REPUBLIC OF KENYA

MINISTRY OF ENVIRONMENT,
CLIMATE CHANGE AND FORESTRY

State Department for
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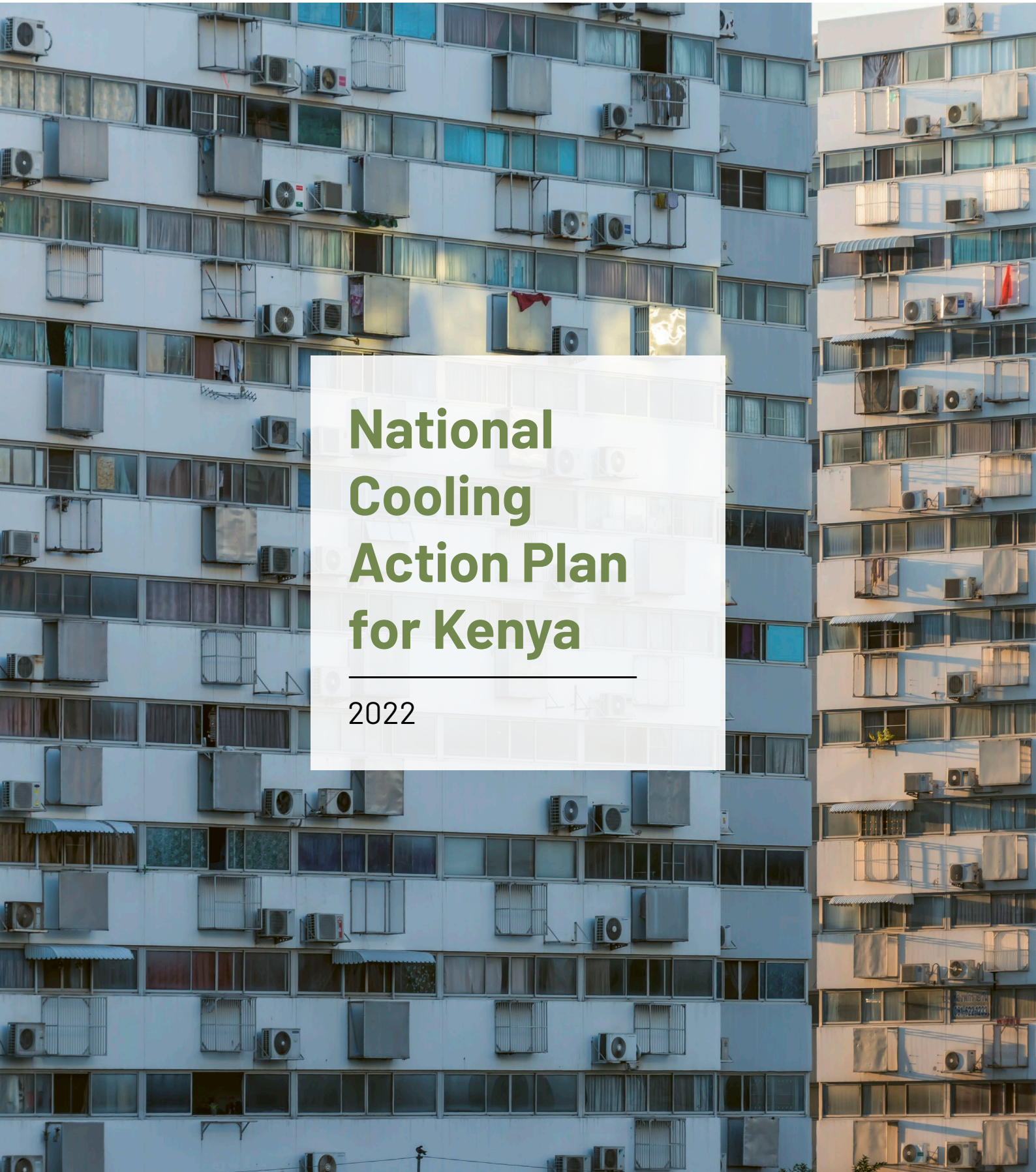

National Cooling Action Plan for Kenya

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IKI INTERNATIONAL CLIMATE INITIATIVE

Foreword

In developing countries and emerging economies, the demand for cooling services and equipment is rising as a result of increasing energy access, economic growth, and higher temperatures due to climate change. Kenya experiences rapid population growth linked with rapid urbanization, growing urban poverty, water scarcity, falling food production and decreasing resilience to climate change. These challenges have led to an increase in demand for Refrigeration and Air-Conditioning (RAC) appliances and services. Transitioning to alternative RAC technologies with high levels of energy-efficiency as well as ozone and climate-friendly refrigerants, holds a large saving potential in terms of electricity costs and Green-House Gas (GHG) emissions, thereby contributing to sustainable development.

RAC emissions, based on Ozone Depleting Substances (ODS), are responsible for damage of the ozone layer and have a significant share of global GHG emissions. Low levels of energy efficiency and high leakage rates of refrigerant gases with high Global Warming Potential (GWP) will increase these emissions drastically.

The National Cooling Action Plan (NCAP) has been developed based on the various mitigation scenarios for the Kenyan RAC sector, and is guided by the Environmental Management and Coordination Act (EMCA) 1999 which is the framework law on environment and conservation. NCAP's five-year plan (2023-2027), is designed to guide the provision of access to sustainable cooling for all Kenyans through; accelerating market transition to high efficiency cooling appliances and equipment; transitioning the cooling sector to natural refrigerants with low global warming potential and increasing access to agricultural cold chain solutions.

To effectively and efficiently deliver the expected transformational outcomes of the National Cooling Action Plan, a multi-sector approach through collective contributions of the national and county government, the private sector, non-state actors and individual citizens, is required. NCAP will also require the support of our development partners and other well-wishers to ensure its effective implementation for the benefit of the present and future generations.

I am sure that NCAP will go a long way in achieving the objectives of Sustainable Development Goals (SDGs) while improving the quality of life of our people.

HON. SOIPAN TUYA, CBS
CABINET SECRETARY
MINISTRY OF ENVIRONMENT,
CLIMATE CHANGE & FORESTRY

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The Ministry of Environment, Climate Change and Forestry acknowledges and appreciates the Department of Multilateral Environment Agreements and the National Ozone Unit for coordinating the development of the National Climate Action Plan (2023–2027).

The contributions and support from various Government Ministries, State Agencies, the County Governments, Specialized sectors/agencies, the academia, Non-Governmental Organizations, the private sector and development partners formed the basis of this Action Plan. The active and invaluable contributions of the Government of Germany through the GIZ Green Cooling Initiative II, CLASP and Sustainable Energy for ALL among others are also well appreciated.

Development partners will particularly find the information provided in the Plan very helpful in their alignment of funding preferences with Kenya's aspirations to attain compliance with the Montreal Protocol on substances that Deplete the Ozone Layer and a low carbon climate resilient economy. We remain grateful to their commitment to walk alongside Kenya in this journey.

It is appreciated that effective implementation of NCAP will require continued input from these stakeholders, and increased partnerships and enhanced support from development partners.

ENG. FESTUS K. NG'ENO
PRINCIPAL SECRETARY
STATE DEPARTMENT FOR ENVIRONMENT
& CLIMATE CHANGE

Contents

Acronyms

AC	Air conditioners
ADB	African Development Bank
BAU	Business as usual
BSRIA	Building Services Research and Information Association
CSPF	Cooling seasonal performance factor
DC	Direct current
DDT	Dichlorodiphenyltrichloroethane
EAC	East African Centre
EACREEE	East African Centre of Excellence for Renewable Energy and Energy Efficiency Ecofridges
ECOWAS	Economic Community of West African States
EE	Energy efficiency
EELA	Energy Efficient Lighting and Appliances
EER	Energy efficiency ratio
EPRA	Energy and Petroleum Regulatory Authority
ETF	Enhanced Transparency Framework
EU	European Union
GCF	Green Climate Fund
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environmental Facility
GHG	Greenhouse gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWh	Gigawatt hour
GWP	Global warming potential
HCFCs	Hydrochlorofluorocarbons
HC	Hydrocarbon
HVAC	Heating, Ventilation, Air Conditioning and Refrigeration Association of Kenya
HFCs	Hydrofluorocarbons
HFOs	Hydrofluoro olefines
HVAC-R	Heating, venting air conditioning and refrigeration
IPCC	Intergovernmental Panel on Climate Change
KEBS	Kenyan Bureau of Standards
KIRDI	Kenyan Industrial Research and Development Institute
KNBS	Kenyan National Bureau of Statistics
KOSAP	Kenya Off-Grid Solar Access Project for Underserved Counties
KRA	Kenya Revenue Authority
MEPS	Minimum energy performance standards
MLF	Multilateral Fund
MRV	Monitoring, Reporting and Verification
$MtCO_2e$	Megatonnes Carbon dioxide equivalent
NAMA	Nationally appropriate mitigation action
NCAP	National Cooling Action Plan
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority
OECD	Organization for Economic Co-operation and Development
PAYG	Pay- as-you-go
PFCs	Perfluorinated chemicals
QCR	Qualification, Certification and Registration
R&D	Research and development
RAC	Refrigeration and air conditioning
RDM	Roadmap
S&L	Standards and labelling
SADC	Southern African Development
SACREE	Community Centre for Renewable Energy and Energy Efficiency
SE for All	Sustainable Energy for All
SEER	Seasonal energy efficiency ratio
SRI	Star Rating Index
SUV	Sport utility vehicle
TBD	To be decided
TFA	Trifluoric acid
U4E	United for Efficiency
UAC	Unitary air conditioning
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar
VRF/VRV	Variable refrigerant flow/ variable refrigerant volume

1

INTRODUCTION

1 Introduction

A National Cooling Action Plan defines a country's ambitions towards sustainable cooling and charts the best possible path for accommodating current and future cooling demand while minimizing possible impacts on the environment, especially climate impacts. The Kenya National Cooling Action Plan is designed to enhance access to sustainable cooling for all Kenyans. The target is a holistic approach across sectors, taking into account the individual appliance, the building shell, as well as cold chains and the cooling needs for the entire population.

This will be achieved by increasing access to and improving efficiency of cooling appliances available in Kenya, transitioning the cooling sector to refrigerants with low global warming potential in general and to natural refrigerants where feasible, and increasing access to agricultural cold chains. In addition, the revision of building codes is initiated to mainstream passive cooling and to avoid the lock-in of poorly insulated new buildings that exhibit a high cooling load. Passive cooling measures can provide critical cooling services to populations lacking cooling appliances or the economic means to operate them, while also reducing and avoiding the cooling energy demand. Kenya's National Cooling Action Plan is a living document, that will be updated in regular intervals to include more measures as capacities for implementation increase. The current focus lies on the promotion of energy efficient refrigeration and air-conditioning appliances, as those are rather straight forward measures that can be implemented in the short and medium term.

To promote the well-being of all Kenyans, strategies need to be developed to provide access to cooling to all inhabitants of Kenya, especially in hot regions. This development goal requires a broader scope than the uptake of energy efficient appliances and includes suitable building design and city planning to reduce active cooling demand in the first place as well as the affordability of cooling, be it active or passive.

