SUSTAINABLE COOLING FOR ALL IN KENYA:

MEETING COOLING NEEDS WHILE ACCELERATING A JUST AND EQUITABLE TRANSITION

ACKNOWLEDGEMENTS

This report is based on a review of recent literature, industry reports, case studies and Sustainable Energy for All's (SEforALL's) insights from in-country access to sustainable cooling support to the public and private sectors in Kenya. Data were collected from various sources, including academic papers, SEforALL's *Chilling Prospects* series, the Kenya Energy Transition & Investment Plan, Kenya's National Cooling Action Plan, the Kenya National Energy Efficiency and Conservation Strategy and GIZ's Greenhouse Gas Inventory for the Refrigeration & Air Conditioning Sector (2022).

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TABLE OF CONTENTS

TABLE OF CONTENTS

ABBREVIATIONS

AC	Air-conditioning
ACES	Africa Centre of Excellence for Sustainable Cooling and Cold-Chain
ACTS	African Centre for Technology Studies
BAU	Business as usual
CaaS	Cooling as a Service
CCE	Cold chain equipment
CCEOP	Cold Chain Equipment Optimization Platform
CCKP	Climate Change Knowledge Portal
EAC	East African Community
EER	Energy efficiency ratio
EPI	Energy performance index
ESCO	Energy service company
ETIP	Energy Transition & Investment Plan
EUI	Energy use intensity
GDP	Gross Domestic Product
GHG	Greenhouse gas
GWh	Gigawatt hour
GWP	Global warming potential
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IEA	International Energy Agency
KEREA	Kenya Renewable Energy Association
KNEECS	Kenya National Energy Efficiency and Conservation Strategy
KPI	Key Performance Indicator
LPG	Liquefied petroleum gas
MEPs	Minimum Energy Performance Standards
MSME	Micro-, Small and Medium-sized Enterprise
MoH	Ministry of Health
NCAP	National Cooling Action Plan
NCCAP	National Climate Change Action Plan
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
NZE	Net-Zero Emissions
OBI	Open Building Insights
ODP	Ozone depleting potential
PaaS	Pay as a Service
PPP	Public private partnership
RAC	Refrigeration and Air-Conditioning
RBF	Results-based financing
SDD	Solar direct drive
SDG	Sustainable Development Goal
SEforALL	Sustainable Energy for All
SME	Small and Medium-sized Enterprise
SPOKE	Specialized Outreach and Knowledge Establishment
SRI	Solar Reflectance Index
UHIE	Urban Heat Island Effect
UNEP	UN Environment Programme
WHO	World Health Organization

EXECUTIVE SUMMARY

Cooling and cold chains are crucial for healthcare, agriculture, thermal comfort and industrial processes. Affordable and sustainable cooling is essential for a thriving society and a healthy nation, sitting at the intersection of the Paris Climate Agreement, the Kigali Amendment of the Montreal Protocol and the UN Sustainable Development Goals (SDGS).

However, millions in Kenya lack access to affordable, reliable, sustainable cooling solutions, exposing them to severe health, well-being, and socioeconomic consequences. Across the country there are 9.6 million rural and urban poor at high risk due to a lack of access to cooling because they live below the international poverty line (less than USD 2.15 per day) in substandard housing without access to electricity. People in the Rift, Northeastern, Eastern and Coast regions experience the most extreme temperatures.

Urban areas, such as Mombasa, are facing increased heat exposure due to the replacement of vegetation with heat-retaining surfaces, exacerbating urban heat island effects (UHIEs) and increasing hospital admissions during heat waves. To combat these challenges, the widespread adoption of passive cooling and nature-based solutions, especially for vulnerable populations, is essential.

Kenya's substantial agricultural sector presents a significant opportunity to develop cold chain infrastructure, projected to reach a market value of US 2.1 billion by 2030. Such development could reduce post-harvest losses, improve food safety, quality and nutritional value, and enhance market access, ultimately improving the economic well-being of farmers. Reliable cooling is also crucial for vaccine and medicine storage, but healthcare facilities in Kenya struggle with reliable electricity and equipment maintenance. Coordinated efforts are necessary to develop and scale accessible cold chains for agriculture and healthcare that support economic development and strengthen food security and health outcomes in rural communities.

Refrigeration and air-conditioning (RAC) usage is increasing among Kenyans who have access to electricity due to rising incomes and temperatures, and ever more frequent heatwaves. This impacts Kenya's energy systems and climate goals. To align with national energy and climate strategies, such as the Energy Transition and Investment Plan (ETIP) 2023-2050, the business-as-usual (BAU) emissions from the cooling scenario presented in the Kenya National Cooling Action Plan (NCAP) need to be abated. To reduce emissions from cooling, and ensure cooling is more affordable and accessible, it is necessary to further develop Kenyan policy interventions to advance higher efficiency standards, phase out hydrofluorocarbon (HFC) refrigerants, and decarbonize the power sector.

Kenya has shown cooling sector leadership in the region with its NCAP and commitment to the Global Cooling Pledge. To build on these policies and create a more coordinated ecosystem to accelerate the transition to sustainable cooling include, the following policy interventions are recommended:

1. Integrate cooling with national and county energy, climate and development policies.
2. Establish a coordinating 'cooling' committee to provide cross-ministerial and sector support, building institutional capacities and implementation frameworks.
3. Enable 'Cool Cities' through a call to action, city networks and leading by example.
4. Increase the adoption of passive cooling in buildings.
5. Accelerate the transition to model minimum energy performance standards (MEPs) and participate in the regional harmonization of MEPS.
6. Stimulate market demand and drive behaviour change for energy efficiency.
7. Enhance access to low climate-impact cooling and cold chain for agriculture and healthcare.
8. Promote sustainable cooling awareness.

The transition to sustainable cooling in Kenya is critical to ensure a healthy and thriving society while the country meets its climate goals. By implementing the recommended strategies and actions, Kenya can accelerate the transition to just and equitable cooling and achieve sustainable cooling for all.

To increase investment and finance for sustainable cooling for all in Kenya and overcome barriers such as high upfront costs and the perceived risks associated with new technologies, a variety of financial mechanisms, including grants, results-based financing (RBF) and concessional loans, are necessary. Priority finance strategies to accelerate the adoption of sustainable cooling in Kenya include:

- Utilizing co-financing, revolving funds and loan guarantees to encourage bank loans for energy-efficient cooling appliances.
- Leveraging green bonds and blended finance to attract private investment in sustainable cooling.
- Building investable company pipelines through business advisory services to increase climate finance demand.
- Promoting Kenya's climate investment opportunities and considering equity guarantees for cold chain infrastructure.
- Fostering collaboration between financial institutions and the cooling finance ecosystem to overcome barriers and enhance deal flow.
- Implementing public financing tools and capacity building to boost cold chain technology adoption and local food processing.

INTRODUCTION

The purpose of this report is to provide Kenya policymakers, investors and other cooling sector stakeholders with a comprehensive overview, and data, policy and financial recommendations to meet Kenya's cooling needs and accelerate a just and equitable transition while cutting emissions.

Cooling is crucial across Kenya for preserving vaccine and medicine efficacy, maintaining fresh food supplies while reducing food waste, ensuring comfortable environments in homes and workplaces, and supporting transportation and industrial systems. Urgent action is required to address the energy and climate issues associated with cooling and to ensure equitable cooling access, particularly for the most vulnerable communities in heat-stressed regions. Figure 1 illustrates how cooling is interconnected with all 17 UN Sustainable Development Goals (SDGs).

With the release of Kenya's Energy Transition and Investment Plan (ETIP) 2023-2050 and the government's commitment to the Global Cooling Pledge, this is a timely moment to develop a detailed roadmap for reducing carbon emissions from the cooling sector that firstly acknowledges the need to address cooling access issues. This includes increasing access to cold chains for Kenya's significant agricultural sector to improve incomes and livelihoods, output and value addition for smallholder farmers, pastoralists and fisher-folk, and enhancing household food resilience, as supported by the national Fourth Medium Term Plan (MTP IV) 2023-2027 and the Agricultural Sector Transformation and Growth Strategy 2019-2029.

Building on Kenya's 2022 National Cooling Action Plan (NCAP) and other climate and development goals, this report aims to:

- Highlight the dual need to address energy and climate issues associated with the pressing energy access and development issues related to cooling to ensure a healthy nation and thriving society.
- Define and contextualize the key impact areas and interventions necessary for a holistic pathway to sustainable cooling for all in Kenya.
- Encourage collaboration across public and private sectors and across different industrial sectors to deliver sustainable cooling for all in Kenya.
- Provide recommendations for priority action areas for policymakers and government officials to address current progress, gaps and opportunities, aiding in achieving sustainable cooling for all in Kenya.
- Highlight key financial mechanisms and recommendations to address financial challenges aimed at creating a robust financial ecosystem that supports sustainable cooling for all in Kenya.

The report is organized into five main sections:

01

Country background: Providing information on Kenya's climate, heat exposure, demographics, economy, energy sector (including electricity for cooling), and heat risk and cooling access gaps.

02

Kenya's cooling challenges and opportunities: Presenting Kenya's context of cooling needs and data related to the challenges and issues associated with a lack of cooling. This covers three high-impact cooling sectors:

1) food, nutrition and agriculture,
2) health services and
3) human comfort and safety.

03

Sustainable cooling for all in Kenya: Presenting an overview of six key themes to achieve sustainable cooling for all in Kenya. The themes are:

1) passive cooling strategies;
2) higher cooling energy-efficiency standards,
3) the phasing out of climate-warming hydrofluorocarbon (HFC) refrigerants,
4) decarbonizing the power sector;
5) cooling equity and access, and;
6) accessible cold chains for agriculture and healthcare.

04

Policy interventions to achieve sustainable cooling for all in Kenya: This section outlines eight priority policy actions and interventions that can bolster Kenya's existing political landscape and enable equitable and sustainable cooling by strengthening existing efforts, new efforts to close policy gaps, and increasing information, awareness and capacity.

05

Increasing investment and finance for sustainable cooling for all in Kenya: This section presents strategies tailored to the unique challenges of the cooling sector to drive investment and foster a more resilient and climate-conscious economy.

Supplementary information is provided in the annexes:

Annex 1: Existing Kenya-based initiatives, projects, products and services working across sustainable cooling

Annex 2: Kenya's progress against the Global Cooling Pledge commitments

Annex 3: Financial mechanisms for sustainable cooling

The report is based on a review of recent literature, industry reports and case studies, as well as Sustainable Energy for All's (SEforALL's) insights from in-country cooling support to the public and private sectors in Kenya. Data were collected from various sources, including academic papers, SEforALL's *Chilling Prospects* series, the ETIP, NCAP, the Kenya National Energy Efficiency and Conservation Strategy (KNEECS) and GIZ's Greenhouse Gas Inventory for the Refrigeration & Air Conditioning Sector.

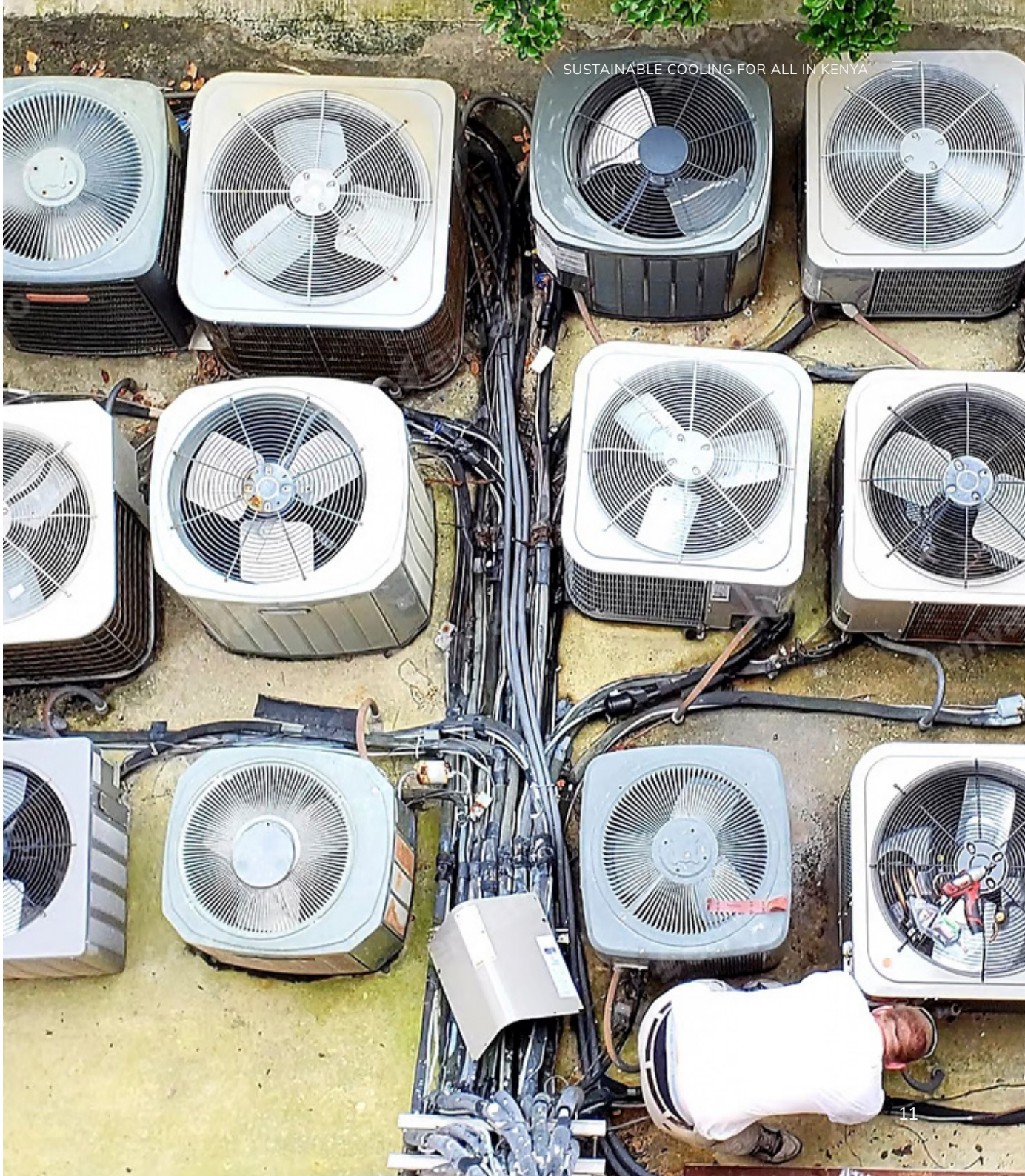


FIGURE 1: Sustainable Development Goals & Cooling in Kenya

Access to sustainable and affordable cooling and cold chains enhances agricultural productivity and reduces post-harvest losses, improving the livelihoods by creating income opportunities for 70% of rural population employed in agriculture.

