebanon (ReMaL) Project	Bilateral	Germany	UN Habitat, Wuppertal Institute	1,924,125	2022-2025	Grant	Cross-cutting	Waste Management	Ongoing
Reduction of UPOPs through Waste Management (UPOPs)	Multilateral	World Bank Group,Global Environment Facility	UNOPS, Ministry of Environment	3,560,000	2022-2026	Grant	Cross-cutting	Waste Management	Planned
REESTART Project	Bilateral	European Union (EU)	LSES, ICU	2,700,000	2019-2022	Grant	Mitigation	Energy	Completed
Rehabilitation and waste management of El-Bared Canal Irrigation System	Bilateral	Norway	FAO	904,215	2020-2024	Grant	Cross-cutting	Water and sanitation	Ongoing
ResAlliance	Bilateral	European research executive agency	Jouzour Loubnan	120,046	2022-2025	Grant	Adaptation	Agriculture	Ongoing
Responding to the WASH Needs in Lebanon	Bilateral	Norwegian ChurchAid	Rene Moawad Foundation	178,824	2022-2022	Grant	Adaptation	Water	Completed
Restauration des surfaces degrades et assistance a la population vulnerable de Rashaya Et Chmestar	Bilateral	AFD	AFDC	535,800	2021-2023	Grant	Adaptation	Forestry	Completed
SEPAL - Services d'Eau Potable Ameliores au Liban Translated title: Improved portable water services in Lebanon	Bilateral	European Union (EU), AFD	UNICEF	1,798,160	2021-2027	Grant	Adaptation	Water	Ongoing
Smart Adaptation of Forest Landscapes in Mountain Areas (SALMA)	Multilateral	Global Environment Facility	FAO	7,147,635	2016-2023	Grant	Adaptation	Forestry, Biodiversity	Completed
STEPping up Nature Reserves Capacity – STEP4Nature	Bilateral	AICS	UNDP	3,368,280	2020-2025	Grant	Adaptation	Forestry ,Biodiversity	Ongoing
Strengthen resilience of refugees and host communities to current and future challenges	Bilateral	BMZ	arche noVa	757,120	2021-2021	Grant	Adaptation	Water	Completed
Strengthening local climate-sensitive and universal WASH capacities	Bilateral	GFFO	arche noVa	532,500	2021-2024	Grant	Adaptation	Water	Ongoing
Strengthening national capacities and regional integration for efficient conservation of plant genetic resources	Bilateral	FAO	ICARDA	435,000	2020-2025	Grant	Adaptation	Biodiversity	Ongoing
Strengthening of Small Lebanese Economic Actors through a Range of Services	Bilateral	AFD	Fair Trade Lebanon	504,764	2022-2025	Grant	Adaptation	Agriculture	Ongoing
Strengthening the resilience and coping capacities of vulnerable rural population in North and East Lebanon	Bilateral	BMZ	Rene Moawad Foundation	400,000	2022-2025	Grant	Adaptation	Agriculture	Ongoing
Strengthening the resilience of vulnerable smallholder farm families	Bilateral	Canada	FAO	1,468,418	2021-2025	Grant	Adaptation	Agriculture	Ongoing
Strengthening Women's Resilience in a Time of Crisis - Women Economic Empowerment and Participation Project	Bilateral	Canada	UNDP	1,016,000	2019-2023	Grant	Adaptation	Agriculture	Completed
Support Business Innovation and Enhance Exports in Lebanon (BIEEL)	Bilateral	Middle East Partnership Initiative (MEPI)	Fair Trade Lebanon	1,200,000	2022-2023	Grant	Adaptation	Agriculture	Completed
Support Marginalized Communities through Agricultural and Agro-food practices	Bilateral	UK Aid	UNDP	200,152	2020-2021		Adaptation	Agriculture	Completed

Support SWM in Jurd el Kayteh and Hasbaya	Bilateral	Italy	AICS	2,240,000	2022-2025	Grant	Cross-cutting	Waste Management	Ongoing
Support to Farmers Affected by the COVID-19 and Financial and Economic Crises	Bilateral	World Bank Group	FAO	4,000,000	2021-2023	Concessional loan	Adaptation	Agriculture	Completed
Support to Women Cooperatives and Associations in the Agri-food Sector of Lebanon	Bilateral	Canada	FAO	1,950,837	2018-2024	Grant	Adaptation	Agriculture	Completed
Supporting construction of SLF	Bilateral	Kuwait	UNDP	1,000,000	2022-2024	Grant	Cross-cutting	Waste Management	Ongoing
Supporting construction of SLF #2	Bilateral	KFW,Germany	UNDP	800,000	2022-2024	Grant	Cross-cutting	Waste Management	Ongoing
Sustainable agriculture and farmer-consumer linkagess	Bilateral	Swiss Solidarity	Swiss Solidarity	120,000	2021-2022	Grant	Adaptation	Agriculture	Completed
Teir Dibba Energy Project	Bilateral	Private Sector	Private Company	130,000	2022-2022	Private Investment	Mitigation	Energy	Completed
Towards a Decentralized Waste Management Integrated Response (TaDWIR) Project	Bilateral	European Union (EU)	UNDP	8,315,421	2022-2024	Grant	Cross-cutting	Waste Management	Ongoing
Vocational Training in Agriculture for Farmers and Youth in Aarsal	Bilateral	Norwegian Refugee Council	Fair Trade Lebanon	159,192	2022-2022	Grant	Adaptation	Agriculture	Completed
Water and Energy for Food Grand Challenge (WE4F) MENA Regional Innovation Hub (RIH)	Multilateral	USAID, BMZ, Netherlands, NORAD, Sida	Berytech	2,355,000	2019-2025	UA	Adaptation	Agriculture	Ongoing
WSC Project	Bilateral	USAID	DAI Global LLC	29,400,000	2021-2027	Grant	Cross-cutting	Energy,Water and sanitation	Ongoing

4.5 Information on technology development and transfer support needed by developing country Parties under Article 10 of the Paris Agreement

The updated Technology Needs Assessment (TNA) of Lebanon, as published in the Fourth National Communication (MoE/UNDP/GEF, 2022) identified and several technologies to support mitigation and adaptation in 4 priority sectors: energy, transport, agriculture, and water.

Based on a long list of potential technologies, a prioritized list (Table 18) was generated by stakeholders following a multi-criteria decision analysis approach based on specific selection criteria such GHG reduction potential, Lebanese context readiness for technology deployment, technology maturity, scalability and economics, technology capital intensity, technology safety, resource predictability, technology deployment time per facility and technology footprint.

Table 18 - Prioritized technologies in the 2022 Technology Needs Assessment

Prioritized Technologies	Technology Updates
Energy sector	
Pumped Hydro Energy Storage (PHES)	The Pumped Hydro Energy Storage (PHES) is a well-established and commercially acceptable technology for utility-scale electricity storage with large volume, long storage period, high efficiency, and relatively low capital cost per unit of energy. PHES requires a hill, pump turbines and two reservoirs of water, one at the top of the hill and another at the bottom. The water reservoirs serve for daily and seasonal energy storage, thus basically solving the energy storage problem. The electrical energy produced in excess by the renewable energy system is converted in potential energy by pumping water to a higher elevation where it can be stored indefinitely and then released as needed to pass through the pump turbines and generate electricity.
Smart grid	Smart grids emerged as a modern alternative to conventional grids, which are often large, inefficient grids that lose power in transmission, requiring an overcapacity of generating capability to cope with unexpected surges in energy use and allow one-way communication only – from provider to customer. The smart grid concept deployment is driven by three technologies: distributed generation, energy storage systems, and demand side management.
Geothermal/ground source heat pumps	Geothermal Energy is a renewable energy where, through proper reservoir management, the rate of energy extraction can be balanced with a reservoir's natural heat recharge rate. Geothermal resources are classified according to their reservoir fluid temperature at 1 km depth into low (< 100°C), medium (100 – 180°C) and high enthalpy (> 180°C). Depending on the geothermal resource temperature, geothermal exploitation could be used for power generation, direct use or for ground source heat pumps.
Transport sector	
Deployment of e-bikes and e-scooters	E-bikes and scooters are emerging as potential alternative means of transportation in cities as they are both powerful and affordable. An e-bike has a rechargeable battery powering an electric motor to help with propulsion. The motor can either assist the rider's pedal power, known as assisted e-bikes or add throttle power, known as motorized e-bikes. A similar technology that offers the same benefits as electric bicycles is electric scooters, which are in general slower than e-bikes, but more affordable.