1.1 Rationale for a National Cooling Action Plan in Kenya

Kenya is currently on an ambitious path to universal electrification with an aim to provide universal access by 2022.[1] Electrification will be achieved through both grid extension and densification, and off-grid solutions. Kenya's climate is also expected to change as global temperatures rise, with the mean annual temperature on trend to increase by up to 1.5°C by the 2030s.[2] Universal electrification and concomitant economic growth will mean more Kenyans will seek access to modern cooling services for the first time – for instance, a refrigerator to store food – while a warmer climate will increase the need for space cooling in homes, business and other workspaces. Currently, only 12.8% of households in Kenya own a refrigerator[3] while air conditioning penetration is estimated at 15% for the residential sector and 30% for the commercial sector.[4]

In addition, the government is committed to ensuring food security, affordable housing, growth in manufacturing, and affordable healthcare for all, as part of the broader Vision 2030 strategy.[5] Cooling[6] is relevant for all four development aspirations:

1. **Reliable cold chains** can enhance food security and nutrition, by reducing food losses, and increasing incomes of small holder farmers, fishermen, and pastoralists. Improved agricultural cold chains would enable transportation of food from the more agriculturally productive regions to those with limited agricultural output.

2. **Refrigeration to preserve vaccines and medical supplies** can facilitate Kenya's goal to vaccinate 90% of children before their first birthday. Vaccine cold chains are also critical to support COVID-19 immunization efforts.

3. **Affordable and efficient cooling appliances** can improve the quality of new homes by lowering the cost of accessing modern cooling services, like refrigeration and air conditioning.

4. **Reduced energy consumption through energy efficient cooling** can free up electrical grid capacity to support manufacturing growth while reducing the electricity costs for manufacturing plants that require process and comfort cooling.

However, enhancing access to cooling services will impact Kenya's climate commitments of a 30% reduction – or 143 Mt CO_2 - of its greenhouse gas (GHG) emissions by 2030.[7] This is because cooling equipment contributes to greenhouse gas emissions both directly and indirectly. Direct emissions come from the refrigerants used in most cooling appliances – hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) – which are potent greenhouse gases and can be released while the equipment is in use as well as at the end of life. Indirect emissions result from the generation of the electricity used to run the appliances. If unaddressed, energy demand from residential refrigerating appliances and room air conditioning alone will reach between 1,760 and 3,145 GWh of electricity in 2030, approximately 7 to 13% of the projected total electricity demand in 2030 in Kenya.[8] Those two applications are responsible for more than 50% of the overall refrigeration and air conditioning (RAC) sector, followed by commercial refrigeration such as cold storage and refrigerated display cabinets. However, investments in passive cooling measures, such as solar reflective surfaces, can beneficially contribute to Kenya's climate commitments by cancelling the warming effect of GHG emissions.

In order to meet this cooling demand sustainably, it will be necessary for Kenya to take actions to address growing electricity used by cooling equipment through increased energy efficiency and to promote a transition to refrigerants with low global warming potential, especially natural refrigerants. Furthermore, in order to build climate resilience, investments in sustainable cold chains to support food security and healthcare outcomes will also be necessary. Current government policies laid out in Kenya's National Energy Efficiency and Conservation Strategy, the National Climate Change Action Plan, and the National Adaptation Plan identify these two cross-cutting objectives as development priorities, in particular:

- **Energy efficiency** as a key action to mitigating climate change, contributing to Kenya's Nationally Determined Contributions, and achieving Sustainable Development Goal 7 (to ensure access to affordable, reliable, sustainable and modern energy for all), and

- **Enhancing the resilience of the agricultural value chain**, in particular, improved access to agricultural cold chains as one of the "climate smart" solutions that enables resilience by reducing post-harvest losses.

With climate change affecting ambient temperatures, space cooling is moving from being a luxury to a necessity. Access to living and working spaces that provide favorable conditions for comfort and efficiency are key for sustained development. Such considerations are described by Sustainable Energy for All (SE for All) and its Cooling for all Needs Assessment[9]. Access to cooling is linked to several SDGs and can be studied in three areas: human comfort and safety; food, nutrition security and agriculture; and health services. Each of those areas comes with a set of indicators to describe the needs-based cooling demand. Including the currently un-met cooling demand in future updates of the National Cooling Action Plan is a corner stone to understand the magnitude of cooling needs and the benefits of met cooling demands. Developing a plan to meet this cooling demand is building on the current National Cooling Action Plan, but also needs to include additional action, especially to deploy nature-based and passive cooling options in settlement and building design, such as shading, air flow and reflection.

1 Government of Kenya (2018). Kenya National Electrification Strategy.
2 Government of Kenya (2016). Kenya National Adaptation Plan 2015 – 2030.
3 Refrigerator ownership levels are estimated to be around 12.8% based on CLASP modeling. ESMAP estimates ownership levels in urban areas at around 13% and in rural areas at <1% (*https://datacatalog.worldbank.org/dataset/kenya-multi-tier-framework-mtf-survey*).
4 BSRIA. 2019. Africa AC and energy efficiency analysis: Kenya.
5 Kenya Vision 2030, at: *https://vision2030.go.ke/about-vision-2030/*
6 The world cooling in this document is used for both process and comfort cooling (i.e., cold storage through refrigeration and thermal comfort through air conditioning).
7 Government of Kenya (2015). Nationally Determined Contribution. Retrieved March 20, 2019, from UNFCCC: *https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Kenya%20First/Kenya_NDC_20150723.pdf*
8 Modeling results compared to 2030 Reference Scenario forecasted electricity demand of 25,195 GWh as published in the Kenya Vision 2030: Least Cost Power Development Plan 2017-2037. Akbari, H., Menon, S. & Rosenfeld, A. Global cooling: increasing world-wide urban albedos to offset CO_2. Climatic Change 94, 275–286 (2009). *https://doi.org/10.1007/s10584-008-9515-9*
9 *https://www.seforall.org/data-stories/cooling-for-all-needs-assessment*

1.2 Goals of the National Cooling Action Plan

Considering the Government of Kenya development aspirations and priorities, the National Cooling Action Plan is designed to develop a pathway to the provision of access to sustainable cooling for all Kenyans. This Plan provides specific actions to achieve this goal, grounded in a review of the Kenyan regulatory framework, an assessment of Kenya's cooling sector, and with inputs from Kenyan stakeholders that reflect national objectives and priorities, including those of government, national industry and civil society. The proposed actions are designed to meet Kenya's growing cooling demand and enhance access to cooling services, while minimizing climate and environmental impacts.

The overall objective can be met through:

1. Accelerating market transition to high efficiency cooling appliances and equipment
2. Transitioning the cooling sector to natural refrigerants with low global warming potential
3. Increasing access to agricultural cold chain solutions

The proposed actions under each objective fall under two categories: short-term actions considered immediate priorities to be implemented within the next three years, and medium-term actions, considered priorities for the next three to ten years. These actions are summarized in *Figure 1*.

Figure 1: Summary of Kenya National Cooling Action Plan Objectives, Short and Medium Term Actions

Targets	Short-Term Actions	Medium-Term Actions
Accelerate market transition to high efficiency cooling appliances and equipment	1.1 Increase ambition of efficiency standards for ACs and refrigerators 1.2 Raise awareness on energy labels for cooling products 1.3 Strengthen compliance and enforcement 1.4 Launch bulk and government procurement programs 1.5 Implement favorable fiscal policies for high-efficiency products	1.6 Expand efficiency standards to cover end-uses with growing energy demand
Transition the cooling sector away from high-GWP refrigerants	2.1 Ratify the Kigali Amendment 2.2 Raise awareness for the application of natural refrigerants	2.3 Ban high GWP-refrigerants in selected product groups 2.4 Establish for·mal qualification, certification, and registration scheme for techr1icians
Increase access to agricultural cold chain solutions	3.1 Create an enabling environment for the cold chain market 3.2 Expand fiscal benefits to cold storage systems 3.3 Raise awareness on the benefits of the cold chain	3.4 Support R&D for technical solutions adapted to local conditions 3.5 Promote access to innovative business models 3.6 Design finance models targeted at small-holder farms

2

GREENHOUSE GAS EMISSIONS FROM THE COOLING SECTOR

2 Greenhouse gas emissions from the cooling sector

Two data sets are the basis for this section in particular and for this report in general. Those data sets have resulted from independent work from two consultancies. The German Gesellschaft für Internationale Zusammenarbeit (GIZ) has focused on the whole refrigeration and air conditioning (RAC) sector, collecting data on appliances sales and appliances in use, as well as projections of refrigerant and energy emission up to 2050 for the five subsectors constituting the majority of emission from the RAC sector: Unitary AC, AC Chiller, domestic refrigeration, commercial refrigeration, mobile AC. Data collection included detailed questionnaires with importers, distributers, as well as large end-users and technicians. The work has been carried out between 2015 and 2017, including data up to 2016 and questionnaire-based assumptions for the market development up to 2020. Under the impact of the COVID pandemic, those growth projections were certainly too optimistic. Therefore the sales projections have been adjusted to reflect the current development.

CLASP has undertaken a very detailed analysis of the residential AC and residential refrigeration markets and was deeply involved in designing the current Kenyan minimum energy performance standards (MEPS) regulation. In 2018, CLASP collected detailed model-level data for 100 room ACs and 1115 domestic refrigerating appliances available for purchase in 43 Kenyan retailers. CLASP further supplemented the 2018 data with product information obtained from the Energy and Petroleum Regulatory Authority (EPRA) product registries for room ACs and refrigerating appliances. Market size and segmentation data was pulled from the 2018 market studies, while the EPRA product registry data was used to develop up-to-date (post-new regulation) efficiency baselines for the major market segments in each product category.

Rather than attempting to smooth out the differences between the approaches and present a single data set here, we chose to offer the added value by highlighting the differences and showing data ranges for results concerning residential split ACs and residential refrigerating appliance.

The most pronounced difference between those two data sets are the appliance sales. GIZ has noticed during their analysis, that importers and distributors claim to have sold many more appliances than recorded in the customs statistics and has decided to build their analysis on the higher, sector reported sales data. It thus represents the higher end of sales and resulting emission projections. In contrast, CLAPS relies on 2012-2017 AC and refrigerator imports data from the Kenya Revenue Authority and, in the case of ACs, sales estimates and forecasts for 2017-2023 from Building Services Research and Information Association (BSRIA) for their appliance sales data.

2.1 GHG emissions from the Kenyan RAC sector

Over the recent years, Kenya has experienced a steady growth in the number of RAC appliances in use. Due to growing population and the expected climate change towards warmer temperatures, the demand for cooling is rising. The resulting greenhouse gas emissions from the RAC sector increased from 3.56 Mt CO_2eq in 2010 to 3.99 Mt CO_2eq in 2015 (*Figure 1*). Based on current trends and a projected hotter climate in Kenya, the GHG emissions from the RAC sector are prone to reach 4.75 Mt CO_2eq in 2030 and up to 7.87 Mt CO_2eq in 2050.

Unitary AC followed by domestic and commercial refrigeration account for the highest proportion of emissions.