Cold chains preserve food and can help reduce the 40% of annual food currently lost in Kenya, improving food security for vulnerable communities.

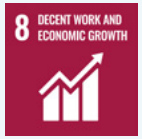
Reliable cooling for vaccine storage in healthcare facilities strengthens medical supply chains, protecting over 9.6 million people at high risk in heat-stressed areas of Kenya.

Passive cooling in schools improves learning conditions, particularly in Kenya's hottest regions, enhancing concentration and long-term academic outcomes.

Sustainable cooling, especially in healthcare and household environments, eases the burden on women, who make up 52% of Kenya's population, by improving maternal health and reducing time spent on cooling-related tasks.

Access to water is crucial during heat waves to reduce heat related illness and morbidity.

Transitioning to energy-efficient cooling technologies helps eases energy access and affordability supporting Kenya's goal to achieve universal electricity access by 2030.



Sustainable agriculture cold chain infrastructure has a potential market value of US$2.1 billion in Kenya that would create jobs and enhance productivity in the growing food and logistics sectors.

Investment in cold chains and sustainable cooling technologies fosters innovation in Kenya's industrial sector

Expanding access to sustainable cooling for underserved communities reduces social inequalities by improving health, food security, and resilience to heatwaves.

Integrating passive cooling and urban greenery reduces heat exposure in cities like Mombasa, mitigating urban heat island effects and enhancing public health for vulnerable communities.

Ensuring sustainable consumption and production patterns includes the responsible and efficient use of energy for cooling, and avoiding HFC refrigerants.

Phasing out HFC refrigerants and adopting energy-efficient cooling technologies reduces cooling-related emissions and mitigates climate impacts

Sustainable cold chains for fisheries help preserve aquatic resources by supporting Kenya's fishing communities to reduce post-harvest losses and enhancing income.

Nature-based cooling solutions, like urban reforestation projects, enhance biodiversity and protect ecosystems whilst reducing heat stress across Kenya.

Coordinating cross-ministerial efforts in sustainable cooling ensures transparent governance and equitable distribution of resources, reducing conflict over scarce cooling access.

Global and regional partnerships, such as the Kigali Amendment, promote knowledge exchange and financing, accelerating Kenya's transition to sustainable cooling solutions.

01 COUNTRY BACKGROUND

CLIMATE

Kenya is in East Africa covering latitudes 4.5° N to 4.5°S. It has a diverse geography, featuring a coastline along the Indian Ocean, savannahs, the Great Rift Valley, the Lake regions and mountain highlands.

Average annual temperatures in Kenya range from a nighttime minimum of 18.3°C to a daytime maximum of 30.3°C. However, certain regions experience much higher temperatures, especially during the dry seasons. For instance, Turkana County in the north of the Rift Valley Province is significantly hotter than the rest of the country; monthly average highs are in the high 30°C's and can reach 40°C. The coastal regions are not as hot as Turkana County, with average daily maximum temperatures around 31°C degrees, but with high relative humidity (around 80 percent).[1] [2]

Kenya has experienced the effects of climate change, including higher temperatures, more frequent and intense heat waves, irregular rainfall patterns and prolonged droughts, impacting agriculture, water resources and livelihoods.

1 Climate Risk Profile: Kenya (2021): The World Bank Group
2 MoALFC. 2021. Climate Risk Profile for Turkana County. Kenya County Climate Risk Profile Series. The Ministry of Agriculture, Livestock, Fisheries and Co-operatives (MoALFC), Nairobi, Kenya.

FIGURE 2: Map of Kenya

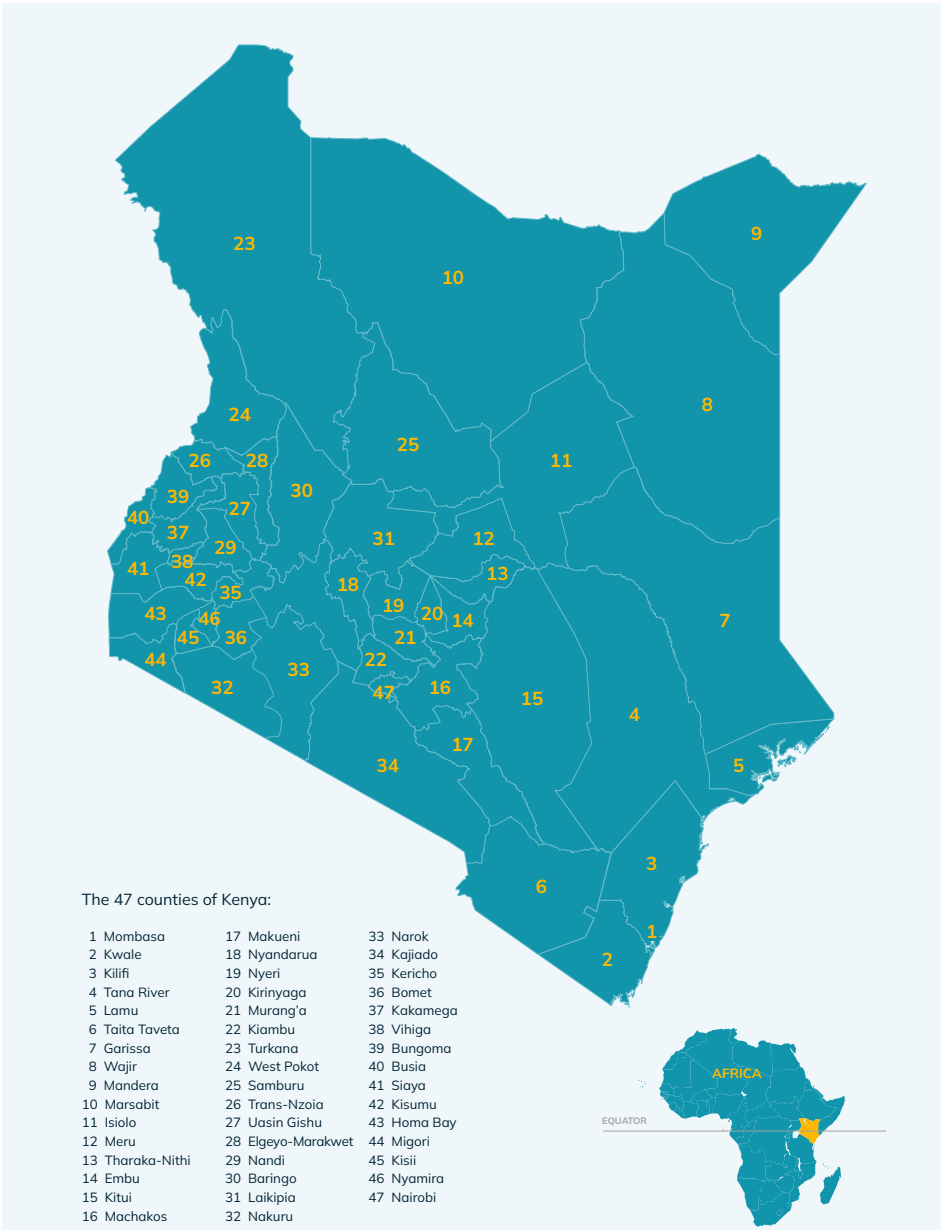
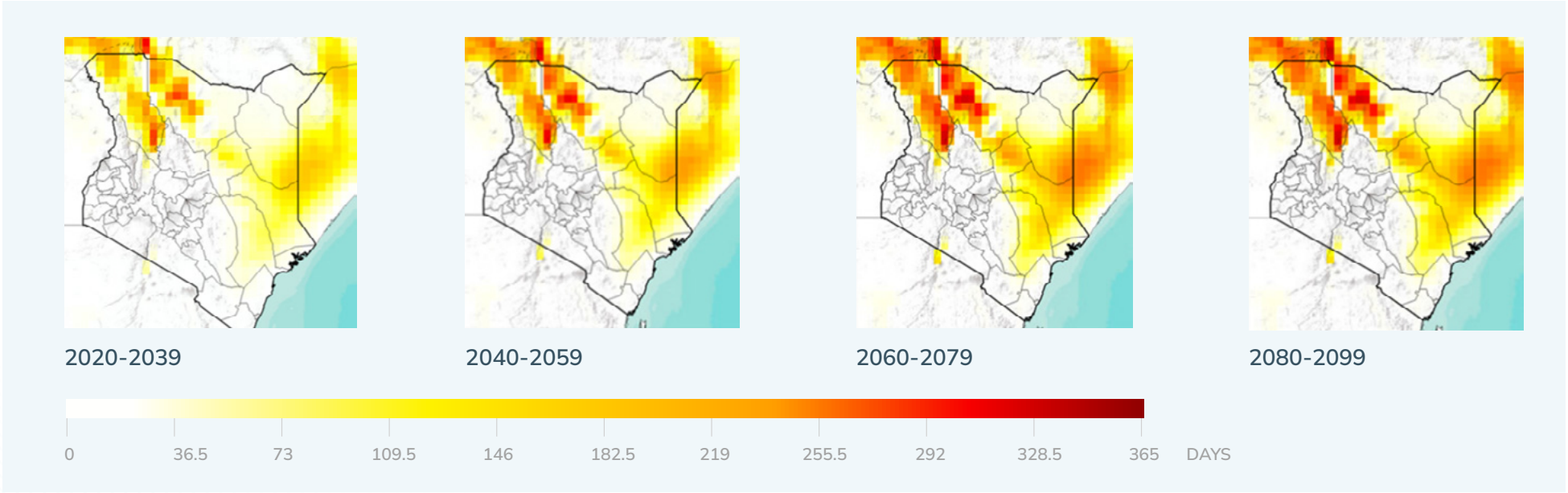


FIGURE 3: Projected number of annual hot days where the maximum temperature exceeds 35°C across Kenya under climate scenario SSP2-4.5; 50th percentile



Source: https://climateknowledgeportal.worldbank.org/country/kenya/heat-risk

Under a business-as-usual (BAU) climate scenario by the World Bank Group's **Climate Change Knowledge Portal (CCKP)** Kenya is expected to see temperatures rise by 1.7°C by the middle of the century and by approximately 3.5°C by the end of the century. The number of hot days and nights will increase, with hot days projected to occur on 19–45 percent of days by mid-century. Hot nights are expected to increase more quickly, projected to occur on 45–75 percent of nights by mid-century and on 64–93 percent of nights by the end of the century.[3]

Even under a *middle-of-the-road* scenario (in which global warming reaches 2.7°C by 2100) rising temperatures will be significant and there will be an increase in the number of hot days; the four heat maps in Figure 3 show the projected annual number of hot days when the maximum temperature exceeds 35°C. Generally, the Rift Valley, Northeastern, Eastern and Coast regions are hotter than other regions of the country.[4]

3 Climate Risk Profile: Kenya (2021): The World Bank Group.
4 https://climateknowledgeportal.worldbank.org/country/kenya/heat-risk

POPULATION & ECONOMY

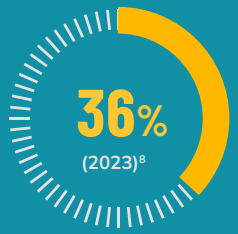
Kenya has a diverse and young population of approximately 55 million people, with a significant portion (nearly 30 percent) residing in urban areas like Mombasa and Nairobi (2023). 36 percent (2021) of the total population lives below the poverty line and 51 percent of the urban population lives in informal, or slum, housing (2020).[5]

Kenya's economy is the largest in East Africa, driven by agriculture (approximately 33 percent of GDP,[6] tourism, manufacturing and services, with recent growth in technology and innovation sectors positioning Kenya as a regional economic hub.

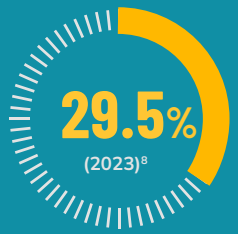
BOX 1

DEMOGRAPHIC DATA

TOTAL POPULATION: **55,100,586** (2023)[7]



POPULATION LIVING BELOW THE POVERTY LINE



URBAN POPULATION

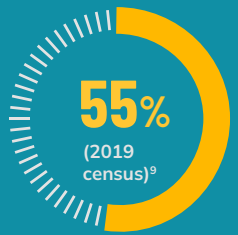
URBAN POPULATION LIVING IN SLUMS

LARGEST CITIES BY POPULATION:

NAIROBI
~ 2.7 million

MOMBASA
~ 800,000

NAKURU
~ 260,000 (2023)[8]



POPULATION LIVING IN RIFT VALLEY, NORTHEASTERN, EASTERN, AND COAST REGIONS

5 World Bank (2024) Data Bank – World Development Indicators https://databank.worldbank.org/source/world-development-indicators

6 Food and Agriculture Organization of the United Nations (n.d) . Kenya at a glance, Retrieved August 16 2024, https://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/

7 World Bank (2024) Data Bank – World Development Indicators https://databank.worldbank.org/source/world-development-indicators

8 Distribution of population in Kenya as of 2023, by city https://www.statista.com/statistics/1199593/population-of-kenya-by-largest-cities/

9 2019 Kenya Population and Housing Census: Volume 2 Distribution of Population by Administrative Units, https://www.knbs.or.ke/wp-content/uploads/2023/09/2019-Kenya-population-and-Housing-Census-Volume-2-Distribution-of-Population-by-Administrative-Units.pdf

POWER & EMISSIONS PROFILE

Over 90 percent of Kenya's electricity generation is from renewable energy sources, with significant contributions from geothermal energy and hydropower. Access to electricity has improved considerably in recent years; 98 percent of urban populations have access, while this number falls to 65 percent in rural areas, making the access rate for the total population 76.6 percent (2022).[10] To increase electricity access and meet growing demand, including for cooling, power generation needs to expand dramatically without relying on fossil fuels.

