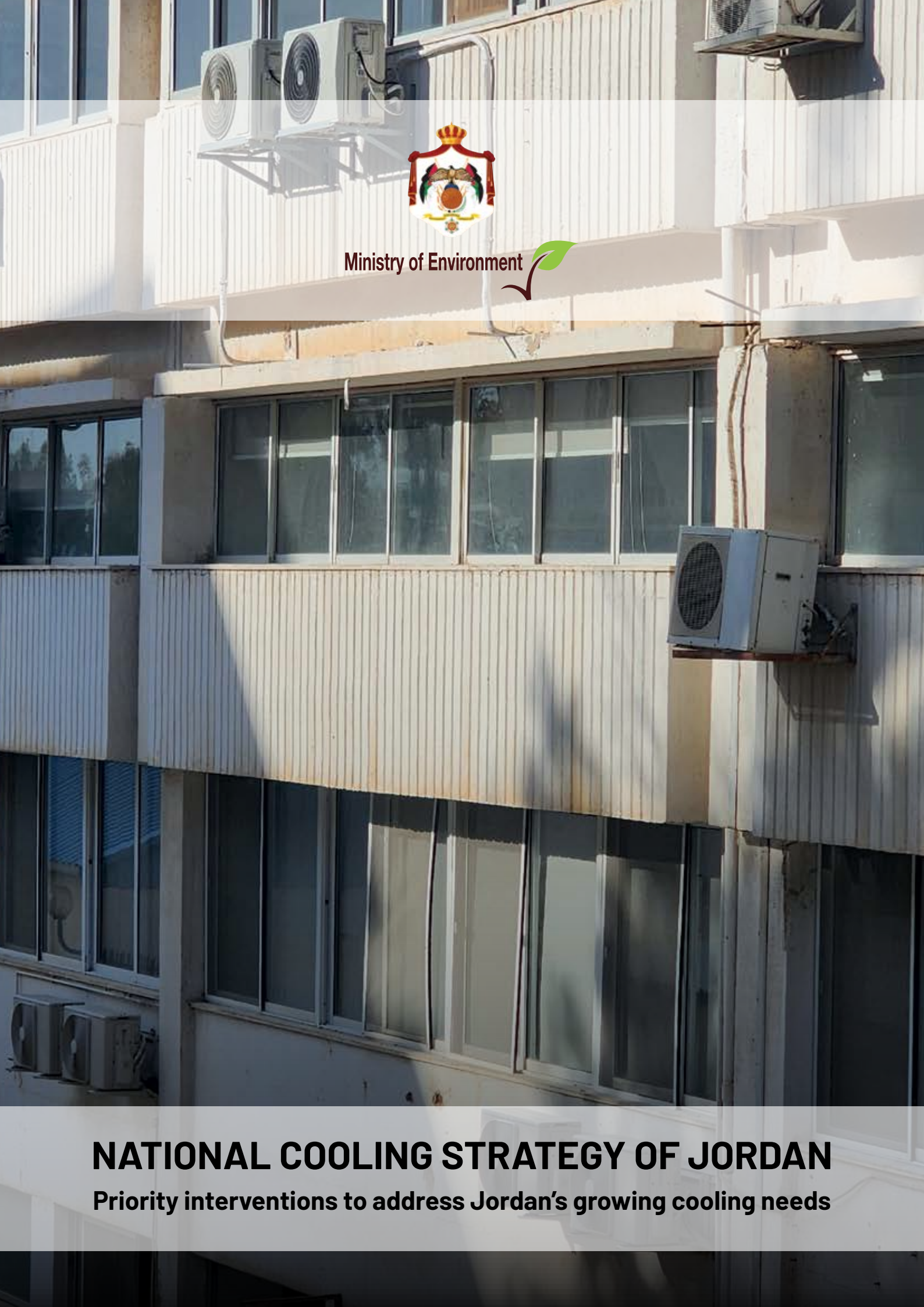

Ministry of Environment

NATIONAL COOLING STRATEGY OF JORDAN

Priority interventions to address Jordan's growing cooling needs

Ministry of Environment

The Ministry of Environment is a distinguished ministry in protecting the components of the environment and sustaining them for a better life. The vision of the Ministry of Environment has evolved with a focus on the institutional dimension by an emphasis towards establishing a distinguished ministry that has the means of institutional structure that is based on comprehensive excellence standards. The Ministry aspires to achieve the highest levels of effectiveness, creativeness and competences in implementing its activities and achieving its objectives.

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Date February 2024

Cool Up
Upscaling Sustainable Cooling

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Foreword

Cooling is one of Jordan's development priorities and plays a vital role in everyday life through applications in space cooling, refrigeration, and various sectors. The arid climate, especially during hot summers, poses challenges to health and productivity, particularly affecting vulnerable groups. National policies recognize cooling as a fundamental service, underscoring its importance for residential comfort and economic value, including food safety, healthcare, tourism, and more. As Jordan's population and GDP rise, the demand for cooling is expected to surge.

Jordan's focus on sustainable cooling aligns with broader development objectives, offering a comprehensive solution that enhances climate resilience, resource efficiency, and reduces greenhouse gas emissions. The three-pronged strategy focuses on reducing cooling demand, enhancing appliance energy efficiency, and transitioning to natural refrigerants. This approach supports Jordan's commitments under international agreements and aligns with its sustainable development goals.

The Ministry of Environment plays a pivotal role in leading Jordan's efforts on sustainable cooling solutions. It is committed to balancing technological advancements with environmental responsibility. Through policies, regulations, and initiatives, it aims to introduce a new era of cooling practices that contribute to reducing carbon emissions, HFC consumption and energy consumption, demonstrating Jordan's dedication to a resilient and sustainable future.

The Ministry of Environment introduces the National Cooling Strategy (NCS), a comprehensive guide developed in collaboration with the Cool Up programme. The NCS serves as a roadmap for transitioning towards sustainable cooling practices, promoting energy efficiency, and advocating for environmentally friendly refrigerants. The strategy integrates with existing policies, plans, and targets related to climate, energy, and economic development, supporting the pillars of the Economic Modernization Vision for Jordan. By fostering economic growth and improving the quality of life, the NCS embodies Jordan's commitment to providing affordable, reliable, and sustainable cooling for its citizens.

Acknowledgements

The formulation of the National Cooling Strategy (NCS) in Jordan has been a collaborative endeavor involving diverse stakeholders, including various Government Ministries/Departments/ Organizations, industry representatives, consulting firms, individual subject experts, and research and development institutions.

The Ministry of Environment expresses gratitude for the active participation and valuable input from various organizations in the development of the National Cooling Strategy (NCS). Special acknowledgment goes to the Cool Up programme, represented by its country partner in Jordan, the Royal Scientific Society. Cool Up is part of the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection supports this initiative on the basis of a decision adopted by the German Bundestag. The support encompassed conducting background analyses, developing and drafting relevant chapters, organizing working group and Steering Committee meetings to facilitate stakeholder engagement, gathering feedback, and finalizing the National Cooling Strategy for publication. The Ministry also recognizes the significant contributions of the Working Group and the Steering Committee teams in various capacities. In addition, the Ministry acknowledges the following organizations for their important contributions to the development of the National Cooling Strategy:

- The Ministry of Energy and Mineral Resources
- Vehicles and Drivers Licensing Department
- Ministry of Agriculture
- Jordan Chamber of Industry
- Jordan National Building Council
- Association of Banks in Jordan
- Jordan Renewable Energy and Energy Efficiency Fund
- Petra Engineering Industries Co. Ltd.
- Mohammed Tahseen Baalbaki & Partners Company
- Jordan Standards and Metrology Organization
- Central Bank of Jordan
- Ministry of Finance
- Jordan Chamber of Commerce
- Jordan Statistics
- Jordan Customs
- Elia Fouad Saba Trading Est.
- Abdin Industrial Est.

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List of abbreviations

AC	Air conditioning
BAU	Business as usual
CBJ	Central Bank of Jordan
CCNAP	Climate Change National Adaptation Plans
CFC	Chlorofluorocarbons
EE	Energy efficiency
GDP	Gross domestic product
GEFF	Green Economy Financing Facility
GGNAP	Green Growth National Action Plans
GHG	Greenhouse gas
GPP	Green public procurement
GWP	Global warming potential
HAT	High ambient temperature
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HFO	Hydrofluoroolefin
HPMP	HCFC Phaseout Management Plan
IEA	International Energy Agency
IMF	International Monetary Fund
JD	Jordan Dinar
JEF	Jordan Environment Fund
JLGC	Jordan Loan Guarantee Corporation
JREEEF	Jordan Renewable Energy & Energy Efficiency Fund
KIP	Kigali Implementation Plan
kW	Kilowatt
MAC	Mobile air conditioning
MEMR	Ministry of Energy and Mineral Resources
MENA	Middle East and North Africa
MEPS	Minimum Energy Performance Standards
MP	Montreal Protocol

MRV	Monitoring, reporting and verification
MT	Metric ton
MW	Megawatt
NCAP	National Cooling Action Plan
NCCP	National Climate Change Policy of Jordan
NCS	National Cooling Strategy
NDC	Nationally Determined Contributions
NEEAP	National Energy Efficiency Action Plan
NEPCO	National Electrical Power Company
NERC	National Energy Research Centre
NOU	National Ozone Unit
NPL	Non-performing loan
ODS	Ozone-depleting substance(s)
PFAS	Per- and polyfluoroalkyl substances
R134a	HFC-123a (tetrafluoroethane)
R22	HCFC-22 (chlorodifluoromethan)
R290	HC-290, Propane (hydrocarbon)
R32	HFC-32 (difluoromethane)
R404A	Mixture composed of HFCs: R143a (trifluoroethane), R125 (pentafluoroethane), R134a (tetrafluoroethane)
R410A	Mixture composed of HFCs: R32 (difluoromethane) and R125 (pentafluoroethan)
R600a	HC-600a, Isobutane (hydrocarbon)
R718	Water (natural refrigerant)
RAC	Refrigeration and air conditioning
SECAP	Sustainable Energy and Climate Action Plan
SME	Small and medium-sized enterprises
TFA	Trifluoroacetic acid
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
VRF	Variable refrigerant flow
W	Watt

1 The national context

1. The national context

1.1 Relevance of cooling

Cooling plays a crucial role in Jordan's development. Applications of space cooling and refrigeration span across sectors and are essential in a modern way of life, whether it be maintaining thermal comfort in homes, offices, or healthcare centres, as well as for the preservation of perishable goods, or enabling industrial processes. Jordan's arid and semi-arid climate, especially the hot summer months, pose risks and challenges to human health, productivity, and overall quality of life, especially for vulnerable groups such as the elderly, people with illnesses, and children.

Jordan is a high ambient temperature (HAT) country and cooling plays a crucial role in its economic development and for achieving its climate targets.

Cooling is key to health, well-being, and productivity and therefore represents a universal basic service and is an important focus for national policies. By 2050, an additional 2.5 million new air conditioners (ACs) are expected to have been installed in Jordan.[1] This will increase the cooling demand and requires electricity grids to supply these units to operate. Air conditioning and commercial refrigeration alone are currently responsible for around 4% of all Jordanian greenhouse gas (GHG) emissions and without switching to clean and sustainable cooling technologies and a full renewable energy transition, the emissions from AC and commercial refrigeration could increase by a factor of 1.25.[2]

Aside from thermal comfort in the home, cooling plays an important role across various sectors of the economy. Reliable cold chains are crucial for a net food importing country such as Jordan, as effective cold chains can improve food safety and reduce food loss. Cooling is also essential in providing high quality healthcare, for keeping both patients and medicines cool. Cooling also plays an important role in sectors such as tourism, gastronomy, and office buildings. Across all these sectors cooling demand is expected to grow due to the expected increase in Jordan's population and the Jordanian gross domestic product (GDP) as well as raising temperatures.

Refrigeration and air conditioning (RAC) in households already represent a major area of energy consumption. The cooling load is not constant, but rather fluctuates depending on several factors, including the climate zone, occupant behavior, and building characteristics. In a recent case study, it was determined that the cooling load can range significantly, spanning from as low as 12% to as high as 74.5%.[3] The use of cooling is expected to continue growing throughout the next decades, especially residential air conditioning, which is expected to grow considerably until 2050 due to increasing living standards and economic growth. Currently, 80% of the existing residential floor area in Jordan lacks air conditioning, showing that substantial growth potential exists.[4] The growing cooling demand results in an increased electricity demand and places a significant strain on Jordan's energy resources and the electricity grid as well as contributing heavily to an increase of **indirect GHG emissions**. Currently, over 75% of Jordan's GHG emissions result from the energy sector (which includes electricity

1 *Cool Up 2023.*
2 *Ibid.*
3 *Bataineh and Al Rabee 2022.*
4 *Ibid.*

Jordan's hot climate can pose risks and challenges to human health, productivity, food security and overall quality of life, especially for vulnerable groups such as the elderly, people with illnesses, and children.

generation and transportation).[5] There is a large potential for energy savings as many of the space cooling and refrigeration systems currently in use have low energy efficiency compared to the best available systems.

The use of halogenated refrigerants, which are still prevalent in today's air conditioners and refrigeration systems, cause direct emissions from the RAC sector. These halogenated refrigerants have high global warming potential (GWP), in some cases, the GWP is several thousand times higher than carbon dioxide and natural refrigerants. Growing consumption levels of halogenated refrigerants put the commitments of Jordan under the Montreal Protocol and its Kigali Amendment at risk.

Meeting cooling demand in a sustainable way will contribute to Jordan's sustainable development targets by boosting climate resilience and resource efficiency, reducing GHG emissions and improving overall quality of life. This can be achieved through the three-pronged approach of reducing cooling demand – via building efficiency – increasing energy efficiency of appliances and switching to natural refrigerants.

1.2 Vision and mission

The National Cooling Strategy envisions Jordan as a regional leader in mainstreaming sustainable cooling practices and technologies, commensurate with Jordan's track record in pioneering climate action in the region. The country is positioned as a model for sustainable cooling in the region, and cooling demand is successfully met in parallel with the nation's environmental objectives and commitments. Sustainable cooling contributes to achieving Jordan's commitments, goals, and targets set out under the Montreal Protocol and its Kigali Amendment, Economic Modernisation Vision, the Nationally Determined Contributions (NDCs) and sustainable development.

The mission of the National Cooling Strategy is to guide the nation's shift to sustainable cooling and to mainstream the use of environmentally friendly and non-halogenated refrigerants, ensuring a better future for both present and future generations and supporting the achievement of Jordan's environmental commitments and targets.

Cooling is a significant contributor to GHG emissions in Jordan – switching to sustainable cooling can mitigate these emissions.

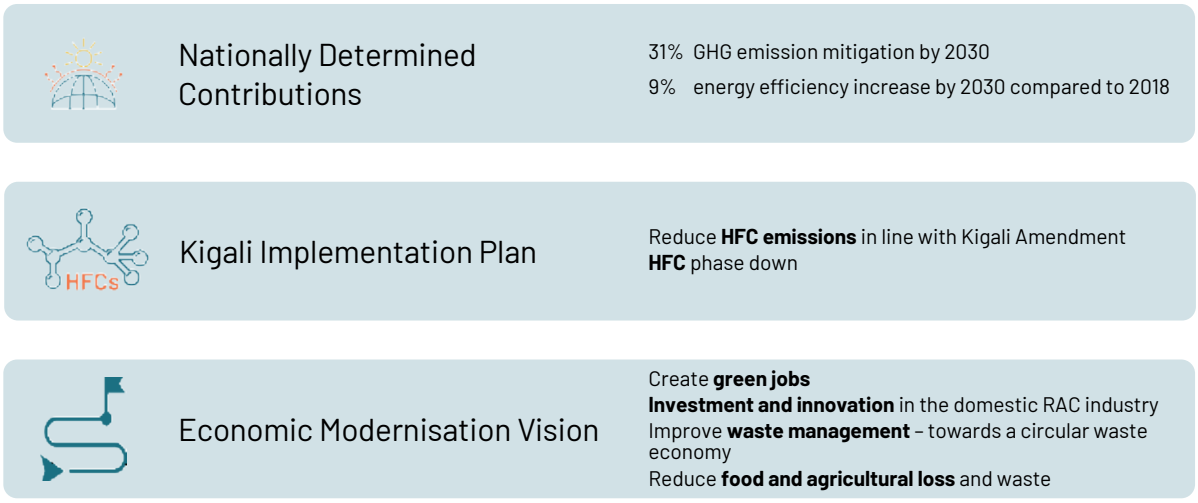
5 *Jordanian Ministry of Environment 2020a.*

2 About the National Cooling Strategy

2. About the National Cooling Strategy

The **National Cooling Strategy** (NCS) of Jordan serves as guidance to holistically support the transition towards sustainable cooling practices, promoting energy efficiency and the use of non-halogenated, environmentally friendly refrigerants. It is an **integrated document** which links and builds upon existing policies, plans, and targets concerning climate, energy, and economic development. The NCS supports the two pillars of the **Economic Modernisation Vision** for Jordan by fostering **economic growth** via investment and innovation in the RAC manufacturing sector and improving **quality of life** by providing access to affordable, reliable, and sustainable cooling to citizens. The strategy supports the objective of the Economic Modernisation Vision to increase sustainability across the different sectors while it also contributes to achieving targets under international agreements such as the **31% emission reduction** by 2030 target under the Paris Agreement NDC and the UN Sustainable Development Goals. The NCS is closely aligned with the Kigali Implementation Plan of phasing down the use of hydrofluorocarbons (HFCs) under the Montreal Protocol's Kigali Amendment.[6]

Figure 1: Contributions of the NCS to existing climate and energy policies



Jordan's National Cooling Strategy: a blueprint for sustainable development, energy efficiency, and climate resilience.