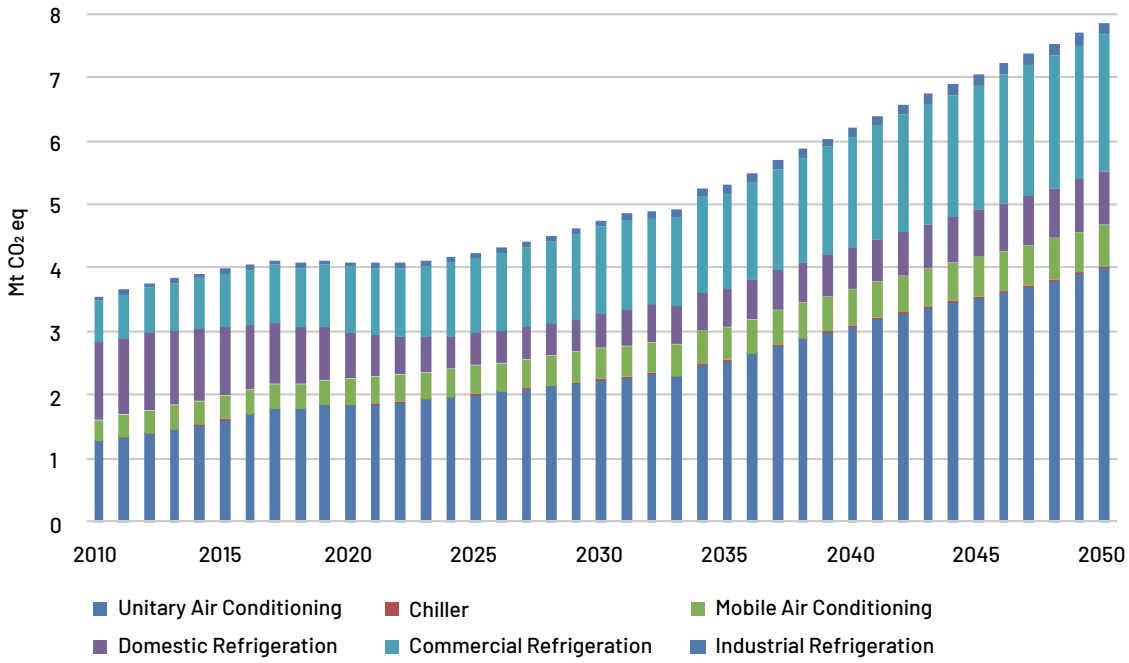


Figure 2: Projected BAU scenario for total GHG emissions in Kenya's RAC Sector (Source: GIZ Inventory of the Kenyan RAC sector)

2.2 GHG Emissions from Room AC Subsector

The two approaches on sales data from GIZ and CLASP also result in different projections of the number of room ACs in use. The average energy consumption of the room AC units is very similar in the 2 data sets and relies on CLASP detailed market research. A detailed description of underlying data sets is included in the respective chapters. The emissions from energy use ranges between 0.28 and 0.91 Mt CO_2 in 2020. The diverging emissions mainly originate from the different sales data used and the resulting diverging number of appliances in use. Direct emissions on an annual basis are modelled by GIZ and amount to 0.44 Mt CO_2eq in 2020.

Figure 3: Range of GHG emissions from room ACs modelled from two different sales data sets.

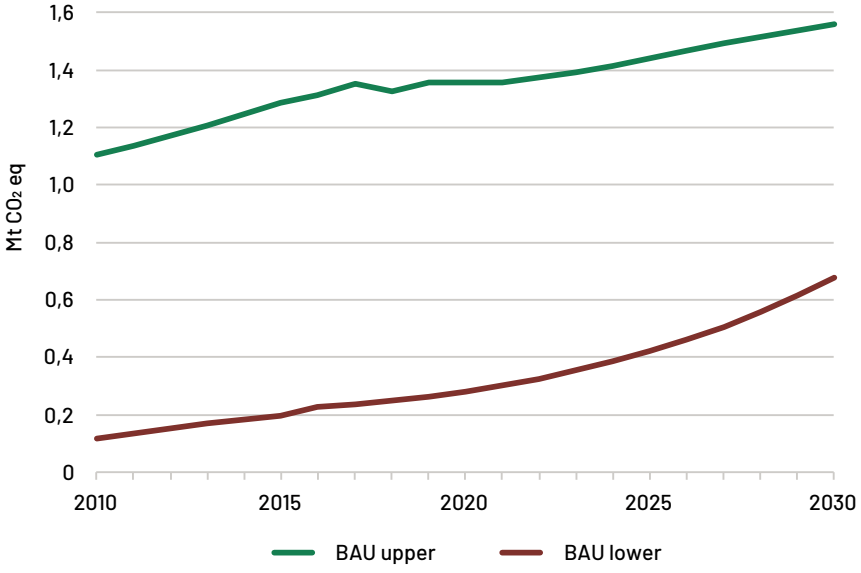
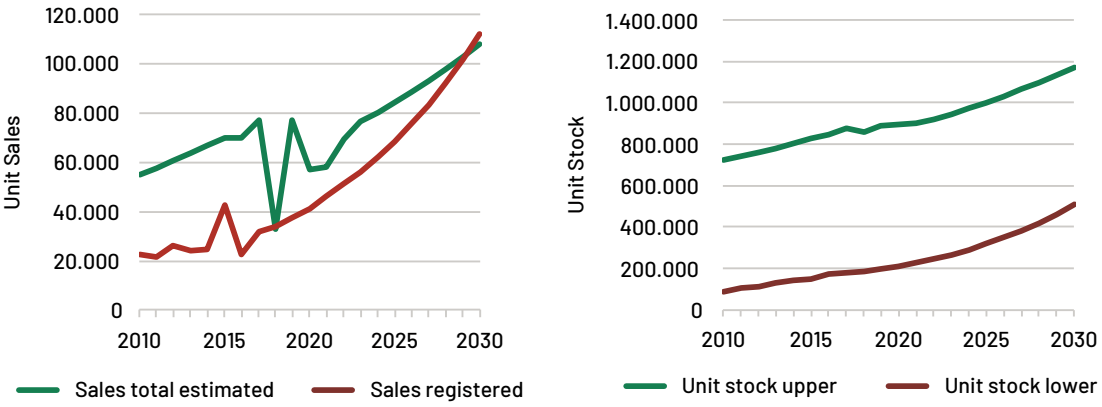


Figure 4: Sales and stock of room ACs from two data sets. In Green: total estimate based on stakeholder consultation; in Red: from sales registered at EPRA and customs.



2.3 GHG Emissions from Domestic Refrigeration Subsector

The two approaches on sales data from GIZ and CLASP also result in different projections of the number of refrigerators in use. The average energy consumption of the refrigerators is very similar in the 2 data sets and relies on CLASP detailed market research. A detailed description of underlying data sets is included in the respective chapters. The emissions from energy use ranges between 0.33 and 0.59 Mt CO_2. The diverging emissions mainly originate from the different sales data used and the resulting diverging number of appliances in use. Direct emission on an annual basis are modelled by GIZ and amount to 0.14 Mt CO_2eq in 2020.

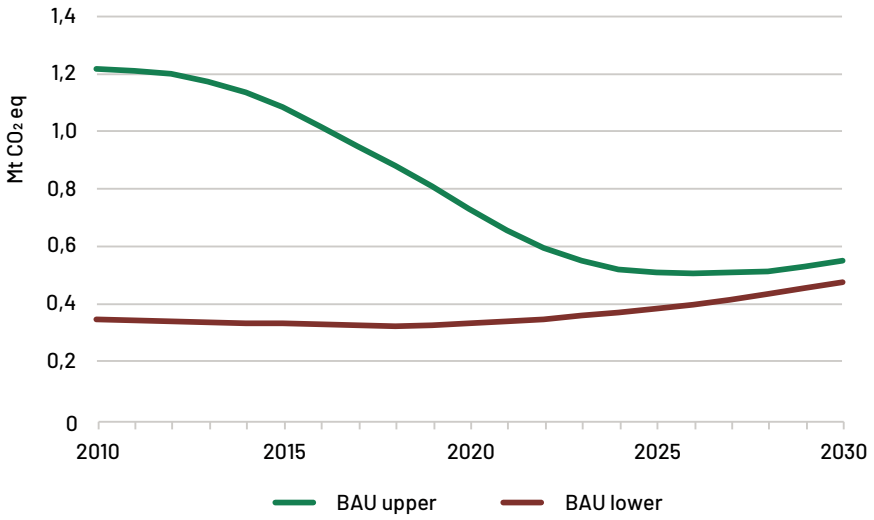


Figure 5: Range of GHG emissions from domestic refrigerators modelled from two different sales data sets.

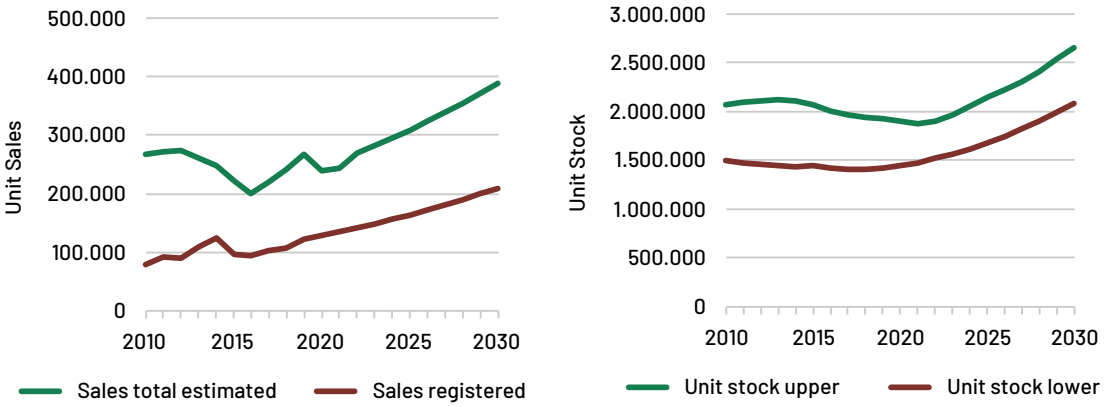


Figure 6: Sales and stock of domestic refrigerators from two data sets. In Green: total estimate based on stakeholder consultation; in Red: from sales registered at EPRA and customs.

3

PROMOTE ENERGY EFFICIENCY

3 Promote energy efficiency

The Government of Kenya has already taken significant steps to increase the efficiency of cooling appliances through policy measures, by implementing a standards and labelling program and revising efficiency levels for room air conditioners (ACs) and domestic refrigerators in 2019 and 2020, respectively. Combined, these two policies are expected to reduce 2030 energy consumption from room ACs and domestic refrigerators by 8% (107 GWh) and avoid 330,000 tCO_2e cumulatively from 2020-2030 (CLASP estimate).

Further improvements on cooling appliances energy efficiency by revising minimum energy performance standards (MEPS) and expanding coverage to growing end-uses can lead to significant energy and GHG savings, and support actions under Kenya's National Energy Efficiency and Conservation Strategy and the National Climate Change Action Plan II. Aligning the split AC and domestic refrigerating appliances MEPS with the U4E Model Regulations for energy efficient ACs and refrigerators in 2025 would reduce associated 2030 energy consumption by an additional 22-31% (390 - 987 GWh), avoiding indirect emissions of between 0.74 and 2.2 $MtCO_2e$ between 2025 and 2030. Again, the ranges also reflect the underlying 2 sales data sets.

While improving efficiency of cooling equipment through regulatory measures is already underway, complementary measures can enhance access to energy efficient and climate friendly cooling appliances by improving their affordability and accessibility. These non-regulatory measures could include bulk procurement, financial incentives, and financing, and can be deployed by government and non-government actors.

The proposed enabling actions to promote energy efficiency will raise ambition of existing policy measures and increase the awareness of consumers and industry on the benefits of energy efficiency, while ensuring that the standards and labeling program keeps pace with technology advancements and developments around the world.

Further action to limit the growth of active cooling demand in the future is to update building codes to make passive cooling a design requisite for new buildings. In a similar fashion, refurbishment of existing buildings needs to include passive cooling strategies, such as the cool roof. Even if active cooling via fans or AC appliances cannot be avoided by such measures, the energy consumption can be significantly lowered.