The Kenya Energy Transition and Investment Plan (ETIP) details a vision for Kenya's energy transition, specifically how the energy sector will contribute to net zero by 2050 while growing the economy and taking advantage of green growth opportunities[11]. The ETIP considers four key sectors as part of the energy system – Power & Hydrogen, Transport, Industry and Cooking/Buildings – and outlines a pathway to reach net zero by 2050 that will see emissions from energy systems peaking around 2035 before beginning a rapid decline.

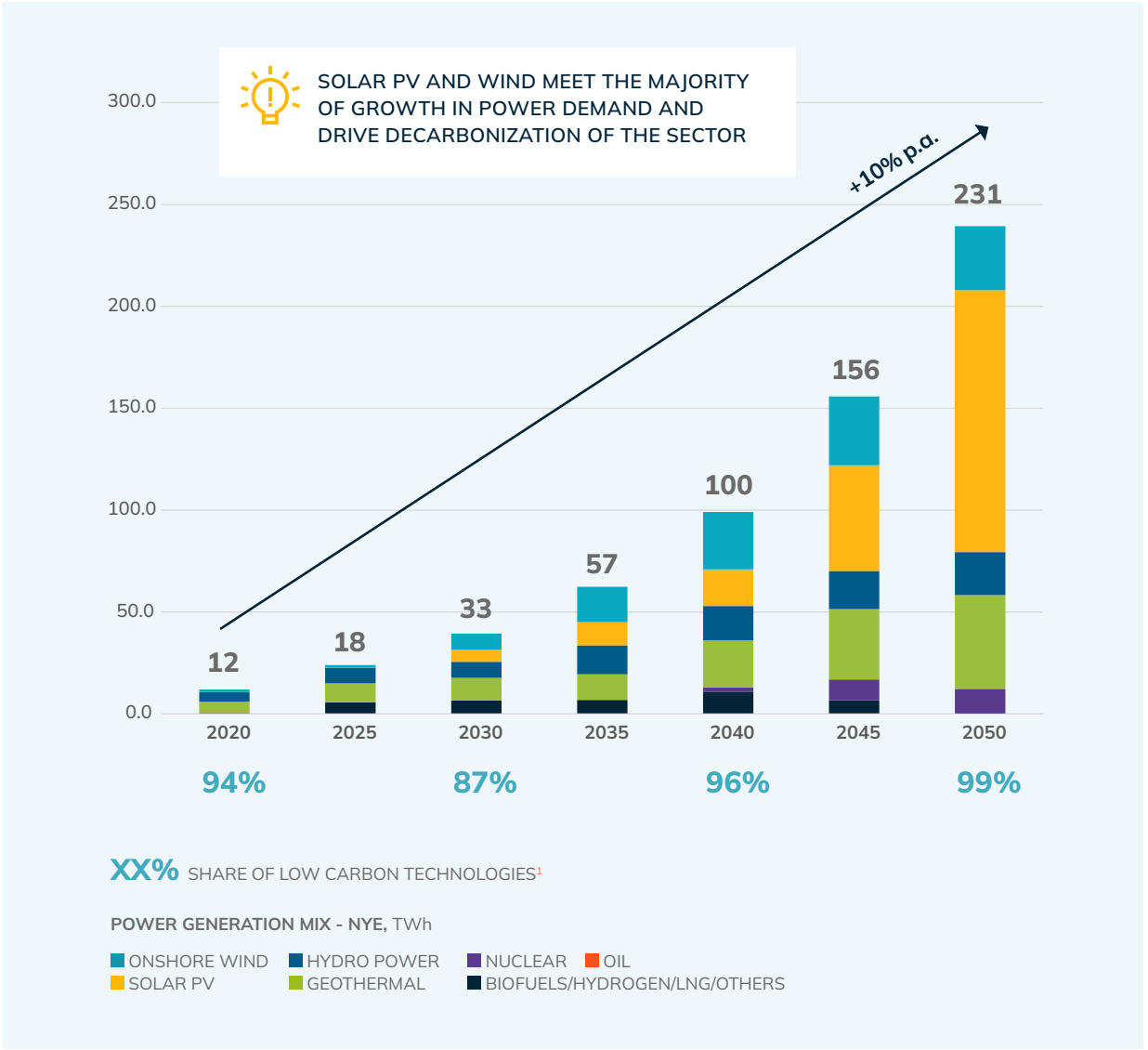
10 Distribution of population in Kenya as of 2023, by city https://www.statista.com/statistics/1199593/population-of-kenya-by-largest-cities/

11 https://climateknowledgeportal.worldbank.org/country/kenya/heat-risk

The pathway includes replacing or avoiding fossil fuels with electrification, energy efficiency and renewable power generation (solar, wind, geothermal, hydro and potentially nuclear).

The transition includes the need for a significant increase in the capacity of renewable power generation to close electricity access gaps and meet the country's growing electricity demand. According to the ETIP, Kenya's annual power generation is 12.02 TWh, predominantly generated by geothermal energy and hydropower. The associated electricity grid carbon factor is 56.81 gCO_2/kWh and total annual carbon emissions from power generation are 0.68 $MtCO_2$. Under the transition pathway to net zero by 2050, Kenya's annual power generation necessary to meet electricity demand is projected to be 20 times more than that of 2020 at 239.40 TWh with an electricity grid carbon factor of –0.07 gCO_2/kWh (negative due to a portion of power being generated through biomass with carbon capture and storage). New solar PV, wind and geothermal energy meet most of this increase and some growth is met with nuclear and hydropower (See Figure 4).

FIGURE 4: Power generation mix and capacity from 2020-2050 under the ETIP Net Zero by 2050 pathway (Source: ETIP)



Under the plan, unabated fossil-fuel energy is phased out by 2040, with storage playing a key balancing role. Around two thirds of the power demand is driven by powering industry and buildings, with the remaining third driven by demand from transport and hydrogen production. Cooling systems are potentially needed across all these sectors.

TABLE 1: Power generation mix & generation for 2020 and 2050 under the ETIP Net Zero by 2050 pathway (Source: ETIP)

POWER SOURCE	2020 POWER GENERATION MIX	2050 POWER GENERATION MIX
Oil	6.24%	Phased-out
Biomass	1.16%	Phased-out
Geothermal	42.09%	19.23%
Hydro power	38.64%	8.81%
Solar PV	0.81%	53.68%
Onshore wind	11.07%	13.15%
Gas	-	0.18%
Biomass with carbon capture & storage	-	0.06%
Nuclear	-	4.90%

COOLING POWER & EMISSIONS

Refrigeration and air-conditioning (RAC) appliances consume electricity, leading to carbon emissions during electricity generation, known as indirect carbon emissions. The demand for cooling, efficiency of RAC appliances and the power source used all impact the resulting indirect carbon emissions. Additionally, RAC appliances produce direct carbon emissions from the refrigerants they use. Refrigerants contribute to direct greenhouse gas (GHG) emissions in two primary ways: leakage during the equipment's operating life; and emissions during equipment manufacture, installation and maintenance and at end of life. The environmental impact of these emissions depends on the refrigerant's global warming potential (GWP) and ozone depleting potential (ODP). The total carbon emissions from cooling are the sum of direct and indirect emissions.

RAC use is on the rise in Kenya driven by a growing population, rising temperatures and rising incomes. The National Cooling Action Plan (NCAP) refers to data from the GIZ Inventory of the Kenyan RAC sector, projecting

that, based on current trends and a projected hotter climate, total carbon emissions (direct + indirect) from the RAC sector will reach **4.75 Mt CO_2eq in 2030** and up to **7.87 Mt CO_2eq in 2050** under a BAU scenario (from approximately **4 CO_2eq currently).**

Under the ETIP net-zero emissions pathway, the electricity grid's carbon intensity factor is expected to near zero, reducing the indirect carbon emissions associated with RAC appliance usage. However, alongside grid decarbonization to lower indirect emissions, it is crucial to ensure energy demand from the RAC sector does not strain energy systems with excessive peak power needs, cause electricity price hikes or rely heavily on private, unclean power generation, making the operation of RAC appliances inaccessible and unaffordable for many. This relies on reducing cooling demand (i.e., by prioritizing passive cooling measures) and improving energy efficiency). The national approach to energy efficiency is outlined in the Kenya National Energy Efficiency and Conservation Strategy (KNEECS), which encouraged market transformation of efficient cooling systems through the development of the NCAP.

In terms of direct carbon emissions, Kenya has taken significant steps to phase out harmful refrigerants in line with global environmental agreements. Kenya ratified the Kigali Amendment to the Montreal Protocol and is committed to freezing hydrofluorocarbon (HFC) consumption from 2024 and reducing their use to 80 percent of the baseline (the average HFC consumption for 2020-2022 +65 percent hydrochlorofluorocarbon (HCFC) baseline in terms of CO_2eq) by 2045.

HCFCs, such as R-22, contribute to ozone depletion and have a high GWP. Kenya aims to phase out HCFC refrigerants by January 2025, which is faster than other Article 5 countries[12] that aim to phase out HCFC by 2030. The phase-out plan involves replacing HCFCs with more environmentally friendly alternatives like R-410A, which has zero ozone depletion potential, and newer refrigerants like R-290 (propane), which has a much lower GWP and no ozone depletion potential.

It is necessary to determine a detailed road-map for Kenya's cooling energy demand and associated carbon emissions that responds to the ETIP and ensures the net zero by 2050 roadmap is not undermined. By updating baseline and projected RAC ownership, as well as usage and energy source data, a new informative roadmap can be developed that highlights sustainable cooling's potential contribution to Kenya's Nationally Determined Contributions (NDCs) to the Paris Climate Agreement.

HEAT RISK & ACCESS TO COOLING GAPS

Sustainable Energy for All's (SEforALL's) Chilling Prospect series analyzes risk factors in high-temperature countries and regions to determine how many people are likely to be at high, medium and low risk to heat exposure due to a lack of access to cooling services.

The risk spectrum is based on the premise that heat disproportionately affects impoverished individuals or those with limited access to services. People without electricity, living in inadequate housing, or residing in rural areas without food or medical cold chains are especially vulnerable. Similarly, those working outdoors or in the informal sector face heightened risks due to limited cooling access.

12 https://ozone.unep.org/classification-parties

Chilling Prospects identifies specific high-temperature regions in Kenya where there are vulnerable people and significant cooling access gaps: Coast, Eastern, Northeastern and Rift Valley. Within these regions, the analysis indicates that:

- 36 percent of the population or **9.6 million people are at high risk due to a lack of access to cooling**. This includes **5.1 million rural poor** who lack electricity and live in extreme poverty, often engaging in subsistence farming without access to intact cold chains, and **4.5 million urban poor** with limited or no electricity access, living in thermally poor housing and facing intermittent electricity supplies.
- **14.8 million people are at medium risk**, representing an increasingly affluent lower-middle-income class on the brink of purchasing the lowest-cost air conditioner or refrigerator on the market, often inefficient models.
- **1.6 million people among the middle-income population are at low risk**, typically owning cooling appliances and possibly being able to afford more efficient ones.

The proportion of the population at high risk in the hotter regions of Kenya is higher than in neighbouring countries like Somalia (28 percent) and Ethiopia (29 percent) but lower than in South Sudan (83 percent) and Uganda (54 percent).[13]

The following section delves more into the specific needs and challenges for those at risk due to a lack of access to cooling. The solutions and actions necessary to ensure a just and equitable cooling transition are presented across the final three sections of this report.

13 The most critical African countries include Nigeria, with 115.9 million poor at high risk (53 percent of the population), and Mozambique, with 27.3 million poor at high risk (83 percent of the population).

FIGURE 5: Risk indicators for a lack of access to cooling (SEforALL, *Chilling Prospects* 2023) & access figures for Kenya high-temperature regions

RISK SPECTUM	HIGH RISK		MEDIUM RISK	LOW RISK
	• No access to electricity • Income below poverty line • Poor ventilation and construction • No access to refrigeration for food • Farmers lack access to cold chains • Vaccines exposed to high temperatures		• Access to electricity • Lower income levels • Ability to run a fan, buildings constructed to older standards • Food is refrigerated • Farmers only have access to intermittently reliable cols chains • Vaccines may have exposure to occasional high temperatures	• Full and reliable electricity • Middle income and higher • Well-built homes can include insulation, passive design, air conditoning • Food is refrigerated reliably • Farmers' goods and vaccines have well-controlled cold chains
RISK POPULATIONS	RURAL POOR	URBAN POOR	LOWER-MIDDLE INCOME	MIDDLE-INCOME
RISK INDICATORS	Lack of access to energy Population living in rural areas on less than $2.15/day	Lack of access to energy Population living in urban slums on less than $2.15/day	Population living on less than $10.01/day outside of rural or urban poverty	Population living on between $10.01 and $20/day
Kenya* 2023 access gaps	5.1 million	4.5 million	14.8 million	1.6 million

*includes high temperature regions only: Coast, Eastern, Northeastern, and Rift Valley

Source: https://www.seforall.org/chilling-prospects-access-to-cooling-gaps-2023/summary

02 KENYA'S COOLING CHALLENGES AND OPPORTUNITIES

The need for heat mitigation, adaptation and access to cooling services is crucial across three key areas:

- Food, nutrition and agriculture
- Health services
- Human comfort and safety
  (which considers cities and the built environment)

The challenges and opportunities related to these three areas are explored in detail in the following subsections to establish the current landscape of cooling. They are followed by a subsection covering other notable cooling needs in Kenya.