6 Cool Coalition 2021.

The NCS creates the framework for the development of a National Cooling Action Plan.

The NCS includes different cooling-related sectors, namely **air conditioning** (stationary and mobile) and **refrigeration** (domestic, commercial, industrial and transportation). It is the first step of a comprehensive assessment of the cooling landscape and covers aspects such as socio-economic growth drivers for cooling demand, technology, and market trends as well as international and national commitments and policies.

The general objective of the NCS is to guide the direction and **identify priority interventions** to address Jordan's growing cooling needs in the transition to more energy efficient technologies and environmentally friendly refrigerants. The NCS provides the strategic guidance to develop the **National Cooling Action Plan** (NCAP) that will elaborate a wide range of concrete measures such as promoting more stringent Minimum Energy Performance Standards (MEPS) and ecodesign measures.

To provide a strong basis for the development of the National Cooling Action Plan, the NCS identifies strategic key areas for intervention.

Under the NCS, Jordan will set out to achieve the following targets in the areas of energy efficiency (in buildings and RAC equipment) and HFC phase down to reduce direct and indirect emissions from cooling:

Figure 2: Contributions of the NCS to targets under national and international agreements

Hydrochlorofluorocarbon (HCFC) phase out plan

- By 2013: Freeze HCFCs consumption at the 2009-2010 average.
- By 2015: Reduce HCFCs consumption by 10%.
- By 2020: Reduce HCFCs consumption by 35%.
- By 2025: Reduce HCFCs consumption by 67.5%.
- By 2030: Achieve total phase-out. 2030 - 2040: Allow 2.5% of baseline averaged over 10 years (2030-2040) for servicing RAC equipment until 2040 if necessary.

HFC phase down by 2050 in line with Kigali Amendment

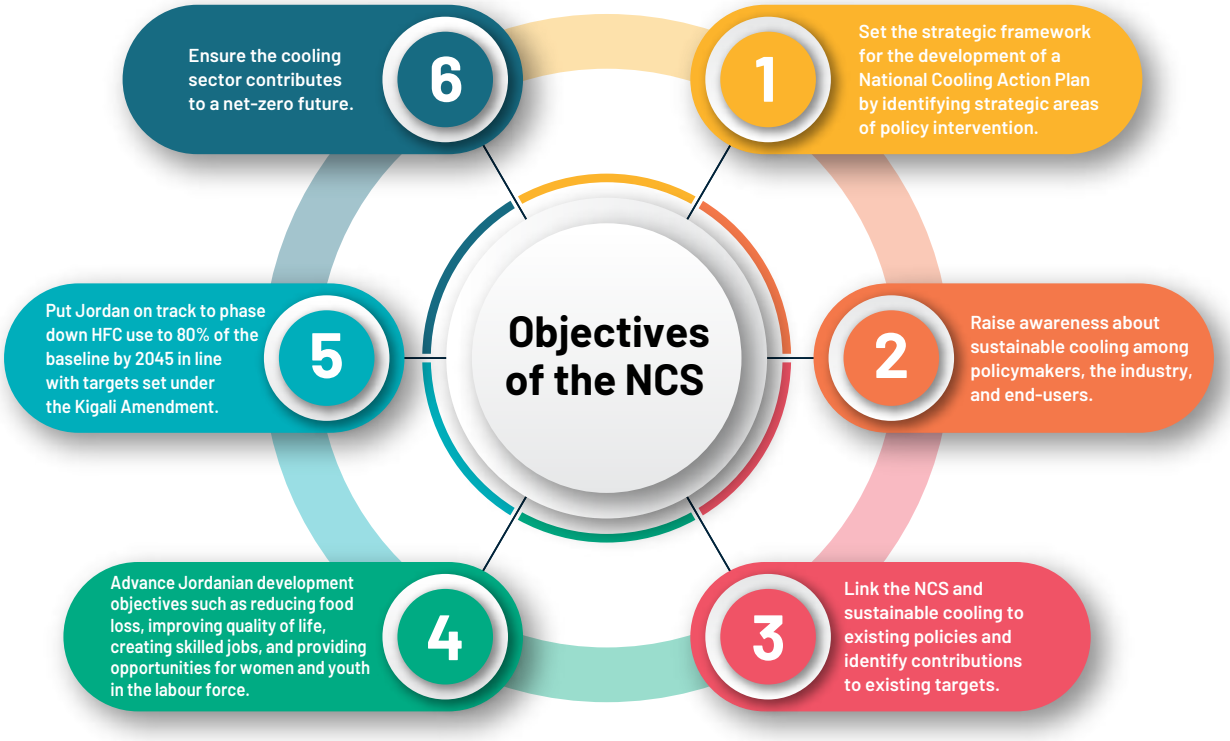
- Freeze HCFCs consumption from 2024 to 2028 at 0%.
- In Step 1 (2029-2034), reduce consumption by 10%.
- In Step 2 (2035-2039), reduce consumption by 30%.
- In Step 3 (2040-2044), reduce consumption by 50%.
- From 2045 onwards, achieve a substantial reduction of 80%.

Energy Efficiency Improvement

- Achieve a 9% energy efficiency improvement in RAC equipment by 2030 in line with existing targets.
- Achieve a 9% energy efficiency improvement in buildings by 2030 in line with existing targets.

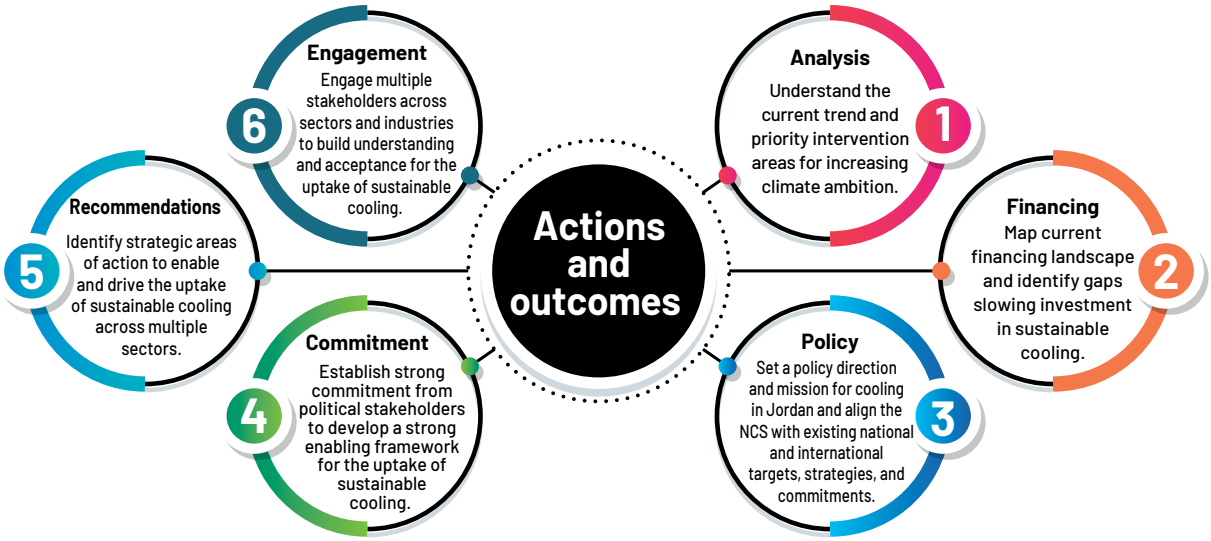
The following figure illustrates the objectives of the NCS:

Figure 3: Objectives of the NCS



The following figure illustrates the actions and outcomes of the NCS:

Figure 4: Actions and outcomes of the NCS



To achieve the above-mentioned actions, the NCS assesses all relevant aspects regarding cooling and the RAC sector. The NCS describes the relevant cooling technologies and applications, the energy sector and role of cooling therein, as well as socioeconomic and environmental drivers and impacts of increasing cooling demand. It sets a policy direction for cooling in Jordan anchored firmly in the existing policy framework. Similarly, it assesses the existing financing options for sustainable cooling and identifies gaps. It gives insights into the direct and indirect emissions from cooling and shows how these may develop under a business-as-usual (BAU) scenario. Lastly, the NCS identifies strategic areas of action where policy intervention can drive sustainable cooling.

Stakeholder engagement and commitment are crucial to the progress and implementation of the NCS and the sustainable cooling transition in Jordan. The NCS was thus prepared in constant exchange with a working group offering technical input and feedback and a steering committee making strategic decisions. The working group was comprised of stakeholders from ministries, agencies, banks, and the industry. The steering committee was headed by the Ministry of Environment.

NCS identifies the key strategic areas of intervention across the residential, commercial, transport, and industrial sector.

3 Classification of the refrigeration and air conditioning sector

3. Classification of the refrigeration and air conditioning (RAC) sector

The Jordanian refrigeration and air conditioning sector can be differentiated into various sub-sectors employing several equipment types as illustrated in the table below.

Table 1 : Classification of RAC sector

	Sub-sector	Equipment type
Refrigeration	Domestic	Fridge, freezer (and combined fridge/freezer)
	Commercial Industrial	- Standalone unit (display cabinet, dispenser unit) - Condensing unit (cold stores, supermarkets, industry) - Centralised system (cold stores, supermarkets, industry) - Chiller
	Transport	Refrigerated containers
Air conditioning	Residential (stationary) Non-residential (stationary)	Self-contained (covering movable, window, through-the-wall, and packaged terminal units) - Single-split unit (non-ducted, ducted) - Multi-split systems - Variable refrigerant flow (VRF) systems - Packaged units (e.g., rooftop) - Chiller
	Mobile	Vehicle AC

Note: *Residential and non-residential AC can also be referred to as stationary or unitary AC.*

A large part of the cooling demand is served with so-called 'active' cooling systems[7], which are dependent on energy consumption to operate. Other methods of cooling that are not based on compression technology (deploying refrigerants) include mechanical ventilation (fans, etc.), which is a cheaper and widely used means of providing thermal comfort in buildings generally. Further, in industrial cooling processes water and cooling tower systems are also used. In contrast to these electricity-consuming technologies, 'passive' cooling rather refers to an alternative building design approach that focuses on heat gain control and heat dissipation.[8]

An alternative classification based on refrigeration and air conditioning application is shown in the table below.

7 *Non-vapor compression cooling technologies are also referred to as 'not-in-kind' solutions.*
8 *Jordanian Ministry of Energy and Mineral Resources 2021.*

Table 2: Alternative classification of the RAC sector (considering application)

Sub-sector	Application	Application scope
Refrigeration	Food	- Domestic (storage of food and drinks) - Commercial: retail (supermarkets, shops etc.) and food service (restaurants and hotels) - Transport (refrigerated vans, trucks and semi-trailers and trailers)
	Industrial	Processing, packaging and storage of raw materials and final products in food and beverages, pharmaceuticals, petrochemicals, and bioprocesses
Air conditioning	Comfort	- Space cooling (residential buildings covering for example single-family and multi-family buildings as well as non-residential including commercial buildings in wholesale and retail (supermarkets, shops), restaurants, hotels, and hospitals as well as public buildings and other buildings, e.g., sports facilities) - Mobile AC (vehicles such as passenger cars, buses, but also larger and specialised vehicles (e.g., used in logistics, on construction sites or in agricultural vehicles)
	Industrial	- Processes (temperature and humidity control), etc.

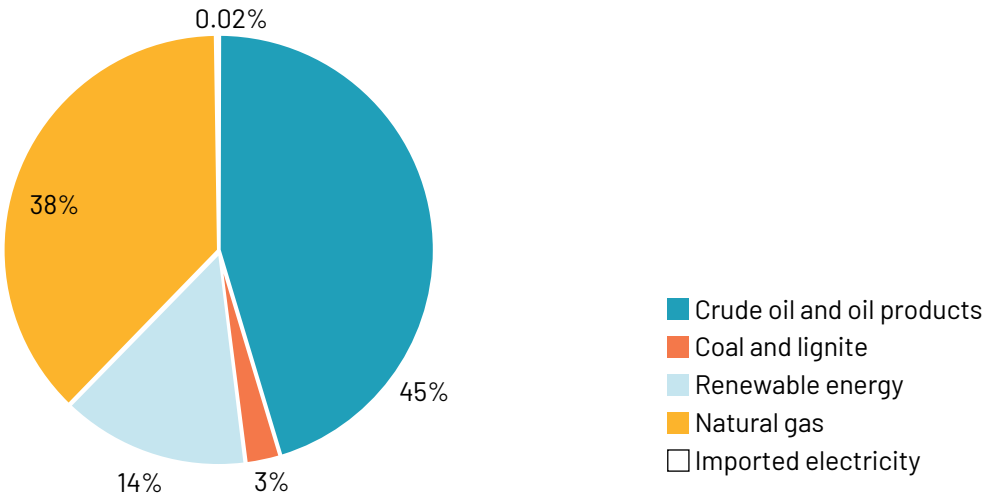
4 Energy sector overview

4. Energy sector overview

4.1 Energy supply

The total energy supply of Jordan is 8.726 Ktoe. 84% of the total energy supply is imported, of which 45% are oil products and 38% is natural gas.[9] Renewable energy sources contribute 14% to the Jordanian energy supply.

Figure 5: Total energy mix[10]



As per the Jordan Energy Strategy[11], the share of electricity generation by fuel type in 2020 is split between natural gas at 61%, renewables at 21%, and oil shale at 15%, for a total demand of 17,672 GWh. Projections indicate that in 2030, the total electric demand will reach 19,701 GWh, with generation split between natural gas (53%), renewables (31%), and oil shale (15%),[12] Jordan have already reached it in 2021. The high demand growth is attributed to rapidly growing populations, urbanisation, and a heavily strained energy infrastructure. Cooling in AC-equipped households already represents a major source of energy consumption in the region. The use of cooling is expected to grow further since, with an improved standard of living, more households are using AC systems. There is large potential for energy-saving as many of the space cooling and refrigeration systems in use have a low energy efficiency.

Cooling represents a high share of electricity consumption and cooling demand is increasing every year.

9 Jordanian Ministry of Energy and Mineral Resources 2019.
10 Ibid.
11 Ibid.
12 Ibid.

4.2 Final energy consumption

The final energy consumption in Jordan decreased from 6.8 mtoe in 2017 to nearly 5.8 mtoe in 2020 because of the COVID pandemic. This figure rose again to reach 6.2 mtoe in 2021. The transport sector is the largest energy consumer, primarily of crude oil derivatives, including gasoline and diesel. The share of households and the commercial and other sectors in final energy consumption has largely remained constant. Meanwhile, energy consumption in industry has fluctuated, with limited growth over the past decade.

A closer look at the final energy consumption by sector provides insights on the slowdown observed in energy use in 2019 and 2020 compared with the previous years, especially in the transport sector. Compared to 2017, industry registered an 8.4% growth in energy consumption in 2021. Meanwhile, the household and transport sectors saw declines. Energy consumption in the household sector reduced by 1.9% for the same period.

The residential sector accounts for 25% of final energy consumption in 2021. For the same year, the residential sector in Jordan is the single largest electricity consumer in Jordan, with 48% of the country's total electricity consumption of 19,306 GWh.[13] The non-residential building sector accounts for more than 10% of total electricity consumption.[14]

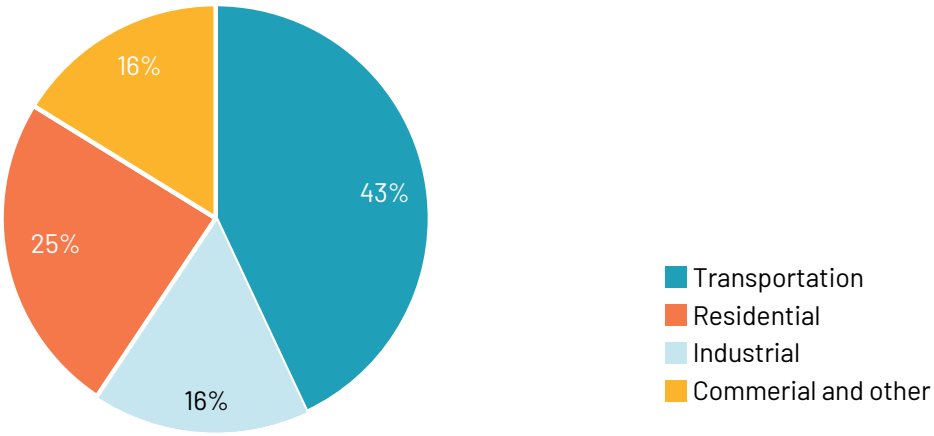
Table 3: Sub-sectoral final energy consumption distribution (Ktoe) 2017 - 2021[15]

Sub-sector	2017	2018	2019	2020	2021
Transportation	3431	3363	3074	2308	2677
Industrial	938	954	891	935	1017
Residential	1549	1463	1484	1487	1520
Commercial and other	950	981	1109	1045	1008
Total final energy consumption	6868	6761	6560	5774	6222

The increase in cooling demand requires additional power generation which should be addressed by energy-efficient cooling solutions, passive cooling measures, and renewable energy.