3.1 Status Quo

Kenya's commitment to reducing energy consumption from cooling appliances is driven by their participation in the Paris Agreement and their own National Determined Contribution (*see Table 1*) and supported by a series of national policies and regulations around energy consumption, efficiency, and cooling.

Table 1: International commitments affecting energy efficiency in cooling

Agreement	Date	Cooling ambition
Nationally Determined Contribution	2020	32% emission reduction across the board but no specific cooling targets. Mentions enhancement of energy and resource efficiency across the different sectors
Paris Agreement	28 December 2016	To reduce GHG emissions by 32% over the business as usual trajectory

Table 2 summarizes the regulations and standards most relevant to efficiency policy in the cooling sector, with more detail available in Annex A. Together, these policies and regulations form the foundation for regulating the efficiency of cooling products ranging from ACs and refrigerators, which are already covered by minimum energy performance standards, to commercial refrigeration and other space cooling products which are not yet regulated.

Table 2: National regulations and standards affecting energy efficiency in cooling

Instrument	Date enacted	Key relevant provisions
Energy Act, 2019	14 March 2019	Cabinet Secretary is empowered to prescribe energy efficiency and conservation building codes, and to develop a national energy efficiency and conservation action plan
The Appliances' Energy Performance & Labelling Regulations, 2016	15 July 2016	Recognition of MEPS and labels Requirement to first register all models to be imported with EPRA
KS 2463:2019 - Non-ducted air conditioners — testing and rating performance	28 June 2019	Test procedures and MEPS for ACs
KS 2464-2:2020 - Performance of household electrical appliances- Refrigerating appliances Part 2: Minimum energy performance standard	9 April 2020	MEPS for refrigerators
Test method KS/IEC 62552:2015 – Parts 1, 2 &3.	9 April 2020	Test methods for refrigerators
Energy Management Regulations, 2012	28 September 2012	Requires large consumers of electricity to carry out audits of their consumption and implement viable measures
National Building Regulations 2015	2017	Requires adoption of passive cooling in building design
National Environmental Policy, 2013	13 February 2013	Recognition of energy efficiency as a contributor to environmental protection
Environmental Management and Coordination (Controlled Substances) Regulations, 2007	31 May 2007	Omitted regulation on HFCs hence under revision

3.1.1 Room ACs

Room air conditioners refer to cooling appliances that improve thermal comfort and air quality in indoor spaces by lowering temperature and humidity.[10] Common room AC types include:

- Split air conditioners, where an indoor unit installed inside the room to be cooled produces the cooling effect and an outdoor unit installed outside the room in open space contains the other main components (i.e., the compressor, condenser, condenser cooling fan and expansion valve).

- Window or wall type air conditioners where all the components (i.e. the compressor, condenser, expansion valve, and cooling coil) are enclosed in a single housing.

The AC market in Kenya is fully import based, with the Kenya Revenue Authority reporting 24,000 – 43,000 units imported annually.[11] Through industry stakeholder consultation, GIZ learned that the number of imports may be higher, between 32,000 - 77,000 AC units imported annually. Most of these units are sold to commercial enterprises, like hotels and banks, and not to residential consumers. Currently, AC ownership is estimated at 30% for the commercial sector and 15% in the residential sector.[12] Imports from China make up the largest portion of ACs while imports from Thailand, United Arab Emirates, South Korea, Malaysia, and other countries account for the rest of the market. In Kenya, 87% of ACs sold are single split ACs.[13]

As mentioned in *Table 2*, room ACs are currently subject to the MEPS adopted in 2019 under KS 2463:2019 - Non-ducted air conditioners — testing and rating performance, which raised the minimum performance level for ACs from EER 2.80 W/W to 3.10 W/W. As of September 2020, there are 132 AC models that meet or exceed the MEPS registered with EPRA for sale in Kenya. The 10.7% increase in efficiency has eliminated approximately 73% of the AC models on the market in 2018, raising the average efficiency level of registered AC models to EER 3.25 W/W. The market shift resulting from the 2019 policy revision alone is expected to save around 60 GWh of electricity annually in 2030, and will reduce 2020-2030 CO_2 emissions by at least 159,000 tons (CLASP estimate).

One of the factors that contributes to the energy efficiency of a room air conditioner is the type of compressor. Room air conditioners with variable speed or inverter compressors are generally more efficient than those with fixed speed compressors. In 2018, 64% of the ACs in the Kenyan market were fixed speed air conditioners, and the remaining 36% were inverter units.[14] Currently, compressor type data is not available through the EPRA registry, so there is no new information on inverter ACs market share following the 2019 policy revision.

The Kenya AC standard currently uses energy efficiency ratio (EER) as the metric for reporting efficiency levels, however the EER metric is not appropriate for capturing the efficiency benefits of inverter ACs, which can vary speed based on the ambient temperature. In order to promote a transition to the most efficient technologies, MEPS and labels should use the same metric and have the same efficiency threshold for all technologies that provide a given service (e.g. cooling) regardless of technology type. Using technology-specific standards slows innovation by not allowing manufacturers to meet the desired performance level in the most cost effective way. Technology neutral energy efficiency requirements for ACs rely on a single efficiency test metric, usually cooling seasonal performance factor (CSPF) or seasonal energy efficiency ratio (SEER) to set consistent minimum energy performance standards regardless of AC compressor type. Technology neutral standards for ACs are becoming a global best practice, having been adopted in the EU, China[15], Brazil, India[16], Vietnam and other major economies in order to ensure that the efficiency benefits from inverter ACs are appropriately recognized.

10 Definition by United for Efficiency (U4E), Accelerating the Global Adoption of energy-efficient and climate-friendly air conditioners. *https://united4efficiency.org/wp-content/uploads/2017/06/U4E-ACGuide-201705-Final.pdf*
11 CLASP. 2019. Kenya Room Air Conditioner Market Assessment and Policy Options Analysis. *https://clasp.ngo/publications/kenya-rac-market-assessment-and-policy-options-analysis-2019*
12 BSRIA. 2019. Africa AC and energy efficiency analysis: Kenya.
13 Ibid.
14 CLASP. 2019. Kenya Room Air Conditioner Market Assessment and Policy Options Analysis.
15 See Fehler! Verweisquelle konnte nicht gefunden werden.
16 See Fehler! Verweisquelle konnte nicht gefunden werden.

3.1.2 On-Grid Domestic Refrigerating Appliance

Similar to the room air conditioner market, all residential refrigerators sold in the Kenyan market are imported. According to customs data, there are between 80,000 to 130,000 units imported into Kenya annually. GIZ attempted to validate this information with industry stakeholders, who argue that the true number of imported products is between 200,000-270,000 units. Currently, refrigerator ownership is relatively low amongst residential consumers – for urban residents refrigerator penetration is around 13%, while for rural residents it is even lower, around 1%.[17] Between 2012 and 2017, 40% to 60% of all refrigerators imported into the country came from China while the rest were imported from India, Thailand, Indonesia, United Kingdom and South Korea, among others.

In Kenya, the most common residential refrigerating appliances are refrigerator-only models (i.e., with a fresh food compartment only), top freezer types (i.e., with a fresh food and freezer compartment on top) and chest freezers.

In 2020, Kenya implemented revised MEPS for domestic refrigerating appliances, which lowered the average MEPS for refrigerating appliances to approximately 414 kWh/year. Since then, implementation began, the market has started to shift towards more efficient products. The 2020 refrigerator policy revision is expected to reduce forecasted 2030 electricity consumption by 47 GWh, and avoid at least 110,000 tons of associated greenhouse gas emissions over the period 2020-2030.

Based on examination of EPRA's domestic refrigeration registry as of September 2020, refrigerator only units now have an average storage capacity of 176 liters and consume on average 271 kWh/year annually while top freezer units with manual defrost have a slightly higher average storage capacity (232 liters) and consequently have a higher average annual energy consumption at 375 kWh/year. Top freezer units with auto-defrost (or frost-free) technology tend to be larger and more expensive, averaging an adjusted storage volume of 412 liters. However, these auto-defrosting units tend to be more efficient at around 365 kWh/year. Chest freezers have an average storage capacity of 448 liters and an average annual consumption of 420 kWh/year. Based on the prevalence refrigerators, refrigerator-freezers, and freezers in the market and average efficiencies determined from EPRA's product registry, CLASP estimated a weighted average energy consumption for new refrigerating appliance of 349 kWh/year.

Based on the stakeholder consultations that GIZ held in 2017, the average annual energy consumption of refrigerators in use was determined to be 760 kWh. This is much higher than the energy consumption of refrigerators on sale found by CLASP. With the ongoing stock-turnover, a tremendous decrease of the energy consumed by refrigerators is expected, as shown in the projections.

Table 3 summarizes the Star Rating Index (SRI) levels used to classify refrigeration equipment into the five star levels.

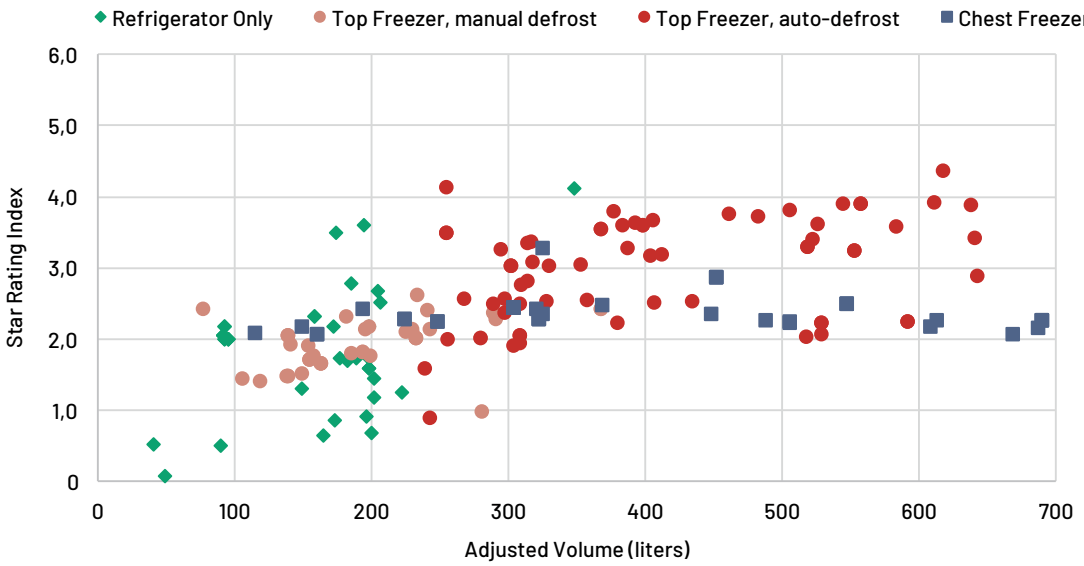
Star Rating Index	Star Rating
$SRI < 2.0$	1
$2.0 \geq SRI < 3.0$	2
$3.0 \geq SRI < 4.5$	3
$4.5 \geq SRI < 6.0$	4
$6.0 \geq SRI$	5

Table 3: Star rating index for refrigerators

17 Dubey, Sunita, Ehui Adovor, Dana Rysankova, Elisa Portale and Bonsuk Koo. 2019. Kenya – Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework. World Bank Group: Washington, DC.

Figure 7 shows the current distribution of efficiency within the most popular types of refrigerating appliances in Kenya. Most of the products currently on the market fall into the 1-3 star range. This trend is particularly relevant in the popular refrigerator only and top freezer with manual defrost categories, which both tend to be significantly less expensive than top freezers with auto defrost function.