Electrified freight vehicles	Freight vehicles include light-commercial vehicles, vans, and trucks of different sizes categorized mainly as medium- and heavy-duty vehicles. Though the electrification of heavy-duty vehicles is underway, the focus in this section will be only on market-ready technologies of electrified light-duty vehicles, vans, and medium-duty trucks. Electrified freight vehicles have the potential to significantly reduce GHG emissions if the electricity mix is cleaned up. In fact, all-electric powertrains have zero tank-to-wheel emissions, meaning that well-to-wheel GHG emissions are only associated with those from power generation and transmission.
Agriculture sector	
Free Mobile applications for smart irrigation	Smart irrigation systems are designed to offer the ability to increase water application efficiency at the farm level, thereby reducing the environmental footprint of agriculture (in terms of water and energy use) while also providing farmers with a financial benefit (by decreasing their operational expenses). New mobile applications for smartphones to calculate crop evapotranspiration in real-time are being developed to support field-scale irrigation management. These apps, such as, AgSAT, uses meteorological data to calculate daily water requirements and vegetation indices from satellite imagery to derive the basal crop growth coefficient. They can provide water requirements data to all types of users, from small-holder farmers to irrigation districts and regional water planners.
National Crop Yield monitor	A crop yield monitor is one of the manifestations of precision agriculture. Yield mapping and monitoring is a technology that can help farmers improve agricultural and yield management through providing open, timely, and remote-sensing driven information and data on the major strategic crops (such as potatoes, wheat, and onions) and their conditions to support planning for food security risks. The crop monitor can bring together crop data, agro-meteorological variables such as rainfall and temperature along with biophysical variables (biomass, derived from remote sensing) to generate information about the crop conditions and yield forecasts that can help assess hazards in the agricultural sector.
Evaporative Stress Mapping	Evaporative Stress Index (ESI) aims to quantify temporal anomalies in the ratio of actual water consumption of the crops to that of the potential water consumption over a spatial domain of interest. Mapping evapotranspiration at the field scale is crucial for a better understanding of the factors that limit crop production under a warming climate and dryer weather conditions. Knowledge of what the optimal conditions should be, in comparison to historical patterns, with distinction between rain-fed and irrigated conditions, would be very valuable for quantifying the evaporative stress and consequently advising the most appropriate action.
Water sector	
Smart water metering at district level	Smart water metering improves operations at the water establishments by monitoring water consumption data and logging any unexpected increases from wastage, leakages, and pipe bursts, thereby improving operational and maintenance costs. Analysing data from smart meters will allow for a real-time evaluation of water deliveries and system losses, which can improve fraud detection, increase data collection accuracy, and provide a better overview of water flow distribution in the various districts while allowing to estimate more precise estimate of consumption patterns in different neighbourhoods.

Water efficient household appliances	Water-efficient fixtures and appliances such as low flow faucet aerators, low flow shower fixtures and toilets, in addition to water efficient washing machines and dishwashers can not only save water, but it can also conserve energy used to heat the water. Promoting such appliances can act as a step forward towards a water management practice that will help reduce stress on the aging water infrastructure found commonly in large cities. Using this technology in restaurants, hotels, hospitals, companies, and other community buildings can make a difference in water demand and help in water conservation. In addition, such technologies can change the mindset of the public through increasing awareness of water conservation practices.
Crowd-sensing for pipe bursts and leaks	Mobile crowd-sensing systems are applications that aim to collect and distribute data, using users' mobile devices in a way that will mobilize social interaction, hence reaching the common goal of having sustainable monitoring across communities. Crowd-sensing applications for pipe bursts and leaks aim at detecting and reporting visible leaks/bursts from water systems to ensure their repair as soon as conveniently possible. The app can report the location of the leak, accompanied by a picture which can be analysed to assess the leak or burst pipe diameter, and it can be complemented by smart sensing of flows and pressures in the network. The sharing of such information can subsequently accelerate the repair process and reduce the volume of water loss.

In order to adopt and implement the prioritized technologies suggested under the TNA, Lebanon needs support to overcome the financial, technical, social, regulatory and human challenges presented in the below Table 19 to Table 22.

Table 19 - Summary of barriers to the suggested technologies for the energy sector

Category	Pumped Hydro Energy Storage (PHES)	Smart Grid	Ground Source Heat Pump (GHSP)
Financial/ economic	High development costs of PHES projects are major deterrents to developers. Market uncertainty, lack of long-term stable policies and regulations for free market tariffs. Lack of Feed -in Tariff.	Lack of financial resources. Long investment payback period compared to the high initial investment. Market uncertainty - Lack of long-term stable policies and regulations for free market tariffs.	High capital cost of GSHP systems. The economic recession hinders the ability of builders to raise high capitals.
Technical	Technical viability dependent on a sufficient price differential between the generation price and the pumping costs to pay for the pumping, repay the heavy capital investment, and account for the efficiency losses in transmission, pumping and generation. National Control Center (NCC) not operational – requires rehabilitation and upgrade	Lack of proper infrastructure. Technology immaturity. Integration of the grid with large scale renewable generation. Lack of coordination between electric energy and telecom agencies. Potential weaknesses concerning worms, viruses, malware, etc. in the smart grid communication system. National Control Center is not operational – requires rehabilitation and upgrade Lack of 24-hour service of electricity. EDL corporate structure is not adapted for effectively managing a smart grid system.	Need for highly skilled system constructors. Lack of marketing by installers and manufacturers of GSHPs. Reluctance by builders to deviate from conventional air conditioning systems. Lack of studies on the GSHP potential in Lebanon.

Regulatory	Lack of appropriate definition for storage as most electrical systems are conceived under a traditional paradigm long ago and are based on obsolete regulation. The stakeholders currently operating the existing hydro facilities and dams do not have Energy Storage in their legal scope.	Lack of Feed-In Tariff.	Lack of policymaker and regulator knowledge of and/or trust or confidence in GSHP system benefits.
Social	Competition over land as the required land can be used for other purposes and requires transmission lines to connect to the electricity market.	Lack of innovation in the industry. Reluctance of the industry for the introduction of new methods maintaining tradition for safe and guaranteed return for investment.	Lack of public awareness and confidence on the GSHP technology potential and benefits.

Table 20 - Summary of barriers to the suggested technologies for the transport sector

Category	E-bikes or bicycles	Electrification of freight transport
Financial	Lack of incentives and subsidies for the purchase of e-bikes, causing conflict with the current tax scheme which reaps tax revenue from fuel imports and car purchases. High implementation cost of e-bike systems with dedicated lanes.	Inappropriate financial incentives and disincentives, which, in their current form, favor diesel and gasoline freight vehicles. High initial cost of electric freight vehicles compared to traditional ones.
Technical	Insufficient availability of charging stations restricts the use of e-bikes. Limited battery range of e-bikes in hilly or long-distance areas. Hilly topography in many parts of Lebanon requires advanced e-bike models with higher torque, which are often more expensive.	Lack of a widespread and reliable network of charging stations for freight vehicles, particularly along major highways and industrial areas. Limited range of electric freight vehicles, especially for long-haul transport Increased demand for electricity from freight electrification putting strain on the power grid, especially during peak hour Lack of compatibility with existing freight management systems and infrastructure, requiring costly upgrades.
Regulatory	Absence of specific laws and regulations governing the use of e-bikes and bicycles, leading to unclear rules about their operation on public roads. Current urban planning and road infrastructure laws do not prioritize cycling, limiting the allocation of safe lanes or shared spaces for bicycles and e-bikes.	Insufficient legal and regulatory support to deploy electrified freight vehicles and their charging systems, as the deployment of electrified freight vehicles goes against the interest perceived under the current tax system. Absence of a sustainable transport policy, along with the poor market demand for electrified vehicles in general, and for the freight transport sector in particular.
Social	Lack of a sense of safety when riding on local roads, due to the lack of dedicated cycle lanes and regulations to protect cyclists and reduce the risk of accidents.	