13 *Jordanian Ministry of Environment 2021a.*
14 *Based on Jordanian Ministry of Energy and Mineral Resources 2020, International Energy Agency 2016, and personal communication with Eng. M. Tawalbeh.*
15 *Jordanian Ministry of Energy and Mineral Resources 2021.*

Figure 6: Sectoral final energy consumption distribution[16]



AC and refrigeration systems are prevalent across the targeted sectors in Jordan and are responsible for a significant portion of energy consumption, particularly in households and non-residential buildings. In the residential sector, the cooling demand could reach 12-74.5% of the total energy consumption depending on the region and the building type.[17] According to data from the Department of Statistics, 32% of households are equipped with air conditioning, and 98% of households include refrigerators.[18]

Electricity demand for space cooling (AC systems) in Jordan is expected to increase rapidly over the next decades from 1 TWh in 2020 to 3.6 TWh by 2050. This significant growth can be attributed directly to the increase in conditioned floor area per building and the related increase in cooling demand.[19]

Understanding the prevalence and patterns of energy-intensive cooling systems is crucial for developing effective energy conservation strategies and adopting sustainable practices to reduce the environmental impact. A comprehensive approach that addresses both residential and non-residential cooling demands is essential to create a more energy-efficient and environmentally responsible future.

Integrating energy innovation with efficient cooling solutions for a sustainable and resilient future to deal with increased cooling demand.

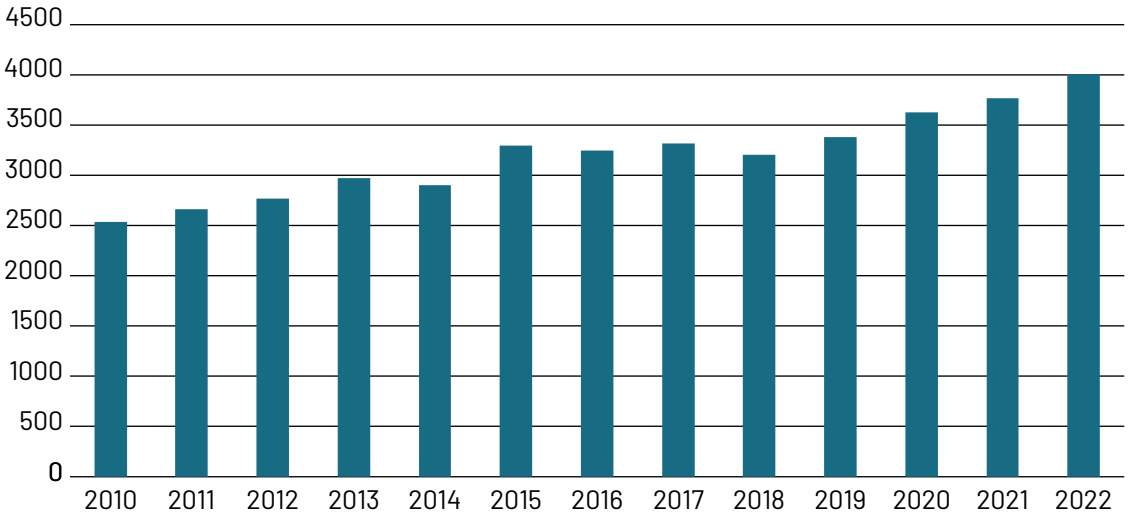
4.3 Electricity grid

The recent years had witnessed a rapid increase in Jordan's peak load. This increase in the peak load is associated with a rapid increase in Jordan's population, where the high rate of natural population growth coupled with the Syrian refugee waves. Summer peak is mainly led by the increased demand for air conditioning and refrigeration. The appliances typically used in Jordan, however, feature low energy efficiency and thus push electricity consumption further as the ambient temperatures increase beyond thermal comfort zone.[20]

16 *Ibid.*
17 *Bataineh and Al Rabee 2022.*
18 *UNDP 2012.*
19 *Cool Up 2023.*
20 *Almuhtady, Alshwawra, Alfaouri et al. 2019.*

In the past few years, power disruptions and blackouts occurred in many regions in Jordan during extremely hot and extremely cold days. Some of these power cuts continued for many hours causing economic losses and, in some instances, dangerous conditions concerning heating, lighting, and security. The National Electrical Power Company (NEPCO) attributed some of these blackouts to sudden load increases to the limits exceeding the generation capacity.[21]

Figure 7: Maximum electrical peak load (MW) according to NEPCO annual reports[22]



Jordan's electrical systems are under frequent development and strengthening efforts to face the constantly increasing demand. The current installed generation capacity is 5,796 MW, out of which 1,584 MW are renewable connected to the transmission grid.[23] renewable energy sources generated 29% of the total electric power generated in the first half of 2022 compared to 26% in 2021.[24] In 2021 renewable energy projects generated 5.5 TWh of electricity by the end of that year. The efforts to expand Jordan's electric network have been successful, guaranteeing access to electricity for 99.9% of the population in 2020, noting that the annual growth in electric demand reached 5.7% in the past 5 years (8.3% domestic, 2.5% industrial).

The Green Corridor project in Jordan is designed to reinforce Jordan's high-voltage electricity backbone network to integrate new renewable generation capacity located in the South, dispatch the production to the centres of consumption in the North, improve reliability of supply, reduce losses in the system, facilitate future regional interconnections and create job opportunities in the renewable energy sector. Jordan's Green Corridor project centre from 500 MW to 1,400 MW. The average energy conversion efficiency for the power plants that depend on fossil fuels are around 34.5% [25]. On the other hand, the emissions intensity from electricity generation in Jordan is 0.4585 $KgCO_2e$/ kWh[26].

National projects are ongoing to reduce loss in electricity transmission and distribution networks, aiming to reduce losses to 9% in 2027 compared to 13.3% in 2020. Executed gradually starting in 2022, and under a grid emission factor of 0.537, the project will achieve an annual emissions reduction of 117 Gg of CO_2eq.

21 Ibid.
22 National Electric Power Company 2022.
23 Ibid.
24 Jordanian Ministry of Energy and Mineral Resources 2022.
25 Central Electricity Generation Co. 2021.
26 Jordanian Ministry of Environment 2020a.

5 Cooling demand drivers and impact of growing cooling demand

5. Cooling demand drivers and impact of growing cooling demand

To understand the increase in cooling demand it is important to analyse the key underlying drivers of cooling demand.

Broad policy intervention is needed to avoid negative impacts in the future that would result from a BAU pathway, which would typically mean that the expected increase in cooling demand is met with currently available non-sustainable technology. This would inevitably lead to a strong increase in emissions and electricity demand and other negative effects.

5.1 Cooling demand drivers

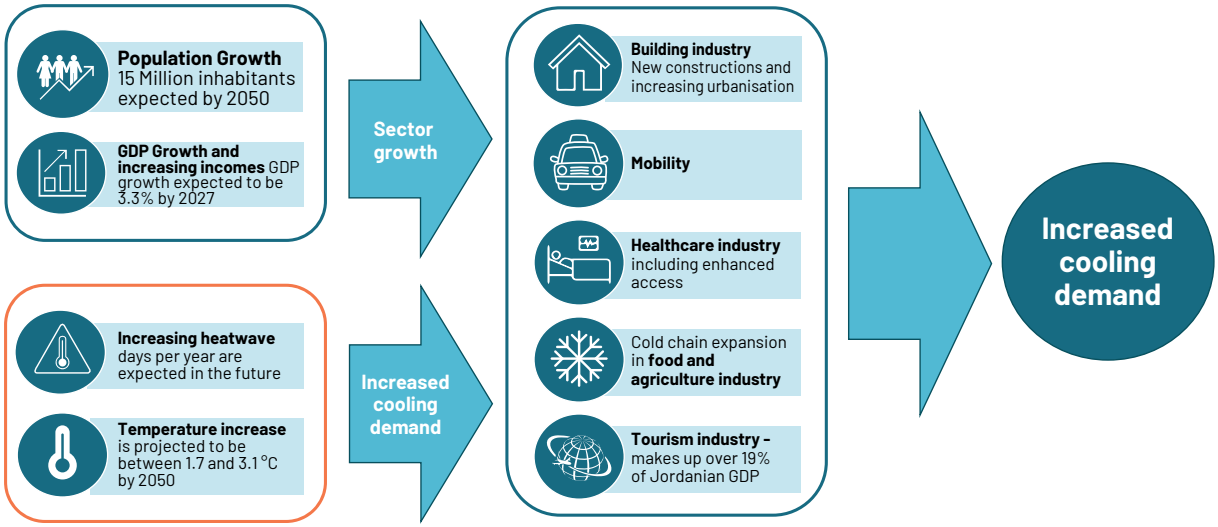
In Jordan, key drivers for cooling demand are **macro socio-economic drivers** such as population and economic growth coupled with **environmental drivers** such as increasing temperatures. Increasing population and economic growth drives the demand for space cooling and refrigeration technologies and thus demand for higher living standards and the associated increase in ownership of appliances. At the same time, it leads to a higher demand for food, for healthcare access and tourism activities.

Cooling demand is also driven by increasing average temperatures and heat waves which increases the demand for space cooling and refrigeration in all RAC sectors.

These drivers lead to growth, above all, in the building, mobility, healthcare, food and tourism industries and cause changes that further increase cooling demand. The expected increase varies across industries. The highest growth of cooling demand is expected to be driven by space cooling. It is expected that until 2050 cooling demand from space cooling will increase by a factor of 3.6.[27]

The following figure provides a general overview of the key drivers. The causal mechanisms behind cooling demand increases across the highlighted industries are described below.

Figure 8: Drivers of cooling demand



27 *Cool Up 2023.*

Population increase, raising income and temperature increase - including extreme heat events - are the main drivers of cooling demand.

Population growth

Population growth is one of the core macro drivers of cooling demand in the medium and long-term. According to UN population growth projections, the population of Jordan is expected to reach 13.4 million by 2050 under a medium scenario compared to 11.2 million in 2021.[28]

Population growth leads to a linear increase in demand for cooling in all sectors described above. Demand for a variety of public and commercial spaces such as schools, hospitals, and shopping areas and thus the demand for space cooling will increase. In addition, the increase in population and incomes drives the demand for refrigeration in the food and healthcare sectors.

Economic growth and increasing income

Jordan's GDP is projected to grow steadily, reaching 3.3% growth by 2027.[29] Economic growth leads to a rise in incomes and thus higher purchasing power. As incomes increase, the ownership rate of appliances per households rises. Increased dwelling size also leads to an increase in appliances as well as the size or capacity of the appliances. Rising incomes also drive changes in lifestyle, e.g., eating at restaurants, buying ready-made food, and thus accelerates growth of commercial services including refrigeration. Thus, increasing incomes leads to non-linear growth, as it increases per capita consumption of goods and services.

Drivers of cooling demand across industries

- **Building industry growth and urbanisation**

Population and GDP growth drive new construction activities in both residential and commercial buildings and an increase in floor area that leads to an increase in cooling demand for space cooling and for refrigeration.

On the household level, currently more than three quarters of the floor area in residential buildings is not air-conditioned. It is expected that increasing purchasing power leads to an increase in AC systems per household since households start to increase the number of rooms that are cooled.[30] It is expected that increased purchasing power also leads to an increase in operational hours of space cooling appliances. The expected increase in average dwelling size per household[31] also leads to the installation of more powerful AC units to meet cooling demand.

Currently, around 60% of new apartments and 80% of new single-family buildings install an AC system, in non-residential buildings the share is between 70-75% for new offices and supermarkets, to between 90-95% for new healthcare and hotel buildings.[32]

The increasing urbanisation rate also drives the increase of cooling demand. Jordan is projected to have an urbanisation rate of 95.3% by 2050, compared to 91% in 2018.[33] Increasing urbanisation leads to urban heat island effects, which increases temperatures in urban areas.

28 Jordanian Department of Population Statistics 2022.
29 International Monetary Fund 2023.
30 Cool Up 2022a.
31 International Energy Agency 2018.
32 Cool Up 2022a.
33 UN Department of Economic and Social Affairs 2018.

- **Mobility growth**

In 2023 there were just over 1.7 million registered vehicles in Jordan, including public, private, freight, construction, and agricultural vehicles.[34] As population and incomes grow, so will the number of cars and buses. Modern vehicles all feature mobile AC (MAC) units, meaning the number of MAC units will increase as new cars replace older ones. Rising incomes mean more households can afford a new car or even a second car.

- **Healthcare industry growth**

In 2017 Jordan had 1.5 hospital beds per 1000 inhabitants.[35] as GDP and incomes increase this number is expected to increase as well. The average of OECD countries is 4.7 beds per 1000 inhabitants, which would mark an almost 3-fold increase.[36] The beds per inhabitant together with the population growth means more hospitals must be built to meet the demand. There are also strategic plans under the Green Growth National Action Plan for Tourism to promoted medical tourism to Jordan.[37] Currently, already 90-95% of newly constructed healthcare buildings install AC systems.[38]

The increase in population means an increase in demand for medicines that require cooling, such as vaccines. This means an expansion of the medical cold chain, including transport refrigeration and commercial refrigeration in healthcare buildings.

- **Food and agriculture industry growth**

A growing population and increasing incomes drive demand for food. The increase in population drives the overall quantity of food needed, which affects cooling across the food value chain, or rather the cold chain, from cold storage after harvest, to cooling during transportation, to refrigeration in supermarkets and finally in homes. This increase in demand will be met via increased domestic agricultural production and food processing as well as imports, both of which increase demand for commercial and industrial refrigeration. Income will also affect the demand for refrigeration across the food cold chain. Food categories that require cooling such as meats, dairy products, and fresh vegetables have a positive income elasticity of demand, meaning as incomes increase so does the demand for these products.[39]

A growing cold chain drives the demand for cold rooms, commercial refrigeration, and transport refrigeration. Currently, 93 kilograms of food are wasted per person per year in Jordan and 22% of domestically grown fruits and vegetables are lost along the supply chain.[40] Efforts to combat this food waste as well as increasing food safety will drive cooling demand across the food value chain.

- **Tourism industry growth (mainly hotel and restaurant sector)**

Jordan's tourism sector presently constitutes 19.4% of the country's total GDP and is anticipated to further expand, leading to heightened demand for hotels and gastronomy.[41] This surge in tourism will consequently boost the need for both AC and commercial refrigeration. As temperatures rise, the demand for space cooling in hotels is expected to increase as well. AC systems are currently installed in 90-95% of newly constructed hotels.[42]

Increasing temperatures and heat wave occurrences

Temperatures in Jordan are expected to rise between 1.7°C and 4.5°C by 2080 compared to pre-industrial levels (base year 1876)

34 Vehicles and Drivers Licensing Department data given to Cool Up.
35 World Bank 2017.
36 Organisation for Economic Cooperation and Development 2019.
37 Jordanian Ministry of Environment 2020b.
38 Cool Up 2022a.
39 Food and Agriculture Organisation 2014.
40 UN Jordan 2022.
41 Jordan Investment Commission 2018.
42 Cool Up 2022a.

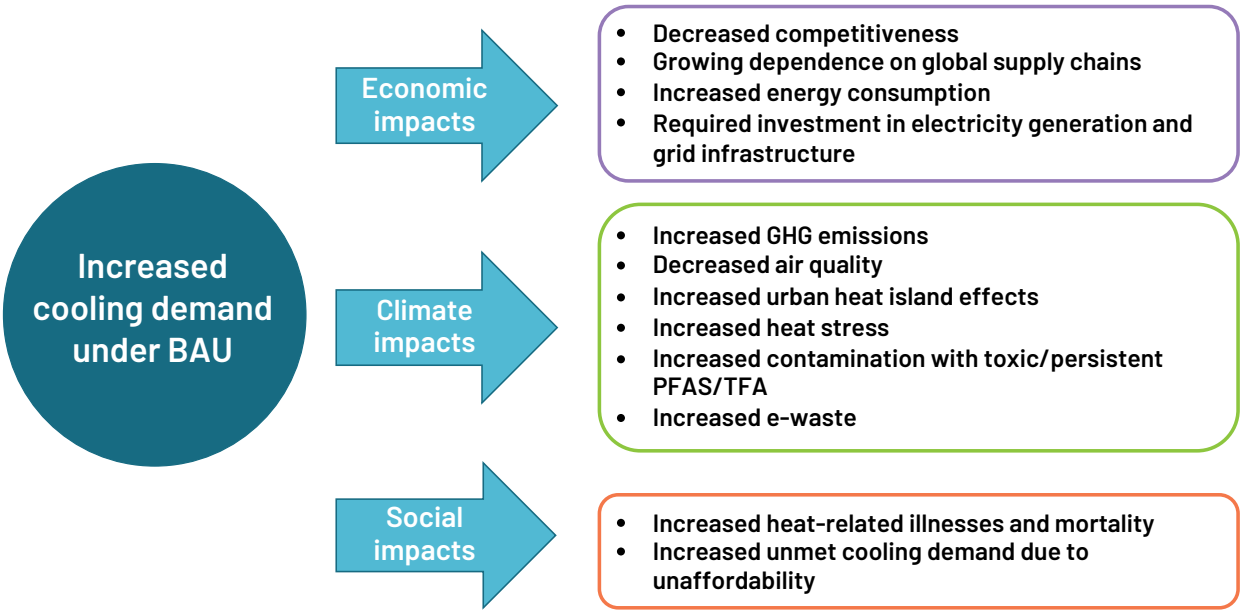
depending on the GHG emission scenario used in the model.[43] The occurrence of very hot days is also projected to increase significantly. The number of days with temperatures above 35°C was 76 in 2000, this is expected to increase by 15 to 26 days and reach 91 to 102 days by 2030.[44] The capital Amman is likely to be impacted very heavily by heatwave occurrences (defined as at least two consecutive days with above average temperatures) with projections estimating 41 heatwave days from 9.8 heatwave occurrences per year by 2050.[45]

The expected rise in average temperatures and increase in heat wave occurrences is a key driver of cooling demand and affects all sectors. As temperatures increase demand for space cooling and refrigeration both for residential and commercial use increases. This affects mainly the capacity of the systems and the operational hours, but also the number of systems both for air conditioning space cooling as well as refrigeration. Jordan is already classified in the Kigali Amendment as a country with "high ambient temperatures"[46] which means the HFC freeze is delayed by four years as cooling is essential for the population's health and wellbeing.[47]

5.2 Impacts of growing cooling demand

Meeting the expected increase in cooling demand using the conventional technology would result in a large increase in electricity demand and both direct and indirect emissions. Based on technologies currently in use and available on the market, as well as existing policies, the rising cooling demand would most likely be met using conventional cooling technology relying on refrigerants in a business-as-usual scenario.[48] The above-mentioned key drivers will lead to a strong increase in cooling demand in Jordan in the future.