FOOD, NUTRITION AND AGRICULTURE

Sustainable cooling systems play a crucial role in logistics (transporting and storing perishable crops), preventing food waste and boosting rural incomes. This also reduces carbon emissions from food waste and increases nutritious food production to combat hunger and food insecurity, which affects an estimated 25 percent.[14]

Globally, the lack of sustainable cold chains results in the loss of 526 million tons of food production, or 12 percent.[15] In Kenya, the loss is even higher with approximately **40 percent of food lost annually** due to inadequate storage,[16] and supply chain inefficiencies.[17]

Given the significance of agriculture in Kenya – contributing 33 percent of GDP and **employing 40 percent of the total population, including over 70 percent of the rural population**[18] – this loss has major implications on the productivity and income of small-scale famers from fishing communities in Homa Bay and Kilifi to dairy farmers in Kiambu and Nyeri.

In the hottest county in Kenya, Turkana, drought and heat stress are major threats that often result in loss of pasture, starving and killing livestock, drying up water sources, and leading to conflict among pastoralists over resources. For instance, high temperatures and inadequate poultry housing that predisposes chicken to heat impacts poultry production and productivity. Ultimately, heat stress results in higher chick mortality such that farmers have fewer birds to sell for profit.[19]

Kenya's existing cold chain infrastructure is fragmented and primarily serves high-value export crops like cut flowers, leaving local

14 Mwaniki, F.N., Nyamu, F.K. (2022). Reducing Food Loss in Kenya for a Sustainable Food Future. In: Leal Filho, W., Kovaleva, M., Popkova, E. (eds) Sustainable Agriculture and Food Security. World Sustainability Series. Springer, Cham. https://doi.org/10.1007/978-3-030-98617-9_18

15 UNEP-FAO (2022) https://www.unep.org/news-and-stories/press-release/amid-food-and-climate-crises-investing-sustainable-food-cold-chains

16

17 Mwaniki, F.N., Nyamu, F.K. (2022). Reducing Food Loss in Kenya for a Sustainable Food Future. In: Leal Filho, W., Kovaleva, M., Popkova, E. (eds) Sustainable Agriculture and Food Security. World Sustainability Series. Springer, Cham. https://doi.org/10.1007/978-3-030-98617-9_18

18 Food and Agriculture Organization of the United Nations (n.d) . Kenya at a glance, Retrieved 16 August 2024, from https://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/

19 MoALFC. 2021. Climate Risk Profile for Turkana County. Kenya County Climate Risk Profile Series. The Ministry of Agriculture, Livestock, Fisheries and Co-operatives (MoALFC), Nairobi, Kenya.

20 Energy for Efficiency Coalition (March 2023), Assessment of the Cold Chain Market in Kenya.

produce vulnerable and **5.1 million rural poor** (see Chapter 2) who lack electricity and live in extreme poverty in the hottest parts of Kenya at high risk to hunger and malnutrition.

The market opportunity for agriculture-related cold chain infrastructure is projected to reach **USD 2.1 billion by 2030** taking into account fresh fruit, vegetable, dairy and fish value chains[20], with investment encouraged by the National Cooling Action Plan (NCAP) and the Agricultural Sector Transformation and Growth Strategy 2019–2029. Focusing on small-scale farmers, fisheries and traders can improve livelihoods and ensure equitable access to opportunities, addressing challenges related to financing and technical support for cooling systems.

Initiatives like Tawi Fresh are investing in cold chain services to improve agricultural value chains and their logistics, increase incomes, create jobs and foster enterprise growth. However, challenges such as: inconsistent policies and standards; lack of awareness of the value proposition of cold chains; high costs of cooling appliances for small-scale farmers; limited access to affordable financial credit; limited access to reliable and affordable energy services and necessary equipment; and a shortage of trained equipment technicians and after-sales support persist. Addressing these challenges and providing more accessible finance and credit solutions are key to growing the sector.

Annex 1 provides a list of private companies, initiatives and products aiming to address the challenges from which lessons can be learned for replicating and scaling sustainable cooling in Kenya's agriculture sector.

HEALTH SERVICES

Cold chains are also crucial for healthcare logistics, i.e., the safe transport and storage of vaccines, blood products and other medical supplies, ensuring they remain effective and safe for use. Without a reliable cold chain, medical supplies can deteriorate, leading to reduced efficacy, potential health risks and medical supply waste. Cold chains are particularly important in regions with high temperatures, where maintaining the integrity of supplies is challenging but essential for public health and the successful delivery of medical services.

The lack of reliable electricity at health facilities in Kenya has been a significant challenge to expanding its vaccine cold chain. While residential electricity access increased from 52 percent to 70 percent between 2016 and 2019, electricity access at government-operated health facilities only grew by 1 percent from 69 percent to 70 percent in the same period. In 2016, 13 percent of facilities relied entirely on liquefied petroleum gas (LPG) as a main source of power. [21,22]

To overcome the challenge of a costly and environmentally damaging cold chain, the Ministry of Health (MoH) has set the ambitious goal of equipping all facilities with optimal cold chain equipment (CCE) by 2026. The effort to update Kenya's healthcare cold chain inventory began in 2016 with the country's successful application to Gavi's Cold Chain Equipment Optimization Platform (CCEOP) and a World Bank loan that resulted in the deployment of 3,082 new refrigerators. 20

20 Energy for Efficiency Coalition (March 2023), Assessment of the Cold Chain Market in Kenya.
21 Kenya National Cold Chain Inventory, 2016 and 2021
22 https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=

percent of these appliances were solar-direct drive (SDD) refrigerators. Despite its success in deploying 8,342 refrigerators to date, Kenya now faces the challenge of continuing to expand as well as of maintaining CCE[23]

In addition to cold chains, heat mitigation and cooling in healthcare facilities in hot regions is crucial for improved care and patient recovery. Heat can significantly impact patient recovery, particularly among elderly people, infants and young children, and pregnant women.

Communities in the coastal town of Kilifi reported that extreme heat during pregnancy, labour and the postpartum period adversely affects women's health, access to healthcare and their ability to perform daily tasks, including caring for infants. Hospitals were described as "unbearably hot".[24] Such an environment in healthcare facilities can also adversely affect the health of healthcare workers and their ability to provide patient care, especially with the use of personal protective equipment.[25] This highlights the importance of integrating sustainable cooling solutions not only for medical supply preservation but also for enhancing healthcare outcomes in the built environment.

Furthermore, a direct correlation between high temperatures during heatwaves and increased hospital admissions has been observed in Kisumu, Mombasa and Nairobi[26]. The challenges and opportunities highlighted in the following section on human comfort & safety, which is related to characteristics of the built environment are, therefore, interconnected to the challenges faced by healthcare services in Kenya.

Annex 2 provides a list of private companies, initiatives and products aiming to address the challenges faced by the health services sector from which lessons can be learned for replicating and scaling sustainable cooling in Kenya.

23 https://www.seforall.org/data-stories/expanding-the-vaccine-cold-chain-in-kenya#1

24 F. Scorgie, A. Lusambili, S. Luchters, P. Khaemba, V. Filippi, B. Nakstad, J. Hess, C. Birch, S. Kovats, M.F. Chersich, "Mothers get really exhausted!" The lived experience of pregnancy in extreme heat: Qualitative findings from Kilifi, Kenya, Social Science & Medicine, Volume 335, 2023 https://doi.org/10.1016/j.socscimed.2023.116223.

25 Quartucci, C., Wibowo, R., Do, V. et al. Assessment of subjective well-being of healthcare workers in response to heat and personal protective equipment under controlled conditions using a standardized protocol. J Occup Med Toxicol 19, 16 (2024). https://doi.org/10.1186/s12995-024-00418-5

26 Kimutai et.al (2022) Identification of local heat thresholds and related health impacts: The case of Nairobi, Mombasa, Kisumu Cities in Kenya: https://preparecenter.org/wp-content/uploads/2022/12/Kenya-Heat-Tresholds-Research-by-J.Kimutai-2022.pdf

HUMAN COMFORT & SAFETY (IN THE BUILT ENVIRONMENT)

Where temperatures are rising, heat waves are becoming more frequent and the urban heat island effect (UHIE) is prominent, heat mitigation and cooling in homes, workplaces and schools is necessary for improved health, well-being, and economic and social outcomes. The World Health Organization (WHO) estimates that annually there are 489,000 heat-related deaths globally, with the elderly, young, pregnant women and medically unwell most impacted[27]. Across Kenya low-income populations and those working outdoors in the agricultural or construction sectors experience the worst health and well-being outcomes due to heat exposure.

Urban populations in Kenya are facing increased heat exposure due to dark, heat-retaining surfaces that cause cities to be typically 2-5°C warmer than surrounding areas, i.e., the UHIE. This can increase to up to 15°C.[28] The coastal city of Mombasa, characterized by high relative humidity, concrete and asphalt roads and minimal vegetation, experiences

27 World Health Organization, 2024, URL: https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health

28 Mentaschi, L., Duveiller Bogdan, G.H.E., Zulian, G., Corban, C., Pesaresi, M., Maes, J., Stocchino, A. and Feyen, L., Global long-term mapping of surface temperature shows intensified intra-city urban heat island extremes, GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS, ISSN 0959-3780, 72, 2022, p. 102441, JRC123644.

significant UHIEand dangerously high land surface temperatures. Key recommendations for addressing the UHIE in Mombasa include retrofitting green infrastructure, creating green ventilation corridors, developing urban micro-forestry and enhancing heat resilience policies, supported by an urban climate laboratory and better data systems.[29]

Impoverishedcommunitieswithoutaccesstoelectricity are most exposed and most vulnerable to the negative impact of UHIEs. In dense informal settlements such as the neighbourhoods of Kibera, Mathare and Mukuru in Nairobi, the lack of vegetation and poorly constructed homes intensify heat such that outdoor temperatures regularly exceed the temperatures of more wealthy Nairobi neighbourhoods by several degrees, reaching temperatures associated with negative health outcomes for children and elderly populations.[30] These communities do not have the resources to adapt to rising heat exposure, which needs to be addressed.

29 Kimuku, C. and Ngigi, M. (2017) Study of Urban Heat Island Trends to Aid in Urban Planning in Nakuru County-Kenya. *Journal of Geographic Information System*, 9, 309-325. doi: 10.4236/jgis.2017.93019.

30 Scott AA, Misiani H, Okoth J, Jordan A, Gohlke J, Ouma G, et al. (2017) Temperature and heat in informal settlements in Nairobi. PLoS ONE 12(11): e0187300. https://doi.org/10.1371/journal.pone.0187300

31 Park, R. Jisung, Joshua Goodman, Michael Hurwitz and Jonathan Smith. 2020. "Heat and Learning." *American Economic Journal: Economic Policy*, 12 (2): 306–39. https://www.aeaweb.org/articles?id=10.1257%2Fpol.20180612

32 Garg et al. (2020). Temperature and Human Capital in India, Journal of the Association of Environmental and Resource Economists, Volume 7, Number 6, https://www.journals.uchicago.edu/doi/abs/10.1086/710066

BOX 2

THE ROLE OF MATERIALS AND BUILDING DESIGN

Building design and construction is a major source of overheating in Kenya's homes, workplaces and schools. A survey of 100 schools under the Kenya National Energy Efficient and Conservation Strategy (KNEECS) project Powering Education through Energy Efficient Lighting, revealed that overheating in classrooms and school buildings is a widespread issue, often exacerbated by insufficient natural ventilation and exposed iron sheet roofing that absorbs solar radiation. Numerous studies have shown that frequent hot days can reduce long-term learning outcomes[31,32] although evidence from developing countries is limited.

Iron roofs are commonplace in housing across Kenya, but these trap heat. Green or thatched roofs keep homes much cooler alternatives. A study in the central county of Kiambu demonstrated a reduction from 48.64 °C to 31.85 °C for a test building first without and then with passive cooling features including a green roof and walls coated with 'cool' (light-coloured) paints. Considering the human body struggles to self-regulate at 35°C wet-bulb temperature, this scale of temperature reduction can literally save lives.

The ownership of cooling appliances is increasing in Kenya. However, 90 percent of air conditioners on the market are low-efficiency models[33], which increase energy demand and operational costs. Consumers have limited access to better-performing models because of their high cost and low market penetration, even though high-efficiency options could significantly reduce energy bills and environmental impact, potentially halving energy costs over the appliance's lifetime. This underscores the need for coordinated efforts to improve energy efficiency and provide adaptive services like cooling centres. Hotter temperatures in cities lead to more intense use of fans and air conditioners, which increases power demand and can stress power supplies.

Coordinated efforts are needed to mitigate the UHIE, reduce heat exposure among vulnerable populations and reduce the risk of overloading electrical systems. It is crucial to safeguard and enhance nature-based cooling solutions, such as trees, vegetation and water bodies in spatial and urban planning, upgrades and expansion. Additionally, incorporating urban 'cool' surfaces (e.g., white roofs, pervious walkways and roads) and wind corridors can mitigate the UHIE and reduce heat exposure, particularly in cities. Where temperatures cannot be reduced, and high temperatures are already a reality for large populations, cities and counties across Kenya must act quickly to provide services that enable residents to adapt and thrive during periods of high temperatures and heat waves. This includes providing basic affordable financial and utility services and innovative services like cooling centres.

OTHER COOLING NEEDS

Beyond the high-impact cooling sectors described above, cooling services are essential for industries in Kenya, including the metalwork, chemical and pharmaceutical sectors, textile and tannery operations, paper mills, plastic and rubber processing, and increasing and expected needs such as data centres, and power and hydrogen generation. For example, Kenya's expanding network of around 13 data centres , including the NBO1 Nairobi Data Centre, requires advanced cooling technologies to manage the substantial heat generated by servers. In the power sector, the deployment of nuclear units (the country's first nuclear power plant is planned for the two coastal counties of Kilifi and Kwale) will generate significant heat that will require effective cooling solutions.

