



# MIENA Region Cooling Status Report

Progress, Opportunities, and Insights | Issue 3





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Regional Center for Renewable Energy and Energy Efficiency  
المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

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# Sustainable cooling: A lifeline for health amid extreme heat

The year 2024 is very likely to surpass 2023 as the warmest year on record, prompting the UN-Secretary General to issue a “Call to Action on Extreme Heat”. The Secretary General’s call emphasizes the need for rapid action to limit global temperature rise. Extreme heat impacts people’s health and the wellbeing of societies both directly and indirectly, posing serious health risks, leading to a variety of health-impacting conditions, such as heat exhaustion, hyperthermia, respiratory distress and vector-borne diseases, and placing immense pressure on public welfare systems.

Access to cooling, along with a transition towards sustainable cooling solutions, is crucial for mitigating the effects of extreme heat on well-being, reducing emissions, and addressing global warming. Sustainable cooling involves adopting passive cooling methods and promoting energy efficient cooling appliances like refrigerators and air-conditioners that operate on natural refrigerants rather than climate-warming and ozone-depleting gases. Transitioning to sustainable cooling has the potential to globally reduce direct and indirect greenhouse gas emissions in the cooling sector and protect approximately 3.5 billion people from extreme heat by 2050.<sup>1</sup>

The MENA region and Türkiye are among the areas most severely affected by rising temperatures, with peak temperatures sometimes exceeding 50°C. This extreme heat is placing significant stress on both the local populations and the environment. Since 2020, the Cool Up programme has been addressing the challenges associated with extreme heat by promoting the deployment of sustainable cooling solutions in its partner countries Egypt, Jordan, Lebanon and Türkiye. Cool Up employs a comprehensive, multi-level strategy that engages a variety of international, regional, and local stakeholders from policy, finance and industry sectors.

In 2024, several milestones were achieved in the region’s efforts to combat extreme heat and transition to sustainable cooling: Egypt and Türkiye launched their first National Action Cooling Plans (NCAP), five MENA countries signed the Global Cooling Pledge at COP28 in the United Arab Emirates, and three additional countries ratified the Kigali Amendment to the Montreal Protocol, which aims to phase down the use of hydrofluorocarbons (HFCs), greenhouse gases commonly used in refrigeration and air conditioning.

In this report, we shed light on status updates in the policy and financial market and technology landscape of sustainable cooling. We also explore the diverse impacts of extreme heat on people’s health and the environment in the MENA region. Additionally, we discuss potential mitigation and adaptation strategies that can be implemented to address the risks associated with extreme heat.



*N. Surmeli-Anac*

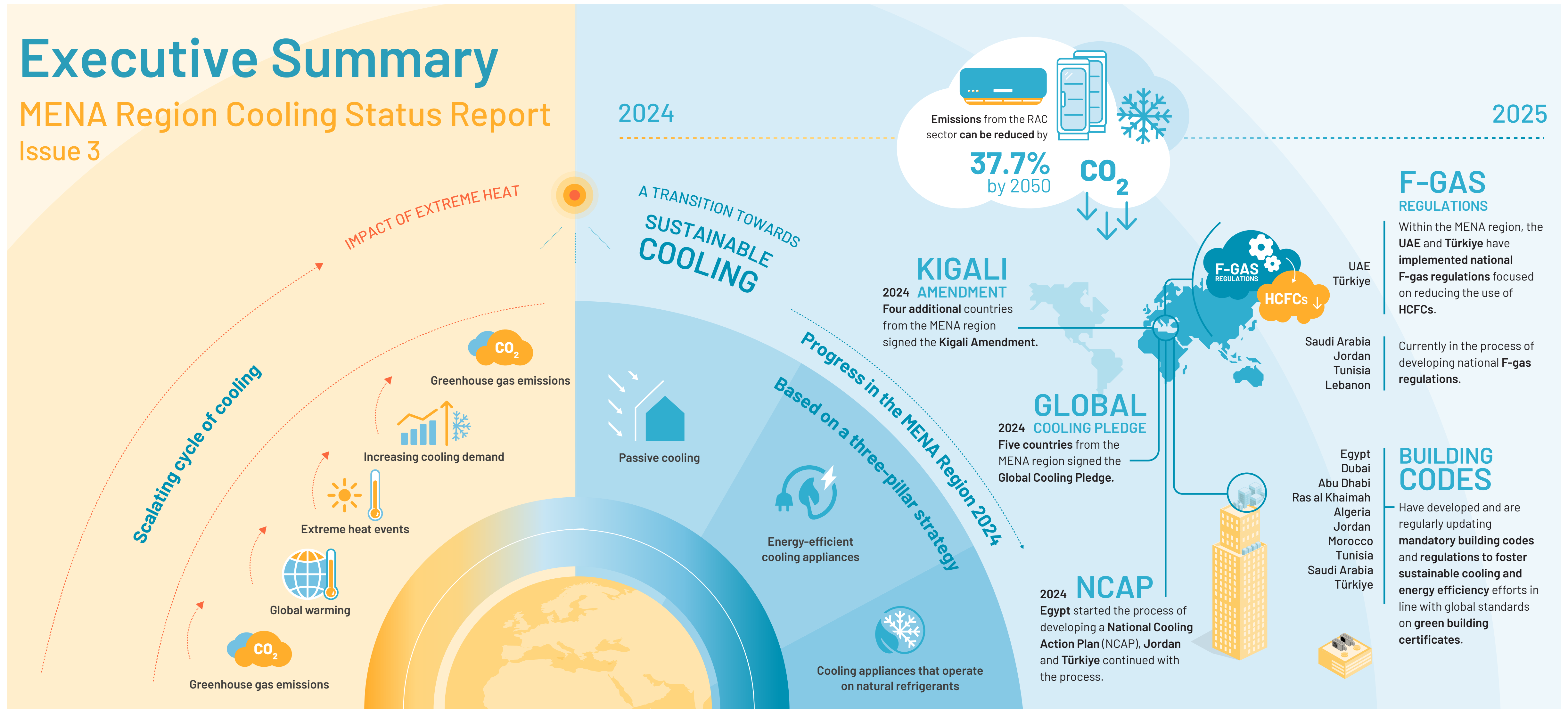
**Dr. Nesen Surmeli-Anac**

Programme Manager, Cool Up programme

<sup>1</sup> United Nations, “United Nation’s Secretary General’s Call to Action on Extreme Heat.”

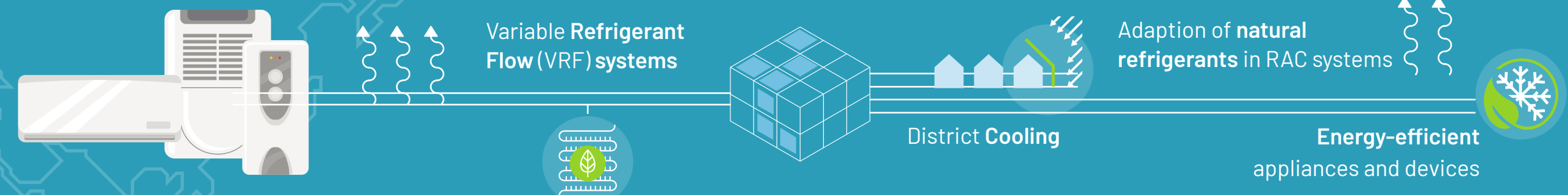
# Executive Summary

## MENA Region Cooling Status Report Issue 3



### Advanced technologies in the RAC sector

The MENA Region has the potential to be a front runner in the uptake of sustainable cooling solutions running on natural refrigerants.







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# Status update: Where are MENA and Türkiye in the transition to sustainable cooling?

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The summer of 2024 recorded the highest global temperatures since systematic temperature tracking began in 1880. According to the Copernicus Climate Change Service, temperatures from June to August 2024 surpassed those of the previous year, making it highly probable that 2024 will be the hottest year on record.<sup>2</sup> The MENA region and Türkiye are among the areas most severely impacted by these rising temperatures, which can reach up to 50°C<sup>3</sup>, placing significant stress on the local population and the ecosystem. In the summer of 2024, nine of the 14 hottest locations globally were situated in the MENA region, including Kebili in Tunisia, Mitribah in Kuwait, Aziziyah and Ghadames in Libya, Wadi Halfa in Sudan, Quriyat in Oman, and Ouargia.<sup>4</sup>

Anthropogenic global warming is the primary driver behind the intensifying and more frequent heatwaves observed globally.<sup>5</sup> The MENA region and Türkiye are among the areas most affected by the climate crisis. Since the 1980s, the region is warming with a rate of 0.4°C per decade, nearly twice the global average,<sup>6</sup> with approximately more than 100 days every year where temperatures are above 40 degrees until 2041.<sup>7</sup> In light of these challenges, it is critical for these countries to implement mitigation and adaptation policies and processes to address the impacts of extreme heat.<sup>8</sup>

Transition to sustainable cooling is a key strategy to break the trend of growing cooling demand.

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2 World Economic Forum, "Summer 2024 the hottest on record, and other nature and climate stories you need to read this week."

3 Dargin, "Beyond 'Green Pledges': Saudi Arabia and Society-Centered Climate Reforms."

4 Skirka and Lau, "Top 14 hottest places on Earth from Tunisia to Kuwait, as heatwaves sweep much of the world."

5 Farhan, Sherman, and Toremark, "Heatwaves, Extreme Heat, and Climate Change."

6 Greenpeace Research Laboratories, "Living on the Edge. The implications of climate change for six countries in the Middle East North Africa region."

7 Saab, "What does the 6th IPCC report mean for the MENA region?"

8 Bolle, "In the Middle East, temperatures are soaring. Will the region remain habitable?"

This transition requires a comprehensive and multi-layered approach involving various stakeholders, such as policymakers, private sector entities, and both national and international financial institutions. Cooling is a core measure for developing heat-resilient societies. This transition strategy can include the adoption of passive cooling measures, i.e. strategies to naturally lower indoor and outdoor temperatures. Another solution is the development and use of energy-efficient cooling appliances for air conditioning and refrigeration. As a third measure, a transition to sustainable cooling solution can include the development and use of cooling appliances (refrigeration and air conditioning) that operate on natural refrigerants instead of climate-warming and ozone-depleting HFC gases.

Examining current policies, projects, and initiatives aimed at transitioning to sustainable cooling, the MENA region exhibits significant potential for a market uptake of sustainable cooling solutions.<sup>9</sup> However, many countries remain in the early phases of this transition, underscoring the need for further development and investment.

## Transition to sustainable cooling is a key strategy to break the trend of growing cooling demand.

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9 Cool Up, "MENA Region Cooling Status Report: Progress, Opportunities, and Insights, Issue 2."



Noteworthy progress has been made. In 2023 and 2024, five additional countries in the region – Egypt, the UAE, Bahrain, Kuwait, and Oman – ratified the Kigali Amendment to the Montreal Protocol, bringing the total number of MENA countries that have ratified it to ten. This underscores a growing regional commitment to phasing down hydrofluorocarbons (HFCs). Furthermore, in 2024, Egypt, Jordan, and Türkiye kicked off their National Action Cooling Plans (NCAP) as part of their intensified commitment to sustainable cooling.

Another milestone marking the global commitment of the sustainable cooling transition is the Global Cooling Pledge<sup>10</sup>, launched at the UN Climate Change Conference COP28 in the UAE. The pledge seeks to reduce cooling-related emissions across all sectors, while expanding access to sustainable cooling for the most vulnerable populations. Among the 71 signatories who committed to the pledge in December 2023, five countries are from the MENA region: Lebanon, Morocco, Syria, Tunisia and the UAE.

In addition to the pledges, agreements, and amendments mentioned, some countries in the MENA region especially the countries of the Gulf Cooperation Council are already progressing in sustainable cooling initiatives.<sup>11</sup> These include district cooling (DC) and solar cooling systems in the refrigeration and air-conditioning (RAC) sector, as well as modern passive cooling measures, such as reviving traditional cooling architecture, urban greening, and the use of reflective surfaces.



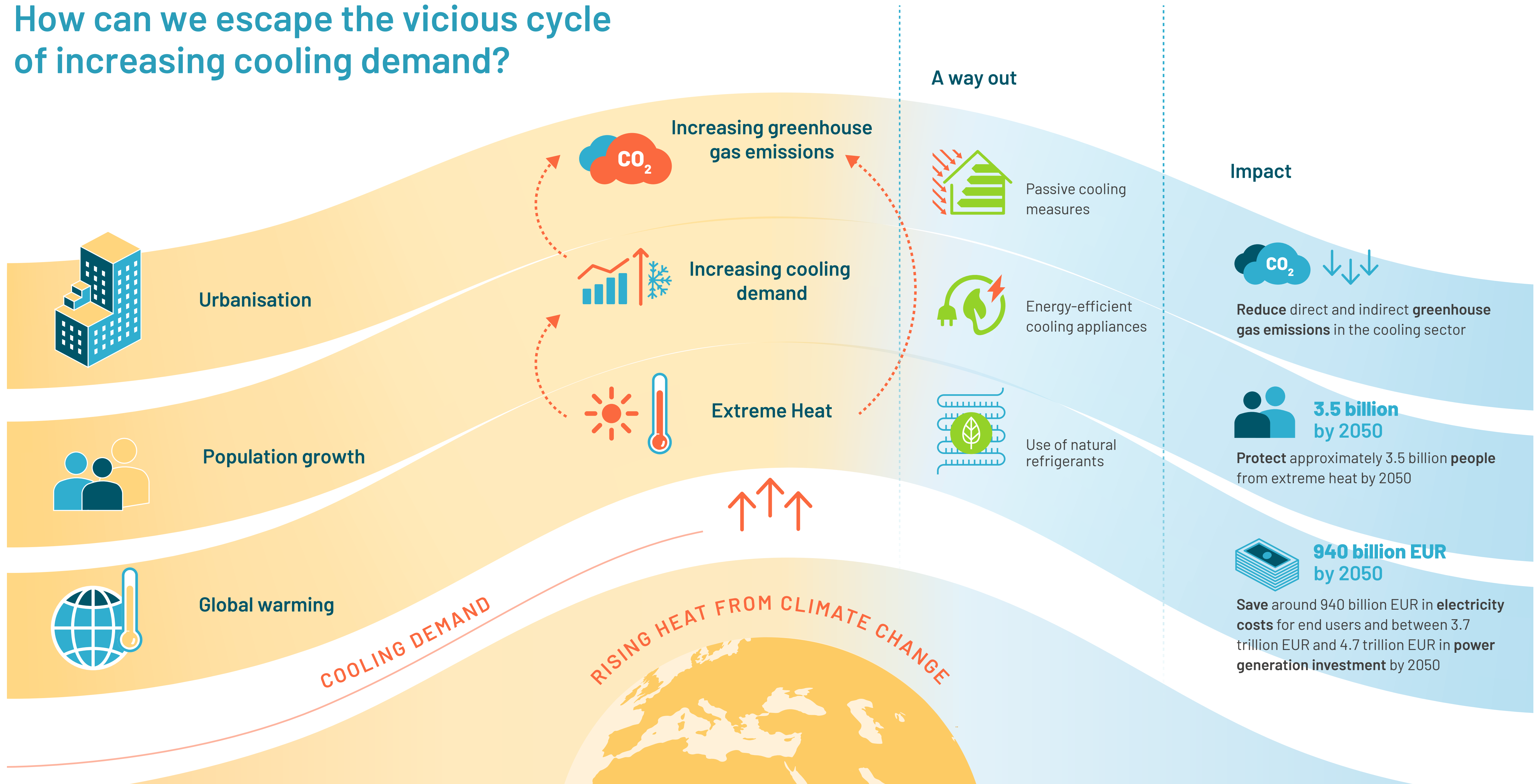
**Noteworthy progress has been made. In 2023 and 2024, five additional countries in the region – Egypt, the UAE, Bahrain, Kuwait, and Oman – ratified the Kigali Amendment to the Montreal Protocol, bringing the total number of MENA countries that have ratified it to ten. This underscores a growing regional commitment to phasing down hydrofluorocarbons (HFCs). Furthermore, in 2024, Egypt, Jordan, and Türkiye kicked off their National Action Cooling Plans (NCAP) as part of their intensified commitment to sustainable cooling.**

<sup>10</sup> *Global Cooling Pledge for COP28, COP28*

<sup>11</sup> Alotaibi and Nazari, "District Cooling in the Middle East & North Africa: History, Current Status, and Future Opportunities."; Hassan et al., "A review of solar thermal cooling technologies in selected Middle East and North African countries."; Provenzani, "Ancient Architectural Techniques in the GCC and the Importance of Natural Cooling: Learning from the Past."; Friess and Rakhshan, "A Review of Passive Envelope Measures for Improved Building Energy Efficiency in the UAE."



# How can we escape the vicious cycle of increasing cooling demand?







# Market and technology landscape

The demand for cooling is steadily increasing. Between 1990 and 2016, air conditioner sales globally nearly quadrupled, reaching 135 million units annually.<sup>12</sup> Within developing economies (Asia, Emerging Europe, Latin Africa, the Middle East, and Africa) the estimated market size for active cooling solutions totaled 258.4 billion EUR in 2023.<sup>13</sup>

The RAC sector contributes to both direct and indirect greenhouse gas emissions. Direct emissions occur from refrigeration and cooling operations themselves, such as refrigerant leaks in cooling systems. Indirect emissions result from the energy demand of cooling or refrigeration systems. This includes electricity consumption by most cooling systems as well as the energy use and emissions associated with the production and transportation of refrigerants and cooling equipment. The increasing use of air conditioners and refrigeration appliances is therefore raising energy consumption, energy costs, and emissions. In the MENA region, current direct and indirect emissions from the RAC sector are projected to rise from 161.36 Mt CO<sub>2eq</sub> in 2024 to 265.73 Mt CO<sub>2</sub> by 2050 under a business-as-usual scenario.<sup>14</sup> With the implementation of the Kigali Amendment, along with advancements in RAC technology and appliances that operate in a more energy-efficient way, emissions in the MENA region could be limited to 165.58 Mt CO<sub>2eq</sub> by 2050.<sup>15</sup>

<sup>12</sup> Randazzo, de Clan, and Mistry, "Air Conditioning and electricity expenditure: The role of climate in temperate countries."

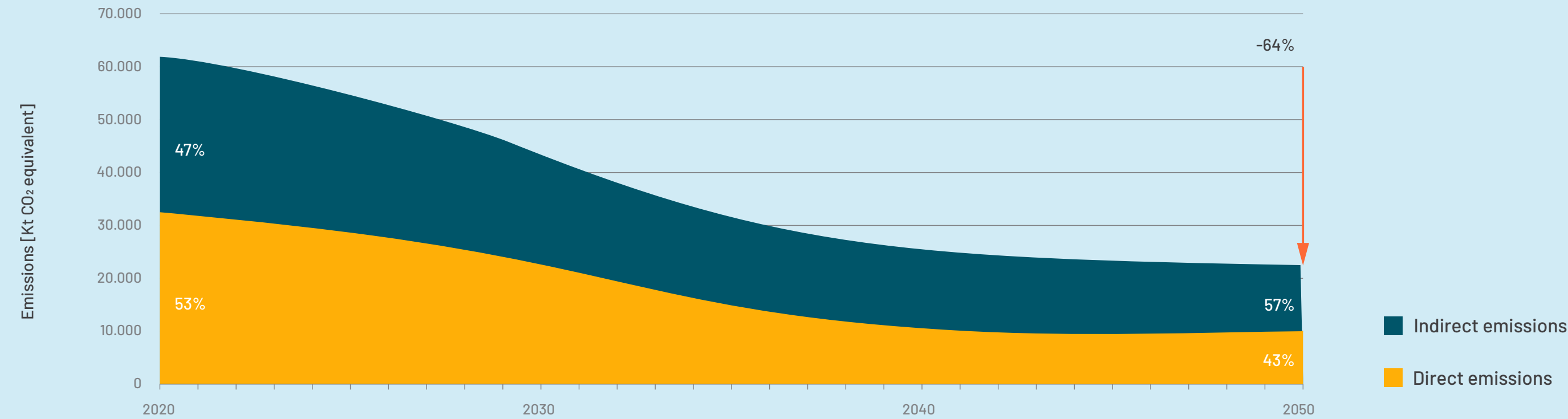
<sup>13</sup> Cool Coalition, "Cooler Finance: Mobilizing Investment for the Developing World's Sustainable Cooling Needs."

<sup>14</sup> Global greenhouse gas emissions from the RAC sector, Green Cooling Initiative

<sup>15</sup> Global greenhouse gas emissions from the RAC sector, Green Cooling Initiative



### Cooling sector GHG emissions under the current policy scenario (Türkiye)



Source: The required input data for model are based on research, statistical data, literature and expert interviews carried out by the Cool Up programme

Türkiye is an example of a country with increased demand for cooling, while at the same time having adopted an ambitious GHG emissions reduction goal of 41% by 2030<sup>16</sup>. The cooling sector accounts for about 12% of total GHG emissions of Türkiye<sup>17</sup>. Without intervention or technological progress, emissions are expected to increase from 58.1 Mt CO<sub>2</sub>eq to 67.3 Mt CO<sub>2</sub>eq by 2050<sup>18</sup>. As exemplified in the graphic on the cooling sector GHG emissions under the current policy scenario, the transition to energy-efficient cooling technologies and the phased-down of refrigerants with high global warming potential is critical for Türkiye to meet its emission reduction goals. Given the measures that ensure Kigali compliance as well as grid decarbonisation efforts and efficiency improvements, the total cooling sector emissions in Türkiye have the potential to decrease by more than 60% in 2050 compared to 2020, decreasing the share of direct emissions from the cooling sector from 53%

16 UNDP Global Climate Promise, "Türkiye. Europe & Central Asia."

17 Greenhouse Gas Emissions Statistics, 1990–2021, Turkish Statistical Institute

18 Global greenhouse gas emissions from the RAC sector, Green Cooling Initiative; Cool Up, "Cooling Sector Prospects Study Jordan. Energy and emission saving potential up to 2050 in the refrigeration and air conditioning sector."; Cool Up, "Cooling Sector Prospects Study Lebanon."; Cool Up, "Cooling Sector Prospects Study Egypt. Energy and emission saving potential up to 2050 in the refrigeration and air conditioning sector."

to 43%.<sup>19</sup> Türkiye cooling sector exemplifies the challenges and opportunities associated with the cooling sector also in the MENA region, showcasing that ambitious climate policies and sustainable technological solutions can mitigate emissions in the cooling industry.