Figure 9: Overview of drivers and impacts associated with increasing cooling demand



43 *Weathering Risk 2022.*
44 *Ibid.*
45 *Alwadi and Abdulla 2022.*
46 *As per UNEP 2018a, HAT countries are defined as countries with an average of at least two months per year over ten consecutive years with a peak monthly average temperature above 35°C.*
47 *UNEP 2018b.*
48 *For example, R404A, and R22 in AC, R134a and R32 used in chillers, and R404A and R134a in commercial refrigeration.*

Climate and environmental impacts

- **Impacts of increasing direct and indirect emissions**

Cooling technologies that are currently used in Jordan are predominantly non-sustainable cooling technologies with low efficiency and charged with high GWP HFC refrigerants combined with a rather high operational leakage rate. Further, inadequate servicing and maintenance activities performed on cooling equipment led to low efficiency of the equipment. Based on existing policies and technologies currently in use, the rising cooling demand would most likely be met using direct expansion systems relying on synthetical refrigerants[49], resulting in large increases in both direct and indirect emissions.

In the RAC sector, increase of direct emissions is inter alia associated with an ongoing and increasing use of high GWP refrigerants, high leakage rates, which occur during the equipment's lifetime as well as during servicing and maintenance activities. Indirect emissions result from an increase in energy demand and, therefore, energy production. Direct emissions are expected to significantly increase by a factor of 1.4 until 2050.[50] Further, the electricity demand for space cooling is expected to increase rapidly over the next decades, more than 3.5-fold by 2050.

Increases of emissions lead to climate change for basically all areas inhabited and used by humans. For the Middle East and North Africa (MENA) region, increases in the frequency, duration, and magnitude of heatwaves are projected towards the end of the century. As projected, heatwaves in the MENA region would last for over a month compared to 3-5 days in the early 2000s,[51] further increasing the cooling demand and putting incomparable pressure on the electricity grid. Jordan's extreme heat hazard carries high heat stress and is a risk for its population.[52]

- **Impacts of current waste handling practices**

For electrical and electronic equipment, the absence of end-of-life management and lack of skilled personnel dismantling equipment at its end-of-life leads to increases in emissions of synthetic high GWP refrigerants[53] and further reduces the lifetime of cooling equipment. The latter is even exacerbated by instable and collapsing energy grids, reducing the lifetime of cooling components, specifically of the compressor, drastically. These constraints concerning electronic and metal waste put pressure on the waste handling infrastructure leading to additional pollution of the environment.

- **Environmental hazards of synthetic refrigerants**

Many of the refrigerants used belong to the group of per- and polyfluoroalkyl substances (PFAS), a large class of human-made chemicals.[54] Among other areas, PFAS are widely used in industrial applications, for firefighting and as refrigerants. Unsaturated HFCs, further referred to as hydrofluoroolefins (HFOs), with short atmospheric lifetimes and low GWPs are increasingly offered on the cooling market. In February 2023, five EU countries published a joint proposal to restrict PFAS, including some HFCs and HFOs refrigerants, to the European Chemicals Agency under the EU Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation. The inclusion in the potential banned list of the refrigerants R125, R134a, R143a and the HFOs R1234yf and R1234ze(E) affects virtually all HFC/HFO refrigerant blends. Besides the adverse effects of the substances itself, HFOs form persistent degradation products in the atmosphere, specifically trifluoroacetic acid (TFA), which is deposited through precipitation. TFA is not degradable, is reported to have ecotoxicological effects on (aquatic) organisms,[55] and will steadily

49 *For example, R404A, and R22 in AC, R134a and R32 used in chillers, and R404A and R134a in commercial refrigeration.*
50 *Cool Up 2023.*
51 *Zittis, Hadjinicolaou, Almazroui et al. 2021.*
52 *ThinkHazard 2020.*
53 *Smith, Brown, Ogilvie et al. 2001 and Climate and Clean Air Coalition 2021.*
54 *United States Environmental Protection Agency 2018.*
55 *Behringer, Heydel, Gschrey et al. 2021.*

accumulate in the biosphere due to the current extent of use in cooling, specifically in mobile AC but also increasingly in stationary systems.

- **Agriculture and food production**

The agricultural sector holds significant importance within the national economy due to its vital role in supplying a significant portion of the country's food requirements, particularly fresh fruits, vegetables, and certain grains.[56] However, in terms of food security, existing levels of dependable cold chains may prove inadequate to meet the anticipated growth of the food sector. This shortfall in meeting the demand for cooling infrastructure along the cold chain has profound implications for people's well-being and livelihoods.

High rates of post-harvest losses are among the key weaknesses of Jordan's agricultural sector and may negatively affect food security in Jordan.[57] Concurrently, food waste makes up an estimated 50 to 65% of municipal solid waste, with varying levels across governorates.[58] To mitigate this issue, the expansion of post-harvest cooling systems (e.g., the implementation of cold storage facilities, cold trucks, and pre-cooling techniques) could contribute to reducing the loss of perishable agricultural products.[59] Developing and expanding post-harvest cooling infrastructure is particularly important in the Jordan Valley, which is the main source of agricultural food production in the country. Further, a reliable post-harvesting cooling infrastructure to reduce food loss by ensuring efficient cooling systems for harvested crops is important for regions experiencing agricultural growth, which particularly applies to the Highlands, where irrigated agriculture has been steadily booming since the eighties.[60]

Economic impacts

On an economic level, Jordan is faced with increasing cost of energy production due to increases in global oil prices and Jordan's high dependence on imported oil for energy production.[61] Rising energy prices may hamper national efforts to meet the projected rise in cooling demand.

With rising demands on energy production, required funds and investments in the energy sector may present a further economic challenge.[62] Also, the energy sector in Jordan is currently encountering a growing challenge due to a scarcity of skilled and competent employees for energy production[63]. The lack of necessary updates over an extended period has rendered the energy grid susceptible to various issues, including frequent power cuts. The most recent example was the countrywide power outage in 2021 due to the grid's inability to handle fluctuating electrical loads and different sources of electricity generation.[64] An expansion of the grid is required to equally distribute the pressure and cover the vast share of unmet cooling demand.[65]

Regarding the sourcing of RAC infrastructure, Jordan depends to a large extent on global supply chains for importing refrigerants, components, and equipment.[66] Increasing prices of refrigerants and other materials for the cooling sector as well as Jordan's limited export opportunities[67] may have a detrimental effect on Jordan's trade balance, jeopardizing its competitiveness in international trade.

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56 Jabarin 2021.
57 Ibid.
58 Jordan Green Building Council 2016.
59 Jabarin 2021.
60 Jordanian Ministry of Water and Irrigation 2023.
61 Alrwashdeh 2022.
62 Ibid.
63 Ibid.
64 Ibid.
65 Ibid.
66 Cool Up 2023.
67 Cool Up 2022b.

Social impacts

• Impacts on employment

Increased heat can deteriorate working conditions and productivity.[68] Various sectors in Jordan are projected to experience increased lost working hours due to heat stress. In 1995, the equivalent of 400 full-time jobs was lost due to heat stress, whereas projections for 2030 estimate the equivalent of 2.300 full-time jobs being lost.[69]

• Public health

Insufficient access to adequate cooling can cause heat-related illnesses and discomfort, particularly affecting vulnerable groups.[70] Heat-related mortality rates are expected to surge in Jordan. In a high emissions scenario, heat-related deaths among the elderly (aged 65+) are projected to rise significantly. By 2050, the heat-related deaths per 100,000 elderly individuals could reach 54, compared to the baseline of 2 deaths per 100,000 annually between 1961 and 1990.[71] Depending on the temperature rise, Jordan could face an 8 to 15-fold increase in heat-related mortality by 2050.[72]

Besides climate-related health impacts of non-sustainable cooling, the contamination of drinking water through TFA or trifluoroacetate deposition is problematic due to its persistence, long lifetime and mobility. TFA inputs in groundwater and drinking water are hard to remove, and recent analyses indicate increasing TFA concentrations in drinking water near precautionary health limits.

• Social inequalities

Due to reduced agricultural productivity, the trend of climate-induced migration to urban areas is likely to continue, creating unprecedented challenges for social systems, hindering sustainable development and exacerbating existing societal inequalities. The quality of housing and urban infrastructure's capacity to handle population growth are significant concerns.[73]

Women in rural areas are vulnerable to worsening social conditions because often, at least initially, men migrate without their families.[74] By expanding access to sustainable cold chains, agricultural yields and income levels can increase, ultimately serving to address gender disparities.

To mitigate the negative impacts of conventional cooling technologies, an accelerated transition to efficient technologies using natural refrigerants is essential. Achieving this transition requires a wide range of interventions, mainly at the policy level.

Business as usual leads to a strong increase in electricity demand and direct emissions.

Sustainable cooling ensures comfort, productivity, and environmental responsibility.

68 *International Labour Organisation 2019.*
69 *Ibid.*
70 *World Health Organisation 2022.*
71 *Ibid.*
72 *Hajat, Proestos, Araya-Lopez et al. 2023.*
73 *Waha, Krummenauer, Adams et al. 2017.*
74 *Ibid.*

6 The NCS in the context of national policies and targets

6. The NCS in the context of national policies and targets

The National Cooling Strategy of Jordan seeks to build on existing policies in the energy and climate fields. Most importantly, the NCS will support the pillars of the Economic Modernisation Vision, seeking to foster sustainable economic growth and improve citizens' quality of life. Due to the cross-cutting nature of cooling, reducing emissions from cooling will see emissions fall across a number of industries.

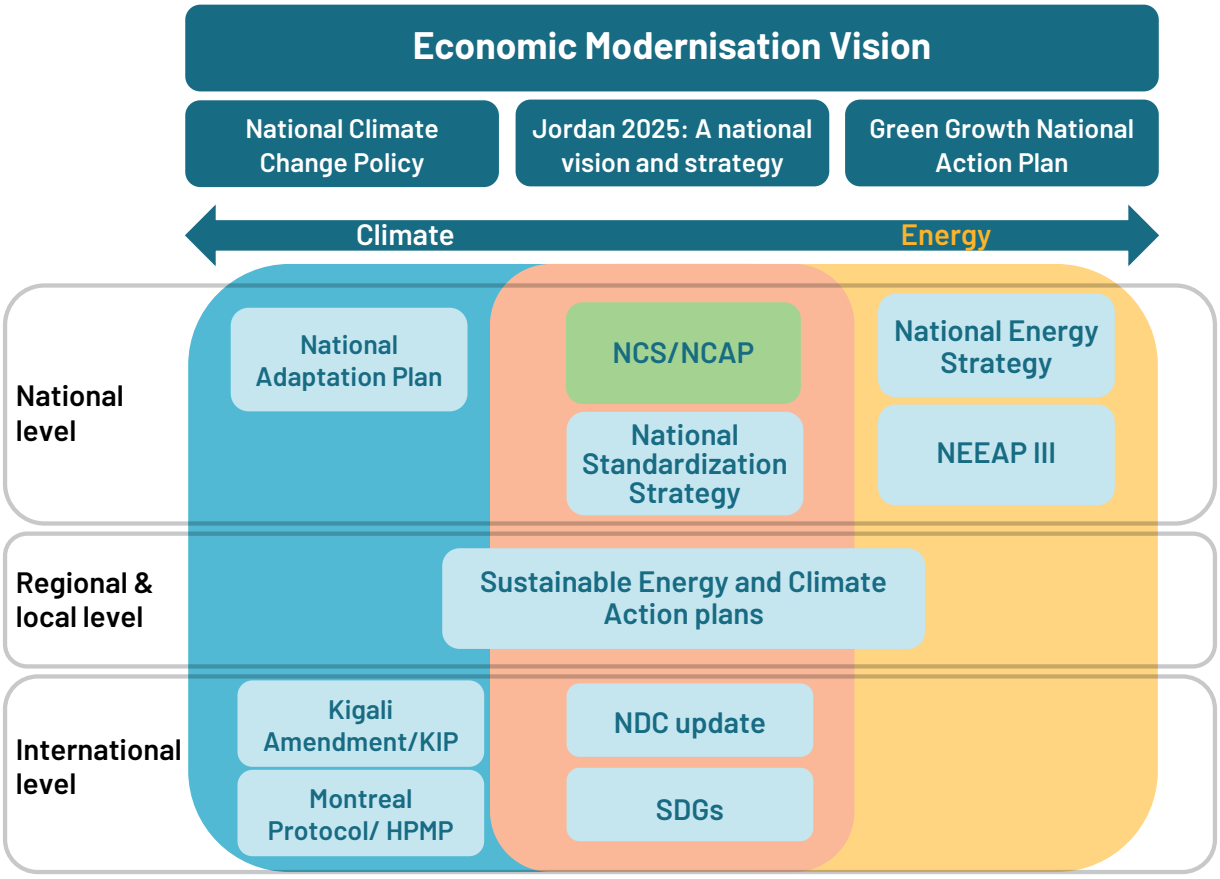
This section provides an overview of the current energy and climate policy landscape and shows how the National Cooling Strategy and National Cooling Action Plan can contribute to existing policies and targets. Current documents and policies already show touchpoints with the cooling sector. Various policies, targets and incentives around energy efficiency are in place, however little focus is given to the RAC sector explicitly. Where measures around space cooling and refrigeration in public and commercial buildings are included, they are limited to improving energy efficiency and do not include any mention of refrigerants with low GWP or natural refrigerants. Similarly, while it is acknowledged that adaptation to increasing temperatures, particularly in urban areas, will need to take place, the plans often do not explicitly include the RAC sector and do not describe how to provide cooling in a sustainable way. It is noteworthy that the salience of cooling across the economic and environmental policies and strategies has increased already, and the NCS complements this by explicitly addressing the RAC sector.

A holistic perspective on Jordan's transition towards sustainable cooling practices entails recognition of the cooling sector's direct interdependence with other vital pillars of Jordan's sustainable development, such as water, energy, and the environment. In this regard, the Water-Energy-Food-Environment Nexus encourages the development of innovative projects that benefit the water, energy, food, and environment sectors simultaneously.

Jordan has committed to several national and international climate and energy regulations and agreements. The following figure provides an overview of key policies, strategies and plans relevant to the cooling sector and illustrates where the NCS and NCAP are situated.

The NCS contributes to achieving Jordan's commitments, goals, and targets set out in the Economic Modernisation Vision. It also supports the achievement of the targets set out in the HFC phase down and the HCFC phase out plans and the Sustainable Development Goals.

Figure 10: Energy and climate policy overview of Jordan



Towards policy linkages and coherence for sustainable cooling

This section summarizes the overall targets and objectives of existing climate and energy policies. For each policy the linkages with the cooling sector are highlighted in areas such as energy efficiency, heat adaptation, food loss/agriculture, and the phase out of HFCs, ozone-depleting substances (ODSs), and the adoption of natural refrigerants.

The ***Economic Modernisation Vision*** is a key pillar of the economic reform and was published in 2022. It aims at boosting economic growth and meeting the expected demand of one million jobs for Jordanians in the next decade.[75] It sets a series of strategic objectives within its two key pillars: economic growth and quality of life, with sustainability as an overarching theme.[76] The Vision already makes a link to the cooling sector. The RAC industry is mentioned as an area of growth where Jordan already has a strong initial position and the capacity to expand and become a leader in the region. The Vision sets out the ambition to improve energy efficiency, waste management, recycling, and reuse, without specifying priority areas or cooling sector-specific measures and targets. Furthermore, it sets out the initiative to revamp the cold chain infrastructure and the ambition to reduce food and agricultural loss and waste.