Figure 7: Storage capacity versus star rating index for common refrigerating appliances registered with EPRA in 2020



3.1.3 Off-Grid Domestic Refrigerating Appliance

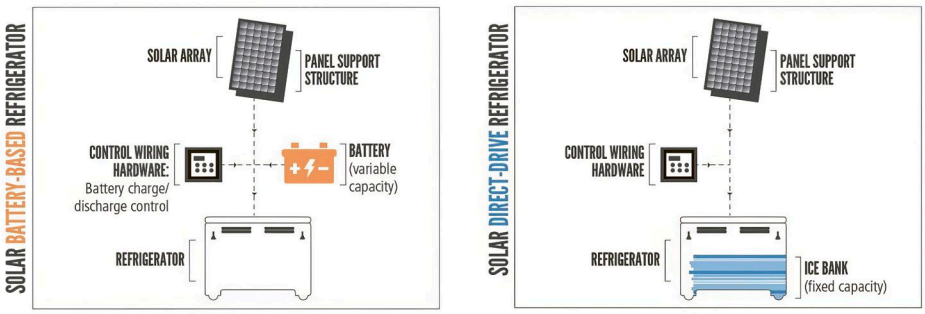
The main difference between on-grid and off-grid refrigerating appliances meant for domestic or small commercial use is that off-grid refrigerators can be powered by a broader range of power sources including direct current sources like batteries or directly by a solar PV array. The Government of Kenya has laid out an integrated electrification plan that identified 1.96 million households will be best served using off-grid standalone solar systems.[18] Therefore, in order to gain access to cooling services, some of these households will have to rely on refrigerators designed for off-grid use.

There are different technology and power supply types available for off-grid refrigerators, including:

- Solar direct drive refrigerator: DC supply refrigerator designed for direct connection with a photovoltaic solar panel, generally containing an integrated thermal and/or electric battery to allow autonomous operation during the night or on days with limited solar radiation.

- Solar battery-based refrigerator: Refrigerator designed for use with an intermittent solar power supply, generally containing an integrated thermal and/or electrical battery allowing autonomous operation during periods when power supply is absent.

Figure 8: Illustration of solar battery-based and direct-drive refrigerator



In the past, off-grid refrigerators were designed for use in health care applications such as vaccine storage in off-grid areas. However, as the penetration of off-grid power solutions in countries with significant off-grid populations has increased, the demand for cooling appliances has grown. In fact, refrigerators are one of the appliances with the highest consumer demand among off-grid households and small businesses.[19] The 2019 Efficiency for Access State of the the Off-grid Market Report profiles Kenya as the foremost market for off-grid appliances in sub-Saharan Africa owing to its mature solar industry, high mobile money penetration, and fast-growing consumer segment.[20] The report estimates that the country's off-grid refrigerator market in 2018 was at 26M USD and by 2030 will be at 110M USD. However, currently off-grid refrigerators have a high upfront cost, from just below USD 200 to more than USD 1,000, for units with storage capacities of less than 300 liters.

In addition to the high upfront cost, the current energy supply requirements of off-grid fridges are too high. A typical off-grid refrigerator currently needs approximately 0.74Wh per day to operate, requiring a fairly large solar power system by off-grid household solar standards, which is beyond the economic reach of most rural off-grid households and small businesses in Kenya.[21]

The Kenyan off-grid refrigerator market is characterized by its low penetration, but demand from off-grid households and small businesses is growing. Efforts to address affordability and promote wider availability of energy efficient off-grid refrigerator products by the government and other actors will be needed to meet the growing demand. Through the Kenya Off-Grid Solar Access Project for Underserved Counties (KOSAP) initiative, the Kenyan government is already seeking to use smart subsidies to expand uptake of solar products in undeserved counties. In addition, Kenya's tax regime has been favorable to reduce upfront costs, with full VAT and import duty exemptions for most off-grid appliances. However, the application of this tax regime (by customs) has been inconsistent and therefore its benefits have not always been realized.

Further technology improvements in refrigerator motors and compressors have the potential to lower overall cost of off-grid refrigerators systems.[22] Creating an enabling environment supportive and conducive to research and development (R&D) activities on energy efficiency improvements for off-grid refrigerators and attractive for investor's and financial institutions to avail loans and other financial packages suited to off-grid appliances will be key to achieve highly efficient and more affordable products.

3.1.4 Larger cooling equipment

The energy efficiency of larger cooling equipment was not systematically assessed. Questionnaires from the GIZ inventory indicate generally rather low efficiencies. However, applying MEPS to that equipment is more challenging than for the categories spelled out in detail above, as there is a higher level of customization and larger differences among the various equipment types. The example from the EU shows that also there, coverage is limited.

For **stand-alone units**, the EU Ecodesign requirements are pending. The benchmark metric will be the same as for domestic refrigerators. The average unit currently in use in Kenya is assumed to have an annual energy consumption of 1770 kWh/year.

18 Government of Kenya (2018). Kenya National Electrification Strategy.
19 Efficiency for Access (2018). Off-Grid Appliance Market Survey.
20 Efficiency for Access. (2019). State of the Off-Grid Appliance Market Report
21 Efficiency for Access. (2018). Appliance Data Trends.
22 Park, W.Y., Shah, N. & Phadke, A. Enabling access to household refrigeration services through cost reductions from energy efficiency improvements. Energy Efficiency 12, 1795–1819 (2019). *https://doi.org/10.1007/s12053-019-09807-w.*

3.2 Target

3.2.1 AC Target

Further improvement of AC MEPS can lead to significant energy and GHG emissions savings, in support of actions under Kenya's National Energy Efficiency and Conservation Strategy and the National Climate Change Action Plan II.

In the absence of additional policy interventions – with the average efficiency of ACs in the Kenyan market remaining at current 2020 levels and the AC market continuing to grow by approximately 5% annually[23] – ACs will consume between 1,035 – 2,170 GWh of electricity in 2030. Generating the electricity to meet that growing AC demand will result in 0.677 – 1.1 Megatons of indirect greenhouse gas emissions. The energy demand for ACs will account for approximately 4 to 6% of the projected total electricity demand in 2030.[24]

In 2019, United for Efficiency (U4E) published Model Regulation Guidelines for air conditioners[25] and urged regulators around the world to be ambitious in their efforts to minimize the greenhouse gas emissions from residential cooling. Adopting comparable policies to the MEPS and label levels in the model regulation in 2025 would allow Kenya to achieve significant greenhouse gas emissions reductions and remove from its market the least efficient ACs. Adopting U4E Model MEPS for ACs immediately would be a significant leap for the Kenyan market; however, intermediate revisions based on the Kenyan energy label's star levels could help Kenya reach this target over time.

3.2.2 Refrigerating Appliances Target

Further improvement of refrigerator MEPS can lead to significant energy and GHG emissions savings, in support of actions under Kenya's National Energy Efficiency and Conservation Strategy and the National Climate Change Action Plan II.

In the absence of additional MEPS revisions for refrigeration equipment and with continued market growth at approximately 5% annually, domestic refrigeration equipment will consume 730 – 976 GWh of electricity in 2030, between 3 and 6% of projected total electricity demand in 2030.[26] Generating the electricity to meet this demand will create nearly 476,000 - 481,000 tons of indirect greenhouse gas emissions.

United for Efficiency (U4E) also published Model Regulation Guidelines for refrigerators[27] in 2019 to guide policymakers seeking to adopt ambitious but technically achievable MEPS. Just as the Kenyan standard does, the U4E Model Regulation Guidelines distinguish between the different refrigation equipment types, and recommend MEPS and label levels that would allow Kenya to achieve significant greenhouse gas emissions reductions if adopted in 2025.

3.2.3 Targets for larger cooling equipment

For **stand-alone units**, the EU Ecodesign requirements are pending. The benchmark metric will be the same as for domestic refrigerators. Since stand-alone units are usually not bought by the public at large, a labelling scheme might not be necessary for an informed purchase-decision. Though, a MEPS and a defined product information sheet containing all relevant technical parameters is recommended. The NCAP scenario assumes a MEPS resulting in an average annual energy consumption of 1570 kWh/year in 2025.

Larger appliances are not as easily categorized as they usually consist of more parts and are often customized to the building where they are being installed. Nevertheless, EU Ecodesign requirements are formulated for "professional refrigerated storage cabinets" including condensing units and process chillers. Once experience with establishing MEPS for the product groups described above is gathered, larger appliances can be included.

23 CLASP developed baseline efficiency estimates for split ACs across three popular sizes (12,000 Btu/hr, 18,000 Btu/hr, and 24,000 Btu/hr) and for domestic refrigeration across four product types (refrigerator only, top freezer with auto-defrost, top freezer with manual defrost, and chest freezers).

24 Based on reference scenario energy demand estimates from EPRA. 2018. Updated Least Cost Power Development Plan: 2017 – 2037.

25 U4E. 2019. Model Regulation Guidelines: Energy-efficient and climate-friendly air conditioners. *https://united4efficiency.org/resources/model-regulation-guidelines-for-energy-efficient-and-climate-friendly-air-conditioners/*

26 Based on reference scenario energy demand estimates from EPRA. 2018. Updated Least Cost Power Development Plan: 2017 – 2037.

27 U4E. 2019. Model Regulation Guidelines: Energy-efficient and climate-friendly refrigerating appliances. https://united4efficiency.org/resources/model-regulation-guidelines-for-energy-efficient-and-climate-friendly-refrigerating-appliances/

3.3 Enabling Actions

3.3.1 Action 1.1

Increase ambition of existing standards and labels for cooling appliances

The current MEPS for room air conditioners and domestic refrigerators have had a positive effect on the performance of products imported into the country, without burdening consumers or industry stakeholders. Since Kenya is an import-only market for ACs and domestic refrigerators, MEPS incentivize importers to source for and import more efficient products and equipment which are already available in major trading partners and source countries (e.g. China).

MEPS should be revised regularly in order to keep up with technology advances and to accelerate a transition to highly efficient cooling appliances. Revision of these standards also prevents dumping of poor performing products from countries that export products to Kenya, as these countries also increase their minimum energy performance standards overtime.

The first revision for the AC MEPS should be initiated in 2023 and implemented in 2025. Subsequent revisions should take place every 3-5 years after that, with impacts analysis carried out to quantify the costs and benefits to consumers, and other benefits relevant to the Kenyan government (i.e., energy savings, GHG emissions avoided, among others).

During the next revision of AC MEPS, Kenya should adopt a seasonal energy efficiency metric and technology neutral standard to promote a transition to more efficient AC technologies. A seasonal energy efficiency metric takes into consideration the energy saving characteristics of inverter ACs which are designed to operate at part load depending on the cooling demand. Inverter ACs are becoming more prevalent in the global AC market and are already available in the Kenyan market.

Considering ongoing efforts in neighboring countries[28] and at the regional level under the sponsorship of the East African Centre of Excellence for Renewable Energy and Efficiency (EACREE)[29] to significantly improve the energy efficiency of cooling appliances, Kenya should align its AC MEPS with U4E model MEPS in 2025. This approach will ensure Kenya reaps the benefits of regional policy alignment, facilitating regulatory compliance while protecting Kenyan consumers from low efficiency and substandard products. Aligning the AC standard with U4E model MEPS in 2025 will result in 270 – 589 GWh) of electricity savings in 2030, and avoid 511,000 – 4.2 Mt CO_2e) cumulatively through 2030.