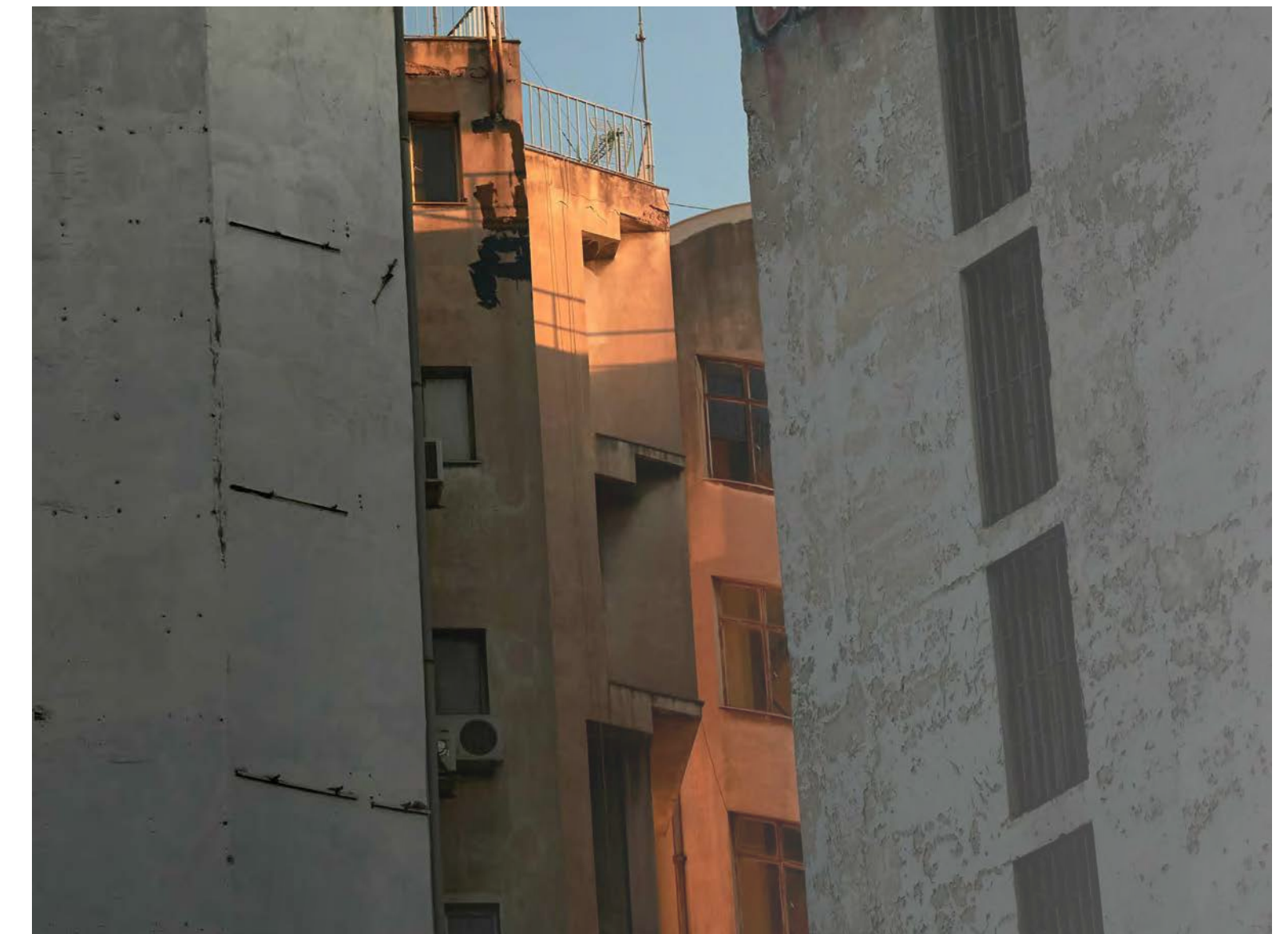
In 2018, the RAC market within the MENA region was valued at 8 billion EUR, and is projected to grow at a compound annual growth rate of 5%, reaching approximately 10.72 billion EUR by 2024<sup>20</sup>. International corporations predominantly led the RAC sector in the MENA region; however, the region has developed local manufacturing capabilities, in particular in Egypt, Morocco, Türkiye, and Jordan.

19 Global greenhouse gas emissions from the RAC sector, Green Cooling Initiative; Cool Up, "Cooling Sector Prospects Study Jordan. Energy and emission saving potential up to 2050 in the refrigeration and air conditioning sector."; Cool Up, "Cooling Sector Prospects Study Lebanon."; Cool Up, "Cooling Sector Prospects Study Egypt. Energy and emission saving potential up to 2050 in the refrigeration and air conditioning sector."; Research, statistical data, literature and expert interviews carried out by the Cool Up programme.

20 Cool Up, "MENA Region Cooling Status Report: Progress, Opportunities, and Insights. Issue 1."

Key challenges faced in the MENA region considering the growing demand for cooling include the absence of natural cold sinks and water scarcity, and a heavy reliance on fossil fuels for cooling technologies. These factors lead to rising production and operational costs, as well as significant environmental effects<sup>21</sup>

In recent years, the RAC industry in the MENA region has increasingly responded to these challenges by introducing advanced technologies that focus on energy efficiency and utilizing natural refrigerants in active cooling and refrigeration technologies. These advanced technologies include, for example, (1) variable refrigerant flow (VRF) air conditioning systems, (2) district cooling systems in urban development, (3) energy-efficient appliances and devices to decrease cooling demand, and a (4) gradual adoption of natural refrigerants in RAC systems, reducing reliance on hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs).<sup>22</sup>



21 Eveloy and Ayou, "Sustainable District Cooling Systems: Status, Challenges, and Future Opportunities, with Emphasis on Cooling-Dominated Regions."

22 Cool Up, "Adopting sustainable RAC technologies in MENA and Türkiye."



## 1. Variable Refrigerant Flow (VRF) systems

Variable Refrigerant Flow (VRF) systems are advanced air conditioning systems that provide precise control over temperature by adjusting the flow of refrigerants to multiple indoor units. These systems allow a “temperature zoning” strategy within a building by giving the required temperature for each individual “zone”. By adjusting the necessary output of refrigerants to the actual cooling or heating demand, VRF systems are highly energy efficient. The VRF systems have become the dominant air condition technology in the MENA region, with several international suppliers offering the technology in the region.<sup>23</sup>

## 2. District Cooling

District cooling (DC) systems involve a centralized plant that supplies cooling to a network of buildings. These systems use large-scale, water-cooled chiller plants that typically consume less energy than conventional cooling systems. The benefits of DC are best utilized in densely populated urban areas with hot climates and a high concentration of buildings. As a result, DC has emerged as a key alternative cooling solution in the Gulf region. Large-scale DC systems whose cooling capacity ranges between 35,000 and 130,000 refrigeration tons (RT) include the Jumeirah Village in Dubai (37,000 RT), Saadiyat Island in Abu Dhabi (69,500 RT), Masdar City in Abu Dhabi (70,000 RT), Lusail City District Cooling in Qatar (100,000 RT), and Pearl District in Qatar (130,000 RT).<sup>24</sup>

## 3. Energy-efficient appliances and devices

Within commercial, industrial and residential buildings, the use of appliances and devices that operate in an energy-efficient way or control the energy consumption of cooling devices are an essential way to decrease cooling demand. These can include automatically controlled movable shading on windows, airtight construction of doors and windows, HVAC systems with SEER (Seasonal Energy Efficiency Ratio) and EER (Energy Efficiency Ratio) ratings, smart thermostats that adapt to cooling

23 Bhatia, “What VRF Air-Conditioning Means for the Middle East?”; MEP Staff, “Technical knowhow essential for VRF systems, says MEP contractor.”; Cool Up, “MENA Region Cooling Status Report: Progress, Opportunities and Insights, Issue 1.”

24 Saadiyat Island District Cooling Plant, ADC Energy Systems; Staff Writer, “Empower Awards Design Contract for District Cooling Plant in Dubai’s Jumeirah Village.”; “Lusail City District Cooling/Lusail City, Qatar, Global District Energy Climate Awards; Kilani, “Behind the Skyscrapers: What Makes Lusail City So Special?”; *Integrated District Cooling Plant (IDCP)*, Global District Energy Climate Awards

needs based on occupancy patterns, and geothermal heat pumps that reject and transfer building heat to the cooler earth and deliver cooled air into the building’s cooling system.

In the MENA region, many buildings are already constructed with energy-efficient and environmentally friendly materials, products and systems. These go hand in hand with the adoption and updating of mandatory building codes and encouraging the adoption of voluntary green building standards, such as LEED and BREEAM.<sup>25</sup>

## 4. Adaption of natural refrigerants in RAC systems

The use of natural refrigerants like carbon dioxide (CO<sub>2</sub>, R-744), propane (R-290), and ammonia (NH<sub>3</sub>, R-717) is increasing in the MENA region to replace HCFCs and HFCs specifically in commercial refrigeration. One example of the usage of natural refrigerants in the RAC sector are central transcritical CO<sub>2</sub> systems. These are specialized refrigeration and air conditioning systems that use carbon dioxide (CO<sub>2</sub>) as the refrigerant in a transcritical cycle. They are mainly being used in industrial cooling and refrigerating as supermarkets, cold storage facilities, and industrial cooling. Although transcritical CO<sub>2</sub> refrigeration systems are said to function better in cooler climates, some pilot projects are being implemented in the region with good performance results, such as a supermarket in the My City Centre Masdar shopping mall in Masdar City, Abu Dhabi and the Al-Salam military supermarket in Amman, Jordan.<sup>26</sup>

Further examples of the development of natural refrigerants are introduced to the market with a new series of refrigerator compressors. The compressors are specifically designed for propane (R-290), that are up to 15% more energy-efficient compared to competitive products (AL series compressors) are primarily distributed and sold in the UAE and Egypt<sup>27</sup>. Other similar examples are launched and currently available in UAE, Kuwait, Qatar and Lebanon.<sup>28</sup>

25 Moneer, “Climate-smart cities in the MENA region: Promise and pitfalls.”; Pradeep, “The Middle East’s hidden sustainable building gems: Everything you need to know.”; Demonstration projects database, Build\_Me

26 *Transcritical System in Super-Warm Abu Dhabi Exceeds Energy Expectations*, R744 CO<sub>2</sub> Cooling Marketplace; Garry, Middle East’s First Transcritical System Is an Energy Saver.”

27 *AL Refrigeration Compressor*, Tecsumeh

28 Transparency Market Research, “Middle East Industrial Refrigeration Equipment Market – Industry, Analysis, Size, Shape, Growth, Trends, and Forecasts, 2023 -2031.”







# Policy landscape

Governments in the MENA region have increasingly recognized that climate change necessitates both immediate policy action and comprehensive, long-term planning to enable sectoral transitions. Several governments have developed plans and implemented direct measures to reduce greenhouse gas emissions and adapt to the impacts of climate change in a sustainable and holistic manner. Key areas of focus include investments in renewable energy, the adoption of energy efficiency standards, the introduction of carbon taxes, urban planning, and public transport development. For example, Saudi Arabia and Bahrain have pledged to reach net-zero emissions by 2060 and UAE by 2050. In Morocco, renewables make up almost two-fifths of its electricity capacity, while in Jordan and Egypt, renewables account for more than 10% of the national energy mix.<sup>29</sup>

Cooling solutions are another focal point of these policies, with initiatives aimed at improving energy efficiency in buildings and RAC technologies, promoting the use of natural refrigerants as alternatives to fluorinated gases (F-gases), and encouraging the adoption of passive cooling solutions. Governments play a pivotal role in setting these agendas and committing to their achievement, while simultaneously implementing, monitoring and evaluating the progress of policy actions.

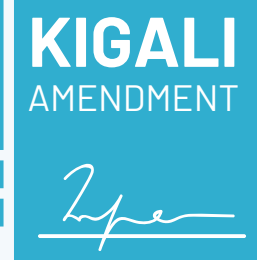
<sup>29</sup> Ahmed, "How MENA Countries Are Adapting to and Mitigating Climate Change."; Alami, "How Morocco Went Big on Solar Energy."; Wehrey and Fawal, "Cascading Climate Effects in the Middle East and North Africa: Adapting Through Inclusive Governance."



# Political developments towards sustainable cooling in the MENA region

## International commitments and pledges

### The Montreal Protocol and its Kigali Amendment



**10 COUNTRIES** in the MENA region have signed the Kigali Amendment.

- OCTOBER 2019 JORDAN
- FEBRUARY 2020 LEBANON
- APRIL 2021 SYRIAN ARAB REPUBLIC
- AUGUST 2021 TUNISIA
- NOVEMBER 2021 TÜRKIYE
- APRIL 2022 MOROCCO
- AUGUST 2023 EGYPT
- APRIL 2024 UNITED ARAB EMIRATES
- NOVEMBER 2024 KUWAIT
- NOVEMBER 2024 OMAN
- JULY 2024 BAHRAIN



### The Global Cooling Pledge for COP28

The **Global Cooling Pledge** is an initiative led by the United Arab Emirates as **host of the COP28** to commit to sustainable cooling with concrete actions.

- LEBANON
- MOROCCO
- SYRIA
- TUNISIA
- THE UNITED ARAB EMIRATES

**AS OF DECEMBER 2023 71 COUNTRIES** have signed the pledge, including **5 FROM THE MENA REGION**

## National plans and strategies

### National Cooling Action Plans

**TÜRKIYE** JUNE 2023  
The Turkish Climate Change Directorate announced the **launch of the first NCAP** for Türkiye.



**EGYPT** MAY 2024  
The **National Ozone Unit (NOU)** of the Egyptian Environmental Affairs Agency (EEAA), initiated Egypt's NCAP.

**JORDAN** JUNE 2023  
The Jordanian Ministry of Environment shared the first draft of **Jordan's National Cooling Strategy**.

### National F-Gas regulations



**THE UNITED ARAB EMIRATES** and **TÜRKIYE** Implemented **national F-gas regulations** focused on reducing the use of HCFCs.

**SAUDI ARABIA**, **JORDAN**, **TUNISIA**, and **LEBANON** Are currently in the **process of developing F-gas regulations**.



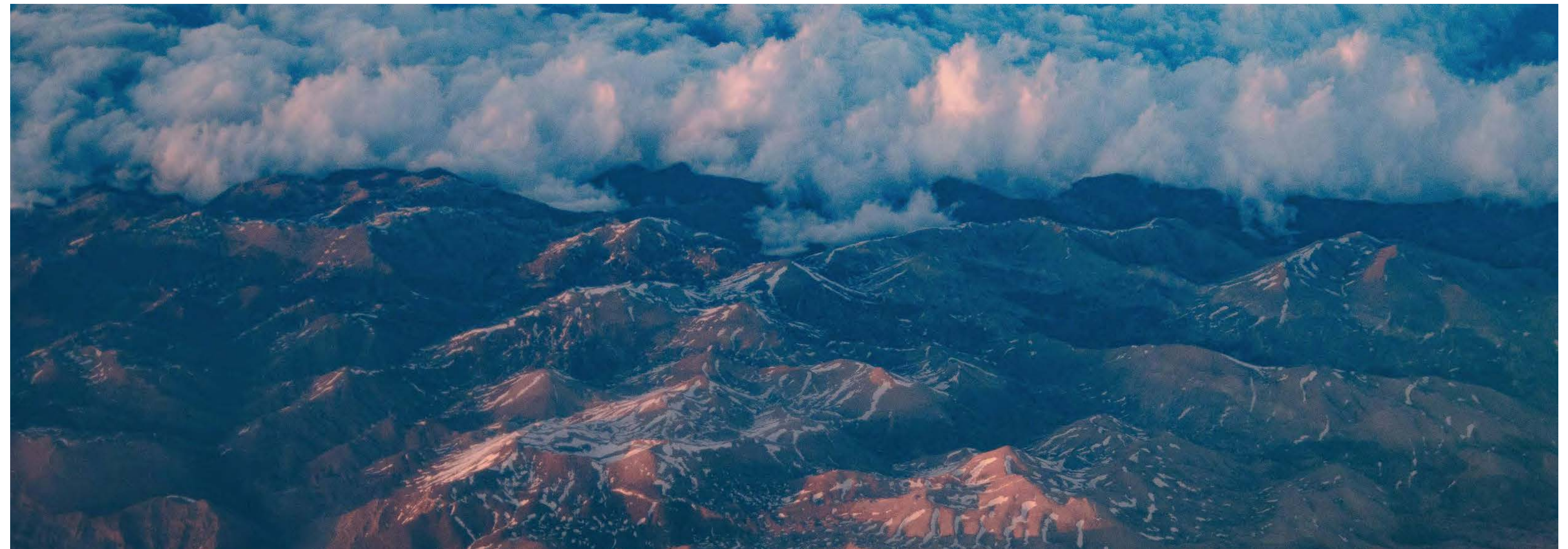
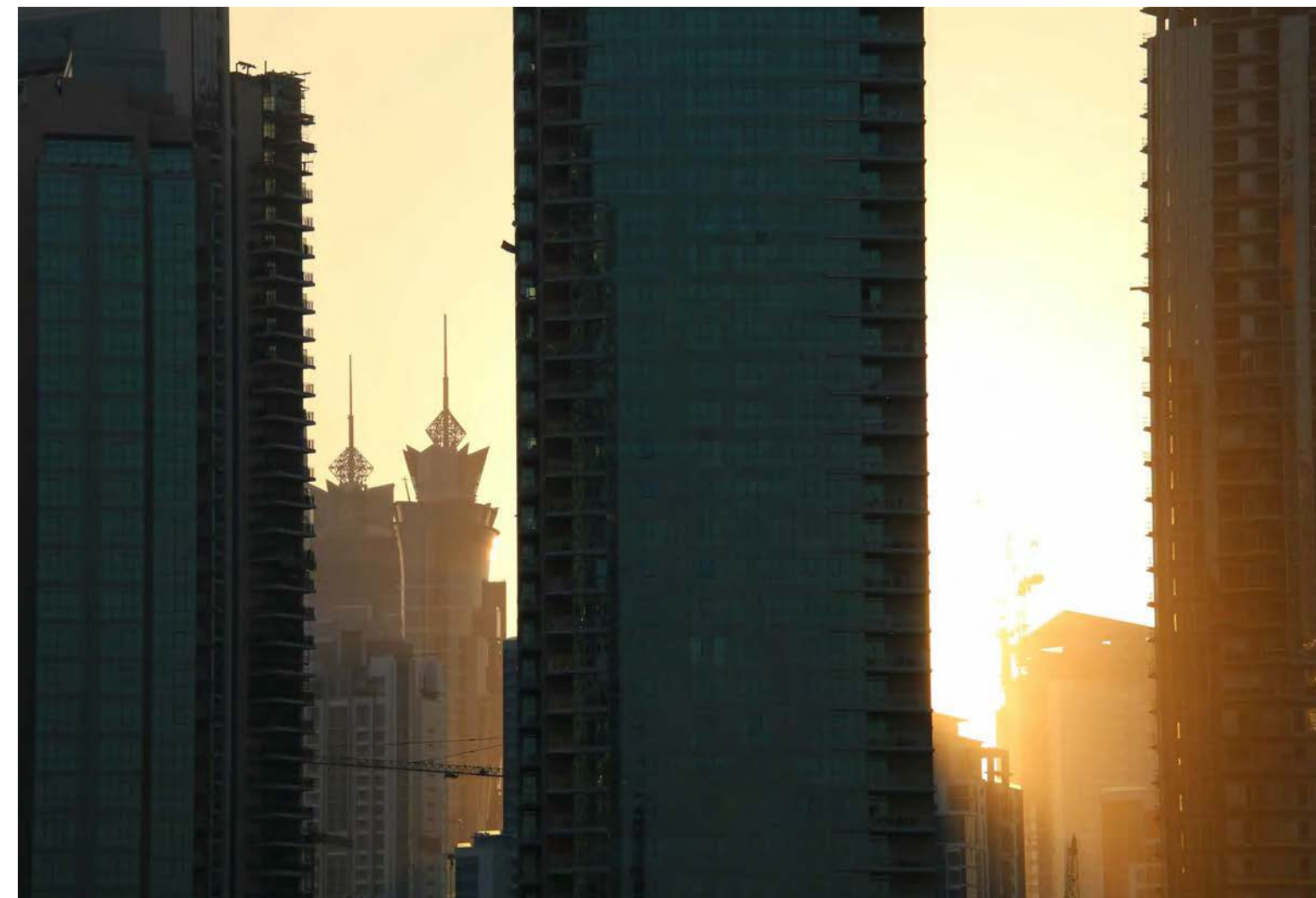
## Recent developments in international commitments

### *The Montreal Protocol and its Kigali Amendment*

The **Montreal Protocol** is an international treaty aimed at protecting the ozone layer by phasing out the production and consumption of substances responsible for ozone depletion, primarily chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). The protocol was signed in 1987 and came into effect in 1989. As of 2015, all UN member states had ratified the agreement, making it the first treaty in UN history to achieve universal adoption.

The UAE and Bahrain ratified the amendment in April and July 2024. The Kigali Amendment, adopted in 2016, was a major update to the Montreal Protocol, expanding its scope to include the phasedown of hydrofluorocarbons (HFCs). While HFCs do not deplete the ozone layer, they are powerful greenhouse gases that contribute significantly to global warming. HFCs have become a widely used alternative to CFCs and HCFCs in the RAC sector, despite their extremely high global warming potential.

Under the Kigali Amendment, different countries follow specific baseline years and phasing down schedules for reducing HFCs.