75 *Central Government of Jordan 2022.*
76 *Ibid.*

The ***National Climate Change Policy of the Hashemite Kingdom of Jordan 2022-2050*** **(NCCP)** provides guidance on building a climate resilient society that aims to reach carbon neutrality by 2050, in alignment with the objectives set under Jordan's Economic Modernisation Vision, United Nations Framework Convention on Climate Change, and the Kigali Amendment to the Montreal Protocol.[77] It is an overarching document for mainstreaming climate change in all sectoral policies, strategies, and action plans. The NCCP includes policies and actions on energy efficiency in household appliances via standards and in buildings via revised building codes and envelope upgrades. It also includes policies on waste management and increased circularity, as well as capacity building via vocational training courses. Lastly, it proposes financial incentives such as tax rebates for implementing energy efficiency (EE) projects.

The ***Jordan 2025: A National Vision and Strategy***, published in 2015, is a broad plan charting the socio-economic development objectives for the country. The Jordan 2025 National Vision and Strategy suggests incentives for specific measures that have interlinkages with the cooling sector, such as incentives for the modernisation of small and medium packaging and refrigeration facilities in the agriculture sector and the activation of the Renewable Energy and Energy Efficiency Fund. The link to cooling in the Jordan 2025 National Vision and Strategy is with the aim of increasing energy efficiency across sectors, even if cooling is not mentioned specifically.

The ***Green Growth National Action Plans*** **(GGNAP)** builds upon the Jordan 2025: A National Vision and Strategy 2025 and was published in 2020. It sets out the sustainable development objectives of Jordan, laying out green growth pathways in the agriculture, energy, tourism, transport, waste, and water sector.

The pathway for energy focuses heavily on energy efficiency[78] and proposes energy efficiency retrofits in public buildings, which will include several measures to improve the energy efficiency of lighting, heating, and cooling, insulation, and appliances. A further proposition is the use of geothermal wells for heating and cooling to reducing energy costs. The pathway foresees a behaviour change campaign aiming at the increased use of energy efficient appliances among end-users, including the evaluation of financing options for end user replacements of old and inefficient devices, such as tax and customs reduction as well as green financing options in collaboration with credit companies, financing companies, and commercial banks.

The pathway for tourism plans to increase energy efficiency in the sector, specifically using energy-saving appliances and the adoption of green building codes in the hospitality sector.[79] The pathway for agriculture stresses the importance of upgrading the cooling of fruits and vegetables in the private sector as an important measure to increase revenues from fruit and vegetable exports and avoid food losses and waste.[80]

The ***National Energy Strategy 2020-2030***, published in 2020, aims to achieve a diverse, secure, and sustainable supply of energy and optimal utilisation of natural resources.[81] The strategy sets out an energy efficiency target of 9% by 2030 compared to 2018. It aims at diversifying energy forms, increasing the contribution of indigenous energy sources, improving energy efficiency in all sectors, and reducing the impact of energy costs on the national economy, making Jordan a regional hub for all forms of energy exchange. The following table summarises the strategy targets related to electricity generation to cover the increased demand of electricity from renewable and non-renewable sources.

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77 Jordanian Ministry of Environment 2023a.
78 Jordanian Ministry of Environment 2020c.
79 Jordanian Ministry of Environment 2020b.
80 Jordanian Ministry of Environment 2020d.
81 Jordanian Ministry of Energy and Mineral Resources 2019.

Table 4: National Energy Strategy 2020 – 2030

Target	2020	2030
Renewable energy targeted capacity	21% (2,400 MW)	31% (3,200 MW)
Share of renewables in the energy mix	11%	14%
Local contributions to the energy mix	15%	48.5%
Electricity generation using natural gas	61%	53%

The ***National Energy Efficiency Action Plan II (2018-2020)*** compiles key measures that are relevant to energy efficiency and related national priorities. The National Energy Efficiency Action Plan (NEEAP) 2018-2020 foresaw a 20% reduction in energy consumption by 2020. The NEEAP II stressed the need to reduce energy consumption for heating and cooling in the building stock, however the only specific measures mentioned were improving roof insulation. The third NEEAP is prepared by the Ministry of Energy and Mineral Resources and will build on the EE measures in the NEEAP II. It has been suggested to include measures on MEPS for AC and refrigeration in the commercial sector, awareness raising and capacity building measures on sustainable cooling and a certification scheme for technicians of cooling installations.

The ***Climate Change National Adaptation Plan*** **(CCNAP)**, published in 2021, provides a vision for climate adaptation in Jordan and identified measures and guides for a range of sectors to implement adaptation initiatives.[82] The CCNAP focuses on energy efficiency in buildings and how to make these more resilient to rising temperatures. A section of the CCNAP (programme U4) specifically focuses on "improving building efficiency for adapting to increased heat in urban centres".[83] This shall be achieved through promoting the use of energy-saving devices via awareness campaigns, amending sector policies such as building codes, and improving building insulation. All these measures are strongly linked to cooling, which can play an important role in climate adaptation.

The ***National Standardisation Strategy***, published in 2022, aligns standardisation priorities with existing national priorities in the areas of economic development, social progress, and environmental protection.[84] The standards must be in line with 9% energy efficiency across sectors and 10% carbon emission reduction targets. The strategy sets out a path to develop and update standards and labels in different priority sectors. Among these are energy, food, transport, and construction. The strategy explicitly calls for standards and technical regulations regarding central cooling devices, including commercial and industrial refrigerators, to use refrigerants that have a lower GWP. More broadly, the strategy aims to set energy efficiency standards for a variety of "energy-using products", setting out aspects such as product design and labelling. The strategy also calls for an update to building construction and management codes to make these greener, promoting green materials, techniques, and energy efficient technologies.

Sustainable Energy (Access) and Climate Action Plans (SE(A)CAP) are developed at the municipal level and describe concrete actions to be undertaken to achieve GHG emission reduction targets.[85] A large focus in Jordanian SECAPs is energy consumption in municipal buildings. The foreseen actions to lower energy consumption include improving the building envelopes, using high-efficiency cooling technologies, adjusting cooling and heating units to the thermal calendar, and improving maintenance of equipment.

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82 Jordanian Ministry of Environment 2021b.
83 Ibid.
84 Jordan Standards and Metrology Organisation 2022.
85 Clima-Med 2023.

Cooling plays an important role in the SECAPs, especially when it comes to energy efficiency in public and private buildings. The SECAPs already include measures and actions targeted specifically at reducing GHG emissions from cooling.

The ***National Determined Contribution (updated NDC 2021)*** sets out the 31% GHG mitigation by 2030 (compared to 2012) target for Jordan.[86] It sets out detailed GHG mitigation and energy efficiency targets for Jordan and is aligned with the long-term strategy of the Climate Change Policy of Jordan. The NDC includes the importance of efficient cooling and the need for pilot projects for sustainable cooling. It also explicitly mentions refrigeration and air conditioning as significant GHG sources. Energy efficiency is also an important focus of the NDC. It calls for amendments to sector policies and regulations such as building codes to reduce energy demand. The updated NDC aims at reducing HFC emissions from the industry and encourages efficient cooling technologies to comply with the national commitments under the Kigali Amendment. HFCs are also included in the GHG inventory to better allow tracking.

Kigali Amendment to Montreal Protocol

Jordan has been a party to the Montreal Protocol (MP) since 1989 and has ratified the five subsequent amendments made under the MP, including the recent Kigali Amendment in October 2019. Jordan has progressed on its commitments relevant to the Montreal Protocol and Kigali Amendment. Jordan completed the second stage of its ***HCFC Phaseout Management Plan*** **(HPMP)**, which seeks to achieve the goal of fully phasing out HCFCs by 2040. Actions such as prohibiting of licensing of new installations based on CFCs, enforcing the labelling of products containing ODS and the alternatives, and regularly updating the regulations to comply with MP commitments are already taking place. Through these actions Jordan was already 69% below the HCFC baseline for compliance in 2018,[87] putting it on track to meet the 2040 target well ahead of schedule.

The strategic interventions of NCS will drive the strengthening and updating of policies as well as the development of new policies to contribute to the NCS goals.

Under the Kigali Amendment, the government approved a HFC consumption phasedown target of 80% by 2045. Jordan has already undertaken the ***HFC Phasedown Management Plan Preparation*** and has started to create an enabling environment for the phasedown of HFCs via capacity building programmes targeted at the technicians working in the RAC industry, an awareness campaign on EE in cooling systems, and training programmes on testing of refrigerants and recovery and recycling of the phased-out refrigerants. Based on this preparation, the ***upcoming Kigali Implementation Plan (KIP) of Jordan*** will lay out a strategy to meet the HFC reduction targets as laid out in the Kigali Amendment.

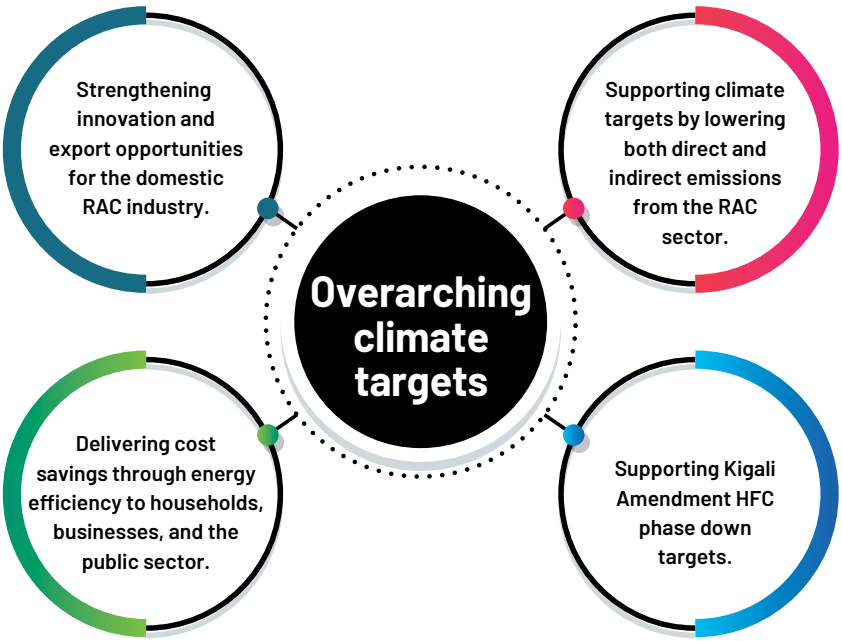
Contributions of the NCS to the existing climate and energy policy framework

The NCS will be an integrated and important part of the policy landscape in Jordan. It contributes to existing targets and objectives (e.g., emission reduction and energy efficiency). It complements the existing strategies by adding specific cooling sector related aims and measures. It addresses the lack of a specific cooling sector related strategy and targets by developing RAC sector-specific recommendations that will bring economic, environmental, and social benefits across sectors and accelerate the uptake of sustainable cooling.

86 Central Government of Jordan 2021.
87 UNIDO 2019.

The NCS contributes to overarching climate targets in various ways:

Figure 11: NCS contribution to the overarching climate targets



The NCS is integrating policies and providing synergies between Jordan 's energy and climate polices aligned under the cooling lens.

The NCS contributes to sectoral climate targets in various ways:

Figure 12: NCS contribution to the sectoral climate targets

Table 5: Overview of contribution of NCS to the objectives of key government strategies

Level	Policy document	NCS contributions to the objectives of key policies
National level	Economic Modernisation Vision (2022)	• Reduce GHG emissions • Expand capacity of AC sector and become regional leader • Improve energy efficiency • Create jobs
	National Climate Change Policy (2022-2050)	• Reduce GHG emissions • Achieve high level of energy security • Support energy efficiency (appliances and building envelope) in households • Promote green energy and energy efficiency in industrial and commercial activities • Develop a circular waste economy • Develop policy framework for phasing down/out HFCs and HCFCs in alignment with the Kigali Amendment • Adapt to increased heat in urban centres through enforcement of green building codes and enhancing retrofitting of existing buildings • Review and update / develop vocational training courses for supporting climate change adaptation and mitigation
	Jordan 2025: A national vision and strategy	• Provide incentives for the development and modernisation of small and medium packaging and refrigeration facilities • Activate energy efficiency programmes to increase energy security • Expand food storage capacity in Jordan • Win a greater share of the regional MICE (meetings, incentives, conferences, exhibitions) market and expand the 5-star hotel market • Explore medical and wellness tourism as a particularly attractive opportunity for Jordan
	Green Growth National Action Plan 2021-2025	• Reduce GHG emissions • Upgrade packaging, scaling, storage and cooling of fruits and vegetables managed by the private sector • Improve energy efficiency in public buildings • Increase awareness around use of energy efficient appliances • Improve the cold chain
	National Energy Strategy	• Improve energy security • Improve energy efficiency
	NEEAP	• Reduce energy consumption via energy efficiency measures
	Climate Change National Adaptation Plan, NAP (2021)	• Improve building resilience to climate change impacts such as increasing temperatures • Reduce energy demand for cooling by improving building techniques • Raise awareness around energy efficiency and promote energy efficiency appliances
	National Standardisation Strategy	• Increase energy efficiency via performance standards • Improve energy efficiency of household electrical appliances, through eco design and labelling • Introduce green building construction and management codes and improve enforcement • Increase use of less environmentally harmful refrigerants in central cooling systems
Regional level	Sustainable Energy and Climate Action Plans (SECAP)	• Reduce GHG emissions • Improve EE in public buildings • Reduce energy demand from cooling by promoting high-efficiency cooling technologies and passive cooling • Update building codes
International level	NDC update	• 31% GHG reduction by 2030 compared to 2021 • 9% improvement in energy efficiency by 2030 compared to 2018 • Promote efficient cooling • Reduce emissions from F-gases
	HPMP and KIP	• Phase out ODS • Phase down HFCs

7 Jordan's sustainable finance landscape

7. Jordan's sustainable finance landscape

This chapter provides an overall view of the finance landscape related to the RAC sector. The financial sector in Jordan provides financing for conventional RAC products and other related items (e.g., household appliances), primarily through banks. Both individuals and corporates avail of financing for acquisition of RAC products. Banks do not specifically categorise "cooling products finance" but provide finance for all products under asset finance. The objective of the banking sector in future is to develop products that promote sustainable development and facilitate the transition to a green economy.[88] On the other hand, financial support needs to be accompanied by awareness-raising campaigns to motivate end users to adopt more efficient and green technologies.

A broad cross-section of financing mechanisms and incentives related to energy, transportation, building construction and other sectors is available. Many of these incentives are linked to energy efficiency and renewable energy and have relevance to the RAC sector.

Financial sector features

The financial services sector in Jordan is well-developed, particularly compared regionally, with a wide range of services from microfinance to retail and corporate commercial and Islamic to investment banking, accounting together with insurance services, real estate & business services for 18.5% of GDP in 2021. Despite the rapid growth of microfinance and financial technologies in recent years, the banking sector is the largest. At present **21 banks** are operating in Jordan, including 12 domestic conventional banks, 3 domestic Islamic banks, 5 foreign-owned conventional banks and a foreign-owned Islamic bank.

The Jordanian banking system is highly stable, with banks' Capital Adequacy Ratios[89] ranging between 17-20% over 2007-2020, more than the Central Bank of Jordan's (CBJ's) requirement of 12%. In 2019 and 2020, the ratio stood at 18.3%, as the banks were instructed not to distribute dividends as part of the CBJ's measures to address the impact of COVID-19 and keep liquidity in the system. Quality of assets remained high, as non-performing loans[90] (NPLs) only rose slightly from 5% at the end of 2019 to reach 5.5% at the end of 2020; banks' provisions covered 71.5% of NPLs.[91] Aggregate assets of commercial banks worth JOD 64.6 billion in 2022 amount to 190% of GDP. Direct credit facilities account for 48% of the banks' total assets and thus are the most significant component of their asset structure. The outstanding balance of credit facilities extended by licensed banks amounted to JOD 32,591.5 million at the end of 2022, compared to JOD 30,028.5 million at the end of 2021, with an increase of 8%.[92]

Role of the Central Bank of Jordan in green finance

Commercial banks in Jordan are regulated by CBJ, which is also authorised to supervise non-bank financial institutions including lending and microfinance companies. The CBJ is in the process of finalizing the Green Finance Strategy 2024-2028 for the financial sector with the support of the World Bank.

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88 Central Bank of Jordan 2023.

89 Capital Adequacy Ratio is an indicator of how well a bank can meet its obligations. The formula for CAR is: (Tier 1 Capital + Tier 2 Capital) / Risk-Weighted Assets.

90 A nonperforming loan (NPL) is a loan that is in default because the borrower has not made the scheduled payments for a specified period.