33 IEA (2023), Energy Efficiency for Affordability Improving people's lives through delivery of a modern, sustainable energy system in Kenya https://iea.blob.core.windows.net/assets/e283fa7f-9c09-4248-a4da-6b14124ded93/EnergyEfficiencyforAffordability.pdf

03 SUSTAINABLE COOLING FOR ALL IN KENYA

To meet the needs and address challenges across the key cooling sectors in Kenya – agriculture, health services and thermal comfort – reduce emissions and achieve sustainable cooling for all, integrated action and crosscutting interventions are necessary.

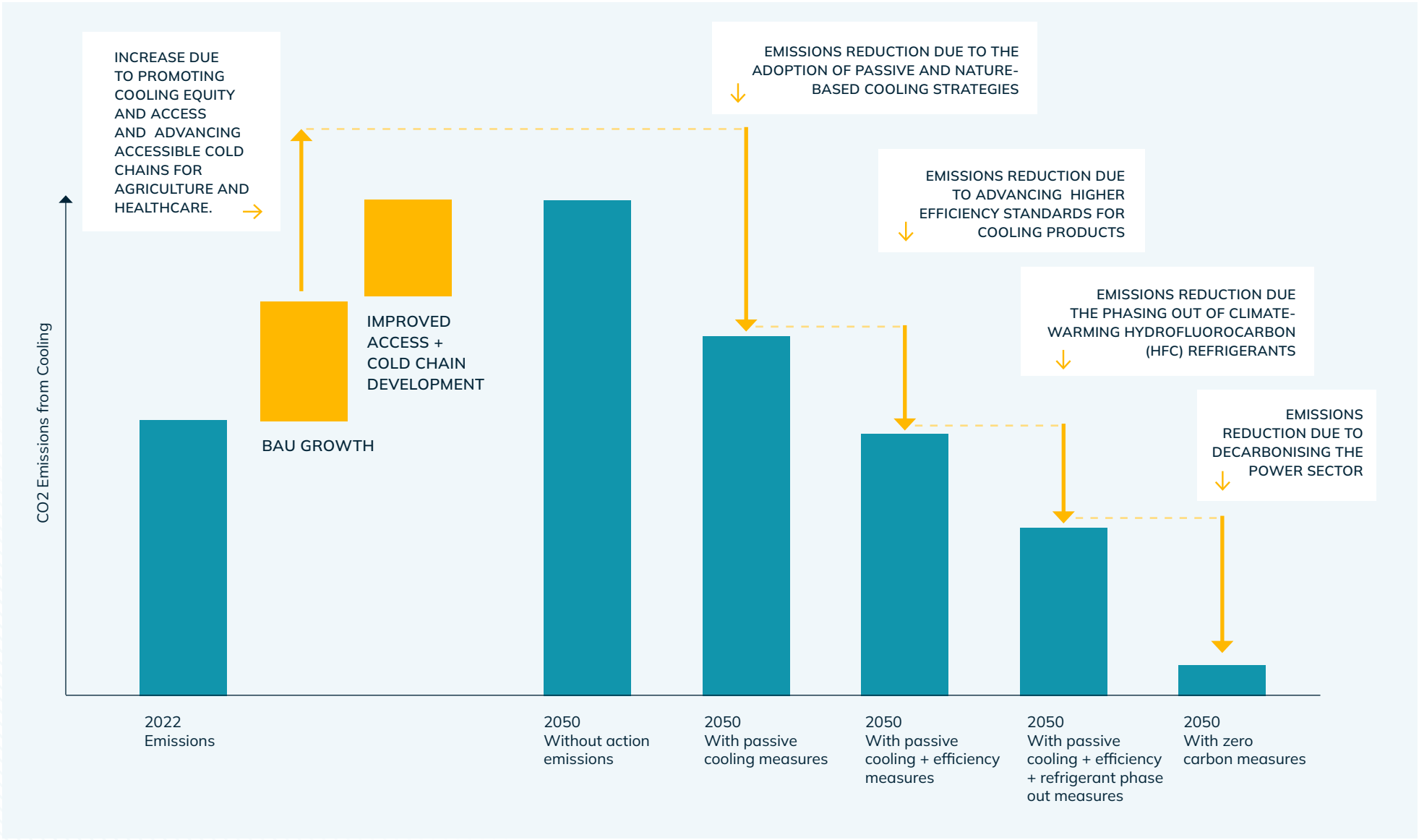
In this chapter, six key themes are identified as the fundamental elements to achieve sustainable cooling for all in Kenya:

- Adopting passive and nature-based cooling strategies
- Advancing higher cooling energy-efficiency standards
- Phasing out of climate-warming hydrofluorocarbon (HFC) refrigerants
- Decarbonizing the power sector
- Promoting cooling equity and access
- Advancing accessible cold chains for agriculture and healthcare.

Figure 6 illustrates the hierarchy and impact of the themes in terms of cooling-related carbon emissions.

Each theme and its relevance to Kenya is outlined below, and further information and implementation opportunities are referenced. The following chapter then provides recommendations for actionable policies and interventions that cut across these themes underpinning sustainable cooling for all in Kenya.

Figure 6: Illustrative emissions contribution from each theme underpinning sustainable cooling for all in Kenya



ADOPTING PASSIVE AND NATURE-BASED COOLING STRATEGIES

The Global Cooling Watch report *Keeping it Chill: How to meet cooling demands while cutting emissions*, by the UN Environment Progamme- (UNEP-)led Cool Coalition, determines that implementing **passive cooling strategies across all sectors could reduce global cooling power loads by 24 percent** compared to business as usual (BAU). In Kenya, the potential impact of passive cooling strategies on future cooling demand is similarly significant. Importantly, passive and nature-based cooling strategies also protect the most vulnerable communities who lack electricity or financial resources to access active cooling by mitigating heat and reducing heat exposure.

Passive cooling strategies are applicable to all scales of solutions from climate-responsive building design, as demonstrated in the **Start-up Lions Campus** by Kéré Architecture located in Turkana County, to nature-based solutions for cities and more traditional cooling methods such as pot-in-pot refrigerators, also known as *zeer* pots, that use evaporative cooling to preserve food without electricity. An example of an initiative successfully implementing nature-based solutions in Kenya is **Miti Mitaani**, a community-initiative that engages youth in planting and maintaining trees along the Nairobi River basin to cool urban areas and build climate resilience.

Some useful resources for practical passive and nature-based cooling solutions in cities in buildings are:

- United Nations Environment Programme (2021). Beating the Heat: A Sustainable Cooling Handbook for Cities. Nairobi. **Link**
- Primer for Cool Cities: Reducing Excessive Urban Heat – With a Focus on Passive Measures (English). Energy Sector Management Assistance Program (ESMAP); Knowledge series 031/20. Washington, D.C.: World Bank Group. **Link**

In addition, this **Airflow for Buildings CFD (ABCFD) tool** based on OpenFOAM is an open-source tool designers, architects and engineers can use to analyze the thermal-comfort impact of insulated walls, external shading and efficient nighttime wind-driven cooling.

Photo of Startup Lions Campus by Kéré Architecture located in Turkana with passive cooling features highlighted

ADVANCING HIGHER COOLING ENERGY-EFFICIENCY STANDARDS

Once cooling demand has been reduced as far as possible with passive and nature-based cooling techniques, highly energy-efficient active cooling solutions are needed to maintain comfortable temperatures.

For health and well-being indoors, circulating fans, exhaust or fresh air supply fans, and evaporative or adiabatic cooling systems can provide space cooling without the need for refrigerants. These are limited in some settings, in which case, split air conditioners, chillers etc., based on the refrigerant cycle can be adopted.

For healthcare and agricultural cold chains, fridge/freezers and cold rooms maintain low and ultra-low temperatures using refrigerant technology.

Higher cooling energy efficiency for fans, refrigerators, freezers and air-conditioning (AC) equipment through **minimum energy performance standards** (MEPs) and behaviour change such as operating **higher internal cooling set points** and proactive maintenance of equipment is fundamental for the transition to just and equitable cooling due to its impact on affordability and emissions. Kenya has made a lot of progress and policy recommendations in the following chapter include actions related to accelerating improved cooling energy efficiency in Kenya.

This resource is helpful to understand space cooling more deeply: ESMAP. 2020. Primer for Space Cooling (English). Knowledge Series; no. 30-20 Washington, D.C.: World Bank Group. **Link**

PHASING OUT OF CLIMATE-WARMING HYDROFLUOROCARBON (HFC) REFRIGERANTS

The phasing out of climate-warming hydrofluorocarbon (HFC) refrigerants is fundamental to the global transition to sustainable cooling. The subsection *Cooling Power & Emissions* highlights Kenya's commitment to the Kigali Amendment and an accelerated phasedown schedule. This includes reducing the global warming potential (GWP) of refrigerants in new and existing equipment (e.g., a move to CO_2-based cooling in supermarkets, enhanced AC MEPS, low GWP limit for AC refrigerants) and preventing HFC emissions from leaking from existing equipment (through checks, servicing and end-of-life recovery supported by appropriate **training and capacity building**). Various refrigeration and air-conditioning (RAC) manufacturers are already creating awareness and driving adoption through benchmarking and south-south collaboration by investing in awareness of R-32 to increase adoption.

UNEP's OzonAction provides guidance and resources on this topic.

BOX 3

REFRIGERANTS

Refrigerants are chemical compounds used in cooling systems, such as air conditioners and refrigerators, to absorb heat and provide cooling. They transition between liquid and gas states, enabling the transfer of heat from inside the system to the outside environment.

The selection of refrigerants is crucial due to their environmental impact, particularly concerning ozone depletion and global warming potential. Under the Kigali Amendment to the Montreal Protocol, HFCs, such as R-134a, R-410A and R-404A, are being phased down due to their high GWP.

Environmentally friendly alternatives with lower GWP include R-32, R-1234yf, R-1234ze, R-744 (CO2), R-717 (ammonia) and R-290 (propane), which are increasingly adopted to reduce environmental impact and comply with the Kigali Amendment.

DECARBONIZING THE POWER SECTOR

To reduce cooling-related carbon emissions using electricity, the power used by cooling devices must be decarbonized. To ensure this, electricity demand for cooling must be managed such that it does not undermine the country's decarbonization plans by stressing the available generation capacity.

The reality of an unreliable or unavailable grid power supply in many developing countries often leads institutions such as schools, hospitals and businesses, to consider on-site power generation. Low- or zero-carbon emission alternatives to diesel and petrol backup generators are options.

The Energy Transition and Investment Plan (ETIP) provides a pathway to meet Kenya's growing electricity demand and reach net-zero carbon emissions from power generation by 2050. It does so through the immediate deployment of solar PV to reach 8 GW generation by 2040 followed by faster deployment at 6 GW per year until 2060; significant ramp-up of green hydrogen production starting from 2040; and nuclear unit deployment starting from 2045. As noted in the *Cooling Power & Emissions* subsection it is necessary to determine a detailed roadmap for Kenya's cooling energy demand and associated carbon emissions in relation to the ETIP and the country's Nationally Determined Contributions (NDCs).

PROMOTING COOLING EQUITY AND ACCESS

Cooling equity and access actions must address the fundamental objectives of Sustainable Development Goals (SDGs) 1 (no poverty), 7 (affordable and clean energy) and 10 (reduced inequalities) so communities have the resources to access affordable, safe and reliable cooling. Access to sustainable cooling helps to alleviate poverty and reduce inequality by improving health, productivity and income opportunities. Efforts must focus on reaching the most vulnerable, e.g., adopting community-based **'cool roof' initiatives across informal settlements**, and addressing equity issues including gender-related challenges (see **Cooling for All and Gender: Towards Inclusive, Sustainable Cooling Solutions**).

ADVANCING ACCESSIBLE COLD CHAINS FOR AGRICULTURE AND HEALTHCARE

Given major social and economic opportunities as well as current challenges in the agriculture and healthcare sectors in Kenya, it is necessary to focus on providing accessible cold chains for agriculture and healthcare that support economic development and strengthen food security and health outcomes in rural communities. This includes adopting sustainable technology and services such as Cooling as a Service (CaaS) provided by SokoFresh and VacciBox. Coordinated scaling and development can build on the work of the African Centre for Technology Studies (ACTS) knowledge centre focused on sustainable cooling and cold chain solutions, which is also known as a Specialized Outreach and Knowledge Establishment (SPOKE) of the Africa Centre of Excellence for Sustainable Cooling and Cold-Chain (ACES).

04 POLICY INTERVENTIONS TO ACHIEVE SUSTAINABLE COOLING FOR ALL IN KENYA

Through its national strategies and international commitments, Kenya has a strong political basis on which to act and achieve sustainable cooling for all.