As of November 2024, 162 parties have ratified the Kigali Amendment. Among these signatories, eleven countries are located in the MENA region: Bahrain (1 July 2024), Egypt (22 August 2023), Jordan (16 October 2019), Lebanon (5 February 2020), Morocco (22 April 2022), Syrian Arab Republic (5 April 2021), Tunisia (27 August 2021), Türkiye (10 November 2021), United Arab Emirates (19 April 2024), Kuwait (6 November 2024), Oman (8 November 2024).<sup>30</sup> Additionally, Qatar and Saudi Arabia have expressed their intention to proceed with the ratification.<sup>31</sup>

### *The Global Cooling Pledge for COP28*

The Global Cooling Pledge is an initiative led by the United Arab Emirates, which hosted the 2023 United Nations Climate Change Conference (COP28). It aims to achieve several goals, including:

- Reducing cooling related emissions by 68% from 2023 by 2050
- Significantly increasing access to sustainable cooling by 2030

<sup>30</sup> Country Data. All ratifications, UNEP

<sup>31</sup> Hines, "The UAE Ratifies the Kigali Amendment."

- Ratifying the Kigali Amendment by 2024
- Publishing a National Cooling Action Plan
- Establishing Minimum Energy Performance Standards (MEPS)
- Increasing the global average efficiency of new air-conditioners by 50%

As of December 2023, 71 countries have signed the pledge, including five from the MENA region: Lebanon, Morocco, Syria, Tunisia, and the UAE.

**The UAE and Bahrain ratified the amendment in April and July 2024. The Kigali Amendment, adopted in 2016, was a major update to the Montreal Protocol, expanding its scope to include the phasedown of hydrofluorocarbons (HFCs).**



## Recent developments in national plans and policies

### National Cooling Action Plans

National Cooling Action Plans (NCAPs) are strategic frameworks developed by countries to address the increasing demand for cooling while minimizing its environmental and economic impacts. These plans aim to guide national efforts towards more sustainable and efficient cooling practices. By addressing each country's specific cooling requirements and potential solutions, NCAPs provide a comprehensive roadmap for implementing these solutions. Recognizing the interconnected nature of cooling across various sectors, NCAPs integrate policies often addressed independently – such as those related to energy, climate, health, agriculture, and housing – into a cohesive strategy to achieve cumulative benefits. The development of NCAPs is a multi-stakeholder consultative process that involves key actors from the public and private sectors as well as civil society.

The process of developing NCAPs has started in 2018, with India being the first country that has launched a national cooling plan in 2019. Other countries that have developed a NCAP are Sri Lanka (2019), Rwanda (2019), Chile (2020), Panama (2020) Trinidad and Tobago (2020), Grenada (2021), Bangladesh (2021), Mexico (2022), Kenya (2022), Nigeria (2022), South Africa (2023), Cambodia (2023), Indonesia (2024) and Gambia (2024).

In June 2023, the Turkish Climate Change Directorate announced the launch of the first NCAP for Türkiye.<sup>32</sup> During the same month, the Jordanian Ministry of Environment shared the first draft of Jordan's National Cooling Strategy.<sup>33</sup> In May 2024, the National Ozone Unit (NOU) of the Egyptian Environmental Affairs Agency (EEAA), initiated Egypt's NCAP.<sup>34</sup>

### National F-Gas regulations

Fluorinated gases (F-gases) are a group of man-made greenhouse gases that include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF<sub>6</sub>), and nitrogen trifluoride (NF<sub>3</sub>). F-gases are commonly used in refrigeration and air-conditioning. They have a much higher global warming potential than naturally occurring

<sup>32</sup> Cool Up, "Thematic group meeting in Türkiye: Launch of NCAP by Climate Change Directorate."

<sup>33</sup> Cool Up, "First draft of Jordan's National Cooling Strategy shared with stakeholders."

<sup>34</sup> Cool Up, "Kick-off of Egypt's National Cooling Action Plan."



greenhouse gases. Many countries globally have put F-gas regulations in place to phase down the use of F-gases.<sup>35</sup> For example, the EU F-Gas-Regulation mandates a gradual phase-down, aiming to phase out all F-gas emissions by 2050.<sup>36</sup>

Within the MENA region, the UAE and Türkiye have implemented national F-gas regulations focused on reducing the use of HFCs. Türkiye has aligned its national F-gas regulations with those of the EU. In 2023, the UAE has issued decree No. 138, which regulates the use and distribution of hydrofluorocarbons (HFCs) in the country, aiming to control their circulation and prevent their emission into the atmosphere.<sup>37</sup> Other countries are currently in the process of developing national F-gas regulations include Saudi Arabia, Jordan, Tunisia, and Lebanon.<sup>38</sup> The recently adopted F-gas

<sup>35</sup> *Overview of Greenhouse Gases*, United States Environmental Protection Agency.

<sup>36</sup> Environmental Coalition on Standards, "Blueprint for an F-Gas-Free Future: The EU's New F-Gas Regulation."; European Commission, "EU-Rules: Guidance on the EU's F-gas Regulation and its legal framework."

<sup>37</sup> Al Fahaam and Aamir, "UAE Issues Decree on Regulation of Hydrofluorocarbons."

<sup>38</sup> "Saudi Arabia Prepares for HCFC Phase-out Management Plan Stage II, Refindustry Refrigeration Tech Hub; Bawaresh et al, "National Cooling Strategy of Jordan. Priority interventions to address Jordan's growing cooling needs."; Republic of Tunisia, Updated Nationally Determined Contribution (NDC) Tunisia; Cool Up, "Regulatory Analysis Egypt: Analysis and recommendation for the regulatory and policy instruments governing the RAC sector."

Regulation (EU) 2024/573 as well as ongoing negotiations and expected commitments regarding revised national F-gas regulations in MENA countries should be closely monitored.

**In June 2023, the Turkish Climate Change Directorate announced the launch of the first NCAP for Türkiye. During the same month, the Jordanian Ministry of Environment shared the first draft of Jordan's National Cooling Strategy. In May 2024, the National Ozone Unit (NOU) of the Egyptian Environmental Affairs Agency (EEAA), initiated Egypt's NCAP.**



# Finance landscape

In addition to political action and the involvement of RAC manufacturers and distributors, the global transition to sustainable cooling requires diverse financing channels to facilitate and support this shift. Financial initiatives, models, and funding can come from government budgets, the private sector as well as international organizations or bilateral donors, such as development banks, international financial institutions (IFI) or foreign countries. While financial resources are needed for the transition process, implementing sustainable cooling measures leads in the long run to considerable savings in electricity and investments cost: In 2023, the Global Cooling report stated that around 940 billion EUR in electricity costs for end users and between 3.7 trillion EUR and 4.7 trillion EUR in power generation investment could be saved by 2050.<sup>39</sup>

The urgent need to mobilize financial support and redefine existing models to assist countries in addressing climate change was a central focus at COP28 in Dubai, UAE. During the event, the first global stock take was concluded, providing an assessment of the current progress and identifying gaps in the global climate response. This stock take underscored a significant gap between the financial support developing countries need and the available support. In the “Declaration on a Global Climate Finance Framework”, it is estimated that 4.8 - 6.7 trillion EUR annually must be mobilized and allocated to climate action and climate-resilient development.<sup>40</sup>

<sup>39</sup> UN Environment Programme, “Keeping It Chill: How to Meet Cooling Demand While Cutting Emissions.”

<sup>40</sup> COP28 UAE Leaders’ Declaration on a Global Climate Finance Framework, COP28 UAE





As a result, one of the key objectives of COP28 was to secure new resources for existing climate funds. Governments pledged 11.90 billion EUR to the Green Climate Fund (GCF), one of the largest funds aimed at assisting developing countries with climate change adaptation. The GCF was established within the framework of the United Nations Framework Convention on Climate Change (UNFCCC).

Additionally, 162.30 million EUR were pledged for two funds managed by the Global Environment Facility (GEF): The Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCD). Both funds support developing countries in advancing towards international environmental goals. In February 2024, the Global Environment Facility's member countries further decided to invest an additional 188.79 million EUR for climate adaptation efforts in "Least Developed Countries, Small Island Developing States, and other countries needing to reinforce their food systems, water resources, and warning systems".<sup>41</sup> Moreover, during COP28, governments pledged 174.84 million EUR to the Adaptation Fund, an international fund established under the Kyoto Protocol of the UNFCCC, aimed at supporting adaptation projects in vulnerable regions.

In recent years, the MENA region has received comparatively limited support from global climate funds. In 2023, the share of climate financing allocated to MENA countries from three major global climate funds amounted to 6.6%. Between 1992 and 2023, the region received cumulative total of 23.18 billion EUR from these funds, one of the lowest allocations globally. However, to date, few of these financial initiatives have been directly allocated towards sustainable cooling solution.<sup>42</sup>

Moreover, a substantial portion of this funding has been provided in the form of loans rather than grants, further exacerbating the debt burdens on national budgets across the MENA region. The majority of approved funding has been directed towards large mitigation projects, with a significant portion of these projects implemented in Egypt and Morocco. Other MENA countries, which often require adaptation measures before launching substantial mitigation efforts, receive comparatively minimal funding.<sup>43</sup>

<sup>41</sup> GEF deploys additional high-impact climate adaptation funding, GEF

<sup>42</sup> Cool Coalition, UNEP and IFC, "Cooler Finance. Mobilizing Investment for the Developing World's Sustainable Cooling Needs."

<sup>43</sup> Watson and Schalatek, "Climate Finance Regional Briefing: Middle East and North Africa."



### International finance

Recent efforts have emerged to address the disparities in available finance support in the region. However, many of these efforts fail to address the challenges of extreme heat and the necessary support for sustainable cooling solutions. This is largely because, in many developing countries there is a lack of systematic data collection and analysis to track and evaluate solutions in terms of place, market size, and financing gaps.<sup>44</sup>

Several global climate funds and financial institutions have recently focused on tackling extreme heat and advancing sustainable cooling solutions, also in the MENA region.

<sup>44</sup> Cool Coalition, UNEP and IFC, "Cooler Finance. Mobilizing Investment for the Developing World's Sustainable Cooling Needs."

While some of this funding goes towards the support of governments and policy makers in decision making regarding the implementation of the Kigali Amendment, other funding sources are more directed towards the private sector enabling it to access loans, grants and knowledge resources to support environmental solutions such as sustainable cooling.

**The Multilateral Fund for the Implementation of the Montreal Protocol**, permanently established in 1994 supports countries worldwide in eliminating ozone-depleting substances and greenhouse gases.<sup>45</sup> In its "Report of the ninety-third meeting of the executive committee", the fund approved 7,217,827.35 EUR for Kigali HFC implementation plans, energy efficiency projects in the refrigeration and air-conditioning sector, HCFC phase-out management plans in 11 MENA countries (Bahrain, Egypt, Iraq, Jordan, Lebanon, Morocco, Oman, Qatar, Türkiye, Tunisia, and Yemen).<sup>46</sup>

**In recent years, the MENA region has received comparatively limited support from global climate funds. In 2023, the share of climate financing allocated to MENA countries from three major global climate funds amounted to 6.6%. Between 1992 and 2023, the region received cumulative total of 23.18 billion EUR from these funds, one of the lowest allocations globally.**

<sup>45</sup> About MLF, Multilateral Fund for the Implementation of the Montreal Protocol

<sup>46</sup> United Nations Environment Programme, *Report of the ninety-third meeting of the executive committee*



# Financial developments supporting sustainable cooling in the MENA region

## Need and losses of climate change



**3.7-4.7 trillion EUR** annually

The sum that has to be mobilised and allocated to **climate action** and **climate-resilient** development according to the:

- DECLARATION ON A GLOBAL CLIMATE FINANCE FRAMEWORK (COP28)

**23.18 billion EUR**

The cumulative total that the **MENA region** received from three major global climate funds between 1992 and 2023.

- GREEN CLIMATE FUND (GCF)
- THE GLOBAL ENVIRONMENT FACILITY (GEF)
- THE CLIMATE INVESTMENT FUNDS (CIF)

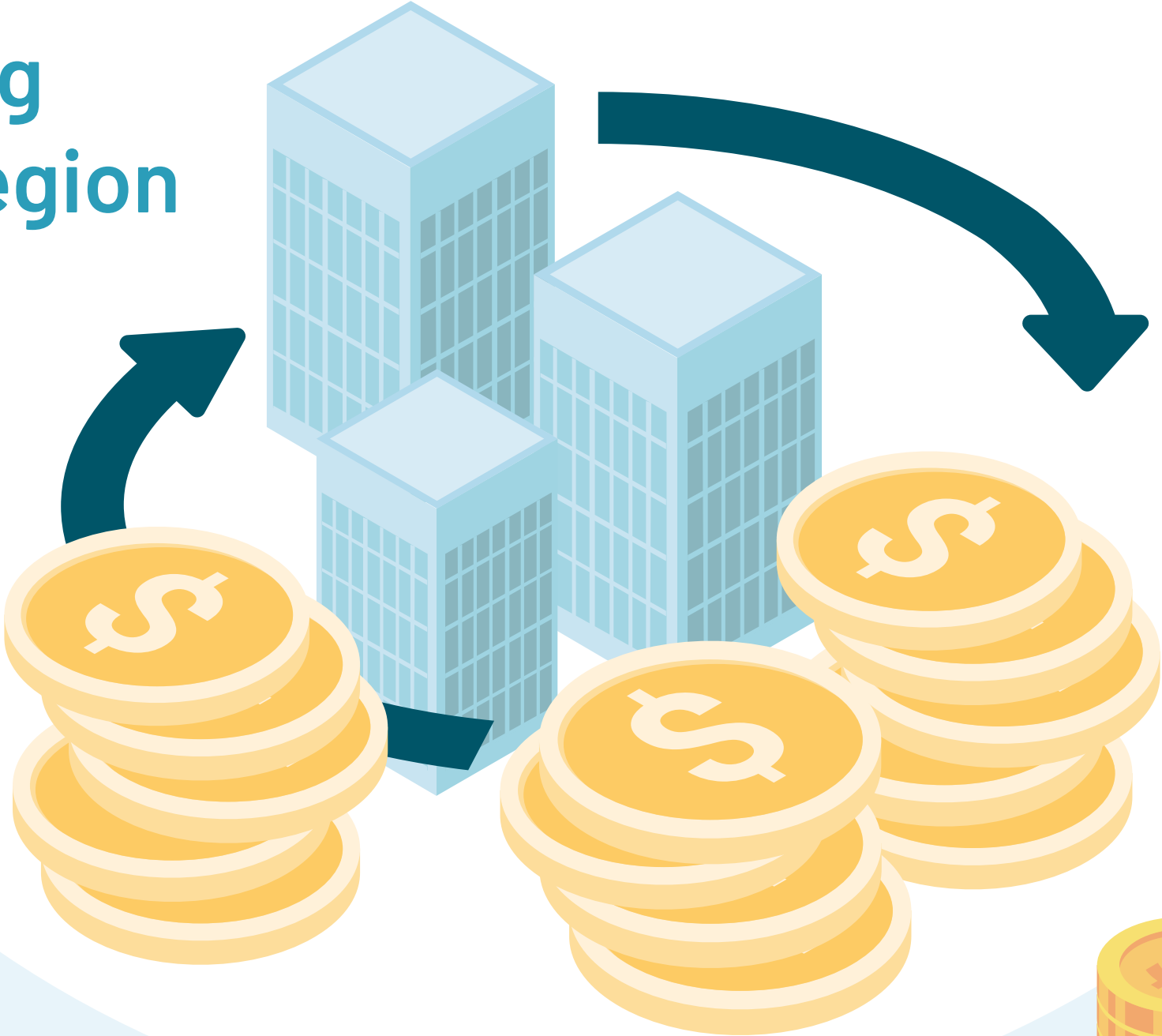
**6.6%**

The share of climate financing allocated to **MENA countries** from three major global climate funds in 2023.

- GREEN CLIMATE FUND (GCF)
- GLOBAL ENVIRONMENT FACILITY (GEF)
- CLIMATE INVESTMENT FUNDS (CIF)

**2.26 trillion EUR**

The amount of the global **GDP loss** due to **decreased labour productivity** under **heat stress**.



## Potential impact of sustainable cooling

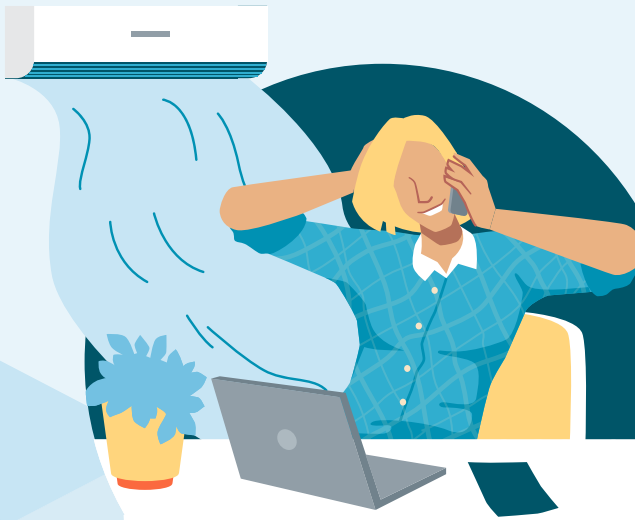


**949 billion EUR**

Amount that end-users can **save in electricity bills** by 2050 due to **reduced cooling energy demand** through the adoption of **sustainable cooling measures**.

**343 billion EUR**

Amount that can be saved in **medical and other costs** due to **occupational safety and health measures** against extreme heat.



## Pledges, funds and opportunities for sustainable cooling

**564 billion EUR** BY 2050

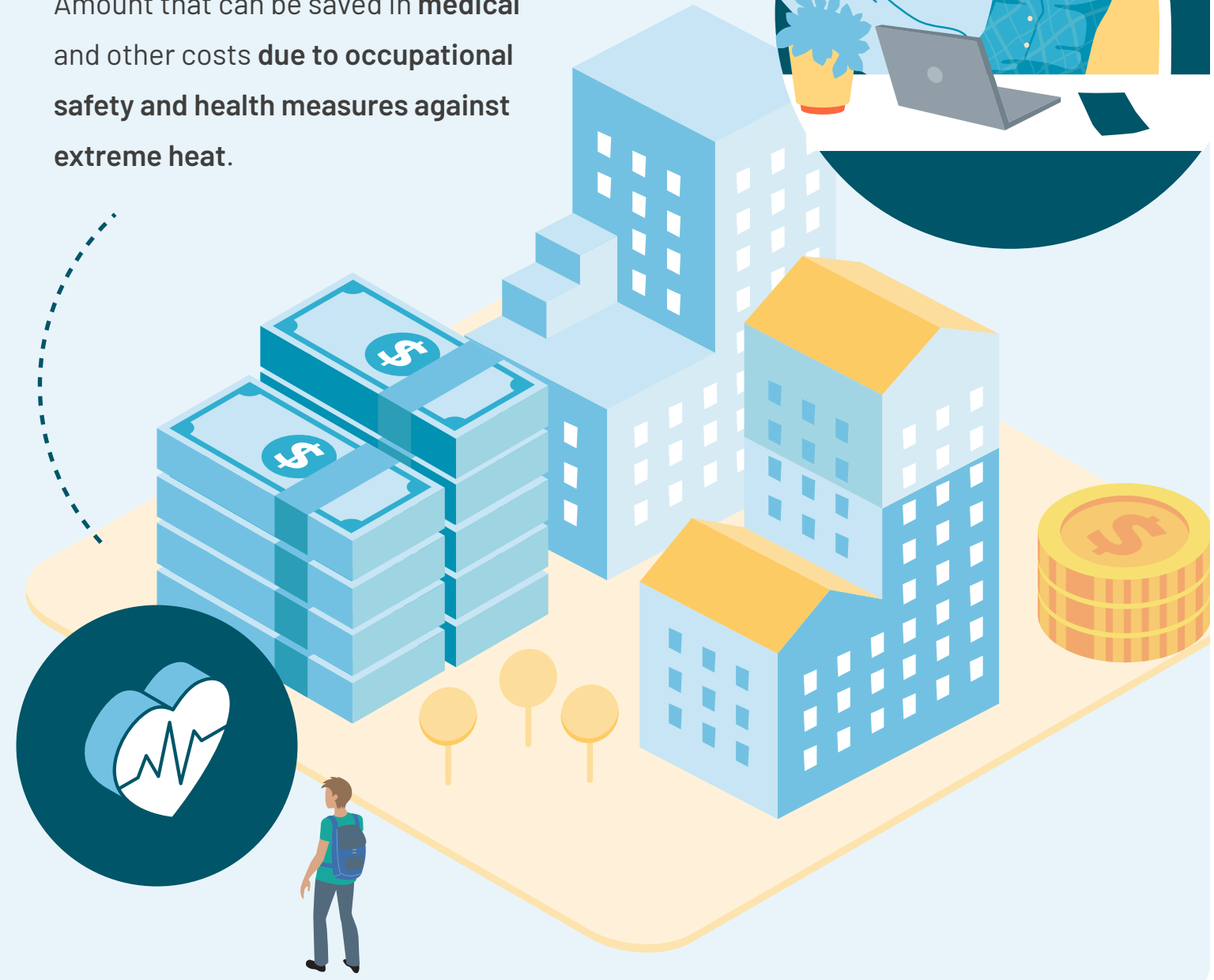
Projected size of the **sustainable cooling market** in developing economies by 2050.

**7,217,827.35 EUR**

Amount that **The Multilateral Fund for the Implementation of the Montreal Protocol** approved for **Kigali HFC implementation plans**, **energy efficiency project** in the **refrigeration and air conditioning sector**, **HCFC phase-out management plans**.