91 Central Bank of Jordan 2020.

92 Association of Banks in Jordan 2021.

Sustainable cooling finance - a green banking product

In 2016, the CBJ joined the Sustainable Banking and Finance Network a voluntary community of financial sector regulators, central banks, industry associations and environmental regulators from emerging markets, with the objective of supporting each other in the development and implementation of national frameworks for sustainable finance. The network provides capacity building and serves as a platform for peer-to-peer knowledge sharing to deepen collective learning and for members to benefit from global best practices.[93]

At present, most banks in Jordan do not have explicit financing options for sustainable cooling solutions. In this regard, it may be observed that the Central Bank of Jordan has established a fund to support different economic sectors, including industrial, tourism, agriculture, renewable energy, information technology, transportation, health, technical and vocational education, and engineering consulting sectors. The CBJ have assigned a JOD 1.3 billion subsidised fund (equivalent to about 4% of direct facilities granted by banks) to be lent to Jordanian banks at an interest rate of 0.5 - 1%. Banks are expected to on-lend to eligible clients at a CBJ capped rate between 2.5 - 4%, depending on the location of the client. Loans have a 10-year tenure and 2 years grace period with a maximum single loan size of JOD 3 million and JOD 4 million for transportation & energy sectors respectively. The CBJ fund concentrates on small, medium to large companies and does not serve individuals, small or micro companies or the construction sector. Nevertheless, this fund has been the main source of financing available for green projects, particularly on more favourable terms, with JOD 233 million disbursed for renewable energy investments accounting for 19% of the total fund utilisation which is JOD 1,216 million. Recently the CBJ announced that they will finance certified green buildings from this subsidised fund. These loans can benefit from the Jordan Loan Guarantee Cooperation Guarantee.[94]Noting that commercial and Islamic banks also provide a wide variety of financing for individuals and businesses from their dedicated source of funds. Where it is accessible for clients and approvals are upon the banks internal credit policy.[95]

Financing sustainable cooling solutions is considered green financing and offers potential for the banking sector.

Jordan Environment Fund (JEF)

The Jordan Environment Fund (JEF) was established in 2009 under the provisions of the Environment Protection Law of the Ministry of Environment, with a mandate to help Jordan advance its national goals for environmental protection and sustainable development. The Fund's mandate includes:

- Support activities that contribute to environmental protection and conservation, and development of environmentally friendly practices.
- Support initiatives that promote resource efficiency, to contribute to sustainable development.
- Contribute to raising environmental awareness, including use of cleaner production technology.
- Focus on priority national sectors and provide support to enable fulfilment of environmental requirements.
- Promote cooperation and knowledge transfer with national, regional, and international entities with similar mandates to coordinate activities in support of environmental protection.

93 Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) 2022.

94 Central Bank of Jordan 2023.

95 Association of Banks in Jordan 2021.

JEF continues to develop its institutional framework to align with international best practice, respond to national priorities, and forge strategic partnerships with local, regional, and international partners. JEF is strategically placed to serve as an implementation arm for the Ministry of Environment and the Government of Jordan in enabling key environmental strategies and plans.

JEF works with beneficiaries from the public, private and NGO sectors, striving to achieve a more tangible impact on Jordan's environment and society, on youth, women, and vulnerable communities. This includes identification of support mechanisms for innovative environmental solutions, particularly those which promote a circulate economy approach. In addition to the objectives listed above, JEF seeks to attract green and climate finance to Jordan. This includes leveraging national funds to attract private sector and international financing institutions in a blended finance approach.

JEF has supported several projects to date on a grant-financing basis, in diverse sectors, areas, and locations across Jordan, including biodiversity, waste management, climate change, awareness raising & behaviour change, and capacity building.[96]

Role of international support

The European Bank for Reconstruction and Development launched a **Green Economy Financing Facility** in Jordan (Jordan GEFF) to support the green economy transition in Jordan with a fund of USD 60 million. GEFF offers a line of credit to participating banks to provide financial assistance to **energy efficiency, small-scale renewable energy**, and water conservation projects. At present Bank Al Etihad and Cairo Amman Bank and one micro finance institution (Micro Fund for Women) have signed-up to offer finance. These institutions are in the process of developing green financial products. Participating financial institutions receive projects from eligible and creditworthy small corporates or small and medium-sized enterprises (SMEs) operating from different sectors, ESCOs, producers, vendors and suppliers of green technologies and residential building owners. GEFF Jordan can offer financial assistance up to **USD 1 million**. GEFF offers technical support to develop green investment projects and can receive grants between 10% to 15% of the cost of project subject to independent verification of successful implementation of projects. GEFF also provides loans as well as cash incentives to eligible certified green building projects.

In addition to approving investment projects based on individual assessment, an online tool called **GEFF Green Technology Selector** is provided to exhibit pre-approved high-performance technologies and materials that qualify for financing under the facility. Establishing minimum performance criteria across multiple technology categories makes it easier for companies to identify and select higher performance technologies.

The Green Action in Enterprises (GAIN) project

The GAIN project in Jordan, commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ), is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), in cooperation with the Ministry of Environment, the Ministry of Industry, Trade and Supply, business associations and the private sector. Technical assistance and training (under the GAIN project) to the Association of Banks in Jordan (ABJ) and banks operating in Jordan are being provided by GIZ and the Frankfurt School of Finance & Management. ABJ has introduced the green finance committee with members from 7

Green finance ensures sustainable development, growth and prosperity banks to offer enhanced green financing options in the future.

96 Jordanian Ministry of Environment 2023b.

banks in Jordan, to follow up on green and environmental policies and encourage banks to develop their green finance products. The mandate of the committee is to support the development of green finance in the banking sector, sharing the green finance knowledge with ABJ members , acting as a facilitator for the dialogue between the regulatory body and the member banks, raising awareness and capacitating member bank stuff regarding green finance development, assisting the CBJ in future activities related to green finance and channelling relevant international and national green finance developments for the member banks. In addition, the committee also supports specialized training-of-trainers programs for green finance in the industrial sector and transferring the knowledge to representatives in the banking sector. The committee successfully trained around 150 employees from the banking sector.

Green finance ensures growth and prosperity

Subsidies, tax rebates, incentives

Jordan initiated substantial energy reforms in 2012 to reduce the large and unsustainable fiscal burden. The Government of Jordan eliminated subsidies on gasoline (high quality), diesel and kerosene and partially cut the subsidies on liquefied petroleum gas (LPG).[97] On the other hand, there are several ways to reduce energy costs such as energy conservation, implementing energy efficiency improvement and using alternative sources of energy such as solar or wind energy. The Government of Jordan provides the following incentives for energy efficiency projects:

Tax rebate:

The Government of Jordan provides rebate on customs duties /fees and sales tax (zero customs duty and zero sales tax) to imported energy efficiency equipment.[98]

Subsidies:

The Jordan Renewable Energy and Energy Efficiency Fund (JREEEF) refunds up to 50% of the energy audit fees to eligible industry units. JREEEF also provides subsidy to solar PV and solar thermal systems for residential users.

JREEEF was established under Article 12 of the Renewable Energy and Energy Conservation Law No. 13 of 2012, within the Ministry of Energy and Mineral Resources, and aims to provide the necessary funding for projects to exploit renewable energy sources and rationalise energy consumption in various sectors. The fund has implemented several projects with the aim of raising the efficiency of energy use and expanding the utilisation of renewable energy in various economic sectors.[99]

In order to understand the magnitude of subsidies for electricity, it is relevant that the energy mix is producing electricity at a high cost of around 0.07 JD/kWh, the 1st electricity category is selling electricity for supported households at 0.05Jd/kWh. This means that subsidized households enjoy prices below generation cost. Assuming that 90% of all households receive that subsidy, its annual total amount equals approximately 144,000,000 JD. Noting that SMEs in the industrial sector also enjoy specialized electricity rates according to the location of the manufactory and the age of businesses, as more benefits are provided for startups.[100]

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97 World Bank 2015.

98 Support by the government is the By-law No. (13) of 2015 of Provisions and Conditions of Exempting Systems of Renewable Energy Sources and its Devices and Equipment and also the Energy Efficiency equipment from the Customs Fees and Subjecting them to General Sales Tax in Percentage or Amount of (Zero) according to the Paragraph (C) of Article (11) of the Renewable Energy and Energy Efficiency Law No. (13) of 2012. The law is followed By-law No. (50) of 2018.

99 Jordanian Ministry of Energy and Mineral Resources 2022.

*100 0.02 JD/KWh x 300 kWh/month and family * 12 month * 2,000,000 families.*

Partial credit guarantee to loans for energy efficiency projects:

The Jordan Loan Guarantee Corporation (JLGC) was established in 1994 to provide guarantees for loans provided by commercial banks and MFIs. JLGC guarantees loans for SMEs and start-ups as these entities do not have adequate assets to be offered as collateral. The maximum loan amount to be guaranteed is JOD 1 million and JLGC provides partial loan guarantees (up to 70-85%) to banks financing for SMEs. A client (an SME) applies for debt finance (loan) to a bank. This lender (bank or microfinance institution) requires a collateral on which basis the financial institution can provide credit approval. The Bank may obtain the guarantee from JLGC in coordination with the client in order to cover the client risk in case the client cannot provide collaterals. The client pays guarantee fees to JLGC.

Towards affordable and bankable sustainable cooling solutions

Incentives for green buildings:

Greater Amman Municipality provides in-kind incentives for promoting green buildings in the form of a density bonus which is an additional percentage (of floor area) to original eligible floor area ratio.[101] Thus, a green building construction receives an additional percentage (e.g., 13%) of floor space as compared to a conventional building.

All stakeholders' efforts and actions, prioritizing affordable and bankable cooling solutions, will promote the adoption of sustainable cooling solutions.

101 *Floor area ratio (FAR) is the ratio of a building's total floor area (gross floor area) to the size of the piece of land upon which it is built.*

8 Cooling sector in Jordan

8. Cooling sector in Jordan

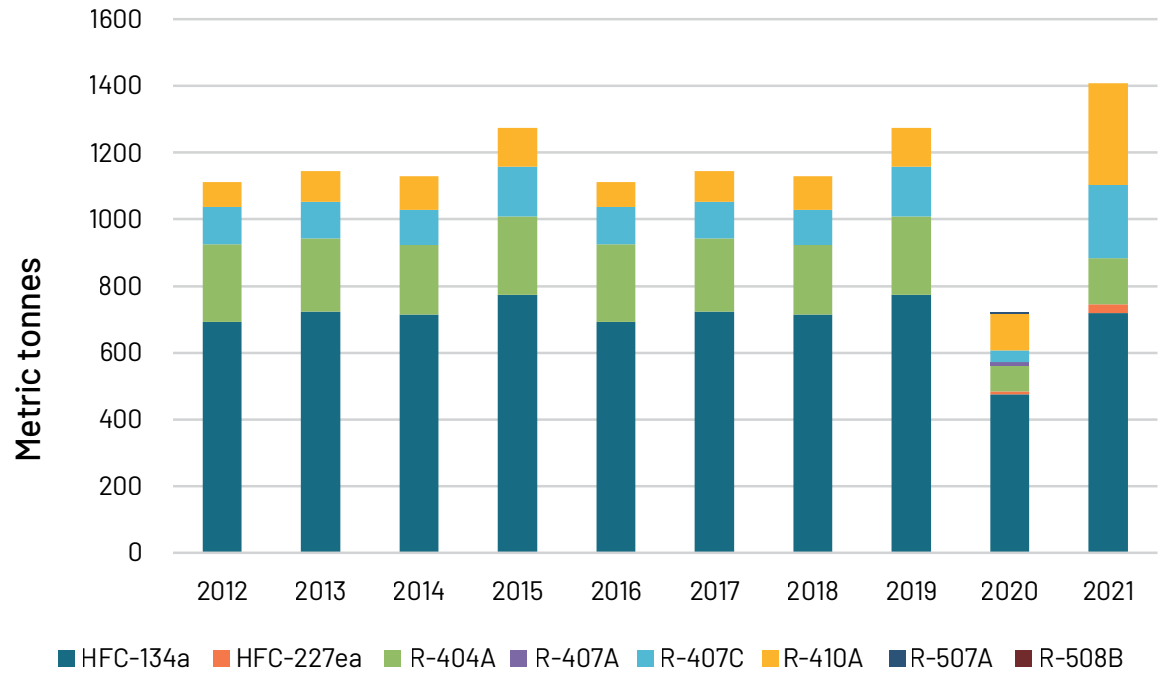
8.1 HFC quantities used in cooling

This chapter provides an overview of key characteristics of the cooling sector and presents preliminary results of the cooling demand based on existing data as well as projections from sector models developed as part of the NCS development. Information on domestic production (if applicable) and imported appliances has been taken from the Cool Up Sector Status Report as well as from the HFC inventory/ODS Alternative Survey.[102]

The data used for projections presented here will be further updated through ongoing stakeholder consultation and future surveys to be conducted as part of the preparation of the NCAP.

The HFC consumption data covering the period from 2012 until 2021[103] amounts to 1145 metric tonnes on average and is presented in the figure below.

Figure 13: Jordan country consumption data covering the period 2012-2021. For 2012-2019, data will be further detailed once an updated version will be made available based on current data collection efforts of the NOU.

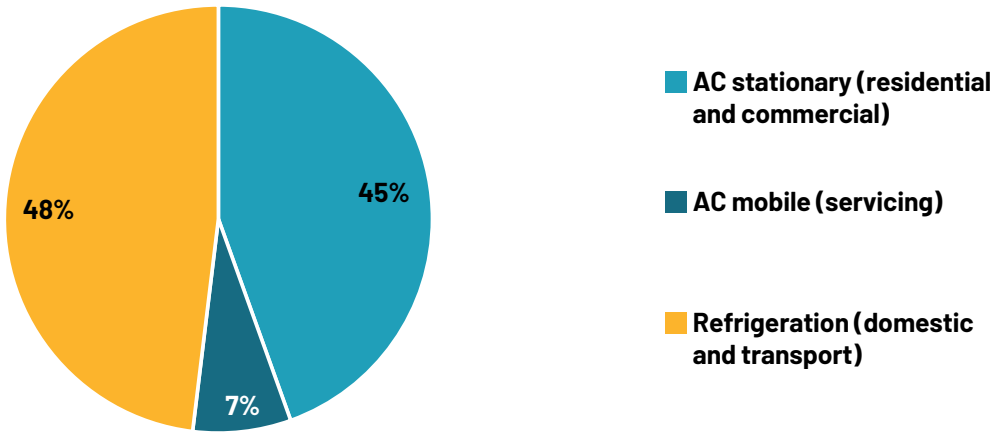


102 Cool Up 2022a.
103 Data obtained from the Jordanian National Ozone Unit.

The COVID pandemic led to variations in HFC consumption in 2020 and 2021. In 2020, the reported HFC consumption was 721 metric tonnes, which is half of what was used in 2021.

When expressed in CO_2 equivalent tonnes, both stationary air conditioning (for residential and commercial AC equipment) and refrigeration (for domestic, commercial, industrial, and transport purposes) contributed almost equally to the total consumption (see figure below). Mobile air conditioning made up only 7% of the total HFCs used in Jordan, considering it in terms of CO_2 equivalent.

Figure 14: Jordan country programme data covering HFCs consumption for 2020 and 2021 (calculated average).

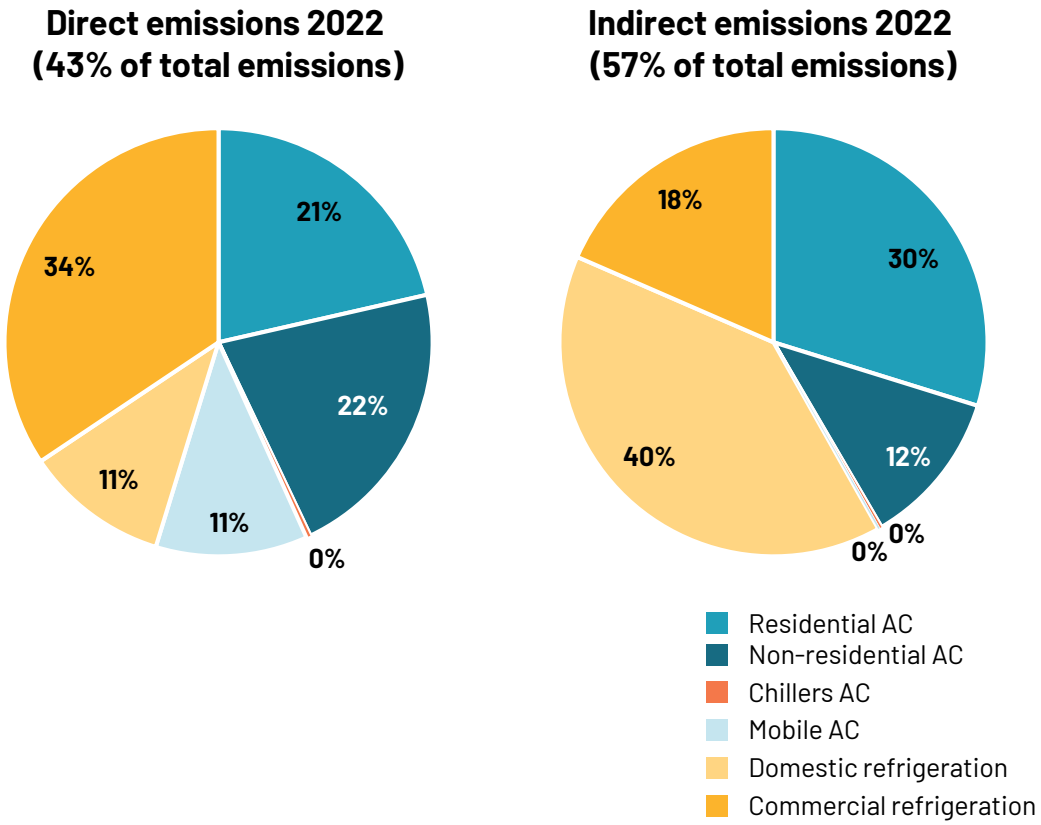


8.2 Emissions from cooling

Similar to the shares calculated based on the Jordan country consumption data (see above), emissions from refrigeration (45%) and stationary AC (43%) both account for almost equally high shares of total direct emissions, while mobile AC contributes only 11%. Direct emissions (from refrigerants leakage and release) for 2022 account for 43% of the total emissions (the sum of direct and indirect emissions).