Table 21: Summary of barriers to the suggested technologies for the agriculture sector

Category	Smart Irrigation Applications	National Crop Monitor	Evaporative Stress Mapping
Financial	High training and dissemination cost: Cost of continuous field validation, surveys, and data monitoring; Cost of training for new personnel; Costs for training. Difficulty in allocating the necessary budget for research and development and demonstration plots and extension.	High cost for the development of the monitor and for field validation. Difficulty in allocating the necessary budget for research and development and demonstration plots and extension.	High cost for the development of the map and for field validation. Difficulty in allocating the necessary budget for research and development and demonstration plots and extension.
Technical	Lack of technical expertise at farmer level. Lack of irrigation management scheme at MoA, extension services and farmers levels. Low internet coverage/slow internet in some agricultural areas (Akkar, Bekaa). Lack of consistent power supply.	Lack of technical expertise at the Ministry level. Lack of crop modeling skills. High uncertainties on data or/ and model since crop yield monitors require input from the farmers on planting and harvest dates. Lack of bookkeeping: most farmers do not keep records of their farming practices.	Lack of technical expertise at the Ministry level. Difficulty of field validation (AI techniques, crop classification).
Social	Low confidence in technology amongst farmers.	Low confidence in technology among farmers.	Low confidence in technology among farmers.
Human	Lack of farmers of know-how. Low literacy rate. Lack of remote sensing and digital skills.	Lack of remote sensing and GIS skills for data processing.	Lack of digital skills.
Information and Awareness	Lack of capacity building. Lack of extension services, and awareness.	Lack of capacity building. Lack of extension services, and awareness.	Lack of capacity building. Lack of extension services, and awareness.

Table 22 - Summary of barriers to the suggested technologies for the water sector

Category	Smart Water Metering/SCADA at the sub-district level	Water-efficient household appliances	Crowd-sensing application to detect and report leakages
Financial	High deployment costs for upgrading traditional flow meters or purchasing new ones. High cost of telecommunication related to big data.	Incremental cost of water efficient technologies.	High cost of developing the application.
Technical	High infrastructure requirements to support smart metering. Lack of structured databases to support decision making. Inter-operability, compatibility and standardization issues with existing systems. Weak communication signals in some locations. Power cabling challenges in confined locations.	Maintenance and sustainability of the equipment. Absence standards and labelling programs for import and local production. Difficulty in retrofitting old houses and replacing inefficient fixtures,	Monitoring and Data management systems. GIS online will automatically be linked to the geolocation of the image. Slow response time for intervention.
Social	Difficulty of access of water establishment staff in some areas due to security issues.	The unwillingness of consumers to invest in replacing the traditional fixtures by water-efficient ones. Prioritization of low-cost water fixtures for real estate developers and contractors.	Lack of trust between the water establishment and people.

Legal	Lack of analysis of existing data and link it to decision making. Lack of implementation of existing laws.	Lack of tax incentives for green equipment. Absence of consumption-based water tariffs.	
Human	Lack of staff for data management and sharing. Weak technical skills for utility workers to manage information systems.		Lack of staff for replying to reporting alerts. Lack of technical staff to repair leaks and bursts.

Based on the previously reported barriers, the technology needs assessment report proposes specific technology action plans to accelerate the deployment of appropriate technologies for mitigation and adaptation, as presented in Table 23 to Table 26. Full technology action plans are detailed in the fourth national communication (MoE/UNDP/GEF, 2022).

Table 23 - Summary table of the technology action plan - the energy sector

	Pumped Hydro Energy Storage (PHES)	Smart- Grid	Ground Source Heat Pump (GHSP)
Measures for technology deployment	Explore the use of existing reservoirs, underground caverns, or the sea as a lower reservoir to mitigate the high costs and long period associated with the conditioning of difficult sites and the absence of infrastructure. Equip PHES facilities with variable speed and reversible pump turbines to increase operational flexibility and support the integration of variable renewable generation. Frame power utility related policies and procedures to ensure compliance with legislative or regulatory requirements for PHES technologies implementation. Adapt a legal framework and amend existing laws or decrees to the PHES concept. Regulate Energy Storage Markets and the complex dynamics in which energy is traded in a well-defined business model that is attractive to banks and investors. Operationalize and modernize the NCC. Attend to environmental and social issues associated with PHES projects, such as the potential use of wastewater in PHES applications to improve water quality through aeration, improved through campaigns of public information, consultation and communication with local communities, and referencing successfully completed and attractive projects.	Provide sufficient proofs for justification for high investments and ensure guaranteed return to systematic payback schemes, supported by public incentives, and subsides. Design a business model of smart grids that does not accommodate subsidies and requires having a tariff structure that reflects the real costs, accommodate marginal capacity costs, high cost of peak loads, time of day tariff etc. Develop an integrated complex system to guarantee the appropriate interconnection amongst large number of dissimilar distribution networks, power generating sources and energy consumers. Operationalize and modernize the NCC. Provie a 24-hour service to enable effective demand side management that relies on the ability to shift loads as needed to optimize the use of the electrical system. Upgrade utilizes human resources, administrative structure, and communication structure in view of enabling effective management of smart grid systems. Frame utilities policies and procedures to assure compliance with legislative or regulatory requirements for smart grid technologies implementation. Provide additional infrastructure including a well-defined communication infrastructure, sensors, intelligent electronic devices, distributed energy resources, cyber security devices, advanced metering systems and other end-user devices.	Provide adequate subsidies or tax exemptions for the installation of GSHP systems. Assemble independent, statistically valid, hard data on the costs and benefits of GSHPs. Include GSHP systems in renewable portfolio standards and goals and related environmental initiatives. Install demonstration systems in governmental buildings and public awareness activities on the technology and its benefits. Provide training of highly skilled system constructors to give confidence in technology. Organize awareness campaigns to decision makers, homeowners, commercial institutions and real estate developers. Invest in studies and data collection to give confidence in the sector and lay the ground for developing the GSHP market.

Table 24: Summary table of the technology action plan - the transport sector

	e-bikes and scooters	Electrification of freight transport
Measures for technology deployment	Provide financial incentives by exempting e-bikes from customs duties and fees and offering a yearly "sustainable transport allowance" for citizens based on the kilometers traveled using e-bikes. Develop market infrastructure by reserving dedicated lanes for e-bikes and bicycles in the Greater Beirut Area (GBA) and major cities and constructing accessible e-bike stations with ramps for people with limited mobility. Strengthen supply channels by ensuring the availability of e-bikes through the development of robust supply chains and maintenance infrastructure. Establish a regulatory framework by setting clear regulations for e-bike operations to reduce accidents, enforcing urban planning reforms, and lowering speed limits in urban areas to enhance rider safety. Enhance Institutional Capacity by recruiting specialized maintenance technicians and management staff to manage and optimize e-bike operations and services. Increase public awareness by launching dedicated media campaigns to inform citizens about the ecological and economic benefits of e-bikes and promote sustainable transportation options.	Provide financial incentives by reducing registration fees and loan interest rates for hybrid and electric vehicles and offering banking facilities to help maintenance technicians purchase necessary equipment. Introduce disincentives for non-efficient vehicles by increasing road usage and registration fees for high fuel-consuming imported pre-owned vehicles and gradually reducing the maximum allowable age for imported pre-owned vehicles. implement a vehicle scrappage program by creating incentives for retiring old trucks and vans and establishing vehicle termination plants to manage the disposal process. Establish coherent tax and emission policies by adopting tax policies that penalize polluters with higher road usage fees, updating vehicle inspection programs for hybrid and electric vehicles, and enacting legislation to govern vehicle emissions. Strengthen institutional capacity and promote R&D by supporting institutions like LIBNOR in developing technical standards, encouraging local spare parts manufacturing, and providing incentives to universities and R&D institutions focused on transport technologies.

Table 25 - Summary table of the technology action plan - the agriculture sector

	Smart Irrigation Applications	National Crop Monitor	Evaporative Stress Mapping
Measures for technology deployment	Conduct training sessions and fieldwork. Conduct experimental studies at the research institutes and farm level. Conduct field days and visits to demonstration plots, seminars, and TV programs. Lobby to get ministerial support to shift from fixed irrigation tariff in LRA to volumetric tariff. Create special packages for internet usage. Prioritize internet delivery systems in farmers areas.	Acquire the necessary funding from donors. Set up and develop the crop monitor. Initiate crop survey. Conduct training sessions for Ministry Personnel on data analytics. Maintain ongoing assessment and validation.	Acquire the necessary funding from donors. Set up and develop the evaporative stress mapper. Conduct training sessions for Ministry Personnel on data analytics. Conduct ongoing assessment and validation. Integrate advanced precision farming and digital agriculture in curriculum of agricultural schools.