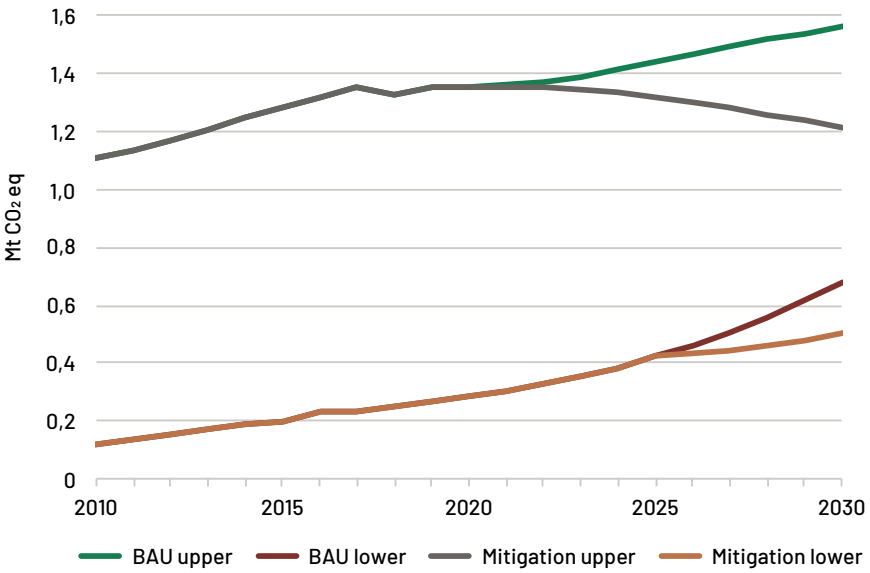
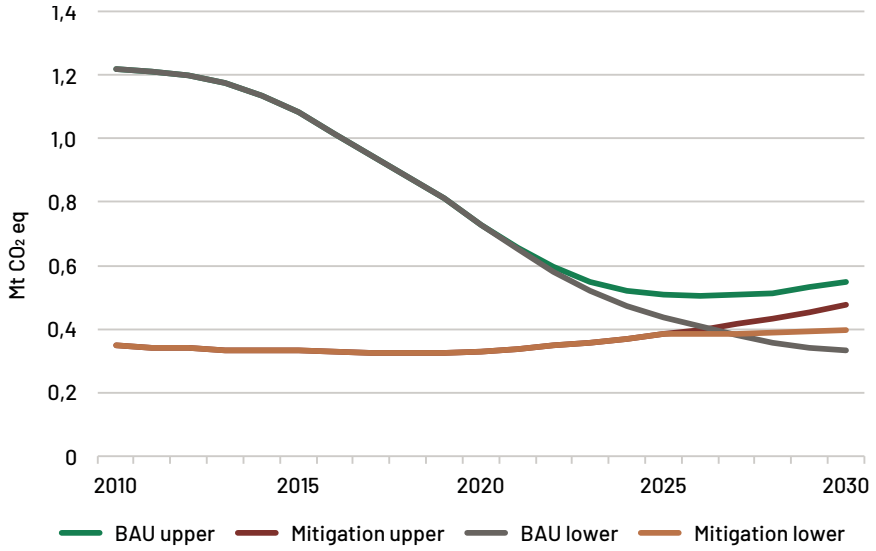


Figure 9: Emission ranges of business as usual (BAU) and mitigation scenario for Kenyan split ACs

28 The Government of Rwanda also released a National Cooling Strategy that establishes MEPS for cooling equipment with ambitious targets to rid the market of the least efficient products. https://www.unenvironment.org/news-and-stories/story/rwandas-ambitious-plan-clean-and-efficient-cooling

29 The Energy Efficient Lighting and Appliances (EELA) project aims to support the development of vibrant markets for energy efficient lighting and appliances across East and Southern Africa. https://www.eacreee.org/project/energy-efficient-lighting-and-appliances-eela-project-southern-and-eastern-africa

Figure 10: Emission ranges of business as usual (BAU) and mitigation scenario for Kenyan domestic refrigeration



The first revision for the refrigerator MEPS should be initiated in parallel and implemented in 2025 (aligned with the ACs). Aligning the refrigerator standard with U4E model MEPS in 2025 will result in 120 – 398 GWh of electricity savings in 2030, and avoid indirect emissions of 0.23 – 3.1 Mt CO_2e cumulatively through 2030.

3.3.2 Action 1.2

Raise awareness on energy labels

Energy labeling is a critical component of effective appliance energy efficiency policy. While MEPS remove the least-efficient products from the market, energy labels drive product markets to higher efficiency in three ways, by:

- Enabling consumers to make informed purchasing decisions by differentiating high efficiency products from average and low efficiency products;
- Incentivizing manufacturers and importers to produce or import more efficient products by allowing them to market their high efficiency products; and
- Providing the basis for market transformation programs by allowing policymakers to easily identify high efficiency products to target for bulk purchasing, financing, and incentives.

Stakeholder awareness, understanding and trust of an energy label is central to its success. Since the implementation of the domestic refrigerator and AC standards and labelling program in 2020 and 2019, respectively, EPRA has registered more than 100 models for each product category that meet the MEPS and can feature the energy label. In order to raise awareness of the new label among consumers, EPRA launched a Kenya Energy Label campaign. This effort should continue in the short term, as building awareness among Kenyan stakeholders on the energy label will help consumers, retailers and importers reap the benefits of the more efficient products.

Case Study – Kenya Energy Label Campaign (2020-2021)

Figure 11: Kenya Energy Label campaign materials

Awareness raising campaigns target specific consumer groups with messaging about the energy and cost saving benefits of energy labels. Conducting a digital consumer awareness campaign is a high-impact, cost-effective marketing approach—combining smart digital advertisements across social media platforms (like Twitter, Instagram, and Facebook) with targeted Google ads that appear when consumers research related topics (such as appliances, cost-saving, energy saving, etc.).

In 2020, EPRA, with support from CLASP, launched a Kenya Energy Label campaign. The campaign was focused on refrigerator/freezers and air conditioners, among others, but will also establish brand recognition for subsequent campaigns on other products covered by energy performance standards. The campaign ran on Facebook, Twitter, Instagram, and Google Ads from October 2020-January 2021. The central campaign message, More Stars, More Savings, speaks to the five-star guide that demonstrates how much energy, and correlated energy expenditures, can be saved by purchasing appliances with higher star-ratings

Prior to launching a consumer awareness campaign, it is important to conduct a baseline survey to understand consumer perceptions and knowledge of the label, as well as to understand their priorities when purchasing appliances. For the Kenya Energy Label campaign, EPRA conducted a comprehensive baseline survey of appliance consumers in major cities across Kenya. The team sent 8 surveyors to shopping centers to survey more than 900 appliance customers. The analysis found that the majority of users (81%) care about their products' energy consumption, but few (27%) were tracking it in practice. The majority of consumers (66%) did not recognize the Kenyan Energy Label and a further 85% did not know what it meant.

To develop the Kenya Energy Label campaign materials, the design team used insights from the baseline survey to design materials that were relevant to target consumer groups, and conducted focus group discussions with different demographics (segregated by gender, age and location), to discuss potential designs and messaging. The final graphics shown in *Figure 11* are characterized by green, indicating environment and money, and prominently feature the products under the label scheme.

Retailers and salespersons are a key contact point for consumers before they purchase appliances. Ensuring that they understand the label and its benefits empowers them to pass on the knowledge to consumers at the point of sale. The goal of retailer awareness campaigns can be to inform retailers and salespersons on the purpose of the energy label and create a better understanding on how to use the label to inform consumers' purchasing decisions (i.e., key label characteristics, how to interpret them etc.). These campaigns can be in the form of training and seminars with materials provided for the retailers to take back to their stores (e.g. flyers and posters).

EPRA should conduct annual retailer awareness seminars between 2022 and 2023 to help retailers understand the newly implemented energy label. Subsequent seminars should be held as needed, especially when revisions to either MEPS or energy labels are implemented. Additionally, EPRA should provide free access to flyers, posters and other communication materials on their website that retailers can download and use to raise consumer awareness.

3.3.3 Action 1.3

Strengthen compliance and enforcement to safeguard benefits of efficiency policy

Strengthened compliance and enforcement will protect the anticipated benefits of Kenya's standards and labels for cooling appliances, and increase consumer trust in both the market and the government cooling policies.

To implement Kenya's MEPS for ACs and refrigerators, EPRA has set up a mechanism to help ensure products imported to the country conform to the standards. Kenya's conformity assessment process requires that importers register their products with EPRA and submit accompanying documentation (test reports and certificates, as well as customs documentation) that demonstrates their products meet the MEPS and that the products satisfy all national market entry requirements.

Although this process is relatively robust, there are certain areas that need to be strengthened to ensure all products entering and sold on the market comply with the national MEPS:

- EPRA requires importers register their products in a national product registration database. This database enables authorities, including EPRA, KEBS and customs, to verify whether products have been authorized access to the market. It also enables the government to track products legally authorized for sale on the market, which not only supports enforcement efforts, but can also help track market trends and inform when policy ambitions can be raised. The existing database should be revised to require more information from importers and other suppliers.

- Efforts to protect the market from non-compliance with the MEPS should be increased, by conducting new market surveillance activities to check for sales of suspicious products, and to take enforcement action against non-compliant suppliers of cooling products. Investment in these activities should be secured, to ensure EPRA have dedicated and trained staff to monitor the market for non-compliant products that are unlabeled or do not meet the MEPS; to procure and test those products to verify whether or not they comply with the MEPS; and to enforce the MEPS by taking actions to remove non-compliant products from the market, to penalize non-compliant suppliers, and to deter others from breaking the law.

- Regional collaboration on compliance activities, such as sharing market intelligence and cooperation on testing efforts, can help strengthen the Kenyan national market and support neighboring markets remove non-compliant products from their own markets. These actions prevent product dumping in the region, reduce the flow of non-compliant products through porous borders, ultimately protecting Kenya's market. Under the Energy Efficient Lighting and Appliances (EELA) project implemented in EAC and SADC regions,[30] the East African Centre of Excellence for Renewable Energy and Energy Efficiency (EACREEE) and the Southern African Development Community Centre for Renewable Energy and Energy Efficiency (SACREE) are discussing with the member countries to establish a regional collaborative approach to compliance in implementing regionally harmonized policies. Kenya should actively engage in and assume a leading role in the upcoming compliance project activities

To protect consumers, a certificate of compliance should be issued to the consumer by the installing technician assuring that the installed equipment is registered in EPRA's database and that installation is done according to state-of-the art practices. Only certified technician can issue such a certificate.

30 *https://www.eacreee.org/project/energy-efficient-lighting-and-appliances-eela-project-southern-and-eastern-africa*

3.3.4 Action 1.4

Launch bulk and government procurement programs

Large consumers in Kenya can promote the use of energy efficient and climate friendly cooling equipment through their procurement choices, particularly through bulk procurement. For instance, the Government of Kenya, through purchases for equipment used in government offices, public schools, universities, hospitals, utilities, and other state-owned facilities and enterprises, can stimulate the market for energy-efficient products while setting an example for corporate buyers and individual consumers. Defining purchasing criteria for highly efficient and climate friendly cooling can encourage importers to source technologies that meet those criteria at competitive prices. The Kenyan government can leverage the existing labeling program to define green public procurement guidelines that require 5-star labeled appliances at a minimum, and incorporating refrigerant requirements.

Other non-government actors can also benefit significantly from bulk procurement. Large consumers can also set procurement requirements, form buyer's clubs, and conduct large-scale procurements in order to access large quantities of energy efficient and climate friendly cooling at a reduced cost.