Improving energy efficiency can partly offset indirect emissions from the expected growth of demand in the cooling sector.

Figure 15: Preliminary emissions for 2020 (expressed in MT CO_2 equivalents) for cooling sub-sectors in Jordan.



Note: No data available for transport and industrial refrigeration.

Residential and non-residential (stationary) air conditioning

In 2022, residential air conditioning and non-residential AC account for 21% and 22% of total direct emissions. For indirect emissions, the share of residential is even larger (30% of total indirect emissions). In Jordan, several local manufacturers are active on the market. Of the total number of AC systems put on the market in Jordan, 50% are produced by local manufacturing companies. However, the country still relies on imports from abroad to meet the growing demand.

Mobile air conditioning

Air conditioning of vehicles licensed in Jordan contributes to ca. 11% of total direct emissions in 2022. According to data on vehicles licences,[104] approximately 1,8 million vehicles are currently registered in Jordan, while the share of air-conditioned vehicle models increased from an average of 62% for the period 2000-2009 to more than 80% in recent years. All operational and newly sold mobile AC units rely on R134a, which is why this refrigerant dominates the entire sub-sector. Jordan has no domestic production of cars, vans, and other large vehicles, so it relies on imports to satisfy the growing demand.[105]

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104 Data were kindly made available through the Driver and Vehicle Licensing Department - West Amman. Licensing data provided by the corresponding authority covered a wide range of vehicles such as passenger cars, busses, special use vehicles, for example used in agriculture.

105 As indicated in the HFC Inventory for Jordan, one company, King Abdulla Bureau for Design and Development (KADDB), is manufacturing small vans body equipped with AC which is assembled and charged with refrigerants domestically.

Domestic refrigeration

Because of the large number of operational refrigerators in the country, which is projected to increase from 2,3 million in 2022, direct emissions account for ca. 11% of total direct emissions in 2022. For indirect emissions, the share is even larger (40% in 2022), owing to the large number of inefficient appliances assumed for Jordan. Jordan has around 29 companies manufacturing different types and models of domestic and commercial (standalone) refrigerators ranging from domestic appliances, display cabinets to refrigeration systems for supermarkets and cold rooms.

Commercial refrigeration

The commercial refrigeration sub-sector covers cooling equipment in shops and supermarkets as well as commercial cold stores. Commercial refrigeration accounts for ca. 34% of total direct emissions and for ca. 18% of total indirect emissions for 2022. For standalone refrigeration systems, food and beverage providers are the main suppliers on the Jordanian market to supermarkets and quick service and casual restaurants. Commercial standalone refrigeration systems are locally manufactured and imported. The Jordanian commercial condensing and centralised refrigeration sector is dominated by local manufacturers, many of which belong to SME categories.

Transport refrigeration

Transport refrigeration is an important link in the cold chain for preserving food, medicine and other perishable commodities. Transport refrigeration will play a vital role in the cold chain to secure food safety and prevent economic loss. One area of the national food supply chain where transport refrigeration is key is transportation of the harvest. Every year, farmers in the country face post-harvest losses as perishable fruits and vegetables etc. go to waste due to a broken cold chain.[106]

Based on information provided in the Jordan HFC inventory, the data covers a total number of more than 2000 refrigerated trucks. The inventory report further indicates that several domestic companies sell refrigerated transport equipment. Further, companies that are active in repair and servicing of such refrigerated systems are using R134a as refrigerant. Due to the absence of domestic production, all systems sold domestically appear to be imported as pre-charged equipment, and therefore their emissions are not included in the estimation. However, three companies were found to manufacture the sandwich panels needed for insulation using HCFC-141b as a foam blowing agent.

8.3 Preliminary results on projected emissions

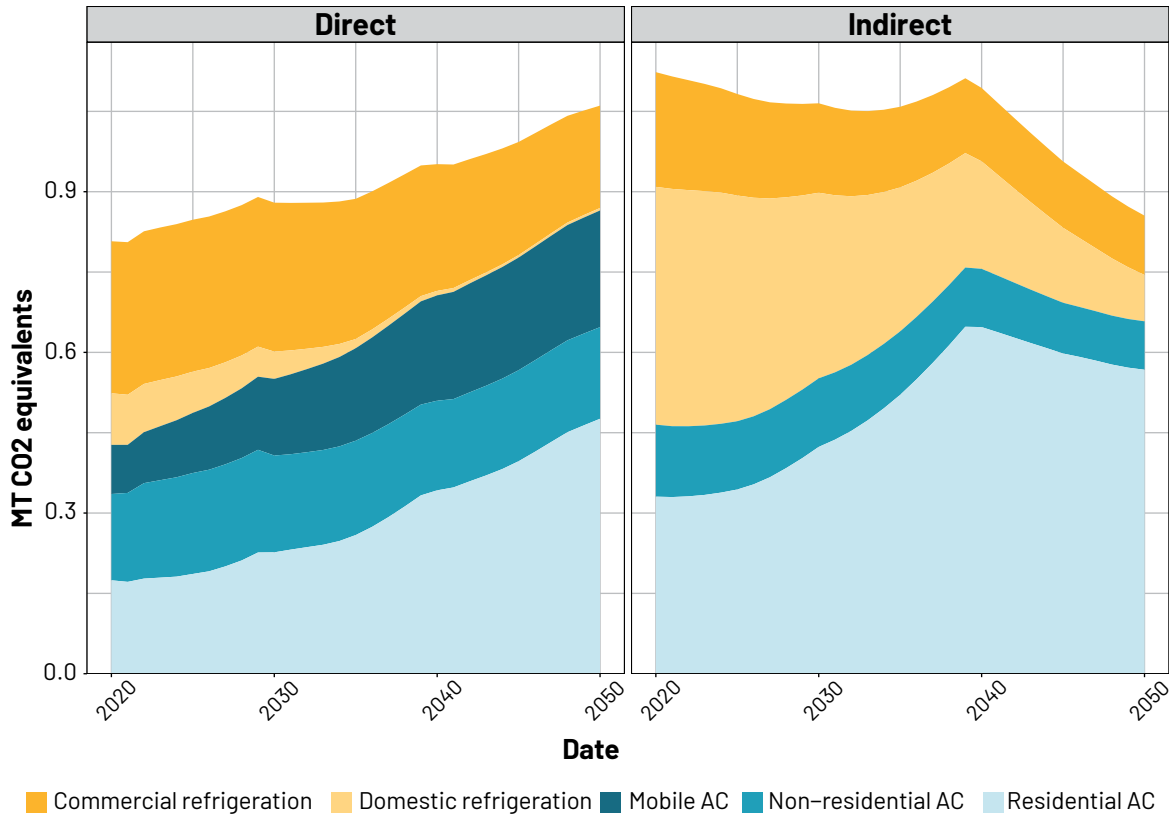
Business-as-usual scenario

Projections presented depict a BAU scenario based on existing policies addressing the cooling sector and technologies that are currently available on the market. Since Jordan is currently in a transition phase where national F-gas legislation, introducing measures such as a HFC phase down and an associated licensing system is absent, the preliminary BAU scenario does not meet the targets set under the Kigali Amendment. However, the latest technological developments such as the uptake of alternative refrigerants in air conditioning and refrigeration have been taken into account based on interviews and contributions from experts in the field. Population growth and GDP values used for the projections align with the data trends shown in the Jordanian Economic Modernization Vision.

Based on preliminary modelling results, direct emissions from the cooling sector show an increase by ca. 31% for the period between 2020 and 2050. The fact that, even under a BAU scenario where strong growth is expected, emissions increase only to a moderate extent is mainly due to the fact that conversion of systems towards refrigerant alternatives with lower GWP is already happening in the cooling sector, primarily in domestic and commercial refrigeration. Overall, the decrease of indirect emissions over time can largely be attributed to increased efficiency gains as well as increased contribution of renewable energy sources to the power system, which outperform the slowing demand for cooling in 2030 and 2040.

106 Jabarin 2021.

Figure 16: Preliminary projected emissions (expressed in MT CO_2 equivalents) for cooling sub-sectors in Jordan covering the period 2020 until 2050. Data on commercial refrigeration, non-residential and residential AC have been taken from the Cool Up Prospects Study.



Note: No data available for transport and industrial refrigeration.

Table 6: Relative contributions of direct and indirect emissions from cooling sub-sectors to total emissions based on preliminary modelling results.

	Year		
	2030	2040	2050
Direct	**42%**	**45%**	**47%**
Residential AC	9%	12%	17%
Non-residential AC	8%	9%	8%
Mobile AC	5%	7%	10%
Domestic refrigeration	5%	3%	0%
Commercial refrigeration	15%	14%	12%
Indirect	**58%**	**55%**	**53%**
Residential AC	17%	22%	32%
Non-residential AC	7%	7%	5%
Mobile AC	NA	NA	NA
Domestic refrigeration	23%	18%	10%
Commercial refrigeration	11%	9%	7%
Total	**100%**	**100%**	**100%**

Note: "NA" = not applicable. No data available for industrial refrigeration.

Results on direct emissions

Residential air-conditioning primarily drives growth of total direct emissions. Direct emissions from this sub-sector increase considerably from 2020 until 2050 (up by 170%) and, by then, are responsible for almost the half of total direct emissions. The growth observed in residential AC primarily stems from the installation of AC equipment in new buildings as well as new installations in existing single-family and multi-family buildings. The refrigerant transition assumed in the modelling reflects the transition from high GWP HFC blends (i.e., R410A with a GWP of 2088) to other synthetical refrigerants (specifically R32 with a GWP of 675) is apparently not leading to sufficient emission reduction.

- Residential air-conditioning shows the largest growth compared to other sub-sectors projected until 2050. Extensive use of refrigerants with high (i.e. R410A) and intermediate GWP (R32) considerably drive increasing emissions under the BAU scenario.
- Owing to its pivotal importance in terms of direct emissions, technology transition in stationary AC needs to be addressed when designing policy action.

The **commercial refrigeration** sector is the second largest sub-sector contributing to direct emissions, whereby a slight decrease in emissions can be observed in the period from 2020 until 2050.

- Ongoing use of high GWP refrigerants (specifically R404A) and high leakage rates in larger systems are a considerable emissions source.
- The initial uptake of low GWP alternatives, assumed to take place as part of the BAU, needs to be fostered to realise the emissions reductions that are possible in this area of application.

For **non-residential AC**, direct emissions show slight increases in emissions from 2020 until 2050 (up by 6%). As for other sub-sectors, the growth of non-residential AC associated with the increase in economic development (specifically in agriculture and tourism), population, and the harsh climatic condition in recent years is outperformed by initial uptake of refrigerants with a lower GWP as assumed in the Cool Up Prospects Study.

- A moderate uptake of low GWP alternatives is apparently not sufficient to assure the relative emission reduction in this sub-sector, which is why the pace of technology transition should be further accelerated.

In **mobile AC** of vehicles in Jordan, direct emissions are projected to increase from 11% to 20% of total direct emissions in 2050. Here, no refrigerant transition has been integrated in the modelling due to the absence of reliable indications in this regard. Legislation in various countries will force a switch to low GWP alternatives.[107] This transition is likely to be achieved in these regions using HFO-1234yf. Here, multinational car manufacturers are likely to standardise their production lines on use of a single refrigerant, as they did in the 1990s when they switched from R12, an ozone-depleting chlorofluorocarbon (CFC), to R134a. Noting the high emission rates during operation as well as maintenance of mobile AC systems, the emission reduction potential in this sub-sector appears to be considerable (see also 'Installation, servicing, repair and decommissioning' below).

- Mobile AC shows high emissions reduction potential associated to better servicing and operation and maintenance practices.

Emissions from leakage and end of life can be reduced by capacity building in the service sector and awareness raising across the supply chain.

107 *For example, in Türkiye from 2018, South Korea from 2020, USA and Canada from 2021 and Japan from 2022, as per UNEP 2018c.*

The NCS sets a comprehensive framework for developing the NCAP. It follows a holistic approach and covers all sectors (residential, commercial and mobile air conditioning and domestic, commercial, industrial and transport refrigeration).

For **domestic refrigerators**, direct emissions show a continuous decrease from 2020 until 2050 (down by 95%), which is a result from ongoing transition from R134a (GWP = 1430) to R600a (a hydrocarbon, natural refrigerant) of local manufacturers.

- Despite the ongoing transition in domestic production lines, Jordanian F-gas legislation should legally oblige corresponding actors in the country to follow this internationally well-established transition pathway.[108]

Results on indirect emissions

For indirect emissions, the share of **residential AC** is projected to increase from ca. 30% in 2020 until almost 60% in 2040. In 2040, a marked drop in indirect emissions can be observed, which can largely be explained by the fact that growth of residential buildings reaches market saturation with a significant drop in new installations as well as increased efficiency effects that outperform the slowing demand for cooling. For **domestic refrigeration**, the high number of units being in operation, coupled with the low energy efficiency of most units, explains its high share of total indirect emission of 39% in 2020. Due to assumed initial enhancements in the energy efficiency of units placed on the market, the share in indirect emissions is projected to decrease to 18% in 2040.

- Residential AC and domestic refrigeration are expected to have the largest share of indirect emissions by 2050.

- Existing standards should be closely monitored and strengthened to achieve the potential emission reductions in the most relevant sub-sectors.

For **commercial refrigeration**, indirect emissions are projected to show a slight decrease from a share of 10% of total indirect emissions in 2020 down to 13% in 2040 and 2050, which is mainly due to initial efficiency effects that overcompensate the growing refrigeration demand in commercial buildings. **Commercial AC** is projected to show a stable contribution to total indirect emissions, again due to initial energy effects as well as increased deployment of renewable energy sources overcompensating the growing number of units deployed in this sub-sector.

- MEPS for commercial refrigeration and AC appliances need to be introduced to considerably decrease emissions in this field.

108 Hydrocarbons21 2019.

Installation, servicing, repair and decommissioning

Activities including the installation, maintenance or servicing, repair or decommissioning of stationary RAC&HP equipment, mobile AC systems as well as refrigeration units on refrigerated trucks or trailers (summarised here as 'servicing') containing or relying on F-gases, lead to considerable emissions due to occurring leakages from almost all types of equipment.[109] As shown in other NCPs, around 30% reduction in cooling energy can be achieved through improvements in cooling equipment efficiency, and better servicing and operation and maintenance practices.[110]

- Servicing needs to be addressed inter alia by increasing awareness along the supply chain, in particular for car workshops.
- Minimum requirements that apply for technical personnel in this sector would need to be strengthened and made compulsory.
- Training and certification of service technicians as well as companies should be established and elaborated in order to prevent direct emissions resulting from operation and maintenance in all RAC subsectors.
- To avoid emissions from end-of-life treatment, the functioning of (existing) recovery, recycling and reclamation & destruction systems needs to enhanced.
- To assure the energy efficient operation of RAC equipment, maintenance performed on the appliances should be carried out by skilled personnel.

109 Factory sealed equipment such as domestic refrigerators or self-contained (light) commercial refrigeration appliances are examples where emissions play a less strong role.

110 Indian Ministry of Environment, Forest and Climate Change 2019.

9 Strategic actions in Jordan's RAC sector

9. Strategic actions in Jordan's RAC sector

Cooling plays a crucial role in Jordan's development. Cooling demand in Jordan is expected to steadily increase in the future.

The National Cooling Strategy paves the way for the development of the National Cooling Action Plan (NCAP). It provides an overview of strategic areas for policy interventions to reduce emissions from the RAC sector.

The sector with the largest growth projection is the residential AC sector, primarily due to the expected increases in population, ownership rate, and higher temperatures. Residential AC is expected to have the largest share of both direct and indirect emissions by 2050 (see ***Table 6***). The residential and to a lesser extent the non-residential AC sector is the main driver for electricity demand increase and thus for indirect emissions increase. The AC sector increase also drives the direct emissions because of the annual leakage and because of the high end-of-life leakage due to the absence of an adequate reclaiming of refrigerant. The commercial refrigeration sector is another key driver of direct emissions especially because of very high leakage rates in larger systems compared to other subsectors due to the lack of frequent service and maintenance. This lack of maintenance also decreases the energy efficiency of the systems over time. The mobile AC sector is another key driver of direct emissions and underlines the importance of the service sector to address leakage. Well-trained service technicians can prevent direct emissions in all RAC subsectors, which, alongside residential AC, is especially important in the MAC and commercial refrigeration servicing sector, of which the direct emissions are expected to account for 22% of total RAC sector emissions by 2050 (see ***Table 6***).

Considering the expected increase in cooling demand, business-as-usual behaviour is not an option because of the related negative environmental, economic, and social impacts.

The increasing cooling demand requires setting up an integrated national long-term cooling strategy for all relevant cooling sectors. The transformation to sustainable cooling technologies is possible since the technology is available. Sustainable cooling technologies could support a reduction in carbon emissions of the RAC sector by more than 73% from 2020 levels by 2050.[111] The increased cooling demand can be tackled by first reducing the demand via increased efficiency of appliances and energy performance of buildings. Secondly, the remaining cooling demand needs to be met with sustainable, i.e., with energy efficient and climate friendly cooling technologies. Lastly, an increased share of renewables will reduce indirect emissions resulting from the remaining cooling demand. The use of sustainable cooling technologies requires a change in the existing types of equipment installed and placed on the market.