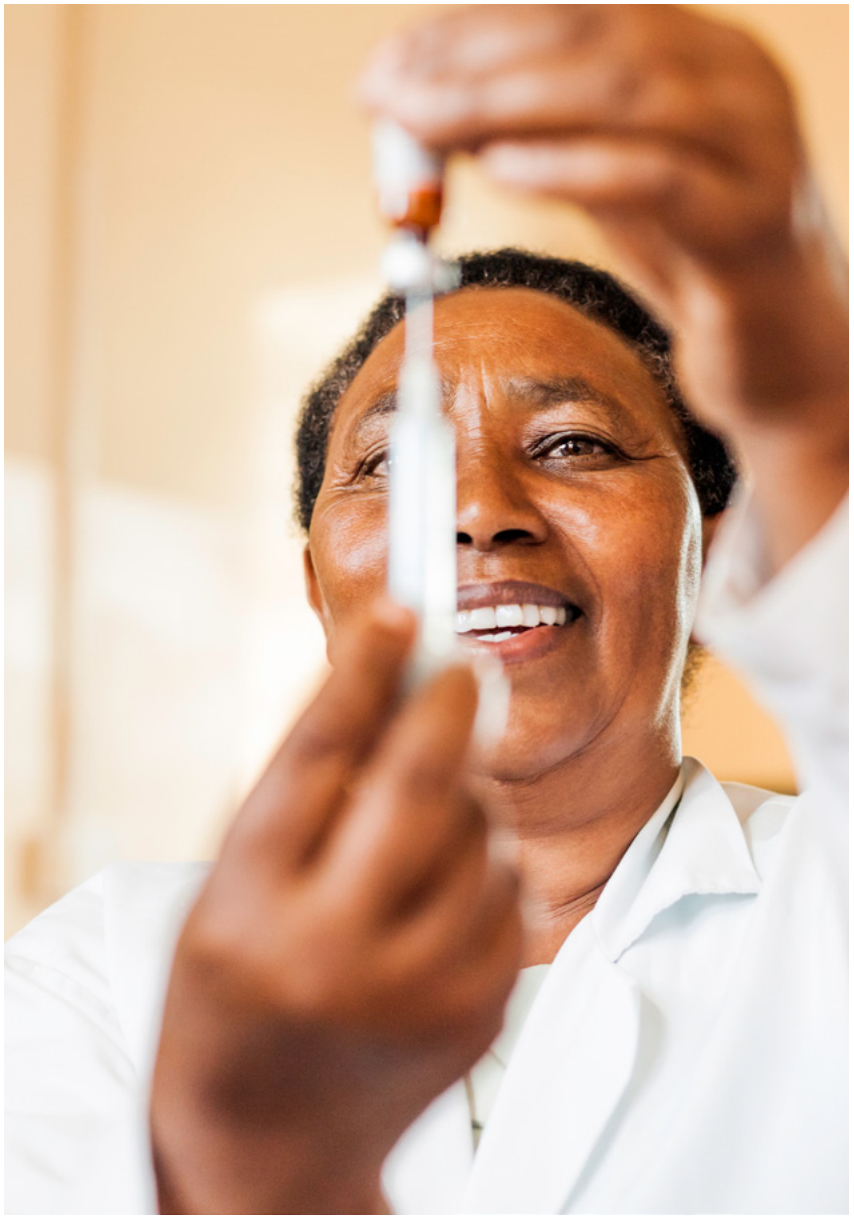
This section outlines eight priority policy actions along with key interventions that can bolster Kenya's existing political landscape and enable equitable and sustainable cooling by strengthening existing efforts, advocating for new efforts to close policy gaps, and increasing information, awareness and capacity.

INTEGRATE COOLING WITH NATIONAL AND COUNTY ENERGY, CLIMATE & DEVELOPMENT POLICIES

Given the wide-reaching impacts of a lack of access to sustainable cooling, it is essential to integrate programmes and activities to meet cooling needs into key national and local agendas on energy, climate and socioeconomic development plans.

For example:

- Considering the potential carbon emissions from cooling under difference scenarios, it will be helpful to highlight the nationwide carbon emissions reduction potential from cooling in Kenya's Nationally Determined Contribution (NDC). Future revisions of Kenya's National Climate Change Action Plan (NCCAP) and National Cooling Action Plan (NCAP) should **integrate NDC-aligned roadmaps for carbon emissions reduction from cooling**, incorporating a holistic view of cooling that includes passive cooling solutions to 'right-size' the demand for mechanical cooling, and strategies to expand access to sustainable cooling for all, in addition to the energy-efficiency and refrigerant-transition measures already covered in the 2022 NCAP.
- Integrating sustainable cooling and cold chain interventions with energy access efforts to extend the life of produce and agricultural/dairy/fishery products and/or provide temperature-controlled environments in healthcare centres.
- Including gender considerations in the NCCAP and NCAP revisions and other implementing policies and action plans will support gender equality in achieving access to sustainable cooling. This includes integrating gender-based analyses and developing gender-disaggregated indicators and participatory mechanisms to inform the design of policies and tracking of outcomes.



ESTABLISH A COORDINATING 'COOLING' COMMITTEE TO PROVIDE CROSS-MINISTERIAL AND CROSS-SECTORAL SUPPORT AND BUILD INSTITUTIONAL CAPACITIES AND IMPLEMENTATION FRAMEWORKS

Given the cross-sectoral nature of sustainable cooling, effective coordination at both national and local levels is essential. This requires the establishment of communities of practice that include representation from various ministries, local governments, civil society and the private sector. To achieve equitable and sustainable cooling, a dedicated coordinating body with clear governance structures and mechanisms for inter-ministerial collaboration is needed. This body would provide the necessary oversight and accountability, building on the roles identified in the Kenya NCAP, and Energy Transition and Investment Plan (ETIP) with the Ministries of Energy and Petroleum and Environment and Forestry serving as the lead agencies.

The key responsibilities of this coordinating body would include:

- **Facilitating inter-ministerial coordination** to leverage synergies and implement integrated solutions, such as aligning investment in refrigerant-transition efforts with appliance energy-efficiency initiatives.
- **Establishing a national centre for sustainable cooling** to serve as a resource hub for provinces, counties and cities, offering training and knowledge exchange to enhance institutional capacities. It could also support the establishment of a government-backed centre for sustainable cold chain development, as recommended in the 'Enable access to low climate-impact cooling and cold chain for agriculture and healthcare' initiative.

- **Assessing and building capacities** by evaluating the capabilities of national and county authorities, as well as key actors, to enforce and implement ongoing and planned cooling initiatives. This includes developing the workforce and technical expertise necessary for delivering sustainable cooling solutions.
- **Instituting national and county-level cooling champions**, potentially in the form of County or City Cooling Officers in flagship counties and cities, to lead cooling initiatives (see the recommendation on 'cool cities').
- **Tracking and updating progress** towards achieving the NCAP goals, developing relevant and more granular indicators, gathering data, integrating new information and technologies into the implementation plan, and ensuring continuous improvement.
- **Coordinating collaboration** among experts and civil servants to draft, update and integrate NCAP strategies, close data gaps and identify opportunities for demonstration projects.
- **Mobilizing funding for implementation and research & development** to advance innovative, energy-efficient, affordable and environmentally friendly cooling technologies, such as low-cost passive cooling solutions using locally available natural materials.
- **Fostering partnerships** and encouraging collaboration among governments, private sector entities, civil society organizations and international institutions to address the complex challenges of sustainable cooling. These partnerships would facilitate knowledge sharing, resource pooling and coordinated action across sectors and regions.
- **Creating a national cooling repository** accessible to provincial, county and city governments, consolidating existing cooling knowledge products and policy toolkits, such as those from the UN Environment Programme- (UNEP-)led Cool Coalition and the World Bank to bridge knowledge gaps.
- **Developing a government-backed cooling appliance database** to track cooling appliance sales and ownership, providing critical data for informed decision-making and NCAP updates and tracking.

ENABLE 'COOL CITIES' THROUGH A CALL TO ACTION, CITY NETWORKS AND LEADING BY EXAMPLE

Given the likelihood of heightened heat exposure in urban environments, it is necessary to focus specific efforts on new and expanding towns and cities while transforming existing community environments. To mitigate the urban heat island effect (UHIE) and deploy interventions that protect the most vulnerable urban populations whilst reducing electricity demand for cooling, the following actions are recommended:

- **Promote 'Cool' Cities:** Encourage flagship counties and cities/towns, such as Homa Bay Town, to develop integrated strategies that address urban cooling needs and mitigate heat. Support these efforts by urging subnational/county governments to sign the Global Cooling Pledge, committing to developing Heat Action Plans, increasing green and blue spaces in urban areas and prioritizing public procurement of low-global warming potential (GWP), high-efficiency cooling technologies. Strategies should focus on vulnerable populations by developing public cooling infrastructure and communication systems for heat warnings and health alerts.
- **City-to-City Learning:** Establish national 'city (or county) cohorts' or knowledge-sharing frameworks to enable learning and scaling of cooling actions across counties and cities, reinforcing their contributions to national climate goals. These networks, supported by structures like the Kenyan Council of Governors, should foster partnerships across and within cities to advance cohesive action.
- **Lead by Example:** City and county governments can set a strong example by implementing high-efficiency building standards, using best-in-class cooling equipment, and adopting procurement guidelines focused on the lowest lifecycle cost. This includes constructing municipal buildings with passive and nature-based cooling measures and choosing cooling systems that minimize energy consumption and environmental impact. These actions can inspire broader adoption of sustainable practices among businesses, organizations and residents.

INCREASE THE ADOPTION OF PASSIVE AND NATURE-BASED COOLING IN BUILDINGS

To ensure new and existing buildings across all sectors and socioeconomic domains do not intensify heat exposure or cooling demand, the following are recommended:

- **Update the Kenya National Building Code** with explicit passive cooling measures suitable for each local climate and improved energy efficiency requirements for cooling equipment and operation.
  - Passive cooling measures could include:
    - Window-to-wall ratios and glazing solar heat gain coefficients to limit solar heat gain.
    - Shading guidelines with detailed instructions based on wall orientation.
    - Roof SRI (Solar Reflectance Index) specifications.
    - Maximum U-values for walls, roofs and floors in air-conditioned spaces.
  - Energy efficiency for cooling equipment requirements could include:
    - Integrate and explicitly reference existing minimum energy performance standards (MEPs) for cooling equipment.
    - Set energy performance index (EPI) or energy use intensity (EUI) targets for different building types. Establish maximum cooling set points (e.g., 24-25°C) and minimum luminous efficacy standards for lighting.
    - Provide guidelines for system commissioning and support with technical design guides like IFC EDGE standards.
- **Develop passive cooling, nature-based solutions and thermal comfort guidelines for low-income housing** that fall outside of the formal building regulations for homes, prioritizing hot regions. This could cover:
  - **Low-cost, local materials** that enhance thermal comfort, e.g., adobe construction.
  - **Designing templates** incorporating passive and nature-based cooling for easy adoption, e.g., vegetation in compounds, white roofs and operable windows.
  - **Community training** to educate residents on maintaining and optimizing passive design features in their homes.

  - **Identifying incentives** such as subsidies for projects meeting passive and nature-based cooling/ thermal comfort standards.

- **Public sector to lead by example** by promoting energy efficiency and sustainable cooling in buildings through public sector improvements that set higher standards than the private sector is likely to follow, aligning with the Kenya National Energy Efficiency and Conservation Strategy (KNEECS) to enhance the green credentials of public buildings managed by the State Department of Public Works. This could include:
  - Establishing **energy-efficiency standards** for public buildings, requiring new and retrofitted buildings to meet benchmarks like IFC EDGE. For example, The Mvule Gardens by 14 Trees development is an EDGE-certified residential development achieving 42 percent energy savings through passive design measures such as natural ventilation and solar shading amongst other energy-efficiency strategies.
  - Enforcing guidelines for **passive and nature-based cooling** in public buildings (e.g., solar shading, cool roofs, green walls, green roofs).
  - Mandating **energy performance disclosure** and **benchmarking** for public buildings, encouraging transparency and continuous improvement.
  - Conducting regular **energy audits** to optimize building performance.

- **Provide training & capacity building for design, construction and building management professionals** on passive cooling practices and materials. For example:
  - **Upskill professionals** (engineers, urban planners, architects, contractors) through continuous professional development, certification programmes and knowledge exchange platforms.
  - **Integrate cooling and sustainable building practices into educational curriculum** and incorporate cooling as one of the 'Skills for National Development Priorities' in the national skills development policies.
  - **Enhance collaboration** with professional bodies such as the Engineers Board of Kenya, the Institution of Engineers of Kenya, the Association of Energy Professionals Eastern Africa and the Kenya Renewable Energy Association to advocate and build capacity for sustainable cooling.
- Use of existing open-source tools like:
  - Open Building Insights (OBI), a freely accessible and publicly available tool developed by SEforALL and piloted in Kenya with the support of stakeholders at national and county government(s). OBI is an open, cloud-based solution, leveraging the potency of openly accessible spatial data and advanced machine learning techniques. It empowers users with useful insights into millions of building structures in the country. Interacting with this tool provides policymakers and practitioners access to a robust suite of building features, facilitating informed decision-making and fostering sustainable planning processes in energy efficiency, cooling and infrastructure interventions.
  - The Airflow for Buildings CFD (ABCFD) tool is an early design decision tool that calculates the natural or assisted ventilation potential of buildings. It is based on a robust simulation engine (OpenFOAM) and has a user-friendly graphical user interface.

ACCELERATE THE TRANSITION TO MODEL MEPS AND PARTICIPATE IN REGIONAL HARMONIZATION OF MEPS

To strengthen and expedite the adoption of energy-efficient and low climate-impact cooling appliances, as mandated by the 2022 NCAP, the following actions are recommended:

- **Adopt more stringent MEPs whilst supporting regional harmonization:** Kenya should align its air-conditioning (AC) MEPS with U4E model regulations by 2025, as recommended by the NCAP, rather than waiting until 2027, which is the current timeline under the draft regional harmonization efforts within the East African Community (EAC). As the dominant economy in the EAC, this could help catalyze a regional transition and market shift, positioning Kenya as a regional leader. Updated MEPs would replace the latest revision for AC MEPs from April 2019, which include a minimum energy efficiency ratio (EER) of 3.1 and phaseout of low-efficiency models and harmful refrigerants like R-22 in favour of R-410A.
- Regional harmonization can be supported by **more stringent import policies** that limit the inflow of sub-optimal cooling products.
- **Consider expanding the scope of MEPS** to include other AC systems, such as multi-split and VRF, which are increasingly being adopted in the market.
- **Establish a cycle of periodic MEPS updates** to keep up with technological advancements and encourage a phased transition to more efficient appliances. Ideally, Kenya could initiate the first AC MEPS revision now for implementation in 2025, with subsequent revisions every three to five years. These revisions should include impact analyses to quantify benefits such as energy savings and greenhouse gas (GHG) emissions reductions that can feed into the country's National Determined Contributions (NDCs).
- **Prepare the industry in advance** by publishing the next edition of MEPS alongside the current standards to provide the industry with sufficient lead time to adapt to more efficient appliances. Frequent, open and formal information exchange between policy developers and private sector experts can also benefit from preparing for a smooth transition and up-to-date policymaking, while providing a

mechanism that is open to prevent collusion.