Table 26 - Summary table of the technology action plan - the water sector

	District Smart Metering	Water saving devices	Crown-sensing
Measures for technology deployment	Identify districts of interest and install the meters to improve water measurement and service delivery of water establishments. Conduct test logging, power and communication and establish platforms at establishments to set up a communication protocol and data center at the establishments for streamlining the data from the meters into the platform. Develop a guiding manual for integrating data and analytics from smart meters into the operational regime of the establishments to enable the effective utilization of smart meter data in the daily and strategic operations of the establishments.	Conduct market assessment of water-efficient devices in Lebanon, status of standards and the current share of water efficient devices in the market, assess the potential and requirements for their market expansion and evaluate status of standards and regulations. Disseminate Decree 167 on customs duty abatement for environmental goods to increase the application rate on water saving appliances and to create a parallel competitive market to traditional ones and lower the cost on the consumer. Develop /update building codes for green certification for incorporating water conservation into designs to ensure the adoption of water efficient fixtures in new buildings. Organize awareness campaigns through seminars, radio, and TV programs, as well as social media campaigns. Build the capacity of plumbers and students in technical schools to pave the way for a new generation of water saving fixtures and phase out the use of traditional ones.	Develop the crowd-sensing application and link it to the hotline service at the water establishments and at the Ministry. Develop and launch a marketing campaign through social media and TV/radio programs. Build capacities of the water establishment personnel to be able to dedicate personnel for analyzing the data and coordinating repair effort.

4.6 Information on technology development and transfer support received by developing country Parties under Article 10 of the Paris Agreement

Lebanon is not reporting information on support received for technology development and transfer due to the lack of disaggregated information in addition to time, budget and personnel limitations.

Lebanon plans to undertake a specific exercise to devise a national methodology for tracking technology transfer including in selecting criteria for defining a project under technology support and monetizing technology transfer, and accordingly track such support received in its subsequent BTRs.

4.7 Information on capacity-building support needed by developing country Parties under Article 11 of the Paris Agreement

Lebanon recognizes the transformative power of education and skills development in driving climate action and is committed to building human capacity through education, training, and public awareness initiatives. The Ministry of Environment is actively fostering climate leadership among youth by participating in a Climate Youth Negotiator Training program, which has so far empowered 12 young Lebanese participants with the skills to engage effectively in international climate negotiations. Furthermore, under the GCF NAP project, Lebanon is developing an executive-level course and a specialized climate change adaptation module tailored for both technical and non-technical audiences.

However, significant support is still needed to further upgrade skills and build capacities for effective climate change mitigation and adaptation. Priority areas for capacity building include developing technical expertise in greenhouse gas inventory management, enhancing skills in climate-resilient agricultural practices, strengthening disaster risk reduction planning, and improving access to and utilization of climate finance. Additionally, capacity-building efforts must address the flexibility provisions outlined in the Biennial Transparency Reports (BTR), enabling Lebanon to meet reporting requirements effectively

while accounting for its unique circumstances. Support for these initiatives could take the form of targeted training programs, technical assistance, access to global knowledge-sharing platforms, and the establishment of specialized centers for climate research and innovation. These efforts would ensure Lebanon's workforce and institutions are better equipped to address the challenges posed by climate.

As part of an extensive study on Lebanon's climate adaptation efforts, stakeholder surveys and consultations were conducted to assess the country's capacity-building needs and the support received to date. This analysis, derived from qualitative and quantitative data in the report, underscores the vital role of capacity building in addressing Lebanon's climate vulnerabilities.

The findings reveal that 91% of stakeholders, mostly non-state actors, identified capacity building as a top priority for enhancing climate adaptation and resilience. Key areas requiring improvement include community engagement and mobilization, ecosystem-based adaptation strategies, and technical expertise in managing climate finance and implementing adaptation measures. Despite these identified needs, significant gaps persist in technical skills, data sharing, and coordination among relevant actors.

Support received to address these challenges includes various workshops, training programs, and targeted initiatives such as the National Adaptation Plan (NAP) Readiness Project. These efforts focus on strengthening governance structures, improving institutional coordination, and enhancing technical capacity at both national and local levels.

4.8 Information on capacity-building support received by developing country Parties under Article 11 of the Paris Agreement

Lebanon is not reporting information on support received for capacity building due to the lack of disaggregated information in addition to time, budget and personnel limitations.

4.9 Information on support needed and received by developing country Parties for the implementation of Article 13 of the Paris Agreement and transparency-related activities, including for transparency-related capacity-building

Lebanon has received diverse support to advance its transparency-related activities under the Enhanced Transparency Framework (ETF). Table 27 summarizes key projects and programs that have contributed to capacity building, institutional strengthening, and technical assistance in alignment with Lebanon's commitments to the UNFCCC and the Paris Agreement. This includes efforts such as the preparation of national communications and biennial reports, enhancing climate resilience planning, and developing robust Measurement, Reporting, and Verification (MRV) frameworks. As well as the establishment of Lebanon's Transparency Framework with funding from the Global Environmental Facility.

Table 27 - Information of support received by developing country Parties for the implementation of Article 13

Title of activity, programme, project or other	Objectives and description	Time frame	Recipient entity	Channel	Amount USD	Status of activity
Enabling activities for the preparation of Lebanon 4NC and BUR3	Prepare and submit Lebanon's third biennial update report and fourth national communication	2019-2023	Global Environment Facility	Multilateral	852,000	Completed
Nationally Determined Contribution Support Programme (NDCSP)	Enhance NDC implementation and synchronization with SDGs - Increase mitigation investment by the public and private sectors - Mainstream gender in NDC	2018-2021	European Union (EU), Germany, Spain	Multilateral	802,500	Completed
Climate Promise 2.0	Support the development of a private sector-oriented investment mechanism for NDC financing. The project also supports the development of Lebanon's low emission climate resilient strategy LTS-LEDS, with youth and gender participation.	2020-2024	UNDP	Multilateral	743,040	Completed
Strengthening and enhancing Lebanon's institutional arrangements and capacity to enable and optimize access to the GCF	Building the capacities of the Nationally Designated Authority to engage with the Fund - Develop a Country Programme -Design and adopt a No Objection Procedure (NOP)	2020-2022	Green Climate Fund	Multilateral	828,159	Completed
Technical Advisory Services for the Preparation of GCF country Programmes	Technical assistance to - Study the macro-economic risk profile from climate change - Study greenhouse gas emissions' scenarios up to 2050 - Develop a climate risk profile for Lebanon	2020-2021	Green Climate Fund	Multilateral	50,000	Completed
Increased climate resilience planning for municipal water resources in Lebanon	Enhance Lebanon's climate resilience through strengthening governance, institutional coordination, and evidence-based planning while building the capacity of national and local stakeholders to mainstream CCA into planning and access climate finance.	2023-2027	Green Climate Fund	Multilateral	1,936,960	Ongoing
Establishing Lebanon's Transparency Framework - Capacity Building Initiative on Transparency	Establish MRV framework in Lebanon, strengthening governance structures, institutional capacities, and data collection mechanisms to enhance national transparency and compliance with the Paris Agreement.	2022-2025	Global Environment Facility	Multilateral	990,000	Ongoing
Lebanon's First BTR and a combined 5NC/ BTR2	Assist Lebanon in the preparation and submission of Lebanon's BTR1 by 2024 and 5NC/BTR2 by 2026 to the UNFCCC.	2023-2027	Global Environment Facility	Multilateral	1,233,000	Ongoing

5. Information on flexibility

Due to time limitations, data unavailability and capacity constraints, Lebanon is using several flexibility provisions for this BTR, as presented in Table 28 .