Existing policies and international commitments and targets already co-relate with the cooling sector (see chapter 6) and show several touchpoints. Although various policies and targets are in place, little attention is paid to the RAC sector explicitly and it is not specified how to provide cooling in a sustainable way today and in the future. The ubiquitous use of cooling by residential, commercial, and industrial users means there are many options and opportunities to tackle emissions and drive change across the RAC sector.

The development of the strategic key areas takes into account the current situation in the RAC sector in terms of indirect and direct emissions but also the foreseen projection. This chapter describes the key strategic areas for sustainable cooling and lays the foundation for a long-term strategy to reduce emission from cooling in Jordan. It builds on the policy analysis (see chapter 6) and address the identified gaps (see Table 5) by developing cooling sector-specific key areas for action, for action, as illustrated in Figure 17.

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111 Cool Up 2023.

Figure 17: Strategic Intervention Areas

Energy supply

The increase in cooling demand is a challenge for the electricity sector. Decarbonisation of electricity is an important area of action to reduce the indirect emissions that currently are responsible for more than half of total emissions in the RAC sector. Investments in energy efficiency, on-site renewable deployment, and smart time-of-use management can reduce help future peak loads which contributes to increased grid stability as well as deferred invest in energy generation capacity, particularly peaking plants which often rely on natural gas.

9.1 Energy efficiency

Building performance standards

Energy efficiency improvements in buildings are crucial in counteracting the expected increase in electricity consumption and indirect emissions from the RAC sector by reducing the cooling load in the buildings.

- Building codes and standards for renovation: Specific energy efficiency measures such as improved insulation or passive cooling measures reduce cooling load and thus indirect emissions from cooling. Public buildings can act as best practice examples in terms of energy consumption. Updated and strengthened building codes apply for new construction and renovations and increase the total energetic renovation rate.

Increasing energy efficiency of RAC appliances – MEPS and labels

Improving the energy efficiency of RAC appliances across all RAC sub-sectors can counteract the expected increase in energy demand and indirect emissions of RAC appliances. As shown in Figure 15, currently 70% of indirect emissions from the RAC sector stem from domestic refrigeration and residential AC, with the latter expected to show strong growth in the future (Figure 16), highlighting the importance of improving energy efficiency in these sectors.

- **Minimum energy performance standards (MEPS):** MEPS reflect the progress made in energy efficiency of equipment placed on the market. MEPS are normally updated every 2-5 years to provide clear guidance to industry as well as sufficient time to react, while stimulating the market towards the use of more energy efficient equipment. In the case of RAC equipment, MEPS can also reference the refrigerant used in the appliance and the corresponding GWP. Jordan introduced MEPS for AC units, refrigerators, and freezers in 2013.

- **Labels:** The standards can be accompanied by an energy efficiency label. Labels, i.e., the label classes' characteristics, are normally updated once a significant proportion of the market (e.g., over 15-20%) is represented in highest labelling classes. Jordan currently has mandatory labels for AC units, refrigerators, and freezers under a comparative system.

- **Expand sectors covered by MEPS:** Based on the current Cool Up analyses of MEPS and regulation governing the RAC sector, it has been concluded that in Jordan labelling requirements and MEPS do not apply for commercial RAC equipment. Therefore, it is of a great importance to expand or adopt new standards (MEPS) for different RAC applications in the commercial sector and update the ones used in the household sector to promote the transition to low GWP alternatives and the use of energy efficient RAC appliances.

Addressing escalating cooling demand with sustainable solutions for a resilient future.

- **RAC equipment replacement:** Targeted replacement of old inefficient RAC equipment across all sectors with new high-energy efficiency equipment, based on MEPS. Equipment replacement programmes can be combined with financial incentives for households or green public procurement rules for public buildings (see Financing and Incentives below).

- **Mandatory inspection of AC systems:** Mandatory inspections of AC equipment by qualified service technicians (see capacity building below) can improve the energy efficiency of systems, as they are kept clean and optimized for their usage purpose which can reduce the consumed energy. Regular maintenance can also lead to early detection of leakage which reduces direct emissions from systems. These inspections are particularly important for large commercial AC and refrigeration systems.

- **Improving and expanding testing:** New testing facilities, the adoption of the newest testing methods, and training testing laboratory staff will make new MEPS easier and more efficient to integrate. Updated facilities, technologies, and methodologies will ensure accurate testing of RAC equipment and can allow for testing of new product categories such as industrial or commercial RAC equipment.

9.2 HFC phase down and switch to natural refrigerants

Refrigerant standards and regulations

Transitioning from ozone depleting gases and HFCs towards natural refrigerants will be crucial in counteracting the expected increase in direct emissions from the RAC sector. As shown in Figure 15, currently 55% of direct emissions from the RAC sector stem from commercial refrigeration and residential AC, with both continuing to be the largest source of direct emissions until 2050 (Table 6). This highlights the importance of transitioning to natural refrigerants in these sectors.

- **RAC equipment replacement:** As described above, RAC equipment replacement programmes for energy efficiency can be combined with programmes which target and replace the equipment using the highest GWP refrigerants.

- **Phase down/out and bans:** Rules on what refrigerant (groups) can be used in which appliances. A clear phase down/out roadmap shows transition schedules for refrigerant use in different sectors. A sectoral analysis can identify the sectors where natural refrigerants can be introduced at the lowest cost and effort (lowest hanging fruit principle) and show where the HFC phase can begin.

- **Safety standards:** Safety standards for natural refrigerants can help overcome the perceived barrier that their use is less safe than fluorinated refrigerants.

Refrigerant supply chain and emissions data collection

Control over the supply chain of refrigerants from arrival to charge can increase transparency in the RAC sector and help with developing targeted interventions and policies.

- **Import procedures:** Prepare clear procedures for the import, shipping, and storage of refrigerants with effective inspection procedures to guarantee safe handling of refrigerants.

- **Collection of electronic logbooks:** Collections of electronic logbooks store activities performed on F-gas containing equipment. The main purpose of such systems (as currently introduced in Türkiye) is tracking of activities performed on equipment, particularly monitoring installation, servicing, leakages, repair activities, and recovery, enabling the National Ozone Unit (NOU) to better control F-gases and as a result to satisfy the obligations resulting from the future national F-gas Regulation. Specifically, the operators of RAC&HP equipment and other relevant F-gas sectors (fire protection, electrical

Interventions across strategic areas of action such as energy efficiency, natural refrigerants, circularity and end of life treatment, cold chain and cross cutting topics such as awareness, information, financing support schemes among others drive positive transformation for sustainable progress.

switchgear, Organic Rankine Cycles, solvent use) are required to monitor and record leakages occurring during relevant activities. Data collected under such a scheme can be considered to be the ideal source for any inventory data collection exercise and CRF reporting under UNFCCC.

9.3 Cross cutting

Awareness and information

Increasing awareness around the topic of sustainable cooling is key in driving the market transition. Awareness and information campaigns can stimulate behavioural change by impacting daily practices, purchasing decisions, construction/renovation choices and equipment operation. The key target groups include end-users, project developers, and commercial and industrial RAC equipment users. The National Energy Research Centre (NERC) carries out public awareness campaigns through seminars, conferences, exhibitions, leaflets, printed materials, and a webpage.

- **Product information:** Product information leaflets can include information beyond the label and MEPS. While the label can include the energy efficiency class based on MEPS and information on the GWP of the refrigerant used, the product leaflet can include any other consumer information such as on maintenance and end-of-life treatment of the product. This will provide quick visual information to consumers which can inform their purchase decisions and how they use and maintain the product. Stores can have special sections showcasing the best rated appliances to entice consumers.
- **Product registry/database**: Develop a national product registry based on the energy labels allowing consumers to easily compare new products entering the market based on their energy label and other information included in the product information sheet.
- **Market awareness and information campaigns:** Target market awareness campaigns at different sectors and consumer groups to sensitise them to the benefits of energy efficiency and natural refrigerants. Pilot projects and public buildings should be used as best practice examples to showcase the benefits of sustainable cooling.

Capacity building for technical personnel and policy makers

The service sector plays an important role in reducing direct and indirect emissions through proper installation, reducing leakages, and optimising the energy efficiency of RAC systems via proper maintenance. RAC technicians also act as important advisers for end user decision making and can thus act as multipliers if they are comfortable and familiar with the new technologies. Where the service sector can have the largest impact is in preventing direct emissions due to refrigerant leakage. This is especially important in the commercial refrigeration, AC, and MAC sectors where the HFC emissions from servicing account for 42% of the total RAC sector direct emissions as shown in Figure 14.

Capacity building can also go beyond service technicians and target policymakers at different levels and industrial and commercial users. Capacity building across the RAC sector is a cross sectoral initiative and will require various specific and coordinated policy actions. The NERC already conducts training with service technicians and other stakeholders, seeking to develop local skills in the field of energy conservation. Broad policy actions to address capacity building are described below.

These can build on the already in place training offered by NERC, with a more specific focus on the RAC sector.

- **Training curricula for service technicians:** Training curricula on installation, operation, and maintenance of RAC systems can improve safe handling of refrigerants, including natural refrigerants through both theoretical and practical elements. Theoretical trainings can be made accessible to a broader audience via e-learning platforms.
- **Certification schemes:** Certification schemes for RAC technicians can help consumers find qualified technicians. This can be complemented by an online database for certified service technicians.
- **Trainings among other decisionmakers:** Capacity building and trainings can be offered to a wide range of stakeholders such as policymakers, members of the business community, and the industry. These can show the benefits of sustainable cooling and how sustainable cooling can be integrated into current operations and practices.

A holistic strategy includes actions towards improved energy efficiency, uptake of natural refrigerants, improved waste management, circularity, ecodesign and financial schemes.

- **Energy audits:** Energy audits in industrial and commercial buildings by qualified service technicians can improve energy efficiency by raising awareness of where the most energy is used and where savings can be achieved. Auditors can identify both low and high intervention measures that can result in significant savings. These can include promoting behavioural changes such as setting temperatures on RAC equipment, fill volumes of refrigerators, usage time on AC, etc. Auditors can also identify the most inefficient equipment and set priorities for replacements in order to achieve the highest savings. This builds on a programme by JREF which covers 50% of the cost of an energy audit (up to 5,000 dinars) in the industry. The programme or a similar approach could also be expanded to commercial buildings focusing specifically on refrigeration and space cooling.

Cold chain

The cold chain is a logistical chain of activities from production to consumption. Domestic and commercial refrigeration are important elements of the cold chain. In Jordan the challenge is to reduce food loss in the country. Key area of action encompasses energy efficiency of facilities along the cold chain such as cold storages and the use of sustainable technologies. Transport refrigeration as an important link in the cold chain plays a key role in the cold chain to secure food safety and prevent economic loss.

Ecodesign, circularity, and end-of-life treatment

Increasing circular economy and improving end-of-life services is key to reducing direct emissions from the RAC sector. Leakage at end-of-life is a large contributor of direct GHG emissions from the RAC sector. Expanding product lifespan via repairs and proper maintenance also reduces lifetime emission from RAC equipment. Circularity in product design is particularly important for domestic ACs and refrigeration as these tend to have a shorter life span and less access to spare parts than large appliances for commercial or industrial use.

- **Enable the three 'Rs', recovery, recycling, and reclamation of refrigerants.**[112] Set up collection points and recycling centres for old RAC equipment. Collaboration with existing waste and recycling companies plays a key role here. How to enable the three 'Rs' should already be a consideration during the design stage of a product as well as during a purchase decision.

- **Take-back schemes:** Implement take-back schemes for RAC equipment and the refrigerants therein. This can be coupled with other programmes for upgrading and retrofitting RAC equipment.

- **Ecodesign:** Set standards to improve the durability, reliability, reusability, upgradability, and reparability of RAC equipment. This includes improving the availability of spare parts and providing repair instructions to third parties.

Gender equality and youth

Participation of women in the workforce is low in Jordan: 14-15% compared to 54% for men.[113] This is assumed to be even lower among service technicians. A survey of businesses by the UNHCR showed that no businesses in the car maintenance sector had hired women.[114] The Jordanian youth unemployment rate is also high at 39.4% in 2022.[115] Hiring and training more women and young people increases the applicant pool and diversifies the sector.

Financing and incentives

The availability of financing and incentives for sustainable cooling technologies will play an important role in their uptake, thus the development of appropriate financial measures for supporting natural refrigerants and energy efficiency will be crucial. Financing and incentives can target different sectors and different points of the RAC supply chain and will be carried out jointly by the government and public and private financial institutions.

The need for financing and incentives spans across the entire RAC sector, especially important are commercial and industrial refrigeration and AC as these require the highest investment costs while also being the largest emitters of direct and indirect emissions.

- **Financial incentives:** Financial incentive programmes such as low interest loans, preferential taxation, or other tax benefits such as tax rebates, subsidies and grants, or any combination of these, specifically incentivise increases in energy efficiency and switching to natural refrigerants. Financial incentives can be targeted at both households and commercial consumers.

- **Green public procurement (GPP):** GPP guidelines can prescribe energy efficiency levels and refrigerants used in appliances procured for public buildings. These normally reference MEPS and labels. GPPs can also

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112 Definitions according to Multilateral Fund 2013:
Recovery: The collection and storage of controlled substances from machinery, equipment, containment vessels, etc., during servicing or prior to disposal;
Recycling: The re-use of a recovered controlled substance following a basic cleaning process such as filtering and drying. For refrigerants, recycling normally involves recharge back into equipment which it often occurs "on-site";
Reclamation: The re-processing and upgrading of a recovered controlled substance through such mechanisms as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance. It often involves processing "off-site" at a central facility.

113 International Labour Organisation 2022.

114 Resilient Youth, Socially and Economically (RYSE) 2022.

115 World Bank 2022.

regulate aspects such as certification requirements for service technicians in public buildings or building codes regarding renovations and new public building constructions.

- **Import levies:** Import levies on RAC equipment based on energy consumption and GWP of refrigerants incentivise the import and use of low GWP or natural refrigerants.

The table below maps the strategic intervention areas across the RAC subsectors.

Table 7: Strategic intervention areas

		Building performance standards	RAC energy efficiency and labelling	Refrigerant standards	Refrigerant supply chain	Awareness and information	Capacity building	End-of-life treatment (circularity)	Financing and incentives
AC	Residential and non-residential		X	X	X	X		X	X
	Mobile				X	X		X	
Refrigeration	Domestic		X	X	X	X		X	
	Commercial		X	X	X	X	X	X	X
	Transport				X	X		X	
	Industrial		X	X	X	X	X	X	X
Cross cutting	Service sector				X	X	X	X	
Reduce cooling load	Buildings	X				X			X

10 The way forward

10. The way forward

The NCS lays the foundation for the development of a National Cooling Action Plan. The NCAP will provide detailed actions and policy measures to be undertaken in order for Jordan to reach the sustainable cooling targets set out in this strategy. It will identify investments needed, potential financing mechanisms, and responsibilities for each proposed measure while also describing the governance framework and Monitoring-Reporting-Verification (MRV) system, to ensure its effective implementation.

Scope and objectives of NCAP

The National Cooling Action Plan (NCAP) acknowledges the increasing GHG emissions from the RAC sector in Jordan under a BAU scenario. The NCAP lays out a set of specific policy actions and measures to transition Jordan's RAC sector to sustainable cooling through the adoption of best available technologies and market-transformation programmes, including MEPS, labelling, and rebate schemes for high-efficiency and low GWP cooling appliances.

The scope of the NCAP includes the entire RAC sector including detailed reviews of each RAC sub-sector, as well as cross cutting sectors such as the service sector. Special attention will be paid to sectors intersecting with other national priorities that help to drive forward the goals set out in existing strategies (see Economic Modernisation Vision in **section 5**).

Action Plan

The National Cooling Action Plan should encompass several key steps. It involves a systematic approach to address the challenges of cooling systems, energy consumption, and environmental impact. The estimated timeline is illustrated in Table 8.

The development and implementation of a robust National Cooling Action Plan is crucial to ensure energy-efficient, environmentally sustainable, and equitable cooling solutions for present and future generations.

Table 8: Steps for the development of the National Cooling Action Plan until December 2024

Step	Description
Sector-wise current and future cooling demand assessment	Creating a data-driven assessment of current and future cooling demand
Sector-specific recommendations & solutions	Identifying solutions and future pathways
Integration	Consolidating sector-specific assessments into a cohesive cooling assessment
Development of NCAP recommendations	Prioritising recommendations and mapping expected impacts
NCAP document	Creating an NCAP report

As part of the NCAP strategy framework, **roles, responsibilities** as well as a **timeline** across activities and responsible bodies (institutions, partners, working groups etc.) will be agreed at an early stage. Monitoring and reporting mechanisms are put in place to track progress. By following this comprehensive approach, a National Cooling Action Plan can effectively promote sustainable cooling, reduce energy consumption, and mitigate environmental impact.

NCAP provides a roadmap, containing concrete actions linked to strategic areas in the NCS, and it sets out the MRV for the implementation.

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