**11 MENA COUNTRIES**





**The Global Environment Facility (GEF)** that includes several funds such as the Least Developed Countries Funds and the Special Climate Change Fund, aims to support government agencies, civil society organizations, the private sector, research institutions, and international organizations in confronting climate change. One of the main topics of the GEF is energy efficiency, including global energy efficiency certification and standards programs for leapfrogging markets to the future of energy efficient appliances such as refrigerators and air conditioners.<sup>47</sup> In Iraq, the GEF, in partnership with the UNDP, is helping to develop a regulatory framework aimed at improving energy efficiency in buildings to promote low carbon development. This project, running from 2021 to 2028, also covers energy efficiency in cooling and heating systems and technologies.<sup>48</sup>

One main international funding for the private sector is the **International Finance Corporation (IFC)**. In 2019, the IFC launched its sustainable cooling initiative, based on expected substantially growing market opportunities in sustainable cooling in developing economies from 256 billion EUR to 564 billion EUR per year by 2050. The IFC supports investments in five areas of intervention including district cooling, cooling for green buildings, consumer and SME finance, innovation for manufacturing and agribusiness, and cold chain and temperature-controlled logistics.<sup>49</sup> The program is based on IFC's Tech Emerge program matching innovators with companies in the sustainable cooling market to accelerate the adoption of state-of-the-art cooling technologies, increasing access, and reducing costs of products and services.<sup>50</sup>

Another support stream for companies in the field of green technologies is the Techselector, an online platform developed by the European Bank for Reconstruction and Development (EBRD). The Techselector connects potential buyers of green technologies with sellers whose products have been pre-approved for EBRD financial programs. Financing opportunities can cover up to 100% of the cost, capped at 300,000 EUR per selected piece equipment. Available cooling technologies include air conditioners, comfort and industrial process chillers, commercial refrigeration

<sup>47</sup> Energy Efficiency, Topics, GEF

<sup>48</sup> Promoting Carbon Reduction Through Energy Efficiency (EE) Techniques in Baghdad City, Projects & Operations, GEF

<sup>49</sup> International Finance Corporation, "Press Release: \$8 Trillion Opportunity in Sustainable Cooling Solutions for Developing Economies – IFC and UNEP Report; Program Sustainable Cooling, International Finance Corporation

<sup>50</sup> An Innovation of IFC (International Finance Corporation), TechEmerge

appliances, and condensing units. The Techselector is accessible for several sellers and buyers from the MENA region and Türkiye.<sup>51</sup>

### National Finance

In recent years, notable changes have emerged within national finance schemes for projects and initiatives addressing climate change. There has been a growing number of green and sustainability-linked loans, often sourced from sovereign wealth funds or government receivable excess. In addition, the importance of increasing private sector investments and of private-public partnerships has been emphasized by many stakeholders, especially in the lead-up to COP29 in Azerbaijan.<sup>52</sup>

In December 2023, the Central Bank of Jordan launched its Jordan Green Finance Strategy, aimed at enhancing the financial sector's capacity to assess climate risks, integrate climate-related factors into regulatory frameworks, and promote green finance initiatives. According to Jordan's estimates, achieving its NDC targets will require 7.125 billion EUR, with the government planning to invest approximately 7.5 percent of that amount (536.75 million EUR). The strategy seeks to mobilize green finance from the private sector and international financial institutions while preparing the country's financial sector to take a leading role in advancing green finance initiatives. The strategy does not focus on sector-specific interventions for climate change risks but instead establishes a comprehensive framework to ensure the financial sector is well-prepared to manage climate-related financial risks. Therefore, the strategy does not specifically address sustainable cooling. However, in the section on climate risk assessment for the financial sector, extreme heat is highlighted as a key risk to be addressed in the Central Bank of Jordan's recommendations to the national finance sector.<sup>53</sup>

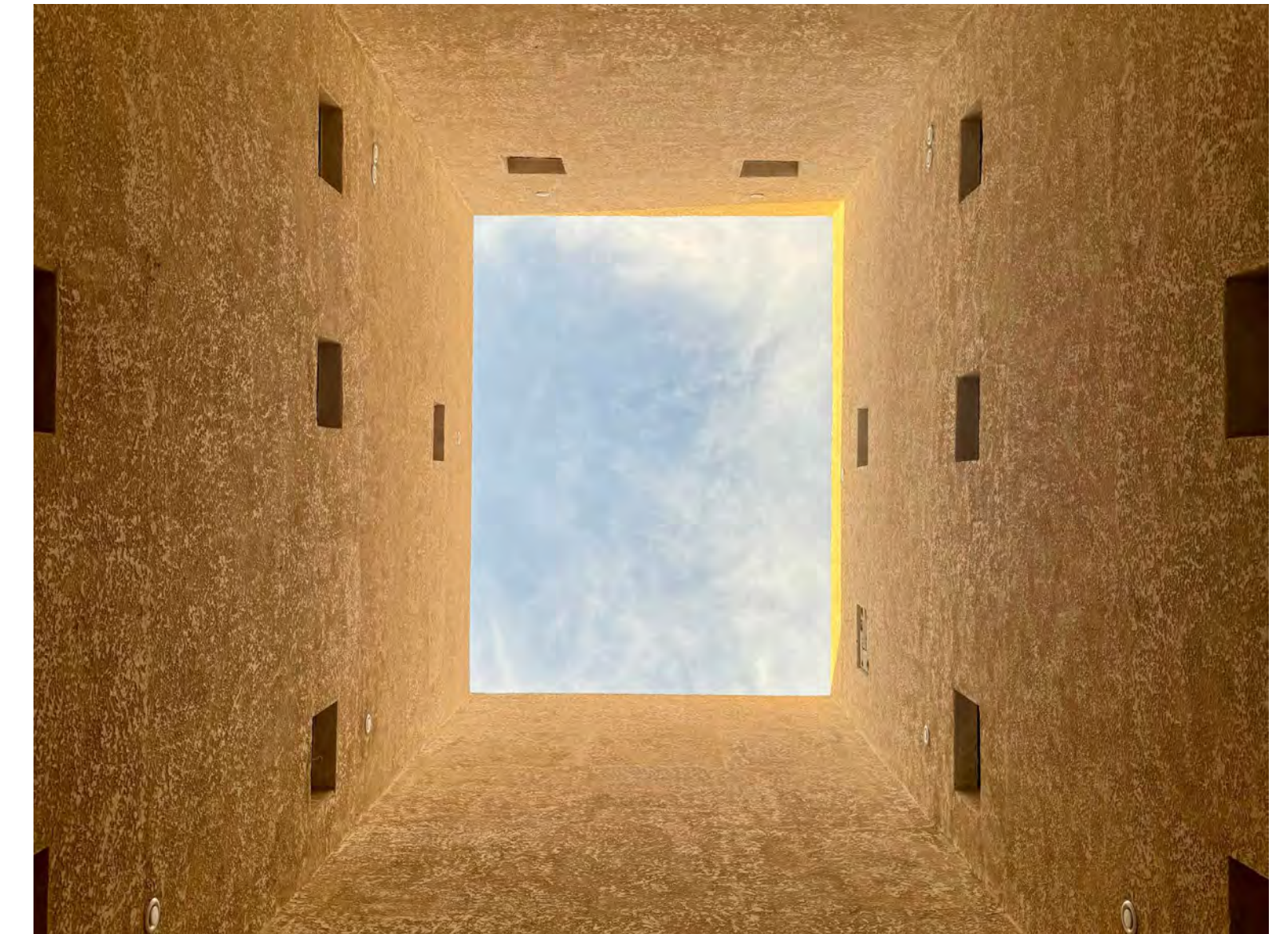
One example for a national initiative is the Saudi Green Initiative (SGI) launched by Crown Prince and Prime Minister of Saudi Arabia H.E. Mohammad Bin Salman in March 2021. The initiative aims to consolidate all existing environmental projects from the public, private and non-profit sector under a single overarching framework.

<sup>51</sup> Product Catalogue, Green Technology Sector.

<sup>52</sup> Laia and Hadap, "With fewer than 100 days to COP29, what's on the agenda?"; Gastelumendi, "The private sector is stepping up on climate resilience. Now governments need to be willing partners."

<sup>53</sup> Central Bank of Jordan, Green Finance Strategy. 2023 – 2028

As part of Saudi Arabia's Vision 2030, the SGI's goals include reducing carbon emissions of 278 million tons by 2030, planting 10 billion trees over the coming decades, and protecting 30% of Saudi Arabia's land and sea by 2030. Since its launch, the initiative has started 77 projects aligned with these targets, supported by an investment of approximately 176.7 billion EUR.<sup>54</sup> Among these projects, urban tree-planting efforts, such as the Green Riyadh Project, aim to reduce ambient temperatures by 2°C during the summer.<sup>55</sup>



**According to Jordan's estimates, achieving its NDC targets will require 7.125 billion EUR, with the government planning to invest approximately 7.5 percent of that amount (536.75 million EUR).**

<sup>54</sup> Project Saudi Green Initiative, Vision 2030. Kingdom of Saudi Arabia

<sup>55</sup> Green Riyadh Project, Royal Commission for Riyadh City





# When Heat Becomes Hazardous: The Crisis of Extreme Temperatures

- 25 Impact of extreme heat on health
- 29 Interview: Hana Abdelatty,  
Atlantic Council's Climate Resilience Center



Climate change is one of the most significant threats of the 21st century, affecting the world at large and significantly diminishing quality of life, especially for the most disadvantaged groups. It will have a tangible effect on most populations worldwide in the upcoming decades, putting ever more lives at risk and jeopardizing the well-being of billions of people.<sup>56</sup> The planet is experiencing a rapid temperature increase despite the ambitious pledge of the Paris Agreement signed in 2016 to limit the long-term increase in global surface temperature to 1.5°C and the Kigali Amendment to the Montreal Protocol with the aim of reducing the emissions of the planet-warming hydrofluorocarbons (HFCs).<sup>57</sup>

According to an analysis of Zeke Hausfather published by the UK based website Carbon Brief the year 2024 will almost certainly surpass 2023 as the warmest year on record. In June 2024, temperatures have been notably higher than average in regions such as South America, the southern parts of the United States and Mexico, North Africa, Western Europe, Central Asia and the Middle East.<sup>58</sup>

The increasing frequency of extreme heat events due to global warming is jeopardizing the functioning of societies and economies worldwide. Beyond the direct health-related risks posed by extreme heat, which will be discussed in more detail in chapter 2.1, extreme heat also affects the overall productivity of workers, severely affecting economic activity. According to a 2019 study by the International Labour Organization, heat stress could result in the loss of working hours equivalent to 80-136 million full-time jobs, causing a global GDP loss of 2.26 trillion EUR.<sup>59</sup> In 2024, the ILO also projected that extreme heat would lead to the annual deaths of 18,970 workers, with those in Africa, the Arab states, and Asia and the Asia-Pacific being the most affected.<sup>60</sup> Jobs particularly at risk are in construction, agriculture and manufacturing as they are often performed outdoors or in environments without adequate cooling.<sup>61</sup>

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56 Costello et al, "Managing the health effects of climate change."

57 United Nations Treaty Collection, "2. f Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer."

58 Hausfather, "State of the Climate: 2024 now very likely to be warmest year on record."

59 Cool Coalition, UNEP and IFC, "Cooler Finance. Mobilizing Investment for the Developing World's Sustainable Cooling Needs."

60 International Labour Organization, "Heat at Work: Implications for Safety and Health. A Global Review of the Science, Policy and Practice."

61 United Nations, "United Nations Secretary General's Call to Action on Extreme Heat."



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## Impact of extreme heat in numbers

**489,000**

deaths were attributed to heat between 2000 and 2019, surpassing fatalities caused by tropical cyclones

**Triple**

Until 2050 the installed capacity of cooling equipment globally will nearly triple

**9.1%**

is the potential increase in poverty for every 1°C rise in temperature

**12%**

of global food production is lost due to insufficient cooling

**80 million**

full-time equivalent working hours are at risk of being lost annually due to extreme heat

**80 million**

students were affected by heat-related school closures worldwide in 2024

**98,314**

lives could be saved each year by scaling up heat health warning systems across 57 nations

**361 billion**

could be saved annually through occupational safety and health improvements, reducing medical and additional costs

**1 trillion**

in electricity bills could be saved by cutting cooling energy demand by 2050

Source: United Nations. 2024. United Nation's Secretary General's Call to Action on Extreme Heat. 25 July 2024.

In addition, extreme heat impacts students' productivity and access to education. Schools often close during heatwaves and learning becomes more difficult during heat especially if no access to cooling is ensured. This can contribute to long-term learning gaps. Additionally, extreme heat disproportionately affects women, mainly due to lower global wages and their overrepresentation in heat exposed jobs like agriculture or the garment industry.<sup>62</sup>

Extreme heat also poses risks to infrastructure and the built environment, particularly in the transport, energy, water and communication sectors which may experience functional interruptions or failures when exposed to high temperatures. Extreme heat also places significant strain on the healthcare sector, as demand for services increases during heatwaves. Additionally, healthcare institutions rely on consistent access to cooling to maintain their operations.<sup>63</sup>

Moreover, extreme heat events severely impact the environment, leading to water scarcity, droughts and reduced plant and crop growth. Heat stress affects both crops and livestock resulting in lower productivity and decreased harvest yield, eventually contributing to increased food loss and insecurity.<sup>64</sup>

**Extreme heat also poses risks to infrastructure and the built environment, particularly in the transport, energy, water and communication sectors which may experience functional interruptions or failures when exposed to high temperatures.**

62 United Nations, "United Nation's Secretary General's Call to Action on Extreme Heat."

63 United Nations, "United Nation's Secretary General's Call to Action on Extreme Heat."

64 United Nations, "United Nation's Secretary General's Call to Action on Extreme Heat."



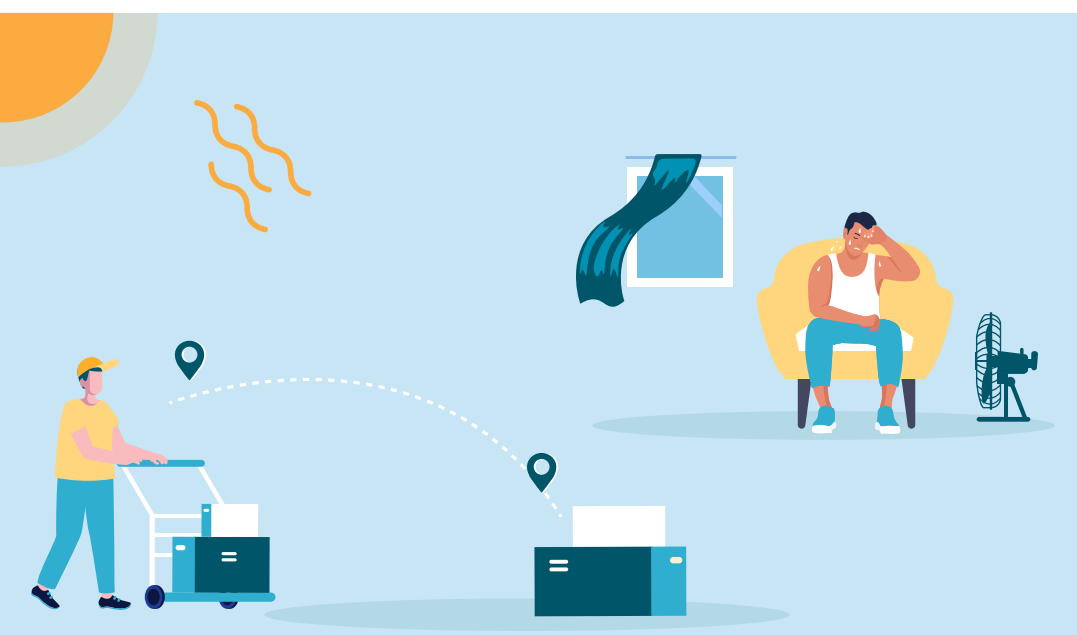
# Risks of extreme heat



## On people

**Health risks**, such as increased **heat exhaustion**, **mental health issues** and **mortality**

Decreased **labor productivity**



**Difficulty to learn and study**

**Decreased economic activity**

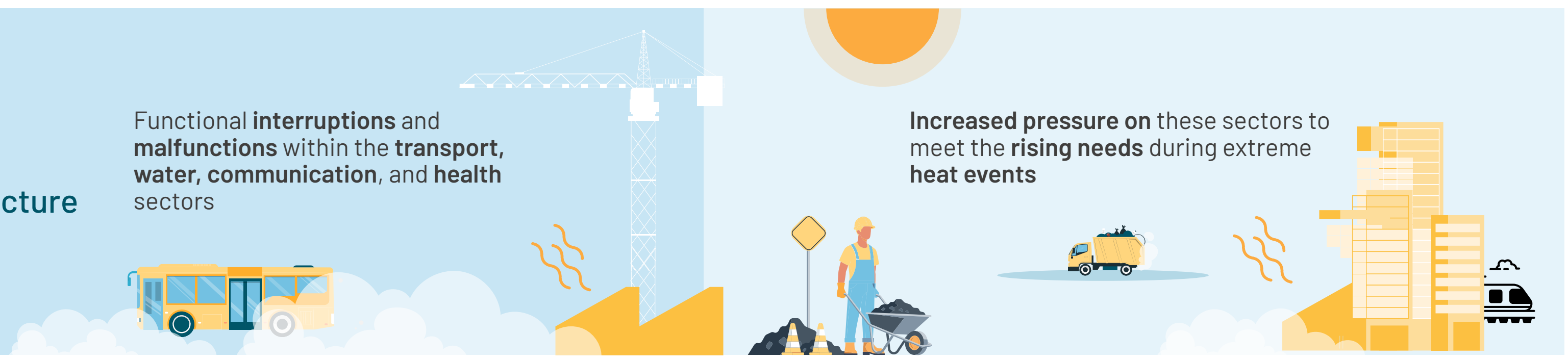
**Increases inequality:** disproportional access to cooling



## On infrastructure

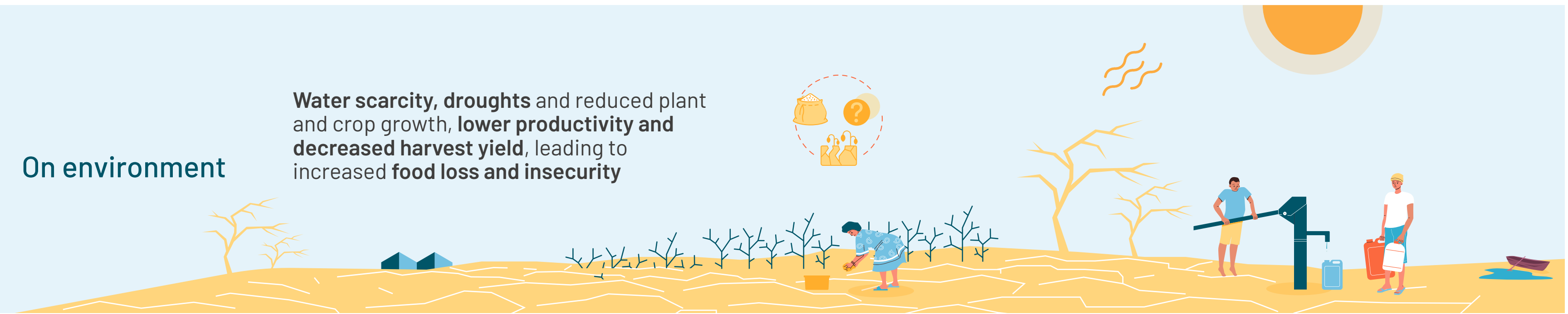
Functional **interruptions** and **malfunctions** within the **transport, water, communication, and health sectors**

**Increased pressure on** these sectors to meet the **rising needs** during extreme heat events



## On environment

**Water scarcity, droughts** and reduced plant and crop growth, **lower productivity and decreased harvest yield**, leading to increased **food loss and insecurity**







# Impact of extreme heat on health

Extreme heat poses serious risks to human health and societal wellbeing. “Heat stress” occurs when the body can’t cope with high temperatures, leading to conditions like heat exhaustion and heatstroke, which can be fatal.

Climate change exacerbates these issues, causing poor air quality and increasing the spread of vector-borne diseases like dengue and malaria. These changes also threaten food and water security, leading to malnutrition and water-borne diseases.

Healthcare systems often struggle to manage the surge in heat-related illnesses, highlighting the need for better resources. To address these challenges, countries must ensure access to cooling technologies, green energy, and sufficient water supplies. Strengthening healthcare and infrastructure is essential to adapt to the growing threat of extreme heat.



## Global context

Extreme heat impacts people's health and the overall wellbeing of societies both directly and indirectly. The term heat stress refers to the direct health impacts of heat – specifically, the human body's inability to compensate for the heat it is exposed to. If body temperature rises above 38°C, a person can experience heat exhaustion, heat cramps and/or hyperthermia. Heatstroke, when the body temperature rises above 40.5°C, can lead to organ damage, loss of consciousness and risk of death, requiring immediate emergency treatment.<sup>65</sup>

Climate-induced heatwaves also have more indirect and long-term effects on human health. Extreme heat is often associated with poor air quality due to lack of wind and precipitation, which trap pollutants in the air. This exacerbates respiratory distress, which can be caused by high temperatures. Additionally, extreme weather conditions influenced by climate change, such as severe heat, increase the risk of vector-borne diseases across expanding geographical ranges. Vector-borne diseases are bacterial or viral diseases transmitted by vectors like mosquitos, ticks, and fleas to humans and other animals. Vector-borne diseases whose prevalence rates have increased due to climate change include dengue fever and malaria.<sup>66</sup>

The geographical expansion in the scope of vector-borne diseases points to broader transformations in environmental systems due to rapidly increasing temperatures. These changes in turn affect human health by negatively impacting societal wellbeing. Increasing water scarcity and a declining global yield potential for fundamental crops threaten food security and lead to restricted access to clean and safe water for many people, increasing the occurrence of malnutrition and water-borne diseases.<sup>67</sup>

65 International Labour Organisation, "Working on a warmer planet. The impact of heat stress on labour productivity and decent work. ILO Geneva."