Table 28 - Flexibility provision used for Para 82 of the MPGs

Flexibility provision	Capacity constraints	Planned improvements	Self-determined estimated time frames
GHG inventory-time-series consistency	Time and technical constraints hinder the migration of the 1994-2022 time-series between the 2 versions of the IPCC software	Migrate 1994-2022 time-series into new version of IPCC software.	BTR2 - 2026
Estimates of expected and achieved GHG emissions reductions	Limited time resources to calculate Emission reduction and submit BTR1 by December 2024.	More time will be allocated to estimate emissions reductions.	BTR2 - 2026
	Data unavailability for correctly estimating emissions reductions relevant to a policy or measure.	Data gaps and indicators will be identified and validated with key stakeholders.	BTR2 - 2026
	No financial resources to develop and track indicators related to specific policies.	Determine methodologies to develop policy indicators.	BTR3-2028
	No accurate information is available to estimated expected GHG emissions reductions from the domestic policies.	Determine methodologies track domestic policies.	BTR3-2028
GHG emissions projections	Given national circumstances and capacities, and due to time and capacity constraints Lebanon is did not prepare any study on GHG emission projection.	Conduct study on GHG emissions projection.	BTR2 - 2026

6. Improvements in reporting over time

Lebanon acknowledges key areas for improvement in its implementation of Article 13 of the Paris Agreement, particularly in data management, institutional coordination, and technical capacity. The lack of a centralized system for collecting and managing climate-related data has led to inconsistencies and gaps, while limited inter-agency collaboration hinders the flow of information and the tracking and implementation of climate policies.

To address these challenges, Lebanon intends to enhance its transparency framework while integrating a Monitoring, Reporting, and Verification (MRV) system to centralize data collection, organization, and archiving across sectors. Furthermore, Lebanon is investing in capacity-building initiatives to enhance technical skills in climate reporting and policy implementation.

Through the progressive preparation of the 4 BURs, Lebanon has prepared itself to transition to Biennial Transparency Reports (BTR), as per the Modalities, Procedures and Guidelines (MPG) for the transparency framework referred to in Article 13 of the Paris Agreement. In addition, challenges have been compiled

through the International Consultation and Analysis (ICA) process of the BUR4 in order to improve Lebanon's reporting (Table 29). Most of these listed challenges are still valid. However, given the iterative nature of submissions under the UNFCCC, improvements are always possible, especially in light of the newly adopted MPGs, with which Lebanon is planning to comply.

Table 29 - Challenges hindering complete and transparent reporting

Challenges	Description
Data collection	Lack of information on the extent to which the existing arrangements allow for the ongoing collection and management of cross-sectoral data for preparing the national reports. Lack of data for reporting a complete GHG inventory, including emissions from private generators, and emissions from solvent use, fire protection and electrical equipment. Untraceable finance flows from central and subnational government and the private sector. Lack of disaggregated financial data per source of funding, the type of support (grant, loan, concessional loan, guarantee etc.), percent of disbursement, etc. Lack of disaggregated data on separate support received for capacity building technical assistance and technology transfer.
Institutional arrangements	Limited time, financial and human resources to undertake specific mapping of support received and needed. Weak institutional arrangements to periodically identify and report support received and needed. Limited awareness and understanding of climate action goals among implementing agencies led to underreporting or misclassification of projects using the Rio markers. Absence of a national donor coordination mechanism to track support received for donor agencies.
Definition and methodology synchronization	Weak definition of climate finance or an understanding of estimating the incremental cost/budget of climate change mitigation and adaption benefits. Incomplete or inconsistent financial data hindered comprehensive analysis and classification for the Rio markers. Differences in project design and documentation across sectors required extensive cross-verification to ensure accuracy. Absence of an established methodology for identifying and tracking capacity-building or technology transfer related to climate change.
Progress tracking	Absence of specific indicators assess the effectiveness of climate finance, and its related progress towards lowering greenhouse gas emissions or increasing resilience.

Although some improvements have been made since Lebanon's BUR4 (as presented in Table 30), the country has yet to enhance its capacity to track and report with respect to mapping domestic and international climate finance flows, clarifying the support received, identifying support gaps, enhancing related decision-making and ultimately supporting Lebanon's NDC implementation.

Table 30 - Improvements made in the previously identified gaps related to tracking of support needed

Improvements planned	Improvements implemented
Identify and characterize climate change projects at the national level in order to improve knowledge on the tracking of climate change financial resources.	Partially, to the extent reflected throughout BTR1.
Develop and implement clear criteria to differentiate climate from non-climate funding of projects.	Yes, using the Rio Markers methodology. Non-climate related projects were not included in the report support received.
Quantify the support aimed at climate change within projects that have only one component relevant to climate change.	Partially, using the Rio-markers methodology.
Enhance the methodology for the data gathering and reporting process.	Partially, through establishing a transparency framework and institutional arrangements under CBIT project.
Improve the capacity of the technical staff responsible for providing data.	Yes, through training of members of the sectoral task forces on tracking and reporting indicators under the CBIT project.
Map roles and responsibilities of relevant actors and defining their roles in the data gathering/reporting process in order to avoid duplication and/or inconsistencies between actors.	Yes, through establishing a transparency framework and institutional arrangements under CBIT project.

As a developing country using flexibility provisions described in section 5, Lebanon aims to gradually reduce reliance on these provisions by implementing sector-specific data protocols and improving data accuracy. The country is also seeking international support to enhance its MRV system and build institutional capacities, strengthening its overall transparency framework and fulfilling its commitments under the Paris Agreement.

7. Any other information the Party considers relevant to the achievement of the objective of the Paris Agreement, and suitable for inclusion in its biennial transparency report

Lebanon recognizes the importance of gender mainstreaming in achieving the objectives of the Paris Agreement. However, significant improvements are needed to understand how gender roles and dynamics influence and are influenced by climate change. This understanding is critical for designing inclusive and effective climate policies. To address this gap, there is a pressing need to gather data on the intersection of gender and climate change to collect relevant data such as:

- Share of women and men in rural/urban population
- Share of men and women working in each sector (agriculture, industry, energy, forestry, transport, public institutions)
- Distribution of men and women by type of activity and position (managerial, assistant, director, etc.)
- Type of unpaid activities and time spent for each activity by sex
- Number and percentage of landowners by sex
- Behavioral studies on water use, transportation pattern, food consumption, etc. by sex
- Level of education by sex and area of residence (urban / rural areas)
- Access to loans and financial possibilities for renewable energy by sex

Besides the need to have sex disaggregated data available, the following capacity building needs are also needed:

- Strengthen the capacities of public institutions in general and gender focal points in particular to mainstream gender in climate change mitigation/adaptation
- Increase awareness on the linkages between climate change and gender
- Review climate related policies, especially the NDC, and mainstream gender in them to the extent possible
- Allocate specific budget lines in ministries and projects to work on linkages between climate change and gender
- Involve women as a vulnerable group in climate change mitigation and adaptation planning

References

Abdallah, C., & Serhal, A. (2019). Risk Assessment to Facilitate Planning for Disaster Risk Reduction and Climate Change Adaptation in Agriculture. Food and Agriculture Organization (FAO) and Ministry of Agriculture (MoA), Lebanon

Al Sayah, M. J., Sarkissian, R., & Abdallah, C. (2022). Review of recent events in Lebanon (2011-2020) and their effect on land degradation. UN-Habitat. https://arablandinitiative.gltn.net/sites/default/files/2023-03/review-of-recent-events-in-lebanon-2011-20-and-their-effect-on-land-degradation_30nov2022.pdf

CAS (2022). Lebanon Follow-up Labour Force Survey January 2022. Beirut, Lebanon: Central Administration of Statistics

CBD (2024). Lebanon - Country Profile. https://www.cbd.int/countries/profile?country=lb

D'Amato, G., Holgate, S. T., Pawankar, R., Ledford, D. K., Cecchi, L., Al-Ahmad, M., ... & Annesi-Maesano, I. (2015). Meteorological Conditions, Climate Change, New Emerging Factors, and Asthma and Related Allergic Disorders. A statement of the World Allergy Organization. World Allergy Organization Journal, 8(1), 1-52.

EDL (2023). Electricity Production and Fuel Consumption Data for EDL Powerplants and Barges. Offical communication.