- **Supplement MEPS with a robust labelling programme** and strong compliance strategies to raise awareness among consumers, retailers and importers about the benefits of energy-efficient products. Strengthening enforcement will safeguard the anticipated benefits of Kenya's standards and labels for cooling appliances, enhancing consumer trust in both the market and government cooling policies.

STIMULATE MARKET DEMAND AND DRIVE BEHAVIOUR CHANGE FOR ENERGY EFFICIENCY

To stimulate market demand and drive behaviour change for energy efficiency:

- **Bulk and government procurement programmes:** The Government of Kenya can stimulate the market for energy-efficient products by launching bulk and government procurement programmes for equipment used in state-owned facilities like offices, schools, hospitals and utilities. This sets an example for corporate buyers and consumers while reducing the cost of new and better-performing products and raising awareness. Additional strategies include targeted incentives and on-bill financing to encourage the adoption of efficient, low climate-impact cooling appliances.
- **Encourage behaviour change:** To reduce energy consumption and enhance affordability, influencing behaviour around cooling equipment use is crucial. By 2030, limiting space cooling temperatures to 24-25°C, as outlined in the International Energy Agency's (IEA's) Net-Zero Emissions by 2050 Scenario, could significantly impact energy savings. The policymakers can enforce these set-point regulations through building codes, awareness campaigns and messaging, particularly in hotels and offices.
- **Incentivize the adoption of low-GWP refrigerants and energy-efficient equipment** – see recommended financial mechanisms in the following chapter.
- **Establish regulations for refrigerant recovery during servicing, supplemented with technician training** such as GIZ Proklima's Cool Training and the Daikin Centre of Excellence.

ENHANCE ACCESS TO LOW CLIMATE-IMPACT COOLING AND COLD CHAIN FOR AGRICULTURE & HEALTHCARE

Kenya's NCAP and the Agricultural Sector Transformation and Growth Strategy (2019-2029) emphasize modernizing cold chain infrastructure to reduce post-harvest losses, improve food safety and enhance market access. This can be achieved through investments, public-private partnerships, technology adoption and supportive policies. To support these goals and advance sustainable cold chains, not only in agriculture but also in other sectors such as healthcare, the following actions are recommended:

- **Establish a government-backed centre for sustainable cold chain development** to advance sustainable cooling and cold chain solutions for both agriculture and healthcare, leveraging the African Centre for Technology Studies' (ACTS') knowledge centre initiated as part of the Africa Centre of Excellence for Sustainable Cooling and Cold-Chains (ACES).
- **Develop a data-driven investment strategy** and policy incentives to guide concessional and commercial investments in agricultural cold chains, aiming to increase financing, boost agricultural incomes and reduce undernourishment.
- **Conduct energy and cooling audits in the health and agriculture sector** to identify opportunities for procuring sustainable cooling and cold chain technologies and explore the potential for off-grid electrification. Such audit data form the foundation of data-driven investment strategy and policy measures. (Public and institutional buildings including schools can also benefit from such audits.)
- **Implement comprehensive training and education programmes** across the cooling value chain, targeting manufacturers, technicians, policymakers and consumers. Focus on promoting best practices in energy-efficient cooling, sustainable refrigerant management and passive cooling design.

PROMOTE SUSTAINABLE COOLING AWARENESS

The effectiveness of cooling strategies can be significantly enhanced through consistent and impactful messaging that emphasizes the urgency and benefits of sustainable cooling practices. Raising awareness can drive behaviour and societal shifts toward more sustainable lifestyles. This effort should target both institutions and the general public:

- **Leverage existing resources and knowledge** from global networks like the Cool Coalition to enhance public awareness about the need for sustainable cooling. At the city level, awareness programmes can be tailored to local resources and expanded over time to increase their impact.
- **Implement public awareness campaigns** to educate consumers and businesses on sustainable cooling practices and energy conservation. Encourage behaviour change initiatives, such as setting temperature guidelines and promoting natural ventilation while providing information regarding how benefits can be made economically and environmentally reducing energy demand and decreasing environmental impact.

05 INCREASING INVESTMENT AND FINANCE FOR SUSTAINABLE COOLING FOR ALL IN KENYA

The cooling sector in Kenya faces significant challenges on both the supply and demand side of the investment and financing ecosystem. Start-ups encounter barriers to access to finance due to the mainstream financial sector's reluctance to extend credit to a sector they perceive as nascent and with new technological risks.

Key obstacles for these solution providers include a lack of sufficient collateral, limited bankable history, absence of audited financial statements and the need for capital-intensive investments with long payback periods. These issues necessitate patient capital, typically provided by multilateral development financial institutions, which often offer funding beyond the reach of small-scale players due to minimum investment ticket sizes. On the demand side, high upfront costs for energy-efficient cooling appliances, perceived risks associated with unbanked consumers, lack of quality standards like minimum energy performance standards (MEPS), and low awareness of affordable cold storage options and their long-tern economic benefits hinder widespread adoption and investor confidence.

Mobilizing financing using innovative mechanisms is important to facilitate the adoption of sustainable cooling solutions among underserved communities in Kenya.

These may include providing incentives for energy-efficient cooling investments, offering financial support for technology deployment, and establishing green financing schemes for cooling projects. But the sector is diverse, requiring different mechanisms for different players at different business stages. Some example financial mechanisms for sustainable cooling can be found in Annex 3. Underlining the need, several pilots (see Annex 1) have been conducted in Kenya to pilot financing mechanisms and innovative business models but are yet to achieve scale.

Priority strategies to accelerate the adoption of sustainable cooling in Kenya include:

- **Strategic use of co-financing**, revolving funds, demand-side loan portfolio guarantees and individual loan guarantees, or a combination of both (blended), will be necessary to encourage banks to provide loans to demand-side consumers on terms that are feasible for repayment by consumers of energy-efficient cooling appliances. The deployment, allocation and combination of the financial mechanism may vary across financial institutions in Kenya.
- **Use of catalytic financing instruments** such as green bonds and guarantees can help leverage finances for sustainable cooling. Moreover, using blended finance instruments can help create added incentives for the private sector to increase climate investments, and diversify investments into sectors with more nascent opportunities.
- **Build pipelines of investable companies** to attract additional climate finance. Catalyzing new private finance flows requires both a supply and demand for capital. Several climate finance providers report limited demand from investable enterprises, including small and medium-sized enterprises (SMEs) and micro-, small and medium-sized enterprises (MSMEs). A stronger ecosystem of business advisory services and capacity enhancement providers could improve the quality and quantity of demand for climate finance through investment readiness and climate impact metrics support. This initiative is being piloted under the Mission Efficiency Ecosystem in Kenya under the Marketplace technical working group for low carbon investments in energy efficiency.
- **Promote Kenya's climate investment opportunities** to diverse private capital providers, including those offering equity instruments that will be ideal for sustainable cold chain investments. This may call for the deployment of equity guarantees in certain cases for example cooling infrastructure.
- **Foster collaboration between financial institutions** and the sustainable cooling finance ecosystem, including business advisory services providers, to build more connectivity between the demand and supply of cold chain finance. Stronger communication on the opportunities and barriers to cold chain finance will allow all actors to contribute to overcoming obstacles to greater deal flow.
- **Promote investment in cold chain** with public financing and fiscal tools. High up-front costs hinder the adoption of cold chain technologies, particularly in the agricultural sector, and public financing tools can help alleviate this challenge. They include re-evaluating the tax regime and the use of subsidies to incentivize uptake and increase local food processing and exports. Publicly funded capacity building for cooling engineers can enhance technical skills, local manufacturing and after-sales service.

In summary, by implementing a diverse range of financing and fiscal strategies tailored to the unique challenges of the cooling sector, Kenya can significantly enhance access to sustainable cooling solutions, drive investment and foster a more resilient and climate-conscious economy.

ANNEX 1
EXISTING KENYA-BASED INITIATIVES, PROJECTS, PRODUCTS AND SERVICES ACROSS SUSTAINABLE COOLING

This annex provides an inexhaustive overview of initiatives, projects, products and services across sustainable cooling in Kenya.

TABLE 2: Overview of initiatives, projects, products and services across sustainable cooling in Kenya 1/3

	ORGANIZATION / PRODUCT (WITH LINK)	BUSINESS/FUNDING MODEL	ENERGY SUPPLY
SECTOR	PRODUCTS AND SERVICES		
AGRICULTURE	Baridi	Cooling as a Service (CaaS)	Solar
	Cold Hubs	Pay-as-You-Store	Solar
	Cold Storage Enterprise Limited	Rental with Comprehensive Service (CaaS)	Grid
	Cold Solutions (EA) Ltd	Lease to Own, 3PL	Solar
	Drop Access - Koyo	Product –as –a Service (PaaS)	Solar
	EcoZenSolution	Community	Hybrid
	Fresh Box	Lease to own / Cash / CaaS	Grid
	Inspira Farms	Lease to own	Grid only or from a mix of grid, solar, and diesel backup
	Keep It Cool	CaaS / PAYG	Hybrid
	Kuza Freezer	CaaS	Grid - solar
	Selfchill		Solar powered
	Soko Fresh	CaaS	Grid
	Solar Freeze	Product Sale, CaaS and integrated cold chain logistics	Grid, Solar
	Soko link	CaaS	Solar
	WeTU - WeCool	CaaS	Grid
	Victory Farms	Vertical Integration	Grid

TABLE 2: Overview of initiatives, projects, products and services across sustainable cooling in Kenya 2/3

	ORGANIZATION / PRODUCT (WITH LINK)	BUSINESS/FUNDING MODEL	ENERGY SUPPLY
SECTOR	PROJECTS/INITIATIVES		
AGRICULTURE	Pilot of Food Loss and Waste Value Chain Selection Guide	Piloted by the Fresh Produce Consortium of Kenya with technical support from Agribusiness Associates Inc., this guide was tested in January 2022. Developed with USDA support and USAID funding, it helps stakeholders select value chains to reduce food loss and waste.	
	Kenya Solar Powered Cold Chain Services	EUR 15.28 m for concessional loans, a credit guarantee facility and a tariff liquidity support facility to make the economic proposition of cold chain services reasonable for service providers and enable crowding-in of third-party private commercial capital. The project expects to leverage EUR 23 million from the private sector.	
	Pilot of Solar-Powered Phase Change Material-Based Cold Room	This project pilots solar-powered Phase Change Material-based cold rooms for farmers, fishing communities and small-scale traders. The pilot cold rooms are to be in Siaya County. The project supports the growth of enterprises providing this technology through affordable green funds.	
	Potato Cold Storage Facility in Meru County	Kenya's national government, represented by H.E. President William Ruto and other dignitaries, unveiled a state-of-the-art potato cold storage facility in Meru County. Kenya's national government established this facility with a capacity of 2,000 metric tonnes per year serving over 14,000 farmers and providing modern infrastructure to reduce post-harvest losses, support micro-, small and medium-sized enterprises (MSMEs), and enhance market access and value addition. It aims to increase agricultural productivity, improve food security and promote economic diversification and entrepreneurial empowerment among small-scale farmers.	
	Banana Cold Storage in Kisii County	Constructed by the national government through the Ministry of Trade and Enterprise Development, this facility supports the transition of bananas from subsistence to cash crops due to increased demand, minimizing losses.	
	PV Cool Kenya	From July 2020 to June 2022, this project, supported by Deutsche Investitions- und Entwicklungsgesellschaft mbH and involving Phaesun GmbH, Solar Cooling Engineering UG and Strathmore University, deployed three SelfChill solar cooling systems in rural Kenya. The systems included a 500-liter milk cooling unit, a 20m³ cold room and a 50kg/day ice machine. Key activities comprised training 40 local technicians on system design, installation and maintenance, and raising awareness among stakeholders. The project aimed to improve food safety, reduce waste and boost incomes for small-scale farmers and food processors through the adoption of solar-powered cooling solutions and a pay-as-you-go financing model.	

TABLE 2: Overview of initiatives, projects, products and services across sustainable cooling in Kenya 3/3

	ORGANIZATION / PRODUCT (WITH LINK)	BUSINESS/FUNDING MODEL	ENERGY SUPPLY
SECTOR	PRODUCTS AND SERVICES		
HEALTH AND CARE	Arch Cold Chain Solutions EA Fund	Pay-per-Use	Grid
	Big Cold Africa	Rental and Lease to own, 3PL	Grid and Off-grid
	Drop Access- VacciBox	Product-as-a-Service (PaaS)	Solar
	PROJECTS/INITIATIVES		
	Case Study: Supporting efficient use of energy for better rural health outcomes	From January 2020 to June 2021, with grant funding from PREO, Afya Research Africa (ARA) installed solar energy systems in 20 rural health kiosks and 4 public health centres in Siaya and Homa Bay. These systems, featuring 100 Wp and 200 Wp solar panels with battery storage, ensure a reliable power supply for essential medical equipment, including lights, fridges, haemoglobin machines and autoclaves.	
TRANSPORT	PRODUCTS AND SERVICES		
	Adamant Logistics Solutions	Lease	Grid
	Arch Cold Chain Solutions EA Fund	Pay-per-Use	Grid
	Big Cold Africa	Rental and Lease to own, 3PL	Grid and Off-grid
	Cold Solutions (EA) Ltd	Lease to Own, 3PL	Solar
	Navitrac Kenya	Integrated Fleet & Cold Chain Solutions	Grid
	PickIT Transport and Logistics	Rental with Comprehensive Service (CaaS)	Grid
	Southern Shipping Logistics Services(SSSL)	Lease/product as a service	Grid
NATURE-BASED SOLUTIONS	Miti Mtaani	Trees for cash	-
	Youth4Nature: INUKA Afrika	Eco youth initiative	-
	Miti Alliance	Social Enterprise	-
PASSIVE COOLING SOLUTIONS	Steam Plant Limited	PaaS	-

ANNEX 2
KENYA'S PROGRESS ON THE GLOBAL COOLING PLEDGE COMMITMENTS

The table below provides Sustainable Energy for All's (SEforALL's) assessment of Kenya's progress against the national and subnational commitments of the Global Cooling Pledge. Currently, the national Government of Kenya is a signatory of the pledge but subnational (i.e., county) governments in Kenya have yet to sign the subnational pledge.