66 Carlson et al, "Climate change increases cross-species viral transmission risk."

67 Watts et al, "The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises."

Often these risks are exacerbated due to the challenges faced by national healthcare systems when it comes to managing the rapid increase in hospitalizations and risks of death triggered by extreme heat.<sup>68</sup> Depending on the available resources of each respective healthcare system, public health institutions may not be able to provide the necessary services for heat-related emergencies and diseases.<sup>69</sup> To adapt to extreme heat, countries must ensure adequate access to sustainable cooling and access to sufficient green energy and water resources.



68 *Heat & Health*, Global Heat Health Information Network.

69 *Heat and Health*, World Health Organization.

The challenges faced by healthcare systems are one example of how increasing temperatures can affect labor productivity in general. Outdoor professions often cannot be performed effectively under extreme heat conditions, and workers face an increased risk of injury.<sup>70</sup> Even indoor jobs are impacted as the cognitive performance of workers decreases when their bodies are exposed to extreme heat.<sup>71</sup>

70 International Labour Organisation, "Working on a warmer planet. The impact of heat stress on labour productivity and decent work. ILO Geneva."

71 International Labour Organisation, "Working on a warmer planet. The impact of heat stress on labour productivity and decent work. ILO Geneva."



The diverse health issues, as well as challenges associated with healthcare access and labour productivity, do not affect people equally. Instead, the interaction of multiple physiological and socio-economic factors determines the extent to which individuals experience the heat-related risks. Generally, older people, infants and children, pregnant women, and those already suffering from chronic diseases are more vulnerable to heat-related health issues and tend to experience these conditions in a more severe form.<sup>72</sup> Additionally, individuals living in poverty or low resource settings are either more prone to heat-related health issues or lack the necessary resources or infrastructure to address them effectively.<sup>73</sup>

### Extreme heat – The silent killer

In July 2024, the Secretary-General of the United Nations (UN) António Guterres issued a call to action on extreme heat, highlighting the urgent need to confront “the challenges of rising temperatures”. The call describes extreme heat as the “silent killer,” referencing the significant death toll it has caused in recent years and the lack of attention this death toll has received compared to “the impact of more visible weather hazards”. The call also notes that extreme heat “does not affect everyone equally”, and that current policies to address it “remain scattered, disjointed and underfunded”. The UN Secretary-General emphasizes the need for focus and action in four key areas: protecting the vulnerable, safeguarding workers, enhancing the resilience of economies and societies through data and science, and limiting global temperature rise to 1.5°C.<sup>74</sup>

### Regional context

The MENA region warms nearly twice as fast as the global average<sup>75</sup>, leading to increased heat waves and extreme weather events, droughts, floods, eroded coastal land, and rising sea level threatening the existence of coastal cities. The effects of climate change have a wide-reaching impact on the environment, societies, and economic development across the region.<sup>76</sup>

<sup>72</sup> *Heat & Health*, Global Heat Health Information Network

<sup>73</sup> *Heat and Health*, World Health Organization

<sup>74</sup> United Nations, “United Nations Secretary General’s Call to Action on Extreme Heat.”

<sup>75</sup> Greenpeace Research Laboratories, “Living on the Edge. The implications of climate change for six countries in the Middle East North Africa region.”

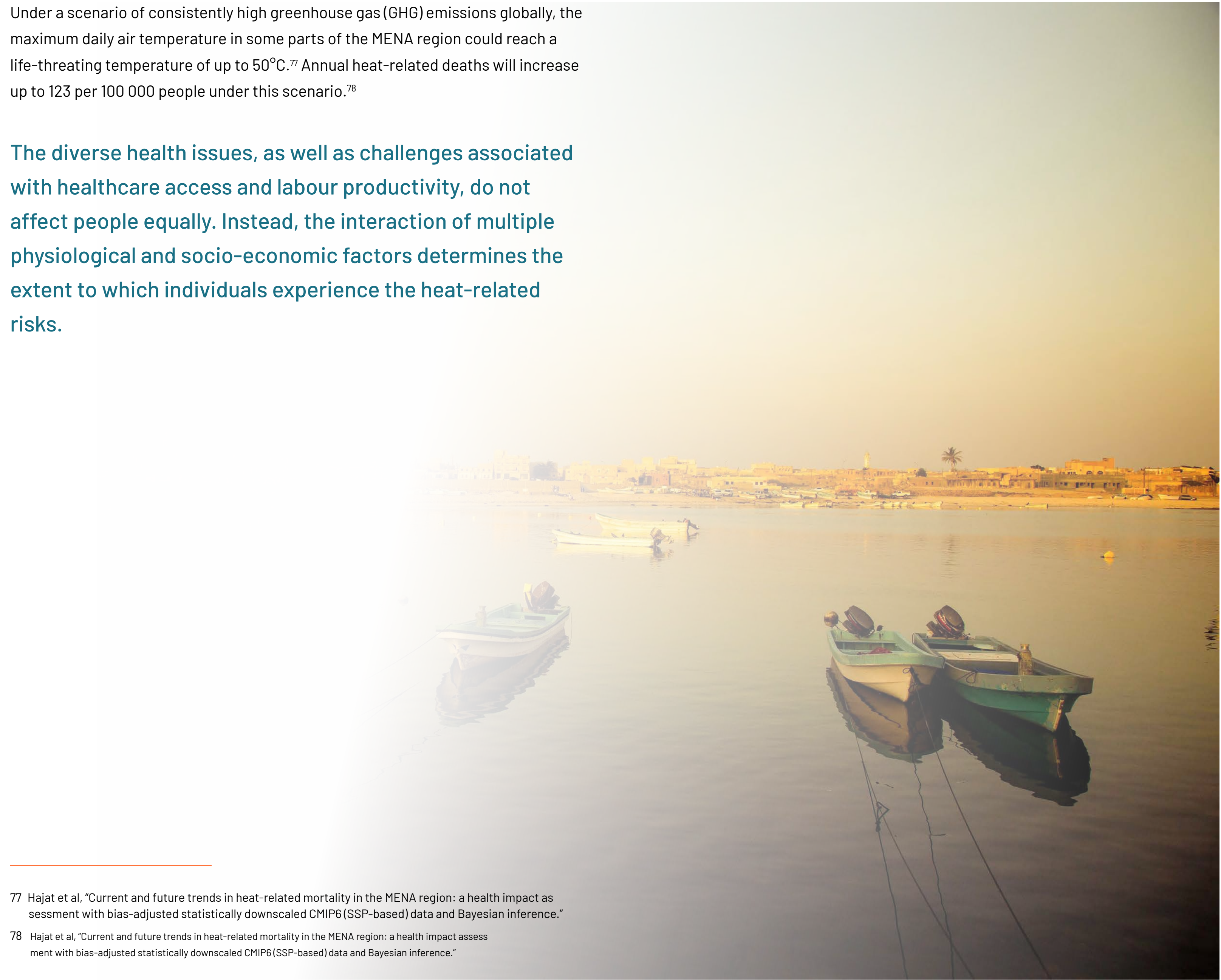
<sup>76</sup> Arkeh and Hamzawy, “Climate Change in the Middle East and North Africa: Mitigating Vulnerabilities and Designing Effective Policies.”

Under a scenario of consistently high greenhouse gas (GHG) emissions globally, the maximum daily air temperature in some parts of the MENA region could reach a life-threatening temperature of up to 50°C.<sup>77</sup> Annual heat-related deaths will increase up to 123 per 100 000 people under this scenario.<sup>78</sup>

**The diverse health issues, as well as challenges associated with healthcare access and labour productivity, do not affect people equally. Instead, the interaction of multiple physiological and socio-economic factors determines the extent to which individuals experience the heat-related risks.**

<sup>77</sup> Hajat et al, “Current and future trends in heat-related mortality in the MENA region: a health impact assessment with bias-adjusted statistically downscaled CMIP6 (SSP-based) data and Bayesian inference.”

<sup>78</sup> Hajat et al, “Current and future trends in heat-related mortality in the MENA region: a health impact assessment with bias-adjusted statistically downscaled CMIP6 (SSP-based) data and Bayesian inference.”







In 2023, the average annual heat-related death rate across all MENA countries was estimated as 2.1 per 100,000 people.<sup>79</sup> Over the past two years, many hospitals in the MENA region have seen an increase in admissions due to heat-related stress.<sup>80</sup> Outdoor and manual workers, including agricultural workers, delivery drivers, construction workers, and personnel are particularly affected by the increasing heat. In most Gulf Cooperation Council states, working under direct sunlight and in open-air areas is prohibited between 12 and 3 p.m. from June until mid-September.<sup>81</sup>

The data on heat-related health risks, morbidity, indirect vulnerabilities, and challenges is limited, which complicates the development of sustainable public health protection systems and mitigation measures on the national and regional level.<sup>82</sup>

Public health institutions in the MENA region face multiple challenges associated

with extreme heat primarily involving additional financial, human resource, infrastructural, and capacity demands. These challenges are exacerbated by pre-existing limitations in the healthcare systems in the region. A review of healthcare infrastructure in developing countries highlights challenges such as limited resources, workforce shortages, infrastructure disparities as well as low health expenditures, increasing pressure from population growth, an aging population, and the rise of non-communicable diseases. Such challenges hinder the development of sustainable mitigation strategies within the healthcare system, preventing a more effective response to extreme heat and its related health issues.<sup>83</sup>

For those affected by heat-related health issues, this often results in limited access to efficient and high-quality healthcare, further constrained by existing vulnerabilities and precarious conditions.

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79 Hajat et al, "Current and future trends in heat-related mortality in the MENA region: a health impact assessment with bias-adjusted statistically downscaled CMIP6 (SSP-based) data and Bayesian inference." al, "

80 Ibrahim, "The Impact of Climate Change on Health in the MENA Region."

81 Human Rights Watch, "I Will Live As Long As Dialysis Lets Me.' Migrant Workers Bear the Brunt of UAE's Extreme Heat."; France 24, "Saudi delivery drivers bake in 'deadly' summer heat."

82 Hajat et al, "Current and future trends in heat-related mortality in the MENA region: a health impact assessment with bias-adjusted statistically downscaled CMIP6 (SSP-based) data and Bayesian inference."

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83 Roncarolo et al, "What do we know about the needs and challenges of health systems? A scoping review of the international literature."; Al Worafi, "Healthcare Facilities in Developing Countries: Infrastructure." Handbook of Medical and Health Sciences in Developing Countries. 2023.





# Interview: Hanna Abdelatty, Atlantic Council's Climate Resilience Center

The Atlantic Council's Climate Resilience Center addresses the challenges posed by climate change, focusing on solutions that enhance resilience and reduce vulnerabilities in communities facing extreme heat. The center creates and delivers transformative adaptation solutions that improve lives, protect livelihoods, and enhance opportunity for communities on the front lines of climate impact.

One of the center's priorities is the development of extreme heat resilience. In its work, the center co-designs, tests, and deploys solutions to mitigate the health and socio-economic impacts of extreme heat—advocating for their adoption and scaling, and supporting governments, civil society, and the private sector in effective heat risk management.

Cool Up interviewed Hana Abdelatty, Assistant Director of Extreme Heat Initiatives at the Atlantic Council's Climate Resilience Center and discussed the Council's work on extreme heat, challenges and risks associated with global warming, as well as different mitigation and adaptation strategies that can be adopted globally and in the MENA region.



**Hanna Abdelatty**

Assistant Director of Extreme Heat Initiatives at the Atlantic Council's Climate Resilience Center





## Heat stress triggers various symptoms in people, and it is crucial to recognize that while extreme heat affects everyone, some groups are more vulnerable than others.

### Cool Up:

First, I would like to talk about extreme heat. Could you tell us about how the Atlantic Council's Climate Resilience Centre defines extreme heat, and what you see as the most significant challenges and risks related to extreme heat?

### Hana Abdelatty:

One of the biggest challenges of extreme heat is that there is still no standardized definition. It is generally characterized as a prolonged period of not just warm but intensely hot weather, which can cause heat stress in the human body. This can vary depending on the region or geographical context, but that is the most widely accepted definition.

There are numerous challenges and risks linked to extreme heat – it affects our livelihoods, health, and economic development. One major challenge I want to emphasize is the impact on public health. Here in the US, extreme heat is the leading weather-related cause of death nationwide. Mortality rates are often underrepresented and even undercounted, but beyond that, we also see the broader public health effects. Heat stress triggers various symptoms in people, and it is crucial to recognize that while extreme heat affects everyone, some groups are more vulnerable than others.

For example, pregnant women, individuals with pre-existing health conditions, people with disabilities, and the elderly are more at risk. On a socio-economic level, extreme heat disproportionately impacts agricultural workers, low-income populations, and marginalized communities. These groups are often more exposed to heat and have historically been under-resourced in their capacity to adapt.

### Cool Up:

Could you describe some of the effective mitigating strategies that can be adopted to address the challenges you have mentioned? And what specific strategies have you been working on?

### Hana Abdelatty:

Mitigation is crucial and must be implemented swiftly and on a large scale across the globe. It is also important to note that mitigation and adaptation go hand in hand, and both are needed simultaneously to build resilience. One strategy we have been working on involves urban farming initiatives, in collaboration with the Chennai Resilience Centre in India. This initiative is community-based and provides households with kits to create rooftop gardens.

The goal is twofold: to mitigate extreme heat through increased vegetation and to address food security issues. At the Atlantic Council's Climate Resilience Centre, we mainly focus on adaptation, but we also work with our partners to help reduce carbon emissions, while recognizing the need to support people on the ground.

### Cool Up:

I would like to talk about the healthcare sector. Could you comment on how it needs to adapt to extreme heat and possibly provide sustainable cooling solutions for hospitals? And what role does it play in broader adaptation and mitigation strategies?

### Hana Abdelatty:

The healthcare sector is extremely important in addressing extreme heat. From a mitigation standpoint, it is increasingly important to provide incentives and opportunities for the sector to transition to cleaner energy. For example, promoting the use of heat pumps, renewable energy like solar power, and micro grids to protect facilities from power outages. This is especially crucial in the US, where the healthcare sector accounts for about 10% of the energy consumption of commercial buildings. Therefore, prioritizing mitigation efforts in this sector is essential.

When it comes to adaptation, the healthcare sector is indispensable in responding to extreme heat. In many parts of the world, it is the healthcare system that steps up to build

resilience among vulnerable populations, such as socially isolated individuals, the elderly, and people with disabilities. Healthcare workers often serve as community health ambassadors, checking in on these people during extreme heat events to ensure that they have the resources they need. The sector is also typically on the frontlines as first responders during such events. It is an important sector to prioritize, especially to provide the resources necessary to help build capacity to fight extreme heat.

### Cool Up:

From a global perspective, what do you see as the key milestones we need to achieve in combatting extreme heat?

### Hana Abdelatty:

There have already been some significant milestones this year. For instance, extreme heat is now widely recognized as a major climate risk, with the UN Secretary-General Call to Action on Extreme Heat. National governments across the globe are increasingly prioritizing extreme heat, and this focus has led to the creation of new roles to build capacity and coordinate efforts across different agencies. Currently, we have eight Chief Heat Officers in seven cities that are leading efforts to develop heat-related solutions tailored to the specific needs of their community. We have also seen this role replicated in Los Angeles and a statewide position in Arizona. We hope to see more of these policies emerge worldwide, which will help bolster the global response to extreme heat.







**Responses to extreme heat must always be contextualized, based on the specific regions, as numerous factors – such as age, financial status, cultural context, and existing environmental mitigation strategies – need to be considered when developing strategies. It is essential to co-develop programs that are inclusive and ensure all communities have access to sustainable cooling solutions, so no one is left behind.**

**Cool Up:**

Considering the political, economic, social, and environmental factors that vary between countries, how can mitigation efforts be effectively contextualized for different regions?

**Hana Abdelatty**

That is a crucial point. Responses to extreme heat must always be contextualized, based on the specific regions, as numerous factors – such as age, financial status, cultural context, and existing environmental mitigation strategies – need to be considered when developing strategies. It is essential to co-develop programs that are inclusive and ensure all communities have access to sustainable cooling solutions, so no one is left behind.

For instance, research has shown that globally, women are 60% more likely than men to lack access to cooling, and during heat waves, women are disproportionately relied upon for unpaid domestic labor, which affects their health and

livelihoods. This is just one way we can consider context when creating heat solutions. Taking these intersectional elements into account allows for a more focused and inclusive approach, ensuring that all communities benefit from mitigation efforts.

**Cool Up:**

From your experience, what do you think are the most suitable sustainable cooling technologies or techniques that you might be aware of?

**Hana Abdelatty:**

It really all depends on the context as we were just discussing. A solution that works well in one part of the world might not be as effective in another, so there is no one-size-fits all approach. However, there are some technologies that have proven to be very effective in certain settings.

One example I have researched is cool roofs and green roofs, which have been particularly useful in densely populated urban areas. These solutions help combat the urban heat island effect, where heat gets trapped in cities due to structures like buildings and roads, making them warmer than the surrounding rural areas. Cool and green roofs have been effective in reducing this heat and cooling down cities.

Another impactful technique is increasing green spaces. Growing up in Egypt, I have seen firsthand how the lack of greenery affects people’s perception of heat – what is called thermal comfort. Planting trees and creating more green space can significantly reduce the actual and perceived temperature. Some studies have shown that shading from the trees can reduce temperatures by 10 to 15 degrees Celsius, which is remarkable. This has been proven to be very effective for enhancing comfort and cooling in urban areas.

**Cool Up:**

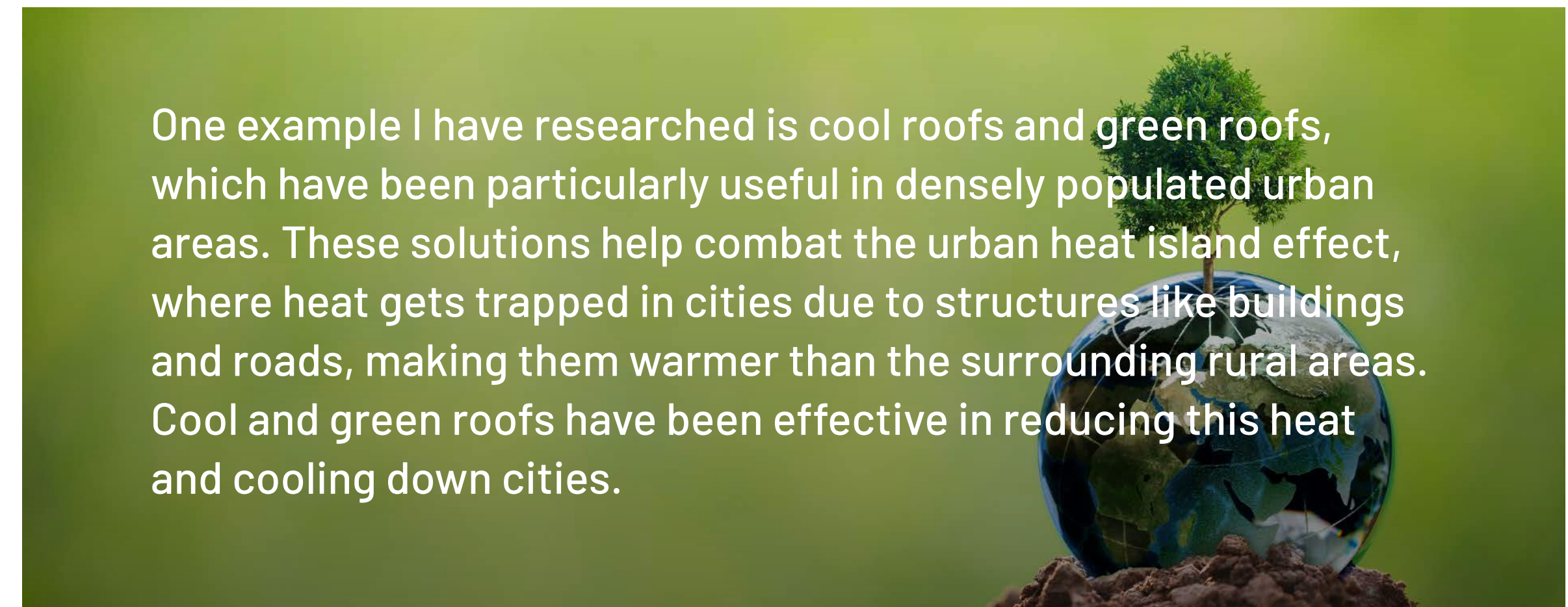
How would you assess the challenges and mitigation strategies related to extreme heat in the MENA region?

**Hana Abdelatty:**

Starting with the challenges, I would say that adaptation needs to be prioritized alongside mitigation. In the MENA region, particularly in the context of urban planning, there has not been enough focus on citywide cooling strategies, such as tree planting and increasing vegetation. This is something that needs to be more fully integrated into the region’s approach to addressing extreme heat.

Another challenge is the need for increased collaboration between national and local government agencies. It would be very beneficial to see more cities and countries in the MENA region implement heat action plans, which would help establish effective short-, medium-, and long-term strategies to deal with heat.

Finally, there is the issue of cultural context and awareness. The MENA region is no stranger to heat, so there is a perception that high temperatures do not significantly affect health.



One example I have researched is cool roofs and green roofs, which have been particularly useful in densely populated urban areas. These solutions help combat the urban heat island effect, where heat gets trapped in cities due to structures like buildings and roads, making them warmer than the surrounding rural areas. Cool and green roofs have been effective in reducing this heat and cooling down cities.





There needs to be more awareness about how heat impacts the body and the potential health risks it poses. Educating people about practical solutions, such as wearing breathable clothing, if you work outside, taking breaks in shaded areas, and staying hydrated, would be extremely valuable.

As for mitigation strategies, the MENA region has shown leadership in adopting some approaches to tackle extreme heat. For instance, the Gulf Cooperation Council has prioritized the transition to clean energy, and there have been significant investments. In Egypt, we have seen the development of the Benban Solar Park, one of the largest in the world. These steps are helping to mitigate the impacts of extreme heat and increase access to sustainable cooling.

#### Cool Up:

You emphasized the importance of collaboration, so how can stakeholders across different sectors – governments, the

private sector, civil society, finance – work together to accelerate the adoption of sustainable cooling solutions?