El Murr (2023). Three Years After the Beirut Explosion: Where Does Lebanon's Disaster Management Stand? The Public Source. https://thepublicsource.org/lebanon-disaster-risk-preparedness

EM-DAT (2024). EM-DAT Platform. https://public.emdat.be/logout

ESCWA (2024). RICCAR Regional Knowledge Hub: GIS platform. Retrieved [insert retrieval date], from https://gis.riccar.org/index.html?domain=mashreq. accessed 1 November 2024

ESCWA (2024a). Climate-proof watershed management design and resilience package: Nahr el Kabir basin. https://www.unescwa.org/publications/climate-proof-watershed-management-design-resilience-nahr-kabir-basin

FAO (2024a). Lebanon at a Glance. https://www.fao.org/lebanon/our-office/lebanon-at-a-glance/en

FAO (2024b). Reforestation and afforestation efforts in Lebanon: A restoration success story. https://www.fao.org/neareast/news/stories/details/reforestation-and-afforestation-efforts-in-lebanon--a-restoration-success-story/en

ILO/FAO (2020). Skills Development for Inclusive Growth in the Lebanese Agriculture Sector - Policy Brief. https://doi.org/10.4060/cb2457en

IPCC (2000). Good practice guidance and uncertainty management in national greenhouse gas inventories. Pennman J., Kruger D., Galbally I., Hiraishi T., buruhani N., Emmanuel S. et al. (Eds). Japan: Institute for Global Environmental Strategies.

IPCC (2003). Good Practice Guidance for Land Use, Land-Use Change and Forestry. Hayama, Kanagawa, Japan: Institute for Global Environmental Strategies (IGES).

IPCC (2006). Chapter 2.3: Mobile Combustion. In 2006 IPCC Guidelines for National Greenhouse Gas Inventories. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Maddah, L. & Darwish, S. (2023). The Road to Recovery for Lebanese Agriculture. Lebanese Center for Policy Studies. https://www.lcps-lebanon.org/en/articles/details/4821/the-road-to-recovery-for-lebanese-agriculture

MedECC (2020). Climate and Environmental Change in the Mediterranean Basin: Current Situation and Risks for the Future. Union for the Mediterranean, Plan Bleu, UNEP/MAP.

MoA (2015). The National Forest Program (2015–2025). Beirut, Lebanon: Government of Lebanon

MoA (2020). Lebanon National Agriculture Strategy (NAS) 2020–2025. Beirut, Lebanon: Ministry of Agriculture.

MoE (2021). Updated Nationally Determined Contribution under the Paris Agreement. Beirut, Lebanon: Ministry of Environment

MoE (2023a). National Strategy for forest fire risk management in Lebanon: updated version (COM Decision 45/2023). Beirut.

MoE (2023b). National Integrated Solid Waste Management Strategy. Beirut, Lebanon: Ministry of Environment

MoE (2024). Lebanon's Green Climate Fund Country Programme. Beirut.

MoE/UNDP/GEF (2022). Lebanon's Fourth National Communication to the UNFCCC. Beirut, Lebanon.

MoE/UNDP (2025). A Pathway towards a Climate Resilient Economy: Lebanon's Long-Term Low-Emission Development Strategy (LT-LEDS)

MoE/UNDP/GEF (2022a). Vulnerability and Adaptation of Health Care Service Providers and lessons learned from COVID-19 Crisis. Beirut, Lebanon.

MoE/UNDP/GEF (2024), Lebanon's National Greenhouse Gas Inventory Report . Beirut, Lebanon

MoE/UNEP/GEF (2016). Lebanon's National Biodiversity Strategy and Action Plan. Ministry of Environment, Beirut.

MoEW (2022). Setting Lebanon's Electricity Sector on a Sustainable Growth Path. Beirut, Lebanon: Ministry of Energy and Water

MoEW (2024). The National Water Sector Strategy (2024-2030). Beirut, Lebanon: Ministry of Energy and Water.

MoEW/EDL/WB (2021). World Bank, Electricité du Liban, & Ministry of Energy and Water. (2021). Lebanon Least Cost Generation Plan. Beirut, Lebanon.

ND-GAIN (2024). ND-GAIN Country Index: Lebanon. Notre Dame Global Adaptation Initiative - University of Notre Dame. Retrieved from https://gain-new.crc.nd.edu/country/lebanon

Nuwayhid et al. (2022). Disaster Management in Lebanon: Time to Break the Deadlock. In: A Dynamic and Responsive Needs Assessment (DARINA) – A Khaddit Beirut Sustainable Model for Rebuilding Lebanon. Khaddit Beirut & TBHF. Beirut, Lebanon. https://bpb-eu-w2.wpmucdn.com/sites.aub.edu.lb/dist/9/287/files/2024/02/Environment-Report-bd79c10ac24e50d0.pdf

UNDP (2014). Assessment of Groundwater Resources of Lebanon. United Nations Development Programme

UN-Habitat (2024). Urbanization in Lebanon: Building inclusive & sustainable cities. https://unhabitat.org/lebanon

World Bank (2017). Droughts and Agriculture in Lebanon Causes, Consequences, and Risk Management. https://documents1.worldbank.org/curated/pt/892381538415122088/pdf/130405-WP-P160212-Lebanon-WEB.pdf

World Bank (2020). Lebanon Power Sector Emergency Action Plan. Washington, DC: World Bank Group.

World Bank (2024a). Lebanon Economic Monitor: The great collapse. World Bank Group.

World Bank (2024b). Lebanon Country Climate and Development Report (CCDR): Aligning recovery with resilient and low-carbon development. World Bank Group

Yared (2023). Water Scarcity in Lebanon: The Edge of Collapse. Fordham University.

Zhang, Y., Wang, S. G., Xia, Y., Shang, K. Z., Cheng, Y. F., Xu, L. I., ... & Li, N. R. (2015). Association between Ambient Air Pollution and Hospital Emergency Admissions for Respiratory and Cardiovascular Diseases in Beijing: A Time Series Study. Biomedical and Environmental Sciences, 28(5), 352-363.

Annex I: Common reporting tables for the electronic reporting of the national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

Lebanon's Common Reporting Tables have been submitted separately to the UNFCCC and are available on the following link:

https://unfccc.int/first-biennial-transparency-reports

Annex II: Common tabular formats for electronic reporting

Lebanon's common tabular formats have been submitted separately to the UNFCCC and are available on the following link:

https://unfccc.int/first-biennial-transparency-reports

Annex III: Indicators development for tracking NDC

The development of indicators to track the progress of Lebanon's NDC has been developed under the CBIT project, adopting the methodology presented in the below figure.

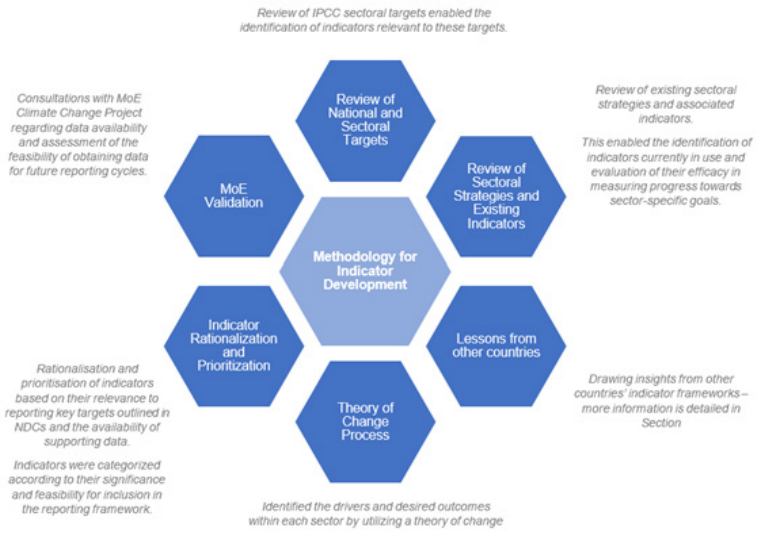


Figure 1: Methodology for indicator development

The documents reviewed to identify the national and sectoral targets and indicators are detailed in the table below.