If new appliances purchased under large procurement programs are intended to replace equipment already in use, it will be important to establish an appropriate take-back scheme, to reduce the risk of old and inefficient equipment entering a second hand market. In addition, proper treatment and disposal of the used equipment will reduce additional harmful environmental impacts.

3.3.5 Action 1.5

Implement favorable fiscal policies for high-efficiency products

The Government of Kenya already uses incentives in the form of lower import taxes or exemptions for certain off-grid products in order to enhance access and improve their affordability. Similar incentives can be applied to promote and encourage the purchase of energy efficient and climate friendly cooling appliances. The standards and labeling program in Kenya can be an important foundation for this type of incentive, because labeled appliances already provide a verified baseline for judging enhanced performance. The selection of products categories or types that would receive this incentive could be used to benefit low income consumers (for instance, by applying lower duties to top freezer models with manual defrost and refrigerator only, which are generally used in low income households), in order to avoid using tax payer funds to benefit high income consumers.

3.3.6 Action 1.6

Expand efficiency standards to cover end–uses with growing energy demand

The proposed short-term enabling actions covered two end-uses (residential refrigeration and air conditioning) that were identified as priority sectors for their expected growth and impact to future energy demand and GHG emissions in Kenya. A major data collection effort, supplemented by a comprehensive market assessment and analysis took place[31] in order to inform actions and recommendations under this action plan. Similar efforts to assess future growing demand of other major cooling sectors, particularly commercial refrigeration and commercial space cooling, should be considered in order to identify growing end-uses where interventions in the medium term will be necessary to continue with the provision of access to sustainable cooling for all Kenyans.

31 Kenya Room Air Conditioner Market Assessment and Policy Options Analysis. CLASP (2018). *https://clasp.ngo/publications/kenya-rac-market-assessment-and-policy-options-analysis-2019.*

4

PROMOTE NATURAL REFRIGERANTS

4 Promote Natural refrigerants

Over the last decades, the Montreal Protocol has driven the global RAC industry towards refrigerants with no ozone depletion potential (ODP). At the same time, the European Union's F-gas Regulation has initiated the transition from high global warming potential (high-GWP) refrigerants to low-GWP refrigerants (EU, 2014). With the Kigali Amendment to the Montreal Protocol in place, developing countries (A5 countries under the Montreal Protocol) must gradually phase down HFCs, thereby increasing the volume of refrigerants with low-GWPs on the market. In most developed countries, such as member countries of the EU, a phase-down of high-GWP HFCs has already started because of national or regional legislation, with increased technical developments.

The most climate and environmentally friendly refrigerants are natural refrigerants such as hydrocarbons (R290, R600a, R1270), CO_2 (R744) and ammonia (R717). We refer to cooling equipment that is energy efficient and relies on a natural refrigerant as "green cooling equipment". In contrast to other low GWP refrigerants such as synthetic HFOs or blends containing them, the environmental effects of natural refrigerants escaping to the ambient are well understood. Low GWP - synthetic refrigerants that are being introduced to the market in recent years are relatively short lived when released to the ambient (This is why their GWP is low.) However, their break down products, such as the toxic trifluoric acid (TFA) accumulate in the aquatic and threaten the eco system. The German Environmental Agency finds that due to its non-degradability and high mobility, TFA spreads within the water cycle and accumulates there over time. This almost infinite residence time and higher concentration increase the extent of damage and the probability of occurrence of unforeseen impacts - because various organisms and substances come into contact with and are exposed to it over a long period of time. Should effects occur, they can no longer be corrected, because TFA cannot be recovered from the environment. There are many examples of chemicals whose complex and long-term effects on health and the environment have been greatly underestimated - such as perfluorinated chemicals (PFCs) or DDT[32]. This means that the increasing uptake of HFOs bears unknown risk and should be only considered where no natural refrigerant can be utilized.

Based on production cost and the fact that there are no or few intellectual property rights, natural refrigerants are very inexpensive. Limited availability is sometimes the factor that drives prices high. Low-GWP natural refrigerant solutions are available for almost every subsector. Because of their characteristics, such as flammability, lower toxicity or higher pressure in the system, they have a slightly different technological set-up compared to HCFC or HFC equipment and require a specific skill set of RAC engineers and technicians. Technical differences include different compressors, a secondary loop system or specific risk reducing measures (i.e. eliminating sources of ignition).

32 UBA Einordnung TFA Leitwert (umweltbundesamt.de), in German. Other useful sources: Report and statement of the downsides of HFO refrigerant usage -Impact of fluorochemical refrigerants and their degradation products on the environment and health, retrieved 8.3.2021 at dc61a9_c2975e689c4645b296eb79040c5c3244.pdf (*filesusr.com*)

4.1 Status Quo

Kenya is a party to Montreal Protocol and is in the process of ratifying the Kigali Amendment, committing to a national phase-down of the HFC consumption.

Table 4: International commitments affecting refrigerants in cooling

Agreement	Date	Cooling ambition
Montreal Amendment to the Montreal Protocol	1997	Phasedown of HCFCs by 2030 – Though Kenya's ambition is to phase out by 2026
Kigali Amendment to the Montreal Protocol	N/A	Yet to ratify, expected in 2022 to define phasedown of HFCs

4.1.1 Room AC Refrigerants

In 2018, the most common refrigerant used in ACs available in the Kenyan market was R-410a; however, the use of R-22 was still prevalent, with 27% of units offered for sale containing this refrigerant. Since the Kenyan government began implementation of the revised AC MEPS in 2019, none of the ACs newly registered for sale in Kenya contain R-22. This is likely because the majority of the R-22 ACs previously in the market were also low efficiency units unable to meet the AC MEPS. As of September 2020, EPRA reported that all 132 AC models registered for sale in Kenya use R-410a refrigerant. As R-410a is a potent greenhouse gas and lower-GWP R-32 ACs are already widely available in much of the world at comparable prices to R-410a units, the Kenyan AC market can be improved to reduce the potential environmental impact of direct greenhouse gas emissions from operational and end-of-life leakage.

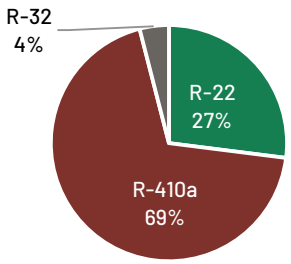


Figure 12:[33] Refrigerants used in ACs in Kenya in 2018

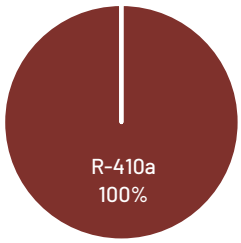


Figure 13:[34] Refrigerants used in ACs registered with EPRA in 2020

4.1.2 Domestic Refrigeration Refrigerants

Prior to the 2020 implementation of new MEPS and label for refrigerators, the Kenyan market contained refrigerators that used one of two types of refrigerant: R-600a or R-134a with the former having the largest market share (*Figure 14*). Isobutane or R-600a is a natural refrigerant with a GWP of 5 over a 100-year time horizon.[35] The GWP of R-600a is very low compared to hydrofluorocarbons (HFCs) like R-134a. Due to its low environmental impact and good thermodynamic properties, R-600a is becoming state of the art for use in residential refrigerators globally. As of September 2020, all refrigerators and freezers regulated under KS 2464:2020 and registered with EPRA use R-600a refrigerant. R-600a already meets the refrigerant requirements outlined in the U4E Model Regulation Guidelines for refrigerators.

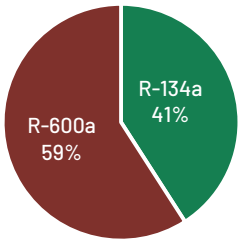


Figure 14: Refrigerants used in residential refrigerating appliances sold in Kenya in 2018

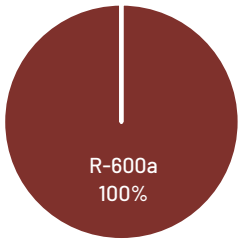


Figure 15: Refrigerants used in residential refrigerating appliances registered with EPRA in 2020

4.1.3 Refrigerants for larger equipment

Due to the long lifetime of larger cooling appliances, HCFC refrigerants such as R-22 are still very common in large equipment. Due to the universal features of R-22, its use is spread over AC and refrigeration uses. With the ongoing transition to HFCs, the variety of refrigerants is growing. New(er) commercial refrigeration equipment often relies on the HFC R-404A, with a GWP that is twice as high as for R-22. R-134a is also common for medium temperature applications, while R-410A is the favoured refrigerant for air-conditioning applications.

33 CLASP. 2019. Kenya Room Air Conditioner Market Assessment and Policy Options Analysis. *https://www.clasp.ngo/research/all/kenya-rac-market-assessment-and-policy-options-analysis-2019/*

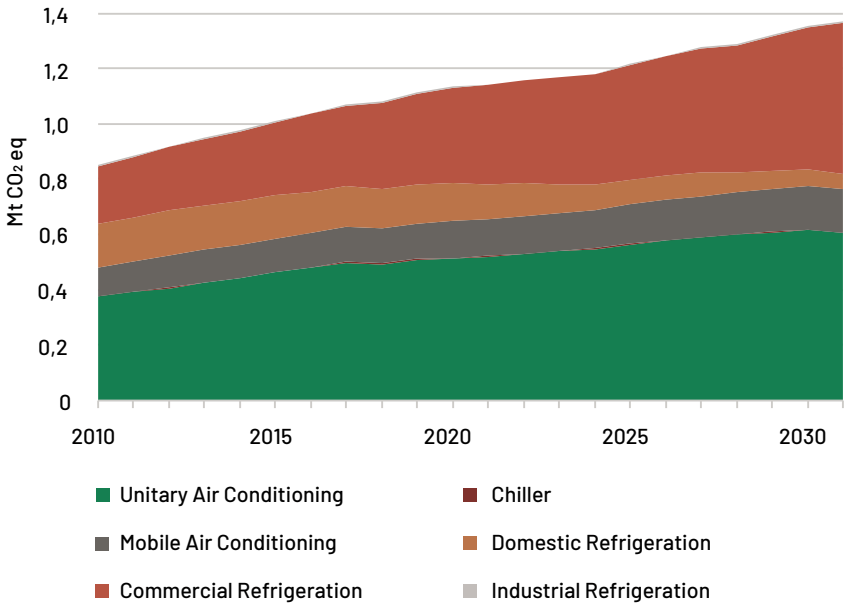
34 Based on information provided to CLASP by EPRA

35 See IPCC. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

4.1.4 Direct Emissions

The greenhouse gas emissions resulting from refrigerant leakage during operation and at end-of-life are referred to as direct emissions. The R-410a used in Kenyan ACs is one of the high-GWP refrigerants scheduled to be phased down under the Kigali Amendment to the Montreal Protocol, which Kenya is in the process of ratifying. Direct emissions are projected to rise from a current (2020) 1.13 Mt CO_2eq to 1.35 Mt CO_2eq in 2030. The increase is mainly a result of increased equipment numbers.

Table 4: International commitments affecting refrigerants in cooling



4.2 Target

In addition to guidance on setting MEPS for split ACs, the U4E Model Regulation Guidelines for Air Conditioners also include a provision requiring that refrigerants used in split air conditioners have a 100-year GWP of less than 750. Currently, there are two major AC refrigerants that meet this standard: R-32 with a GWP of 675 and R-290 (propane) with a GWP of <1. However, also R-32 can only be a transition refrigerant. With the HFC-phase-down progressing, the GWP of R-32 is too high to fit under GWP-weighted quota. In addition, the revised GWP value for R-32 in the 6th Assessment report to be issued by the IPCC next year is likely to be higher than the 750 threshold. Split ACs using the natural refrigerant R-290 are also slowly gaining market shares and is the long-term refrigerant choice. Due to the flammability of the refrigerant, there are still wide-spread safety concerns that need to be answered by educating the AC technicians.