#### Hana Abdelatty:

That is a very important question. We will not be able to achieve our global heat resilience goals – whether in adaptation or mitigation – without collaboration between public and private stakeholders. One key factor to keep in mind is that there is no one-size-fits-all approach to building resilience to extreme heat. Civil society plays a crucial role in providing information about the specific needs of communities, whether in the MENA region or elsewhere.

Policy makers, based on these community needs, must then create an enabling policy environment that incentivizes the private sector to engage and invest more in sustainable cooling and heat resilience initiatives.

All these stakeholders – government, private sector, civil society – need to work together to foster a collaborative environment.

For instance, the Atlantic Council’s Climate Resilience Centre has been advancing this through our call for collaboration, which was launched at COP28. This initiative encourages the private sector to commit to working with policy makers to increase investment and financing in climate adaptation. This is also timely because our Senior Director Jorge Gastelumendi just published an article on the Atlantic Council’s website highlighting the private sector involvement in making climate resilience strategies financially viable, and ensuring they are actionable and implementable across different regions. We are hoping to see more of this type of collaboration both globally and locally moving forward.

**We will not be able to achieve our global heat resilience goals – whether in adaptation or mitigation – without collaboration between public and private stakeholders.**





# Heat Resilience: Adaptation and mitigation strategies for the region

- 36 Extreme heat mitigation and adaptation strategies for the MENA region
- 39 National and local efforts: Examples of tailored solutions across the region
- 43 International experts comment on the impact of extreme heat and prospects for the region





Adaptation to and mitigation of extreme heat is a complex, multilayered process that requires action at various levels and the involvement of multiple stakeholders. These stakeholders range from governments and policymakers to the private sector, financial institutions, technicians, experts, researchers and the general public. While adaptation measures aim to address the potential effects of extreme heat during its occurrence, mitigation efforts focus on preventing or reducing the frequency of extreme heat events. Adaptation and mitigation strategies are often globally applicable and are frequently the outcome of international negotiations and agreements. However, factors such as income levels, economic conditions, institutional capacities, societal awareness, and governance capabilities influence different countries' abilities to adapt and adjust to complex environmental changes like global warming and extreme heat. In the MENA region, differences in heat adaptation and mitigation strategies are evident not only in the direct and indirect effects of global warming but also in the different political and socio-economic status and associated vulnerabilities within these countries.

Adaptation to extreme heat events can include the development of national or urban heat and cooling action plans. These usually outline coordination of different stakeholders in the case of extreme heat events. Possible actions include issuing heat warnings, bringing awareness and outreach to people, especially vulnerable communities and outdoor workers, preparing and equipping health professionals and institutions, improving people's access to sustainable cooling, and the issuing of special legislations and regulations such as binding thresholds on working hours and work intensity during extreme heat. An accurate and timely response to extreme heat events requires the collection and evaluation of relevant data related to climate, weather, geography, population, health and infrastructure.

The development and implementation of mitigation strategies are essential for fulfilling national and international pledges and commitments aimed at limiting the exposure to extreme heat and addressing global warming. The 1987 Montreal Protocol, its 2016 Kigali Amendment, and the 2016 Paris Agreement are the three essential international commitments addressing global warming and extreme heat. All three global commitments aim to limit greenhouse gases in the atmosphere and support the phase out of ozone-depleting substances (ODS) including chlorofluorocarbons

(CFC), hydrochlorofluorocarbons (HCFC) and hydrofluorocarbons (HFC). A key element in fulfilling these commitments is the deployment and implementation of sustainable cooling solutions, which provide continuous and comprehensive access to cooling without increasing greenhouse gas emissions through the increased use of cooling appliances.

This dual requirement places diverse stakeholders at a critical crossroads; governments, policymakers, urban planners, architects, and companies in the cooling sector must ensure that passive cooling measures are integrated into urban structures, districts, and buildings. In addition, they must develop and enforce regulations for energy efficient buildings and cooling appliances, while fulfilling the commitment to phase out climate-warming gases used in cooling equipment.<sup>84</sup> When stakeholders adopt this triple strategy of passive cooling, higher energy efficiency and fast phase-down of climate-warming refrigerants, it will not only reduce direct and indirect GHG emissions from the cooling sector but also protect approximately 3.5 billion people from extreme heat by 2050. Additionally, it could lead to savings of up to 950 billion EUR for populations and up to 4.75 trillion EUR for the power sector by 2050.<sup>85</sup>

84 UN Environment Programme, "Keeping it chill. How to meet cooling demands while cutting emissions.;" Khosla, "COP28: countries have pledged to cut emissions from cooling – here's how to make it happen."

85 United Nations, "United Nations Secretary General's Call to Action on Extreme Heat."





# Sustainable cooling as strategy to combat extreme heat

## Public sector

**NDCs NAP** Integration of cooling and heat strategies into national and international climate plans and actions

**NCAP** Development of National Cooling Action Plans

**F-GAS REGULATIONS** Adoption of F-Gas regulations

Development of mandatory building codes and regulations to foster sustainable cooling and energy efficiency efforts

Ensure **effective public health** infrastructure with sufficient cooling equipment

Allocate state **financing or financial incentives** to a transition to sustainable cooling

Raising awareness about extreme heat and possible mitigation strategies

## Private sector

Development and marketing of energy efficient ACs, fans, and coolers

Development and usage of chillers working with **natural refrigerants**

Integration of **passive cooling** into building designs

Investment into trainings and **capacity building** on energy-efficiency and sustainability in the RAC sector

Development of public private partnerships to **finance sustainable cooling** technologies

## Finance sector

Development of targeted **finance programs** to finance sustainable cooling technologies/transition

Development of public private partnerships to **finance sustainable cooling technologies**

Allocation of **funds/grants** for sustainable cooling technologies/transition

## Civil Society/ Research centers

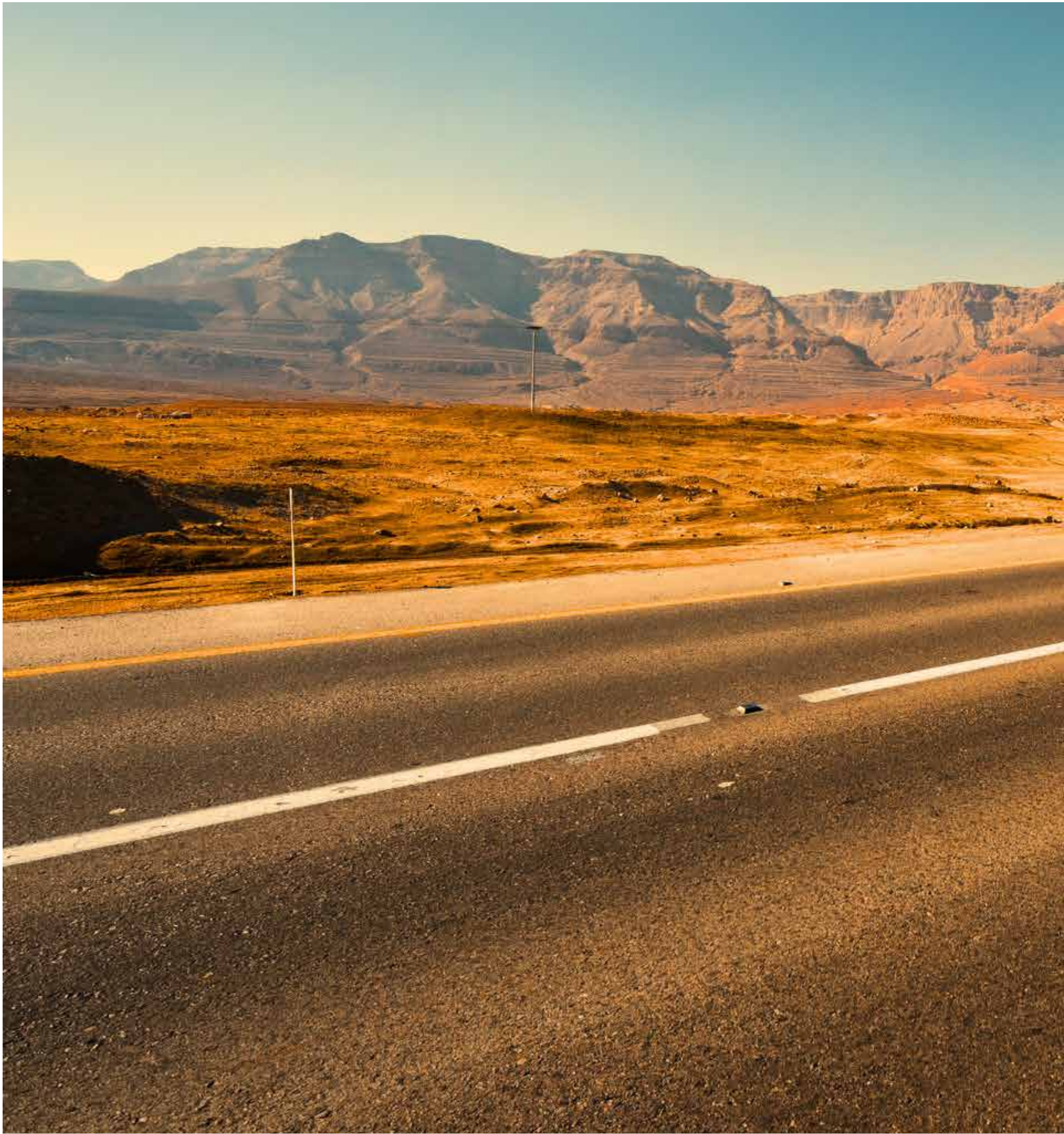
Engage the community on extreme heat adaptation and sustainable cooling adoption

Raise awareness on extreme heat and sustainable cooling

Conduct **vulnerability assessments** for heatwaves in cities and areas

Demand the integration of **passive cooling solutions**





# Extreme heat mitigation and adaptation strategies for the MENA region

Recent years have shown a growing commitment from governments in countries of the MENA region to acknowledge the need to adapt to urgent climate change challenges. The 2016 Paris Agreement requires each participating party to prepare and communicate its Nationally Determined Contribution (NDC), outlining their commitment to reducing greenhouse gas emissions in line with the agreement and detailing the specific actions they plan to take to achieve this goal.<sup>86</sup> 12 countries in the MENA region (Jordan, Morocco, Tunisia, Egypt, Iraq, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and UAE) and Türkiye incorporated cooling commitments in their NDCs and started to implement related programs.<sup>87</sup> Furthermore, Tunisia, Lebanon, the UAE, Türkiye, and Oman have pledged to achieve net-zero emissions by 2050 (2053 for Türkiye) as part of their national climate change strategies. Bahrain, Saudi Arabia, and Kuwait have committed to reaching net-zero emissions by 2060.<sup>88</sup>

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<sup>86</sup> Osman, "Assessing Climate Adaptation Plans in the Middle East and North Africa."

<sup>87</sup> Clean Cooling Collaborative, "Mid-Program Impact Report (2022 - 2024). Setting a Course for Efficient, Climate-Friendly Cooling for All."

<sup>88</sup> Ahmad, "How MENA countries are adapting to and mitigating climate change."





This underscores the need for broader recognition and integration of such risks in adaptation strategies across the region, particularly given the region's vulnerability to extreme heat and arid conditions. As climate impacts intensify, the development and implementation of robust NAPs will remain a cornerstone of regional resilience and sustainability efforts.<sup>90</sup>

**NDCs and NAPs are interconnected, with advancements in one often influencing and enhancing the effectiveness of the other. This synergy is particularly crucial for developing and vulnerable regions, where coordinated efforts are needed to address the dual challenges of mitigation and adaptation.**

The Paris Agreement emphasizes not only the development and periodic updates of Nationally Determined Contributions (NDCs) but also the formulation of National Adaptation Plans (NAPs). NAPs serve as comprehensive blueprints that detail the strategies, programs, and concrete measures a country intends to adopt to mitigate the impacts of climate change and adapt to its consequences. These plans are essential in ensuring that nations are prepared for climate-related challenges and can sustainably manage their resources under changing conditions.

NDCs and NAPs are interconnected, with advancements in one often influencing and enhancing the effectiveness of the other. This synergy is particularly crucial for developing vulnerable regions, where coordinated efforts are needed to address the dual challenges of mitigation and adaptation.

In the MENA region countries have made significant progress in this regard. For instance, Kuwait, Morocco, and Sudan have completed and submitted their NAPs to the United Nations Framework Convention on Climate Change (UNFCCC). Meanwhile, other nations, including Jordan, Egypt, Lebanon, Iraq, Oman, the UAE, and Tunisia, are actively working on their NAPs and aim to finalize them in the near future.<sup>89</sup> Heat-waves have emerged as a pressing climate hazard, highlighted in 14 of the 48 NAPs submitted globally. Within the MENA region, Kuwait's NAP explicitly identifies heat-waves as climate-induced disasters.

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<sup>89</sup> Osman, "Assessing Climate Adaptation Plans in the Middle East and North Africa."

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<sup>90</sup> UNFCCC LDC Expert Group, National Adaptation Plan. Progress in the Formulation and Implementation of NAPs; International Monetary Fund, "Feeling the Heat. Adapting to Climate Change in the Middle East and Central Asia."; *Kuwait National Adaptation Plan*, Environment Public Authority Kuwait



On an urban level, many municipalities and local actors are making increasing efforts to address the urban heat island effect, a term describing the significantly warmer temperatures of cities compared to their rural surroundings. The difference in heat between cities and rural areas is due to several factors, but mainly due to the trapping and storage of heat by urban structures and activities such as tall, closely spaced buildings, building materials, street surfaces, urban canyons, traffic, space heating, industrial activities, air pollution, and reduced wind speed. Many local policy makers increasingly recognize the twofold urgency to neutralize the emissions impact of current cooling needs while enabling access to cooling without contributing to more urban heat in the future. In 2021, the UNEP launched the Sustainable Cooling Handbook for Cities, providing recommendations for comprehensive urban heat island mitigation and adaptation strategies along with a shift to more sustainable cooling while at the same time appealing to cities to take urgent action to implement these recommendations<sup>91</sup>. In line with these efforts, the project “Sustainable Building Climate Control in Europe,” commissioned by the German Environment Agency (Umweltbundesamt) and conducted by Guidehouse Germany GmbH, explores sustainable building climate control in Europe. The project emphasizes the importance of integrating energy-efficient cooling technologies and passive cooling measures to reduce the urban heat island effect. By focusing on innovative solutions such as green roofs, reflective building materials, and enhanced ventilation systems, the project aims to create a more sustainable and comfortable urban environment while mitigating the adverse impacts of climate change.<sup>92</sup>

91 Cool Coalition and UN Environment Programme, *Beating the Heat: A Sustainable Cooling Handbook for Cities*

92 Umweltbundesamt, *Nachhaltige Gebäudeklimatisierung in Europa. Konzepte zur Vermeidung von Hitzeinseln und für ein behagliches Raumklima*


93 Cool Coalition and UN Environment Programme, *Beating the Heat: A Sustainable Cooling Handbook for Cities*

Among the measures outlined in the handbook, which are under the principal or shared responsibility of municipalities, are the realization of a heat-resilient urban design and infrastructure such as the creation of urban green spaces or of cool roofs or green roofs in buildings. Further measure can include the development and implementation of obligatory building codes that ensure the construction of energy- and thermally efficient buildings in a city as well as raising awareness and capacity building to support sustainable cooling, securing funding for sustainable urban cooling measures, and the launching of community-centered initiative to advance heat equity within a city.<sup>93</sup>

**Many local policy makers increasingly recognize the twofold urgency to neutralize the emissions impact of current cooling needs while enabling access to cooling without contributing to more urban heat in the future.**







# National and local efforts by multiple stakeholders: Examples of tailored solutions across the region

A successful transition to sustainable cooling requires different measures and actions. Looking at the adoption of related decisions and the implementation of measures and concrete actions, initiative and collaboration among several stakeholders are needed. In this chapter, the different efforts across the MENA region are categorized into three categories, each being the responsibility of a specific stakeholder group or the collaborative efforts of several stakeholders: 1) the development and adoption of policy measures, decrees, and regulations established by stakeholders such as ministries of environment, energy, or health, as well as municipalities and government agencies; 2) innovation and further development of sustainable cooling solutions in the refrigeration and air-conditioning (RAC) sector led by private sector stakeholders; and 3) awareness and research initiatives conducted by various stakeholders, including political entities, civil society actors, and researchers or research centers.

By looking at tailored solutions across the region, examples of how policy strategies can be implemented and how different stakeholders collaborate will be highlighted.





### Building codes and MEPS – the role of governments and ministries

Heat mitigation and cooling strategies can be included into NDCs, NAPs, and outlined in each country’s NCAP. It is the role of policy makers such as ministries, municipalities and government agencies to implement these strategies in laws, regulations, and decrees. Examples of such laws and regulations are the adoption of building codes or Minimum Energy Performance Standards (MEPS). While the former refer to regulations or requirements for entire residential, commercial or industrial buildings including those related to energy efficiency, ventilation, and water conservation, MEPS are binding regulations, to ensure that individual appliances contribute to energy savings. The stakeholders responsible for the adoption of both regulations are governments and typically ministries responsible for energy, housing, urban development, or environment.

Within the MENA region, Morocco is one example for a country that has included heat mitigation and cooling strategies in its NDCs in 2022. In 2020, the North African nation adopted decree no. 2.20.716, which set minimum energy performance standards (MEPS) for all appliances and equipment running on electricity, natural gas, and liquid or gaseous petroleum products.<sup>94</sup>

Regarding building codes, countries across the MENA region are increasingly recognizing the critical role of sustainable construction and energy efficiency in addressing climate change. Egypt, Tunisia, Jordan, Saudi Arabia, Türkiye, and the emirate states of Dubai, Abu Dhabi, and Ras al Khaimah committed to implementing mandatory building codes and regulations that prioritize sustainability.<sup>95</sup> These commitments can be seen as part of a broader shift towards adopting green building practices that align with international certification standards, ensuring that new developments are not only energy-efficient but also environmentally responsible.

On a regional level, the United Cities and Local Governments Middle East and West Asia Section (UCLG-MEWA), a regional local government association operating in 16 countries with over 250 direct members, aims to incorporate the perspective of the Middle East and West Asia in urban planning discussions to foster collaboration and knowledge exchange among cities, and to ensure that local governments have a voice on international platforms. Within the MEWA section, the UCLG-MEWA Committee on Environment, provides capacity building opportunities to local governments for a green transition, including building capacities for efficient energy use and increasing urban resilience.<sup>96</sup>

These national, regional and collaborative measures and efforts reflect a growing understanding among policy stakeholders of the urgent need to balance economic growth with ecological preservation. By embedding energy efficiency requirements

into building codes, these countries aim to reduce their carbon footprint while fostering innovative solutions for sustainable cooling – an essential adaptation in a region facing rising temperatures and expanding urbanization.



<sup>94</sup> Belkebir, “Building Labelling and Standards in Morocco.”; Clean Cooling Collaborative, “Mid-Program Impact Report (2022 – 2024). Setting a Course for Efficient, Climate-Friendly Cooling for All.”

<sup>95</sup> Shamseldin, “Proposed Role of the Local Saudi Building Codes in Assessing the Energy Performance of Buildings in KSA’s GBRS.”; Government of Dubai, Dubai Electricity & Water Authority, Dubai Municipality, *Green Building Regulations and Specifications*; meetMed, *Energy Efficiency in Buildings*; SolarQuarter, “Turkey Introduces New Energy Efficiency Regulations for Buildings.”; Clean Energy Business Council and Issam Fares Institute for Public Policy and International Affairs, AUB, “Whitepaper: Energy Efficiency in Existing Buildings in the United Arab Emirates: Towards Effective Policies and Regulations.”

<sup>96</sup> UCLG MEWA, United Cities and Local Governments Middle East and West Asia Section



## Sustainable cooling in urban development

In addition to the adoption of regulations and decrees specifying energy efficiency and sustainable cooling measures in buildings and appliances, it is upon urban planners, architects, as well as technicians, manufacturers and suppliers in the RAC sector in collaboration with municipalities and local policy makers to implement building codes and MEPS in concrete urban development and planning.

Within urban planning, the development and implementation of passive cooling measures can significantly and sustainably reduce urban temperatures. These measures include increasing urban greening, installing green roofs and green walls, and using light-colored or reflective materials for streets, sidewalks, and parking lots. Additionally, shading structures can play an important role in mitigating heat.

In buildings, passive cooling elements may involve the use of appropriate materials and design features, such as insulation, energy-efficient windows, and shading devices. Other strategies include utilizing natural ventilation and thermal mass to absorb, store, and release heat effectively.

In the MENA region, traditional architecture has long incorporated natural cooling processes to provide protection against extreme outdoor temperatures. A notable example is the wind tower, or barjeel, historically prevalent in the Gulf region. These structures are designed to release heat from the interior of buildings while funneling cooler, fresh air downward, creating a natural ventilation system. Today, wind towers continue to inspire modern architecture in Gulf countries, where traditional cooling methods are integrated into contemporary building designs. One example is Madinat Jumeirah in Dubai, where wind towers have been constructed to enhance cooling within buildings, blending heritage techniques with modern functionality.<sup>97</sup> Also, cities such as Amman (Jordan) and Tetoutan (Morocco), have integrated sustainable traditional building methods and materials into modern construction, including wind towers or shading techniques.<sup>98</sup>

97 Abhyankar, "Dubai's Wind Towers Are the City's Traditional and Beautiful Way to Beat the Heat."

98 Cities Alliance, *Cities Without Slums: Climate-Proof Cities, Cities for People. Cities Alliance Strategy for the Middle East and North Africa (MENA) Region.*



Many countries in the Gulf region have included technical innovations in sustainable cooling particularly in urban settings, such as the construction of district cooling systems (DC). DC systems involve a centralized plant that supplies cooling to a network of buildings. These systems use large-scale, water-cooled chiller plants that typically consume less energy than conventional cooling systems.<sup>99</sup> Today, the world's largest district cooling plant is installed in Qatar with a DC capacity of 1.2 million tones refrigeration, accounting for 19 percent of total cooling capacity of the country.<sup>100</sup> In July 2024, the Qatar-based Hamad International Airport announced its goal to improve its DC infrastructure, supporting the airport's increasing cooling needs with sustainable cooling solutions.<sup>101</sup> In August 2024, an Abu Dhabi-based DC firm obtained the "Verified Carbon Standard" for one of its Abu Dhabi plants, which prevents approximately 19,320 tons of carbon emissions each year due to savings in electricity consumption. The company is the first DC company globally that reached this standard.<sup>102</sup>

99 Alotaibi and Nazari, "District cooling in the Middle East & North Africa; history, current status, and future opportunities."