Table 2 - List of documents reviewed ahead of indicator development

Documents reviewed	
Lebanon's 4th National Communication	IRENA Energy Profile Lebanon
Lebanon's Updated Nationally Determined Contribution	Summary of the Lebanon Solid Waste Roadmap for 2023 and 2026
Lebanon's 2015 Intended Nationally Determined Contribution	Lebanon's National Action Program (NAP) to Combat Desertification
NDC Partnership Plan	Lebanon's National Agricultural Strategy Results Framework
NDC Energy Compact	National Agriculture Strategy 2020 - 2025
National Energy Efficiency Action Plan 2011-2015	National Forest Program 2015 - 2025
National Energy Efficiency Action Plan 2016-2020	National Biodiversity Strategy and Action Plan 2016
IRENA Outlook Report	National Framework for the Health and Environment Strategy 2021 - 2026
The First Energy Indicators Report of the Republic of Lebanon 2018	

An important step within the methodology for developing the suggested indicators was to review best practice examples from other countries (mainly the UK climate change committee mitigation monitoring framework, Rwanda and Mexico). Insight was mainly drawn on how to develop, frame, and structure the indicators, including how to navigate progress indicators where the measured unit suits a qualitative response rather than quantitative unit. Accordingly, the following approach was used:

1. **A multi-dimensional approach** is used, combining quantitative data with qualitative analysis to assess the effectiveness of various mitigation strategies. For each major sector, a mapping exercise has been undertaken to understand the relationships and interdependencies between the policies, drivers, and outcomes required to meet the Lebanon's climate targets. Following this theory of change process, an initial mapping process was undertaken to identify the ideal set of indicators.

2. **A classification of indicators** is undertaken where every sector incorporates headline indicators concerning emissions and mitigation efforts. These headline indicators are then supported by a range of supplementary supporting indicators that monitor the drivers of these emission trends as well as the implementation of mitigation actions.

Headline indicators are intended to show a trend in GHG emissions or strongly relate to the defined adaptation priorities and will be the primary element to track progress of the NDC commitments.

The supporting indicators then present supplementary information to understand the drivers behind the trends as identified by the headline indicator or additional indicators which relate to the adaptation activities defined under the NDC adaptation priorities. Implementation factors relate to the qualitative progress of supporting activities, including sectoral plan development, strategy implementation, development of legislation, project procurement or the installation of measures to provide additional insight into the progress of action towards reducing emissions, e.g., the progress of the fuel switch at the energy plant.

3. **Qualitative indicators** are developed to track progress on supporting actions that will enable emission reductions in the future, such as developing laws to support renewable energy generation. Several preliminary qualitative stages or milestones have been identified for each mitigation or adaptation indicator that requires reporting of qualitative progress. However, as agreed in the task forces, these indicators have been kept as qualitative including a brief description if the progress of specific actions.

This approach aims to help comprehensively consolidate progress across GHG inventory sectors and adaptation priorities by tracking not only the developments related to targets (e.g., sectoral GHG trends), but also the drivers influencing these developments (e.g., increased shares of renewables in power generation) as well as activities influencing these drivers (e.g. programmes supporting renewable energy use).

Within the context of adaptation, adaptation priorities and associated adaptation activities are often multi-faceted and thus more difficult to quantitatively define and assess. Adaptation-related indicators therefore lean more on activities and project implementation compared to mitigation indicator sets. For mitigation, apart from comparing GHG levels with the levels under the BAU scenario, an indicator presenting GHG trends as a comparison between the most recent reporting year and a previous inventory year is also used. This combination would allow understanding of progress towards the NDC target expressed as reduction against BAU, but also, how GHG emission levels have generally developed.

Building on from the hierarchy, for each of the indicators a priority score has been given from 1-3. Where an indicator relates to a target within the NDC, regardless of the data availability, it is rated as a priority 1. It is understood that there may be some data gaps for these priority 1 indicators which may not be immediately remedied. As such, the roadmaps reflect that there are short term, medium term, and long-term actions needed for these priority 1 indicators. Where an indicator does not directly reflect what is included within the NDC, these are rated priority 2 and 3 indicators. Priority 2 indicators are described either where data is available for these indicators that do not relate directly to NDC tracking, or there is a potential source of data that can be identified. Priority 3 indicators are those where they do not feed directly into the NDC targets, and where it is expected data availability is a longer-term challenge.

Validation of the suggested indicators and data sources were validated with key stakeholders through sectoral task forces to confirm the indicator availability and accessibility and identify potential data holders. Training sessions for task force members were organized to further explain and validate indicators and provide an opportunity to highlight any gaps or additional data availability.

Table 3 - Supporting indicators to track the implementation of Lebanon's NDC – mitigation

Indicator #	Indicator	Unit	Priority
Supporting Indicators			
Electricity supply/demand/efficiency			
E.S1	Share of fuels in electricity generation (including diesel oil breakdown by power plant/private generation/industry)	GWh and %	2
E.S2	Emissions intensity of grid supply	Gg CO_2eq./GWh	1
E.S3	Total power demand	GWh	1
E.S4	Total heat demand	GWh	1
E.S5	Share of fuel consumption for electricity production	Tonnes and %	2
E.S6	Transmission losses from power network	%	2
E.S7	Distribution losses from power network	%	2
E.S8	Average efficiency of all power plants	%	2
E.S9	Progress of grid improvement – percent reduction in non-technical losses	%	1
E.S10	Progress of grid improvement – percent reduction in technical losses	%	1
E.S11	Percent improvement of efficiency of energy plants	%	2
E.S12	Share of electricity consumption by sector – domestic, commercial	%	2
E.S13	Primary energy consumption – national	Mtoe	1
E.S14	Final energy consumption – national	Mtoe	1
	Electricity generation from private generation	GWH	1
Mitigation measures – installed capacity			
E.S15	Installed capacity – Hydro	MW	1
E.S16	Installed capacity – Wind	MW	1
E.S17	Installed capacity – Solar PV	MW	1
E.S18	Installed capacity – Solar Water Heaters	MW	1
E.S19	Generational capacity – Hydro	MWh	1
E.S20	Generational capacity – Wind	MWh	1
E.S21	Generational capacity – Solar PV	MWh	1
E.S22	Generational capacity – Solar Water Heaters	MWh	1
Other Consumption and Generation			
E.S23	Consumption fuel mix for heat in buildings – Other Sectors 1.A.4	Tonnes and %	1
E.S24	Share of fuels in electricity generation – Manufacturing Industries and Construction 1.A.2	GWh and %	1
E.S25	Share of fuels in electricity generation – Other Sectors 1.A.4	GWh and %	1
E.S26	Progress of natural gas switch	Qualitative	1
E.S27	Progress on adoption of Building Code for Lebanon	Qualitative	2
Demand			
T.S1	Total transport demand	Total vehicle km	1
T.S2	% share public transport demand	%	2
Vehicle Emission Intensity			
T.S3	Vehicle fleet emission intensity	g CO_2/km	3
T.S4	Average CO_2 intensity of vehicles on road by vehicle type	g CO_2/km	3

Mitigation Measures			
T.S5	Total length bike lanes installed since baseline year [2015]	km	2
T.S6	Number of passengers using government managed bus routes in year X	#	2
T.S7	Number of passengers using private managed bus routes in year X	#	3
T.S8	Number of passengers using rail routes in year X	#	2
T.S9	Number of Hybrid and electric vehicles	#	1
Implementation Factors			
T.S10	Progress of National Transport Strategy 2014	Qualitative	2
T.S11	Progress of supporting actions – setting up centre for transport statistics	Qualitative	2
T.S12	Progress of supporting actions – framework for car scrappage	Qualitative	2
T.S13	Progress of supporting actions – vehicle and fuel tax incentives	Qualitative	2
T.S14	Progress of supporting actions – educational awareness campaigns for public and specific segments of population	Qualitative	2
T.S15	Progress of supporting actions – supporting public transport operators with electrification or alternative fuels	Qualitative	2
T.S16	Progress of Law 78/2018 on the Protection of Air Quality	Qualitative	2
Land Use			
F.S1	% increase in forest cover in year X	%	1
F.S2	Total hectares of trees planted in year X	Ha	1
Implementation Factors			
F.S3	Progress on implementation of the Pilot Master Plan for Reforestation and the National Afforestation/Reforestation	%	1
F.AP2.S6	Progress on the key actions listed in the Brummana Declaration	Qualitative	1
F.AP2.S8	Implementation of the Forest Fire Management Plan 2023	Qualitative	1
Waste Treatment			
W.S1	Waste generation per capita	tonnes/capita	1
W.S2	Percent of waste – Solid waste disposal (anaerobic landfill)	%	1
W.S3	Percent of waste – Solid waste disposal (semi-anaerobic landfill)	%	1
W.S4	Percent of waste – Biological waste management	%	1
W.S5	Percent of waste – Incineration	%	1
W.S6	Percent of waste – Recycled	%	1
W.S7	Percent of waste – Dumpsites	%	2
W.S8	Percent of waste – Openly burnt	%	1
W.S9	Total waste diverted from open dumpsites (recycled or properly disposed of) in year X	Tonne	1
W.S10	Weight of waste diverted to W2E facilities	Tonne	2
W.S11	Volume of methane recovered from landfills	Cubic meters	1
W.S12	Amount of power generated from methane recovery (from landfill sites)	GWh	1
Implementation Factors			
W.S13	Progress of National SWM Strategy	Qualitative	1
W.S14	Progress of Local Waste Plans and Service Zone Master Plans	Qualitative	2
Wastewater			
Wt.S1	Volume of wastewater treated	Cubic meters	1
Wt.S2	Volume of wastewater generated – domestic	Cubic meters	1
Wt.S3	Volume of wastewater generated – industrial	Cubic meters	2
Wt.S4	Volume of methane recovered from wastewater treatment plants	Cubic meters	1
Wt.S5	Number of wastewater treatment facilities in year X – Primary treatment level	#	2
Wt.S6	Number of wastewater treatment facilities in year X – Secondary treatment level	#	2
Wt.S7	Percent untreated wastewater discharged in rivers/streams	%	1
Wt.S8	Percent untreated wastewater discharged in sea	%	1
Wt.S9	Percent untreated wastewater discharged in septic systems	%	1