TABLE 3: Kenya's national progress on the Global Cooling Pledge commitments 1/4

NATIONAL GLOBAL COOLING PLEDGE COMMITMENTS	PROGRESS	RECOMMENDATIONS FOR NEXT STEPS
Commit to working together with the aim of reducing cooling-related emissions across all sectors by at least 68% globally relative to 2022 levels by 2050, consistent with limiting global average temperature rise to 1.5°C and in line with reaching global net-zero emissions targets with significant progress and expansion of access to sustainable cooling by 2030. This aim will be advanced through individual countries' domestic actions as consistent with their domestic plans and priorities, and international collaboration.	The 2022 Kenya National Cooling Action Plan (NCAP) aims to reduce Kenya's cooling-related carbon emissions by accelerating market transition to high-efficiency cooling appliances and equipment and transitioning the cooling sector to natural refrigerants with low global warming potential (GWP).	Each of the priority policy actions recommended in the main body of this report will contribute to this commitment. Most notably Kenya should Integrate cooling with national and county energy, climate & development policies including NDC-aligned roadmaps for carbon emissions reduction from cooling.
Commit to ratifying the Kigali Amendment by 2024 for those countries that have not already done so.	Kenya ratified the Kigali Amendment to the Montreal Protocol in 2018.	• Enhance access to low climate-impact cooling and cold chain for agriculture & healthcare. • Incentivize the adoption of low-GWP refrigerants and energy-efficient equipment. • Limit the amount of HFC sold in country to remain the same as the ceiling. • Reduce the GWP of refrigerants in new and existing equipment (e.g., move to CO2-based cooling in supermarkets, enhanced AC MEPS, low GWP limit for AC refrigerants). • Prevent HFC emissions from leaking from existing equipment (through checks, servicing and end-of-life recovery). • Establish regulations for refrigerant recovery during servicing, supplemented with technician training.
Commit to supporting robust action through the Montreal Protocol Multilateral Fund for early action to reduce HFC consumption and to promote improved energy efficiency for the hydrochlorofluorocarbons (HCFC) phase-out and hydrofluorocarbon (HFC) phase-down.		

TABLE 3: Kenya's national progress on the Global Cooling Pledge commitments 2/4

NATIONAL GLOBAL COOLING PLEDGE COMMITMENTS	PROGRESS	RECOMMENDATIONS FOR NEXT STEPS
Commit to publishing a NCAP, considering cooling when publishing a national action plan, or publishing a regulation or equivalent by 2026 to reflect relevant efforts in designing NDCs under the Paris Agreement and HFC phase-down plans.	Kenya published its first NCAP in 2022, providing actions to meet Kenya's growing cooling demand and enhance access to cooling services, while minimizing climate and environmental impacts by: • Accelerating market transition to high-efficiency cooling appliances and equipment. • Transitioning the cooling sector to natural refrigerants with low GWP. • Increasing access to agricultural cold chain solutions.	The current NCAP actions can be supported by progressing the priority policy action recommendations provided in the main body of this report. In particular, the next update of the NCAP should consider: • Integrating cooling with national and county energy, climate & development policies including NDC-aligned roadmaps for carbon emissions reduction from cooling. • Enabling 'Cool Cities' through a call to action, city networks and leading by example. • Encouraging the increased adoption of passive cooling in buildings. • Targeting programmes for the most heat-vulnerable communities.
Commit to establishing national model building energy codes that incorporate market appropriate measures such as passive cooling and energy-efficiency strategies at the latest by 2030 for new and refurbished buildings as appropriate for those countries with jurisdiction of national building codes, or for those countries that do not have such jurisdiction, support adoption of building energy codes at the sub-national level*.	• The Kenya National Building Code 2022 includes a section on Energy efficiency and thermal comfort and Sustainable building design strategy, which includes high-level requirements for buildings to, for instance, prevent heat gain through building planning and glazing choice. However, the code does not explicitly prescribe or provide performative requirements for passive cooling measures.	Act on the recommendations in the main body of the report to increase the adoption of passive cooling in buildings, which includes updating the Kenya National Building Code with explicit passive cooling measures suitable for each local climate and improved energy-efficiency requirements for cooling equipment and operation. Support with training & capacity building of design, construction and building management professionals.
Commit to working together to support increased market penetration of highly efficient air-conditioning equipment and innovative technologies and collectively increase the global average efficiency rating of new air-conditioning equipment sold by 50% by at the latest 2030 from global 2022 installed baseline.	Kenya's NCAP includes relevant enabling actions including: • Increasing ambition of existing standards and labels for cooling appliances. • Raising awareness on energy labels. • Strengthening compliance and enforcement to safeguard benefits of efficiency policy.	Consider progressing actions from the report recommendation including: • Accelerating the transition to model minimum energy performance standards (MEPs) and participating in regional harmonization of MEPS. • Stimulating market demand and driving behaviour change for energy efficiency.
Commit to establishing MEPS by 2030 at the latest and aim to routinely raise ambition and progress consistent with respective national laws with a view to achieve net-zero emissions by 2050 and noting best available technology and available model regulation guidelines.	Kenya has established MEPS for various appliances, including air conditioners, refrigerators and circulating fans, to enhance energy efficiency and reduce environmental impact. The MEPS for air conditioners, revised in April 2019, increased the minimum energy efficiency ratio (EER) to 3.1 and phased out low-efficiency models and harmful refrigerants like R-22 in favour of R-410A. For refrigerators, the standards set specific energy consumption limits based on size and type, ensuring only efficient models are available.	Focus on accelerating the transition to model MEPs and participate in regional harmonization of MEPS and stimulating market demand and drive behaviour change for energy efficiency (see recommendations in the main body report).

TABLE 3: Kenya's national progress on the Global Cooling Pledge commitments 3/4

NATIONAL GLOBAL COOLING PLEDGE COMMITMENTS	PROGRESS	RECOMMENDATIONS FOR NEXT STEPS
Commit to establishing or updating public procurement policies and guidance for low-GWP and high-efficiency cooling technologies and innovative solutions where feasible or ensure broader arrangements are in place that drive such approaches in public procurement at the latest by 2030.	The NCAP includes an enabling action to launch bulk and government procurement programmes, however, this is yet to get off the ground.	Through a newly cross cooling established cooling committee, pursue public procurement of low GWP and high-efficiency cooling technologies focused on the lowest lifecycle cost in public buildings.
Commit to supporting collaborative research, innovation and deployment activities at the local and international level such as renewable energy-based cooling solutions in rural, remote, off-grid locations or research and development of cooling systems applying refrigerants with GWP less than 150.	The African Centre for Technology Studies (ACTS) in Kenya hosts the first Specialized Outreach and Knowledge Establishments (SPOKEs) as part of the Africa Centre of Excellence for Sustainable Cooling and Cold-Chain (ACES). ACES conducts collaborative research, equipment testing, knowledge development, and training in sustainable cooling and cold-chain solutions across Africa. Kenya's SPOKE will demonstrate solutions, provide technical support, and spread knowledge to local markets.	Continue to support and expand collaborative research and innovation initiatives, focusing on sustainable and low-GWP cooling solutions. Establish a government-backed centre for sustainable cold chain development and develop a data-driven investment strategy for cold chains (building on ACTS).
Commit to supporting existing international cooling emissions reduction and cooling access. initiatives, such as those of the United Nations Environment Programme-(UNEP-)led Cool Coalition, to advance global cooperation and domestic actions.	Kenya actively participates in international cooling initiatives and collaborates through ACES.	Strengthen Kenya's involvement in international initiatives and continue to promote domestic actions in alignment with global cooling emission reduction efforts. Mobilize funding for implementation, research and development of innovative cooling technologies.
Commit to pursuing the life cycle management of fluorocarbons in particular addressing HFC banks, if feasible, such as through the Initiative on Fluorocarbons Life Cycle Management.	Kenya is making progress in managing fluorocarbons through regulations for refrigerant recovery during servicing and technician training programmes like GIZ Proklima's Cool Training.	Expand life-cycle management initiatives for fluorocarbons, focusing on HFC banks, and enhance technician training and public awareness. Promote sustainable refrigerant management practices and passive cooling design across the cooling value chain.
Commit to reviewing progress towards the target of the Global Cooling Pledge on an annual basis until 2030 and have a dedicated high-level meeting at the UN Climate Change Conference.	Kenya is committed to reviewing progress and engaging in high-level discussions on the Global Cooling Pledge.	Maintain up-to-date, transparent and publicly available information on Kenya's policies and commitments to inform progress reviews and relevant reports. Enhance tracking and updates on NCAP goals, integrating new information and technologies into the implementation plan.

TABLE 3: Kenya's national progress on the Global Cooling Pledge commitments 4/4

NATIONAL GLOBAL COOLING PLEDGE COMMITMENTS	PROGRESS	RECOMMENDATIONS FOR NEXT STEPS
Commit to maintaining up-to-date, transparent and publicly available information on Kenya's policies and commitments to inform the progress reviews and relevant reports such as the UNEP Global Cooling Stocktake.	Kenya is committed to reviewing progress and engaging in high-level discussions on the Global Cooling Pledge.	Continue to align national actions with the Global Cooling Pledge and explore new commitments annually. Foster partnerships and encourage collaboration among governments, private sector entities, civil society organizations and international institutions.
Commit to using as appropriate the national action agenda to make further progress towards the ambition of the Global Cooling Pledge and consider new commitments in the Global Cooling Pledge on an annual basis until 2030 as appropriate.	This is being addressed through the NCAP.	Continue to align national actions with the Global Cooling Pledge and explore new commitments annually. Foster partnerships and encourage collaboration among governments, private sector entities, civil society organizations and international institutions. Implement action and updates to the NCAP considering the priority action areas recommended in the main body of the report.
Call on subnational governments and non-state actors including the private sector, financial institutions and philanthropies to help support the implementation of the Global Cooling Pledge.	Whilst several ministries and private organizations have a focus on sustainable cooling in Kenya, there is currently a lack of cross-ministerial and sector coordination.	This can be coordinated through the recommended cooling committee (main body of the report) to strengthen engagement with county governments, private sector and other stakeholders to support the implementation of the Global Cooling Pledge. Promote city-to-city learning and lead by example with sustainable cooling practices in public buildings.
Call on other states to join the Global Cooling Pledge.	Of the countries neighbouring Kenya, Ethiopia and Somalia are the only signatories of the Global Cooling Pledge.	Kenya can continue advocacy for broader participation in the Global Cooling Pledge and related initiatives, e.g., regional harmonization of MEPs. Implementing public awareness campaigns to educate consumers and businesses on sustainable cooling practices and energy conservation can also support cross-border cooling transitions.

ANNEX 3
FINANCIAL MECHANISMS FOR SUSTAINABLE COOLING

TABLE 4: Financial mechanisms for sustainable cooling

CLUSTER OF FINANCE	CHARACTERISTICS	USES	STRENGTHS AND WEAKNESSES
GRANTS/TECHNICAL ASSISTANCE	• Provided by development and philanthropic actors • No financial return expectation	• Supporting instruments, intended to help achieve impact goals • Important when entering new markets • Preferred for nascent technologies where secondary market hasn't developed	• Require less financial knowledge • Need to strike a balance between accountability and flexibility • Historically criticized for lack of effectiveness • Cause market distortions.
RESULTS-BASED FINANCING (RBF)	• Links impact creation directly to financial rewards/Incentives • Allows stakeholders with different interests to be aligned • Addresses an impact-specific need with performance-based KPIs	• Directly creates impact and strengthens the relationship between impact and the financial payment • Demonstrates the effects of the instrument • Can be combined with grants and technical assistance/Capacity enhancement instruments	• Creates knowledge sharing of an impact sector or region among stakeholders • Clear impact measurement and reporting • Tends to be smaller in size and higher in complexity–needs to answer the question of scalability and phaseout • Requires appropriate and material financial reward to be effective • Can invite public scrutiny when misunderstood as subsidizing the private sector • Creates knowledge sharing of an impact sector or region among stakeholders
MARKET-RATE DEBT & EQUITY, SUBORDINATED DEBT, CONCESSIONAL DEBT & EQUITY	• Clear distinction between debt and equity capital • Equity takes a higher risk, higher return and ownership; debt takes a lower risk, lower return and no ownership • Subordination is about risk–taking a junior position and a lower priority for repayment • Concessionally is about lower return and/or longer time horizons • Capital providers can be both subordinate and concessional, but are not necessarily so	• Varying motivations depending on debt vs. equity, market-rate vs. subordinate vs. concessional capital • Chosen for being an established instrument • Important to align risk and return expectations by using clearer terminology	• Established instruments easily understood by the private sector and other stakeholders • Require financial knowledge • Impact not explicitly built into the structure • Financial and impact additionality is contested

ABOUT SEforALL

Sustainable Energy for All (SEforALL) is an independent international organization that works in partnership with the United Nations and leaders in government, the private sector, financial institutions, civil society and philanthropies to drive faster action on Sustainable Development Goal 7 (SDG7) – access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement on climate change.

SEforALL works to ensure a clean energy transition that leaves no one behind and brings new opportunities for everyone to fulfil their potential. Learn more about our work at www.SEforALL.org