100 Zafar, "District Cooling in the Middle East: Potential and Challenges.;" Staff Writer, "Increased district cooling aiding Qatar's sustainability drive."

101 Future Travel Experience. On the Ground, "Hamad International Airport partners with Siemens to pioneer sustainable cooling solutions."

102 Al Helou, "Abu Dhabi's Tabreed achieves carbon verification, reducing emissions by 19,320 tons annually."

**In buildings, passive cooling elements may involve the use of appropriate materials and design features, such as insulation, energy-efficient windows, and shading devices. Other strategies include utilizing natural ventilation and thermal mass to absorb, store, and release heat effectively.**





### Raising awareness on extreme heat and the potential of sustainable cooling

The vicious cycle of extreme heat, its associated risks, and the resulting surge in cooling demands necessitates the generation and accessibility of both general and context-specific knowledge and data. This includes raising awareness about potential mitigation and adaptation strategies and solutions. A comprehensive transition to sustainable cooling can only succeed if this knowledge and awareness are widely available and effectively disseminated. In the MENA region, stakeholders such as policy makers, local and international civil society actors, as well as research centers have made efforts to raise awareness about the challenges and impacts of extreme heat as well as possible mitigation and adaptation strategies.

In Greater Amman, Jordan, the municipality has conducted evidence- and scientific-based, district-level vulnerability assessments for heatwaves in the city, starting in 2022, with the aim to design and prioritize adaptation projects and allocate budgets for localized climate change interventions.<sup>103</sup> Many Gulf nations such as the UAE, Saudi Arabia, Qatar, Kuwait, and Oman are taking steps to protect outdoor

<sup>103</sup> Halaseh, "Assessing Climate Vulnerabilities in Amman City."

laborers from the increasing risks of extreme heat. These include not only policies like midday work bans for outdoor workers during summer months but also targeted information and education campaign for migrant workers on how to manage heat street in the workplace.<sup>104</sup> In Lebanon, the International Federation of Red Cross organizes regular in-person and online awareness campaign about the impacts of extreme heat during summer months.<sup>105</sup>

In addition to mandatory building codes, research organizations such as BRE (Building Research Establishment) have developed a method to evaluate the environmental, social, and economic sustainability performance of buildings, encouraging sustainable considerations and practices in building construction and use. BREEAM (Building Research Establishment Environmental Assessment Method) rates, among other features, the energy efficiency and reduction of energy use of the building. In the MENA region, the building complex Kanyon in Istanbul, Türkiye has obtained a BREEAM rating of 'outstanding' in 2016, among others since the combination of a heat recovery system in fresh air units, efficient cooling systems and the widespread provision of daylighting, reduces energy consumption in the building by 45%.<sup>106</sup> Another example in the MENA region is the Al Zahia compound in the Sharjah Emirate, that used BREEAM Communities certification to measure ecological, health and wellbeing and other factors to great effect. The development achieved a rating of 'very good'.<sup>107</sup>

Furthermore, the BUILD\_ME project conducted by Guidehouse Germany GmbH has introduced the Building Energy Performance (BEP) Tool, specifically designed for the MENA region. This free software tool allows users to calculate the overall energy performance of buildings and the cost-effectiveness of energy efficiency measures.

By considering local climatic conditions and building specifications, the BEP Tool provides a comprehensive analysis of energy demand and potential savings, supporting sustainable building practices in the region.<sup>108</sup>

<sup>104</sup> *Mastering Heat Stress: A Joint OSH Campaign of BWI and Qatar Ministry of Labour*, BWI (Building and Wood Workers' International)

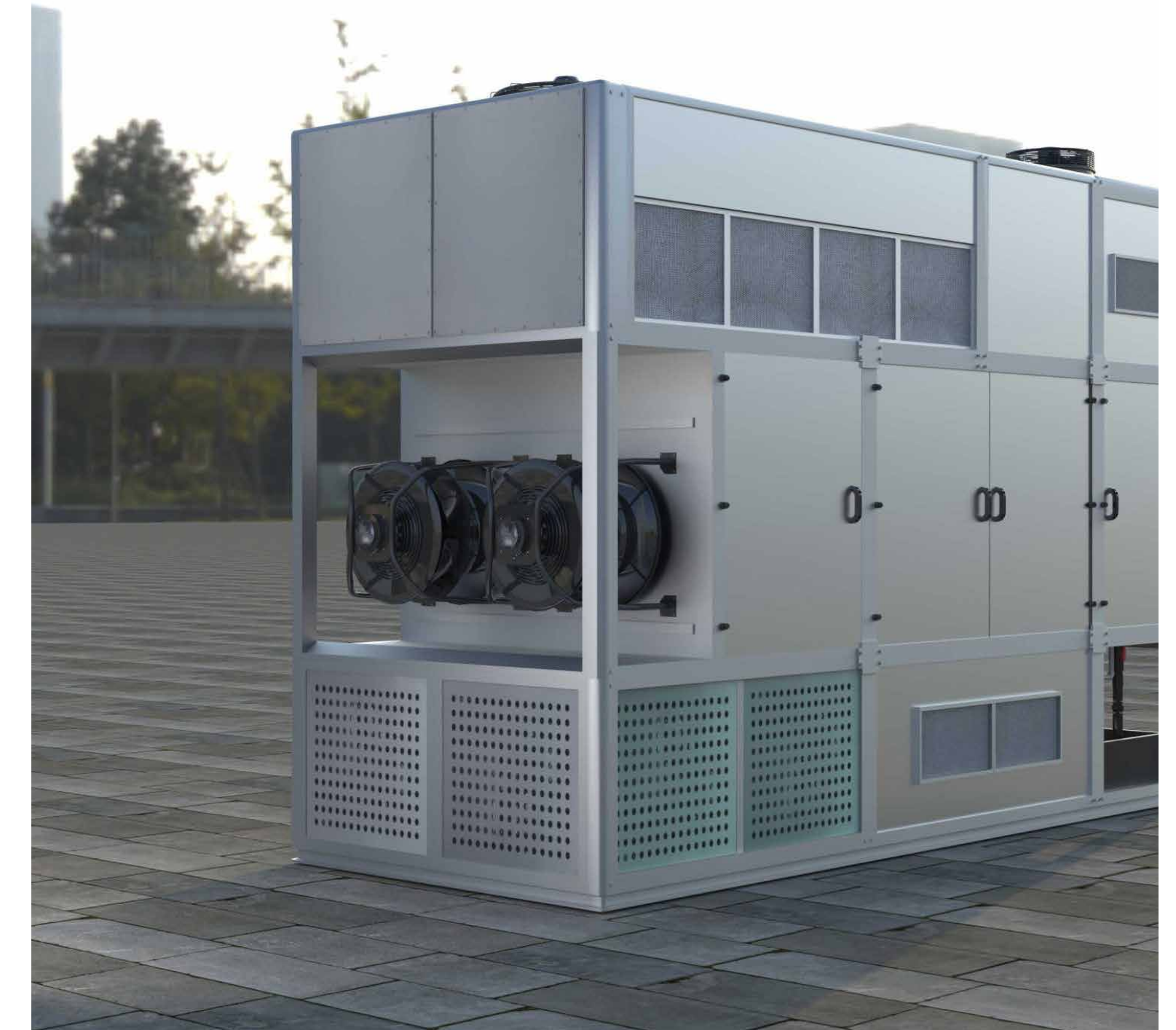
<sup>105</sup> IFRC, "Taking action on heat: Getting ahead of extreme heat by taking their message to the street."

<sup>106</sup> *BRE Group Kanyon First Breeam Outstanding Award Turkey*, BRE Group

<sup>107</sup> *Al Zahia is a milestone community in the Emirate of Sharjah*, UAE, BRE Group

<sup>108</sup> *Building Energy Performance Tool*, BUILD\_ME

The examples above demonstrate not only that interest in sustainable cooling is growing among stakeholders in the MENA region, with efforts increasingly being initiated by these parties, but also that a transition to sustainable cooling requires the facilitation and implementation of a wide variety of measures and action. It is within this comprehensive, integrated approach that a successful transition to sustainable cooling can be reached.



Countries in the Gulf region are currently at the forefront in the MENA region when it comes to assessing innovative approaches to sustainable cooling particularly in urban settings.





# International experts comment on the impact of extreme heat and prospects for the region

The escalating impacts of extreme heat and climate change pose significant challenges to the MENA region and Türkiye, necessitating innovative solutions and global collaboration. With rising temperatures exacerbating water scarcity, desertification, and economic instability, sustainable cooling technologies have become an essential focus.

In this context, experts from diverse backgrounds share insights into the urgent need for targeted policies, cross-sectoral cooperation, and actionable strategies to mitigate the risks and build resilience. Their perspectives underscore the importance of phasing out harmful substances, enhancing energy efficiency, and prioritizing affordable, sustainable cooling solutions tailored to the region's unique vulnerabilities.





“As extreme heat rises in its intensity, frequency and duration, sustainable cooling has become integral for maintaining the wellbeing of people in every corner of the world.

In 2016, the world committed to phasing out planet-warming hydrofluorocarbons through the Kigali amendment to the Montreal protocol. Taking our current commitments further – particularly implementing faster phase out of hydrofluorocarbons, passive cooling technologies, and higher energy efficiency of cooling equipment is necessary to reach a zero-emissions cooling future.”

**Dr Radhika Khosla**

Associate Professor at the Smith School of Enterprise and Environment, University of Oxford



“The Middle East is particularly susceptible to the adverse effects of heating and climate change, which can exacerbate water scarcity, desertification, and extreme weather events. These issues present significant societal

challenges, including food and water security, public health risks, and economic disruptions. Innovative solutions such as sustainable cooling technologies that are affordable are crucial to mitigate the impact of rising temperatures and ensure a sustainable future for the region.”

**Neeshad V. Shafi**

Co-founder and Executive Director, Arab Youth Climate Movement Qatar



“Addressing the challenges posed by extreme heat requires a coordinated effort that spans across multiple sectors, including the engagement of policymakers, the private sector, and financial institutions.

It is crucial that we prioritize gathering targeted data to provide decision-makers with the evidence they need, promote cross-country knowledge sharing and develop actionable strategies on urban planning as well as urban heating and cooling. This is why institutions like the World Bank emphasize data-driven, practical approaches that focus on sustainable and resilient cooling solutions.”

**Adeel Abbas Syed**

Regional Coordinator, Climate Change, Middle East & North Africa, The World Bank





# Closing thoughts



# The time to act is now

The increasing challenges posed by extreme heat and its far-reaching consequences require urgent and coordinated action across all sectors. Sustainable cooling solutions based on the use of natural refrigerants offer a unique opportunity to address these challenges while promoting environmental sustainability and public health. The Middle East and North Africa region is at a critical inflection point where proactive action can either mitigate the devastating impacts of climate change or, if delayed, exacerbate vulnerabilities.

It is essential for governments, industries, and communities to prioritize the development and implementation of energy-efficient cooling systems that rely on eco-friendly technologies. Policymakers must integrate sustainable cooling strategies into national frameworks, supported by robust regulations and incentives. At the same time, private-sector innovation in natural refrigerants and green cooling solutions can revolutionize the market, creating a ripple effect of positive environmental and economic outcomes.

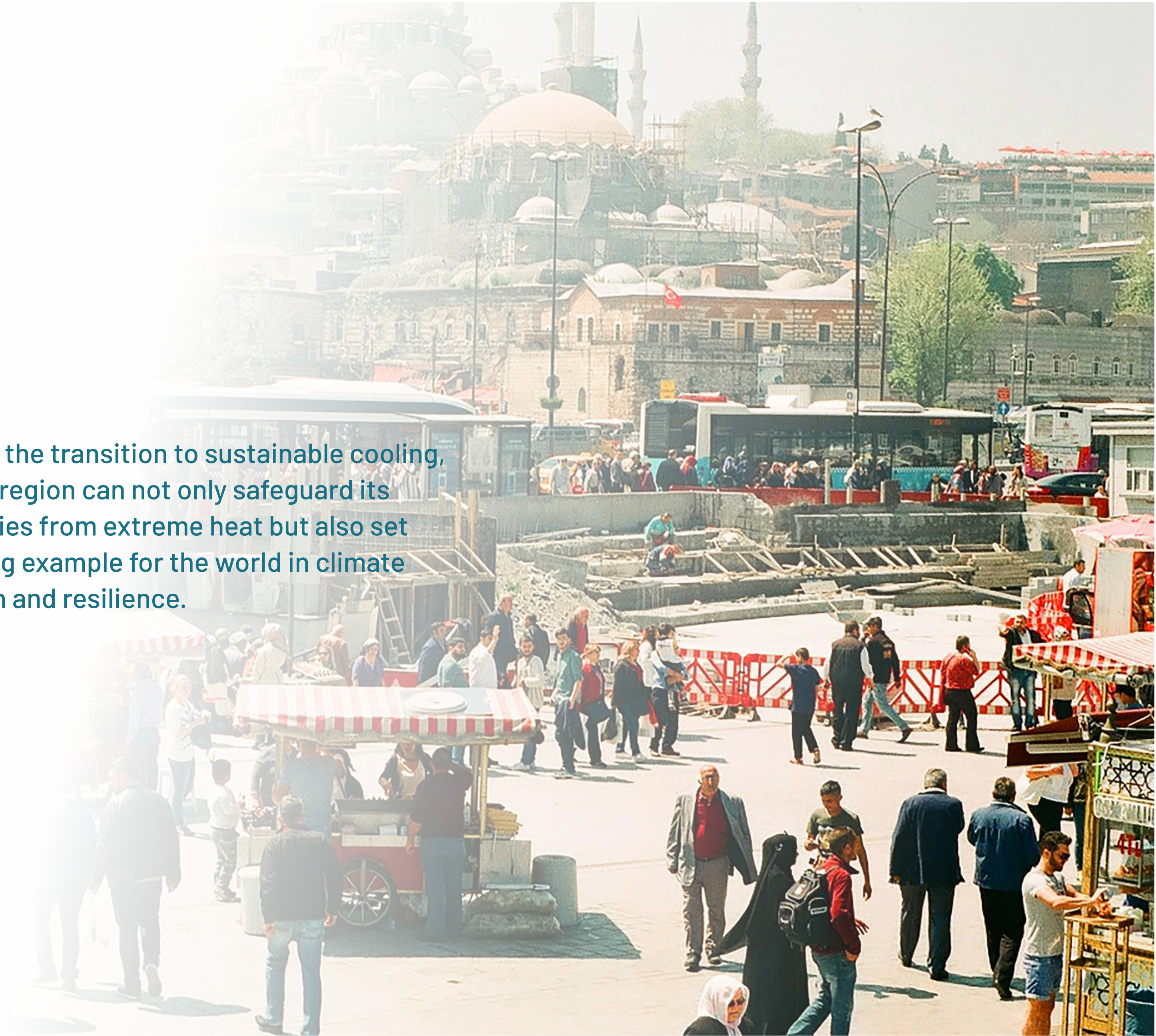
Amidst the escalating challenges posed by extreme heat, our focus on promoting sustainable cooling in the MENA region and Türkiye has never been more critical. As temperatures continue to rise, sustainable cooling is no longer a luxury—it is a necessity. The path forward requires collaboration, investment, and unwavering commitment to scalable solutions that balance human well-being with environmental stewardship. By leading the transition to sustainable cooling, the region can not only safeguard its communities from extreme heat but also set an inspiring example for the world in climate adaptation and resilience. The time to act is now.



*A. Pohl*

**Alexander Pohl**  
Communications Lead, Cool Up programme

By leading the transition to sustainable cooling, the MENA region can not only safeguard its communities from extreme heat but also set an inspiring example for the world in climate adaptation and resilience.





# References

Abhyankar, Shoma. "Dubai's Wind Towers Are the City's Traditional and Beautiful Way to Beat the Heat." Matador Network. 21 June 2021. <https://matadornetwork.com/read/dubais-wind-towers-citys-traditional-beautiful-way-beat-heat/>.

"About MLF." Multilateral Fund for the Implementation of the Montreal Protocol. Accessed on 2 December 2024. <https://www.multilateralfund.org/about>.

Ahmad, Yasir. "How MENA Countries Are Adapting to and Mitigating Climate Change." EY Shape the Future with Confidence, 24 January 2023. [https://www.ey.com/en\\_ly/services/climate-change-sustainability-services/how-mena-countries-are-adapting-to-and-mitigating-climate-change](https://www.ey.com/en_ly/services/climate-change-sustainability-services/how-mena-countries-are-adapting-to-and-mitigating-climate-change).

Alami, Aida. "How Morocco Went Big on Solar Energy." BBC, 19 November 2021. <https://www.bbc.com/future/article/20211115-how-morocco-led-the-world-on-clean-solar-energy>.

Al Fahaam, Tariq and Muhammad Aamir. "UAE Issues Decree on Regulation of Hydrofluorocarbons." Zawya by LSEG, 15 May 2023. <https://www.zawya.com/en/legal/regulations/uae-issues-decree-on-regulation-of-hydrofluorocarbons-nejln4br>.

Al Helou, Elias. "Abu Dhabi's Tabreed achieves carbon verification, reducing emissions by 19,320 tons annually." Middle East Economy. 29 August 2024. <https://economymiddleeast.com/news/abu-dhabis-tabreed-achieves-carbon-verification-reducing-emissions/>.

"AL Refrigeration Compressor." Tecsumeh. Accessed on 2 December 2024. <https://www.tecumseh.com/Products/AllProductFamilies/AL>.

Alotaibi, Sorour and Mohammad Alhuyi Nazari. "District Cooling in the Middle East & North Africa: History, Current Status, and Future Opportunities." Journal of Building Engineering 77 (15 October 2023). <https://www.sciencedirect.com/science/article/abs/pii/S2352710223017023>.

Arkeh, Joe and Amr Hamzawy. "Climate Change in the Middle East and North Africa: Mitigating Vulnerabilities and Designing Effective Policies." Carnegie Endowment for International Peace. 20 June 2024. <https://carnegieendowment.org/research/2024/06/climate-middle-east-north-africa-vulnerability>.

Barbara, Laia and Ameya Hadap. "COP29: Why it matters and four key areas for action." World Economic Forum. 12 August 2024. <https://www.weforum.org/stories/2024/08/what-is-cop29-climate-change-summit-priorities/>.

Bawaresh, Sawsan et al. "National Cooling Strategy of Jordan. Priority interventions to address Jordan's growing cooling needs." Ministry of Environment 2024. [https://www.moenv.gov.jo/ebv4.0/root\\_storage/en/eb\\_list\\_page/national\\_cooling\\_strategy\\_of\\_jordan\\_finalest.pdf](https://www.moenv.gov.jo/ebv4.0/root_storage/en/eb_list_page/national_cooling_strategy_of_jordan_finalest.pdf).

Belkebir, Nada. 2023. "Building Labelling and Standards in Morocco." MeetMed Week. May 2023. [https://meetmed.org/wp-content/uploads/2023/09/08\\_D3\\_meetMED-WEEK\\_Session-CA-Buildings\\_BELKEBIR.pdf](https://meetmed.org/wp-content/uploads/2023/09/08_D3_meetMED-WEEK_Session-CA-Buildings_BELKEBIR.pdf).

Bhatia, Neha. "What VRF Air-Conditioning Means for the Middle East?" Construction Week Middle East, 2 September 2018. <https://www.constructionweekonline.com/business/article-50135-what-vrf-air-conditioning-tech-means-for-the-middle-east>.

Bolle, Isabelle. "In the Middle East, temperatures are soaring. Will the region remain habitable?" Fanack Water. Water of the Middle East and North Africa, 15 June 2024. <https://water.fanack.com/in-the-middle-east-temperatures-are-soaring-will-the-region-remain-habitable/>.

"BRE Group Canyon First Breeam Outstanding Award Turkey." BRE Group. N.D. Accessed on 28 October 2024. <https://bregroup.com/case-studies/kanyon-first-breeam-outstanding-award-turkey>.

"Building Energy Performance Tool." BUILD\_ME. N.D. Accessed on 28 October 2024. <https://www.buildings-mena.com/info/building-energy-performance-tool>.

Carlson, Colin J. et al. "Climate change increases cross-species viral transmission risk." Nature 607 (28 April 2022). <https://www.nature.com/articles/s41586-022-04788-w>.

Central Bank of Jordan. "Green Finance Strategy. 2023-2028." 2023. [https://www.cbj.gov.jo/EN/Pages/Green\\_Finance\\_Strategy](https://www.cbj.gov.jo/EN/Pages/Green_Finance_Strategy).

Cities Alliance. "Climate-Proof Cities, Cities for People. Cities Alliance Strategy for the Middle East and North Africa (MENA) Region." 2024. [https://www.citiesalliance.org/sites/default/files/2024-01/climate-proof\\_cities\\_cities\\_for\\_people\\_cities\\_alliance\\_2023.pdf](https://www.citiesalliance.org/sites/default/files/2024-01/climate-proof_cities_cities_for_people_cities_alliance_2023.pdf).

Clean Cooling Collaborative. "Mid-Program Impact Report (2022 - 2024). Setting a Course for Efficient, Climate-Friendly Cooling for All." August 2024. <https://www.cleancoolingcollaborative.org/report/clean-cooling-collaborative-mid-program-impact-report/>.

Clean Energy Business Council and Issam Fares Institute for Public Policy and International Affairs, AUB. "Whitepaper: Energy Efficiency in Existing Buildings in the United Arab Emirates: Towards Effective Policies and Regulations." 2024. <https://engiemiddleeast.com/resources/whitepaper-energy-efficiency-in-existing-buildings-in-the-united-arab-emirates/>.