Implementation Factors			
Wt.S10	Progress on wastewater generation and discharge practice studies	Qualitative	2
Wt.S11	Progress on installing meters at water sources and along water systems	Qualitative	2
Wt.S12	Progress on adoption of wastewater sector national strategy	Qualitative	1

Table 4 - Supporting indicators to track the implementation of Lebanon's NDC – adaptation

Indicator #	Indicator	Unit	Priority
Supporting Indicators			
Adaptation Priority 1 – Strengthen the agricultural sector's resilience to enhance Lebanon's agricultural output in a climate-smart manner			
Ag.AP1.S1	Financial stability of agricultural producers	Income (USD) of agricultural producers over a time period	1
Ag.AP1.S2	Economic value of agricultural export capacity	USD	1
Ag.AP1.S3	Economic value of climate finance and private investment in technical solutions for agri-food value chains	USD	1
Ag.AP1.S4	Percentage of food secure households with year-round access to nutritious food	% of households	1
Adaptation Priority 2 – Promote the sustainable use of natural resources, restore degraded landscapes, and increase Lebanon's forest cover while meeting the ecological, social, and economic needs of sustainable forest management.			
Ag.AP3.S1	Economic value of investment in enhancing efficiency of physical irrigation infrastructure	USD	1
Implementation Factors			
Ag.AP1.S4	Development of plan to enhance institutional structures relating to agriculture	Details	1
Adaptation Priority 2 – Promote the sustainable use of natural resources, restore degraded landscapes, and increase Lebanon's forest cover while meeting the ecological, social, and economic needs of sustainable forest management.			
F.AP2.S1	Production capacity of wood and non-wood forest product processing industry	%	1
F.AP2.S2	Employment within forestry and forest management services	%	2
F.AP2.S3	Number of sustainable rangeland management projects	#	1
F.AP2.S4	Number of forest fires prevented through Early Warning Systems	#	1
F.AP2.S5	Hectares of degraded landscapes that have been restored	Ha	1
Implementation Factors			
F.S3	Progress on implementation of the Pilot Master Plan for Reforestation and the National Afforestation/Reforestation	%	1
F.AP2.S6	Progress on the key actions listed in the Brummana Declaration	Qualitative	1
F.AP2.S7	Development of management plan for pest or disease outbreak	Qualitative	1
F.AP2.S8	Implementation of the Forest Fire Management Plan 2023	Qualitative	1
F.S3	Progress on implementation of the Pilot Master Plan for Reforestation and the National Afforestation/Reforestation	%	1
Adaptation Priority 3 – Structure and develop sustainable water services, including irrigation, in order to improve people's living conditions			
Wt.AP3.S1	Quantity of renewable energy utilised within water sector – drinking water supply	MWh	1
Wt.AP3.S2	Number of financing tools for water services	#	2
Wt.AP3.S3	Number of stakeholder engagement and capacity building sessions or workshops in relation to sustainable water services	#	2
Wt.AP3.S4	Quantity of renewable energy utilised within water sector – irrigation	Renewable energy share of total demand	2
Implementation Factors			
Wt.AP3.S5	Progress on the key actions listed in the Beirut Water Declaration 11 (2015)	%	2
Wt.AP3.S6	Development of operational and legal institutional framework to enhance management of water sector	%	1
Adaptation Priority 4 – Value and sustainably manage Lebanon's terrestrial and marine biodiversity for the preservation and conservation of its ecosystems and habitats and the species they harbour in order to adequately respond to anthropogenic and natural pressures and to ensure Lebanese citizens equal access to ecosystem goods and services.			
DRR.AP4.S1	Percentage of known flora and fauna species conservation status defined	%	1
DRR.AP4.S2	Percentage of threatened species where conservation projects are implemented	%	1

DRR.AP4.S3	Percentage of natural terrestrial and marine ecosystems protected	%	1
DRR.AP4.S4	Number of projects relating to sustainable management of natural ecosystems	#	3
DRR.AP4.S5	Hectare difference between ecological footprint and biocapacity	Ha	1
DRR.AP4.S6	Number of nonindigenous or invasive species	#	1
DRR.AP4.S7	Percentage of degraded sites safeguarded	%	1
Adaptation Priority 5 – Reduce the vulnerability of climate change impacts on coastal zones, especially in cities.			
DRR.AP5.S1	Investment into protective coastal defence mechanisms	USD	2
DRR.AP5.S2	Volume of sea-water intrusion into major coastal aquifers	m^3	1
DRR.AP5.S3	Volume of artificial recharge through injection of water	m^3	1
DRR.AP5.S4	Area of natural habitats (e.g., fisheries) protected	Ha	1
DRR.AP5.S5	% of sea-water intrusion into major coastal aquifers	%	1
Adaptation Priority 6 – Ensure overall public health and safety through climate-resilient health systems			
CRH.AP6.S1	Number of annual climate-related deaths	#	1
Implementation Factors			
CRH.AP6.S2	Development of vulnerability and risk assessment (VRA) for the public health sector to climate change	Qualitative	1
CRH.AP6.S3	Upgrade epidemiological surveillance to incorporate new health outcomes in the Epidemiological Surveillance Unit	Qualitative	1
Adaptation Priority 7 – Reduce disaster risk and minimise damages by mitigating and adapting to climate-related natural hazards and extreme weather			
DRR.AP7.S1	Log of climate-related extreme events	Qualitative	1
DRR.AP4.S8	Number of vulnerable ecosystems defined through a Vulnerability and Risk Assessment (VRA)	#	1
Implementation Factors			
DRR.AP4.S9	Development of vulnerable ecosystem adaptation plan	Qualitative	1
DRR.AP4.S10	Progress on implementation of rehabilitation plans for degraded sites	Qualitative	2
DRR.AP5.S6	Development and update of water budgeting assessment across Lebanon's eight major aquifers	Qualitative	1
DRR.AP5.S7	Development of modelling of karstic, saline and porous aquifers	Qualitative	1
DRR.AP7.S2	Completion of initial multi-hazard vulnerability and risk assessment (VRA)	Qualitative	1
DRR.AP7.S3	Completion of upgrade of flood, fire and drought risk maps	Qualitative	1
DRR.AP7.S4	Development and upgrade of early warning systems platform and institutional arrangements for upgrade of platform defined	Qualitative	1
DRR.AP7.S5	The update of the National Forest Fire Management strategy	Qualitative	1

UNDP IS THE LEADING UNITED NATIONS ORGANIZATION FIGHTING TO END THE INJUSTICE OF POVERTY, INEQUALITY, AND CLIMATE CHANGE. WORKING WITH OUR BROAD NETWORK OF EXPERTS AND PARTNERS IN 170 COUNTRIES, WE HELP NATIONS TO BUILD INTEGRATED, LASTING SOLUTIONS FOR PEOPLE AND PLANET.

LEARN MORE AT UNDP.ORG.LB OR FOLLOW AT @UNDP_LEBANON