Cool Coalition et al. "Cooler Finance: Mobilizing Investment for the Developing World's Sustainable Cooling Needs." 2024. <https://www.unep.org/resources/publication/cooler-finance-mobilizing-investment-developing-worlds-sustainable-cooling>.

Cool Up. "Kick-off of Egypt's National Cooling Action Plan." 21 May 2024. <https://www.coolupprogramme.org/knowledge-base/news/kick-off-of-egypts-national-cooling-action-plan/>.

Cool Up. "MENA Region Cooling Status Report: Progress, Opportunities, and Insights, Issue 2." 2023. <https://www.coolupprogramme.org/knowledge-base/reports/mena-region-cooling-status-report-issue-2/>.

Cool Up. "Cooling Sector Prospects Study Jordan. Energy and emission saving potential up to 2050 in the refrigeration and air conditioning sector." 2023. <https://www.coolupprogramme.org/knowledge-base/reports/cooling-sector-prospects-study-jordan/>.

Cool Up. "Cooling Sector Prospects Study Lebanon." 2023. <https://www.coolupprogramme.org/knowledge-base/reports/cooling-sector-prospects-study-lebanon/>.

Cool Up. "Cooling Sector Prospects Study Egypt. Energy and emission saving potential up to 2050 in the refrigeration and air conditioning sector." 2023. [https://www.coolupprogramme.org/wp-content/uploads/2023/03/Cool-Up\\_Cooling-Sector-Prospects-Study-Egypt.pdf](https://www.coolupprogramme.org/wp-content/uploads/2023/03/Cool-Up_Cooling-Sector-Prospects-Study-Egypt.pdf).

Cool Up. "Thematic group meeting in Türkiye: Launch of NCAP by Climate Change Directorate." 7 June 2023. <https://www.coolupprogramme.org/knowledge-base/events/launch-of-national-cooling-action-plan-in-turkiye/>.

Cool Up. "MENA Region Cooling Status Report: Progress, Opportunities, and Insights. Issue 1." 2022. <https://www.coolupprogramme.org/knowledge-base/reports/mena-region-cooling-status-report-issue-1/>.

Cool Up. "Regulatory Analysis Egypt: Analysis and recommendation for the regulatory and policy instruments governing the RAC sector." 2022. <https://www.coolupprogramme.org/knowledge-base/reports/regulatory-analysis-egypt/>.



Cool Up. "Adopting sustainable RAC technologies in MENA and Türkiye." Snapshot. N.D. <https://www.coolupprogramme.org/knowledge-base/snapshots/shaping-a-cool-tomorrow-adopting-sustainable-rac-technologies-in-mena-and-turkiye/>.

COP28. "Global Cooling Pledge for COP28." Accessed on 27 October 2024. <https://www.cop28.com/en/global-cooling-pledge-for-cop28>.

"COP28 UAE Leaders' Declaration on a Global Climate Finance Framework." COP28 UAE. 2023. Accessed on 2 December 2024. [https://www.cop28.com/en/climate\\_finance\\_framework](https://www.cop28.com/en/climate_finance_framework).

Costello, Anthony et al. "Managing the health effects of climate change." *Lancet* 383 (16 May 2009). <https://pubmed.ncbi.nlm.nih.gov/19447250/>.

"Country Data. All ratifications." UNEP. Accessed on 2 December 2024. <https://ozone.unep.org/all-ratifications>.

Dargin, Justin. "Beyond 'Green Pledges': Saudi Arabia and Society-Centered Climate Reforms." Carnegie Endowment, 6 July 2023. <https://carnegieendowment.org/posts/2023/07/climate-change-and-vulnerability-in-the-middle-east?lang=en#sa>.

"Demonstration projects database." Build\_Me. Accessed on 2 December 2024. <https://www.buildings-mena.com/info/demonstration-projects-database>.

"Energy Efficiency." GEF Topics. Accessed on 28 October 2024. <https://www.thegef.org/what-we-do/topics/energy-efficiency>.

Environmental Coalition on Standards. "Blueprint for an F-Gas-Free Future: The EU's New F-Gas Regulation." 2024. <https://ecostandard.org/publications/blueprint-for-an-f-gas-free-future/>.

Environment Public Authority Kuwait, "Kuwait National Adaptation Plan." 2019. Accessed on 28 October 2024. <https://unfccc.int/sites/default/files/resource/Kuwait-NAP-2019-2030.pdf>.

"EU-Rules: Guidance on the EU's F-gas Regulation and its legal framework." European Commission. N.D. Accessed on 2 December 2024. [https://climate.ec.europa.eu/eu-action/fluorinated-greenhouse-gases/eu-rules\\_en](https://climate.ec.europa.eu/eu-action/fluorinated-greenhouse-gases/eu-rules_en).

Eveloy, Valerie and Dereje S. Ayou. "Sustainable District Cooling Systems: Status, Challenges, and Future Opportunities, with Emphasis on Cooling-Dominated Regions." *Energies* 12.2 (13 January 2019). <https://www.mdpi.com/1996-1073/12/2/235>.

Farhan, Anum, Suzannah Sherman, and Lisa Toremark, "Heatwaves, Extreme Heat, and Climate Change." Chatham House, 13 August 2024. <https://www.chathamhouse.org/2024/08/heatwaves-extreme-heat-and-climate-change>.

Friess, Wilhelm A. and Kambiz Rakhshan. "A Review of Passive Envelope Measures for Improved Building Energy Efficiency in the UAE." *Renewable and Sustainable Energy Reviews* 72 (2017). <https://www.sciencedirect.com/science/article/abs/pii/S136403211730045X>.

Garry, Michael. "Middle East's First Transcritical System Is an Energy Saver." *Natural Refrigerants News & Marketplace*, 30 October 2020. <https://naturalrefrigerants.com/middle-east-jordan-first-transcritical-system-is-an-energy-saver/>.

Gastelumendi, Jorge. "The private sector is stepping up on climate resilience. Now governments need to be willing partners." *New Atlanticist*. 24 September 2024. <https://www.atlanticcouncil.org/blogs/new-atlanticist/the-private-sector-is-stepping-up-on-climate-resilience-now-governments-need-to-be-willing-partners/>.

"GEF deploys additional high-impact climate adaptation funding." *GEF News*, 8 February 2024. Accessed on 2 December 2024. <https://www.thegef.org/newsroom/news/gef-deploys-additional-high-impact-climate-adaptation-funding>.

"Global greenhouse gas emissions from the RAC sector." Green Cooling Initiative. Accessed on 27 October 2024. <https://www.green-cooling-initiative.org/country-data>.

Government of Dubai, Dubai Electricity & Water Authority, Dubai Municipality. "Green Building Regulations and Specifications." 2018. [https://www.dm.gov.ae/wp-content/uploads/2018/01/05\\_ENG\\_DCL\\_LawsLegislation\\_EngineeringSection\\_GreenBuildingRegulation.pdf](https://www.dm.gov.ae/wp-content/uploads/2018/01/05_ENG_DCL_LawsLegislation_EngineeringSection_GreenBuildingRegulation.pdf).

"Greenhouse Gas Emissions Statistics, 1990–2021." Turkish Statistical Institute. Accessed 27 October 2024. <https://data.tuik.gov.tr/Bulten/Index?p=Greenhouse-Gas-Emissions-Statistics-1990-2021-49672&dil=2>.

Greenpeace Research Laboratories. "Living on the Edge. The implications of climate change for six countries in the Middle East North Africa region." Greenpeace, 2 November 2022. <https://www.greenpeace.org/static/planet4-mena-stateless/2022/11/b57fcf2f-greenpeace-living-on-the-edge-full-english.pdf>.

"Green Riyadh Project". Royal Commission for Riyadh City. N.D. Accessed on 28 October 2024. <https://www.rcrc.gov.sa/en/projects/green-riyadh-project>.

Hajat, Shakoor et al. "Current and future trends in heat-related mortality in the MENA region: a health impact assessment with bias-adjusted statistically downscaled CMIP6 (SSP-based) data and Bayesian inference." *The Lancet Planetary Health* 7.4. (April 2023). [https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196\(23\)00045-1/fulltext](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(23)00045-1/fulltext).

Halaseh, Reem. "Assessing Climate Vulnerabilities in Amman City." Carnegie Endowment for International Peace. 23 May 2024. <https://carnegieendowment.org/research/2024/05/amman-jordan-climate-vulnerability-adaptation>.

"Hamad International Airport partners with Siemens to pioneer sustainable cooling solutions." *Future Travel Experience*. On the Ground. July 2024. <https://www.futuretravelexperience.com/2024/07/hamad-international-airport-partners-with-siemens-to-pioneer-sustainable-cooling-solutions/>.

Hassan, Afif Akel et al. "A review of solar thermal cooling technologies in selected Middle East and North African countries." *Sustainable Energy Technology and Assessments* 54 (December 2022). <https://www.sciencedirect.com/science/article/abs/pii/S2213138822009195>.

Hausfather, Zeke. "State of the Climate: 2024 now very likely to be warmest year on record." *Carbon Brief*. 24 July 2024. <https://www.carbonbrief.org/state-of-the-climate-2024-now-very-likely-to-be-warmest-year-on-record/>.

Hayley Skirka and Evelyn Lau. "Top 14 hottest places on Earth from Tunisia to Kuwait, as heatwaves sweep much of the world." 22 June 2024. <https://www.thenationalnews.com/travel/2024/06/22/hottest-places-on-earth-heatwave-summer-2024/>.

"Heat and Health." World Health Organization. 28 May 2024. Accessed on 28 October 2024. <https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health>.

"Heat & Health." Global Heat Health Information Network. N.D. Accessed on 28 October 2024. <https://ghhin.org/heat-and-health/>.

Hines, Michael. "The UAE Ratifies the Kigali Amendment." *Natural Refrigerants News & Marketplace*, 26 April 2024. <https://naturalrefrigerants.com/the-uae-ratifies-the-kigali-amendment/>.

Human Rights Watch. "I Will Live As Long As Dialysis Lets Me.' Migrant Workers Bear the Brunt of UAE's Extreme Heat." 2023. <https://www.hrw.org/video-photos/interactive/2023/11/21/migrant-workers-bear-the-brunt-of-uae-extreme-heat>.

Ibrahim, Imad Antoine. "The Impact of Climate Change on Health in the MENA Region". *gLAWcal*. N.D. <http://www.glawcal.org.uk/news/the-impact-of-climate-change-on-health-in-the-mena-region>.



IFRC. "Taking action on heat: Getting ahead of extreme heat by taking their message to the street." 07 June 2024. <https://www.ifrc.org/article/taking-action-heat-getting-ahead-extreme-heat-taking-their-message-streets>.

"Integrated District Cooling Plant (IDCP)." Global District Energy Climate Awards. 2013. Accessed on 27 October 2024. <https://www.districtenergyaward.org/integrated-district-cooling-plant-idcp/>.

International Finance Corporation. "Press Release: \$8 Trillion Opportunity in Sustainable Cooling Solutions for Developing Economies – IFC and UNEP Report." 25 September 2024. <https://www.ifc.org/en/pressroom/2024/8-trillion-opportunity-in-sustainable-cooling-solutions-for-developing-economies>.

International Labour Organization. "Heat at Work: Implications for Safety and Health. A Global Review of the Science, Policy and Practice." 2024. [https://www.ilo.org/sites/default/files/2024-07/ILO\\_OSH\\_Heatstress-R16.pdf](https://www.ilo.org/sites/default/files/2024-07/ILO_OSH_Heatstress-R16.pdf).

International Labour Organisation. "Working on a warmer planet. The impact of heat stress on labour productivity and decent work." 2019. [https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms\\_711919.pdf](https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_711919.pdf).

International Monetary Fund. "Feeling the Heat. Adapting to Climate Change in the Middle East and Central Asia." IMF Middle East and Central Asia Department. Department Paper. March 2022. <https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2022/03/25/Feeling-the-Heat-Adapting-to-Climate-Change-in-the-Middle-East-and-Central-Asia-464856>.

Kilani, Hazar. "Behind the Skyscrapers: What Makes Lusail City So Special?" Doha News, 31 October 2022. <https://dohanews.co/behind-the-skyscrapers-what-makes-lusail-city-so-special/>.

Khosla, Radhika. "COP28: countries have pledged to cut emissions from cooling – here's how to make it happen." The Conversation. 23 December 2023. <https://theconversation.com/cop28-countries-have-pledged-to-cut-emissions-from-cooling-heres-how-to-make-it-happen-219630>.

"Lusail City District Cooling/Lusail City, Qatar." Global District Energy Climate Awards. 2017. Accessed on 27 October 2024. <https://www.districtenergyaward.org/lusail-city-district-cooling/>.

"Mastering Heat Stress: A Joint OSH Campaign of BWI and Qatar Ministry of Labour." BWI (Building and Wood Workers' International). N.D. Accessed on 28 October 2024. <https://www.bwint.org/cms/mastering-heat-stress-a-joint-osh-campaign-of-bwi-and-qatar-ministry-of-labour-3146>.

meetMed. "Energy Efficiency in Buildings." Medener and RCREEE. 2020. [https://meetmed.org/wp-content/uploads/2022/02/MeetMED\\_EE-in-Buildings.pdf](https://meetmed.org/wp-content/uploads/2022/02/MeetMED_EE-in-Buildings.pdf).

MEP Staff. "Technical knowhow essential for VRF systems, says MEP contractor." Mechanical Electrical Plumbing Middle East, 28 August 2018. <https://www.mepmiddleeast.com/people/71283-there-is-a-lack-of-understanding-among-people-for-vrfs-systems-says-mep-contractor>.

Moneer, Zeina. "Climate-smart cities in the MENA region: Promise and pitfalls." Middle East Institute, 4 June 2024. <https://www.mei.edu/publications/climate-smart-cities-mena-region-promise-and-pitfalls>.

Osman, Saber. "Assessing Climate Adaptation Plans in the Middle East and North Africa". Carnegie Endowment for International Peace. 15 April 2024. <https://carnegieendowment.org/research/2024/04/assessing-climate-adaptation-plans-in-the-middle-east-and-north-africa>.

"Overview of Greenhouse Gases." United States Environmental Protection Agency. Last updated 11 April 2024. Accessed on 2 December 2024. <https://www.epa.gov/ghgemissions/overview-greenhouse-gases>.

Pradeep, Anghita. "The Middle East's hidden sustainable building gems: Everything you need to know". Construction Week Middle East, 4 June 2023. <https://www.constructionweekonline.com/analysis/the-middle-east-s-hidden-sustainable-building-gems-everything-you-need-to-know>.

"Program Sustainable Cooling." International Finance Corporation. Accessed on 28 October 2024. <https://www.ifc.org/en/what-we-do/sector-expertise/climate-business/addressing-climate-challenges-in-key-sectors/sustainable-cooling>.

"Project Saudi Green Initiative." Vision 2030. Kingdom of Saudi Arabia. N.D. Accessed on 28 October 2024. <https://www.vision2030.gov.sa/en/explore/projects/saudi-green-initiative>.

"Promoting Carbon Reduction Through Energy Efficiency (EE) Techniques in Baghdad City." GEF Projects & Operations. Accessed on 28 October 2024. <https://www.thegef.org/projects-operations/projects/10392>.

Provenzani, David. "Ancient Architectural Techniques in the GCC and the Importance of Natural Cooling: Learning from the Past." LinkedIn, 11 June 2024. <https://www.linkedin.com/pulse/ancient-architectural-techniques-gcc-importance-david-provenzani-kc7jf>.

Randazzo, Teresa, Enrica de Clan, and Malcolm N. Mistry. "Air Conditioning and electricity expenditure: The role of climate in temperate countries." Economic Modelling Vol. 90 (August 2020). <https://www.sciencedirect.com/science/article/pii/S0264999319308168>.

Republic of Tunisia. "Updated Nationally Determined Contribution (NDC) Tunisia." October 2021. <https://unfccc.int/sites/default/files/NDC/2022-08/CDN%20-%20Updated%20-english%20version.pdf>.

RFI. "Saudi delivery drivers bake in 'deadly' summer heat." 7 August 2024. <https://www.rfi.fr/en/middle-east/20240807-saudi-delivery-drivers-bake-in-deadly-summer-heat>.

Roncarolo, Frederico et al. "What do we know about the needs and challenges of health systems? A scoping review of the international literature." BMC Health Services Research 17, 636 (2017). <https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-017-2585-5>.

Saab, Mario. "What does the 6th IPCC report mean for the MENA region?" Cundall, 3 April 2023. <https://www.cundall.com/ideas/blog/what-does-the-6th-ipcc-report-mean-for-the-mena-region>.

"Saadiyat Island District Cooling Plant." ADC Energy Systems. 2014. Accessed on 27 October 2024. <https://www.adcenergysystems.com/projects/saadiyat-island-dcp/>.

"Saudi Arabia Prepares for HCFC Phase-out Management Plan Stage II." Refindustry Refrigeration Tech Hub 18 June 2023. Accessed on 2 December 2024. <https://refindustry.com/news/market-news/saudi-arabia-prepares-for-hcfc-phase-out-management-plan-stage-ii/>.

Shamseldin, Amal. "Proposed Role of the Local Saudi Building Codes in Assessing the Energy Performance of Buildings in KSA's GBRS." Ain Shams Engineering Journal 14, no. 5 (May 2023). <https://www.sciencedirect.com/science/article/pii/S2090447922002775>.



Staff Writer. "Empower Awards Design Contract for District Cooling Plant in Dubai's Jumeirah Village." Zawya Projects, 29 August 2024. <https://www.zawya.com/en/projects/utilities/empower-awards-design-contract-for-district-cooling-plant-in-dubais-jumeirah-village-ush3f5eo>.

Staff Writer. "Increased district cooling aiding Qatar's sustainability drive." ZAWYA, 5 August 2024. <https://www.zawya.com/en/business/energy/increased-district-cooling-aiding-qatars-sustainability-drive-jsuq17e6>.

TechEmerge. "An Innovation of IFC (International Finance Corporation)." 2024. Accessed on 28 October 2024. <https://www.techemerge.org/>

"Transcritical System in Super-Warm Abu Dhabi Exceeds Energy Expectations." News Refrigerants News and Marketplace, 12 October 2020. <https://naturalrefrigerants.com/transcritical-co2-system-in-super-warm-abu-dhabi-exceeds-energy-expectations/>.

Transparency Market Research. "Middle East Industrial Refrigeration Equipment Market - Industry, Analysis, Size, Shape, Growth, Trends, and Forecasts, 2023 -2031." N.D. <https://www.transparencymarketresearch.com/middle-east-industrial-refrigeration-equipment-market.html>.

"Turkey Introduces New Energy Efficiency Regulations for Buildings." SolarQuarter. 4 January 2023. <https://solarquarter.com/2023/01/04/turkey-introduces-new-energy-efficiency-regulations-for-buildings/>.

"Türkiye. Europe & Central Asia." UNDP Global Climate Promise, 28 November 2023. <https://www.undp.org/sites/g/files/zskgke326/files/2024-11/climatepromise-booklet.pdf>.

UCLG MEWA, United Cities and Local Governments Middle East and West Asia Section. N.D. Accessed on 28 October 2024. <https://uclg-mewa.org/en/>.

Umweltbundesamt. "Nachhaltige Gebäudeklimatisierung in Europa. Konzepte zur Vermeidung von Hitzeinseln und für ein behagliches Raumklima." 2022. [https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/cc\\_30-2022\\_nachhaltige\\_gebaeudeklimatisierung\\_in\\_europa.pdf](https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/cc_30-2022_nachhaltige_gebaeudeklimatisierung_in_europa.pdf).

UN Environment Programme. "Keeping It Chill: How to Meet Cooling Demand While Cutting Emissions." 2023. <https://www.unep.org/resources/global-cooling-watch-2023>.

UN Environment Programme. "Report of the ninety-third meeting of the executive committee." 19 December 2023. <http://legacy.multilateralfund.org/93/Report%20of%20the%20ninetieth%20meeting%20of%20the%20Executive%20C/1/93105.pdf>.

UNFCCC LDC Expert Group. "National Adaptation Plans 2023. Progress in the Formulation and Implementation of NAPs." 2023. <https://unfccc.int/sites/default/files/resource/NAP-progress-publication-2023.pdf>.

United Nations Treaty Collection. "2.f Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. Kigali, 15 October 2016." Accessed on 28 October 2024. [https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg\\_no=XXVII-2-f&chapter=27&clang=\\_en](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-2-f&chapter=27&clang=_en).

United Nations. "United Nation's Secretary General's Call to Action on Extreme Heat." 25 July 2024. <https://www.un.org/en/climatechange/extreme-heat>.

Watson, Charlene, Liane Schalatek and Aurelien Evéquoz. "Climate Finance Regional Briefing: Middle East and North Africa." Climate Finance Fundamentals. 2021. [https://climatefundsupdate.org/wp-content/uploads/2022/03/CFF9-MENA\\_2021.pdf](https://climatefundsupdate.org/wp-content/uploads/2022/03/CFF9-MENA_2021.pdf).

Watts, Nick et al. "The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises." Lancet 2021, 397(2 December 2020). [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)32290-X/abstract](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)32290-X/abstract).

Wehrey, Frederic and Ninar Fawal. "Cascading Climate Effects in the Middle East and North Africa: Adapting Through Inclusive Governance." Carnegie Endowment for International Peace, 24 February 2022. <https://carnegieendowment.org/research/2022/02/cascading-climate-effects-in-the-middle-east-and-north-africa-adapting-through-inclusive-governance?lang=en&center=global>.

World Economic Forum. "Summer 2024 the hottest on record, and other nature and climate stories you need to read this week." 11 September 2024. <https://www.weforum.org/stories/2024/09/summer-2024-hottest-on-record-nature-climate-news/>.

Zafar, Salman. "District Cooling in the Middle East: Potential and Challenges". EcoMENA. 27 July 2023. <https://www.ecomena.org/district-cooling-middle-east/>.