Under a business as usual scenario where no additional refrigerant regulations are issued and the current pace of the refrigerant transition continues, refrigerant leakage from split ACs in Kenya will generate 5.1 Mt CO_2eq) emissions between 2020 and 2030. However, if Kenya were to adopt the U4E refrigerant provision in 2025, allowing only R-32 or R-290 equipment, Kenya could avoid between 290 kt CO_2eq of direct emissions in 2030. As a large proportion of direct emissions occur at the end-of-life of the equipment, the savings from a refrigerant transition lag behind. The shift in 2025 can lead to emission savings of 3.1 Mt CO_2eq until 2050. (GIZ estimate)

4.3 Enabling Actions

Short term actions

4.3.1 Action 2.1

Ratify the Kigali Amendment

Kenya is already in the process of ratifying the Kigali Amendment to the Montreal Protocol that regulates the production and consumption of HFCs. This Amendment has the potential to avoid up to 0.4oC of global warming and significantly contribute to the Paris Agreement goal of keeping the temperature rise below 2oC in this century. Ratifying the Amendment and beginning the implementation of the HFC phase-down schedule will help Kenya meet its climate commitments. With the ratification, Kenya is also obliged to include HFC into the reporting of consumption data to the Montreal Protocol (Article 7 of the Montreal Protocol).

The phase-down schedule agreed upon in the Kigali Amendment for Article 5, Group 1 countries - including Kenya - requires a freeze in HFC consumption in 2024 and a step-wise reduction in consumption to 80% of the baseline consumption by 2045 (*Table 5*). As the most common refrigerant used in ACs available in the Kenyan market is R-410a (an HFC), the AC sector plays a strategic role within the phase-down schedule following ratification. Kenya is currently collecting HFC consumption data to define its HFC consumption baseline, that affects the freeze level and consecutive phase-down steps.

Baseline average production/consumption	2020 – 2022
Freeze both production and consumption	2024
10% reduction	2029
35% reduction	2035
50% reduction	2040
80% reduction	2045

Table 5: The Kigali Amendment Article 5 Group 1 HFC phase-down schedule

4.3.2 Action 2.2

Raise awareness for the application of natural refrigerants

Awareness raising within stakeholders and enforcement officers is ongoing under Montreal Protocol and should be extended to also include HFC issues and energy efficiency.

- To enforce the import quota and selected bans as described above, awareness and training of customs and other law enforcement officers is crucial;
- **Demonstration projects** to show the benefits of the use of natural refrigerants and engage stakeholders in the sector;
- **Raising awareness among consumers and the industry** on regulations, controls, phase-out schedules, emerging alternatives, and the benefits of a transition to natural refrigerants.

Medium term actions

4.3.3 Action 2.3

Ban high GWP-refrigerants in selected product groups

Despite the Kigali Amendment, giving an expiry date to the widespread use of HFCs, the presently employed refrigerants are still predominantly HFCs. It requires a strong political signal for the market to shift towards low-GWP refrigerants. The best-practice example is the EU F-gas Regulation (EU, 2014), setting a strict quota system to reduce the use of HFCs to 21% of its 2014 level until 2030. Additionally, the EU F-gas Regulation bans the use of refrigerants above a certain threshold where low-GWP alternatives are established (*Table 6*).

Banning the use of high-GWP refrigerants in selected applications still provides a strong market signal. The product group with a well-established low-GWP natural alternative is domestic refrigeration. Banning the sale of domestic refrigerators using refrigerants with a GWP above 150 might not result in a high emission reduction but shows importers that HFCs are no longer favoured. Similarly, self-contained ACs, single-split ACs and commercial stand-alone units could be targeted. Since the EU F-gas Regulation targets the same product groups, the market is developing sufficient alternatives.

Another subsector that could gradually move towards natural refrigerants could be the commercial / (light) industrial refrigeration subsector where the horticulture, especially the flower industry, is highly dependent on the EU market. The additional benefit of this subsector moving to low-GWP technology might be an increased competitiveness of state-owned and private production, processing and logistics companies.

As for certain HFCs, a ban is also advisable for HCFCs. Currently, the Environmental Management and Coordination (Controlled Substances) Regulations do not control the importation of cooling appliances containing HCFCs. In 2018, the AC Kenyan market still contained R22 (a HCFC). However, since the implementation of the revised AC MEPS in April 2019, EPRA has not registered any R-22 ACs. This is likely because the majority of the R-22 AC models that were in the market had low efficiency levels. To safeguard this gain, continue with the transition from HCFCs in the AC and refrigeration sector, and to meet Kenya's target of total phase out by 2026, a revision of the controlled substances regulation to ban the importation of cooling appliances containing HCFCs such as R-22 is recommended.

Table 6: Prohibition years for selected product groups under the EU F-gas Regulation and suggested years for Kenya

Product group	GWP threshold	Year of prohibition EU F-gas Regulation	Year of prohibition Kenyan NCAP scenario
Self-contained ACs	150	2020	2025
Split ACs (below 3 kg charge)	750	2025	2025
Domestic refrigeration	150	2015	2025
Commercial stand-alone units	2500	2020	2025
	150	2022	*2025*

4.3.4 Action 2.4

Establish formal qualification, certification, a registration scheme for technicians

To increase the skills and also provide documentation of technicians' skills, we recommend the establishment of a formalised Qualification, Certification and Registration (QCR) scheme for RAC technicians. Work was undertaken for the development of a curriculum according to EN 13313. The curriculum upgrade is a slow process; however, the trainers are making efforts to incorporate the necessary components into existing courses.

Being able to prove a certain skill level also to international technology suppliers is crucial for gaining market access to technologies using flammable (HCs) and/or toxic (ammonia) refrigerants. In addition, skills are equally required to maintain high-EE throughout the lifetime of the equipment. In absence of national safety standards, international standards could be adopted, providing legal security on applying safety standards.

Safety as a public concern

While new alternatives are environmentally safe, there are several technical challenges to overcome. For example, the use of flammable substances for refrigeration, as is the case with HCs, requires a different safety concept and control than for substances classified as not flammable. Public safety is a key concern when introducing new alternatives. This is even though the introduction of such alternatives in products and installations in Europe achieves, without compromise, the same level of safety as with HFCs. The introduction of new, often more complex, technologies, requires new skills, know-how and quality control. Conformity of process, product, or service with required good practice and standards can be enforced with certification, regulation and market incentives. Companies, as well as technicians need to conform with good practice and standards. Finally, the safety of the product or installed equipment needs to be verified.

Training builds capacity of personnel. However, critical aspects of the impact of personnel on public or environmental safety need to be assessed through third-party verification. In other words, the introduction of new alternatives will also depend on the availability of qualification and verification systems and intermediaries that enable certification of conformity of relevant processes, products and services. Therefore, the objective is to establish a framework for RAC technologies at various levels through policy action, private sector cooperation and code of practice and commercial services & requirements that enable overall monitoring of the quality of products, services and processes.

Creating public acceptance through QCR schemes

Qualification systems need to ensure that personnel in the public and private sectors is trained in fulfilling relevant technical standards and that requirements are enabled to qualify for examination and certification. For certificates to be reputable and accepted worldwide (i.e. by suppliers of parts and equipment), accreditation of independent third-party certification bodies (although not always mandatory) is strongly recommended.

Accreditation is validating the appropriateness of the structure and governance of the certifying body, the characteristics of the certification programme, the information required to be available to applicants, and the recertification initiatives of the certifying body. Furthermore, accreditation is facilitating acceptance of the certification bodies and their certification schemes and mutual recognition of personnel competences and services at the national and international level.

The recommended QCR scheme should include:

1. **Qualification**
   Education, experience and knowledge are the basis for evaluating the qualification level of trainees. An entry exam helps to tailor training courses to the needs of the trainee.

2. **Training**
   Courses can be conducted by any institution with demonstrated experience in the field. They can be supported by standardised curricula.

3. **Training certificate for successful participation**
   Training institutes will certify successful completion of the training. However, this is in general not considered enough when liability issues are involved.

4. **Application for certification**
   With proven entry qualification 3rd party examination can be applied for. A diversified structure is needed to allow all levels of proficiency to acquire certified competence.

5. **Examination by third party**
   Internationally or nationally accredited training institutes will issue a certificate based on locally adapted international standards for certification.

6. **Registration**
   After certification, the certified person needs to be registered by a national body.

An example for skill levels defined by EN 13313 (see Annex B):

a) Basic Appreciation (BA) Category I
   - Recognises importance of Skill to business and society, and relevance to own job;
   - Interprets information on the Skill for own tasks;
   - Knows where to obtain professional help in the skill.

b) Working Knowledge (WK) Category II
   - Assesses and diagnoses issues in the Skill;
   - Provides reasoned challenges to specialists in the Skill;
   - Supervises or directly works with practitioners of the Skill.

c) Fully operational (FO) Category III
   - Performs all normal activities in the Skill;
   - Resolves problems and makes improvement in the Skill;
   - Applies and adapts best practice in the Skill to local conditions.

d) Leading Edge (LE) Category IV
   - Able to create major innovations in the Skill;
   - Creates best practice in the Skill; Acts as a recognised reference point for the Skill.

Specific steps towards comprehensive training schemes have already started with the development of curricula according to EN 13313. The next step is to engage suitable trainers and set up training equipment.

The lead for the implementation of the QCR scheme is with the the Ministry of Education, in cooperation with the Ministry of Environment Climate Change and Forestry for technical input.

5

IMPROVE AGRICULTURAL COLD CHAINS

5 Improve agricultural cold chains

Enhancing access to agricultural cold chains in Kenya can increase food security and improve farmer's livelihoods, in particular for small scale farmers that currently lose 30% of their produce due to a lack of access to an adequate cold chain infrastructure. The proposed enabling actions are aimed at easing regulatory procedures and using financial incentives to mitigate some of the challenges slowing the adoption of cold chain technologies in Kenya.

5.1 Status Quo

The agricultural cold chain refers to the temperature management of perishable products in order to maintain quality and safety throughout the supply chain from farm to table.[36] They play a critical role in reducing food loss and increasing food supplies. Examples of types of cold value chains in off-grid areas are shown in *Figure 17* and described below:

- **Fresh Fruits, Vegetables, and Flowers** have significantly different cooling requirements for storage. For example, the recommended storage temperatures for bananas, cucumbers, and tomatoes are somewhere between 10-15°C. However, the recommended storage temperature for apples, cabbages, and lettuce are much lower – close to 0°C.

- **Meat and Fish** once slaughtered and processed, are either frozen or chilled just above freezing as they make the journey to their final resting plate. The cooling process usually begins with one of three approaches: liquid cooling, ice slurry cooling, or combined blast and contact cooling. Fattier fish are typically stored at -21°C while leaner fish is cooled to -18°C. While freezing is the most common approach to fish cold transport, the freezing process can cause ice crystal formation in the protein leading to drip-loss, reduced ability to hold water, and textural deterioration. To avoid the negative effects of freezing some fish cold chains use ice glazes and transport conditions that range from -0.9 – 2°C.

- **Milk Chilling and Storage**. Freshly harvested milk contains few microorganisms. However, the microbial growth will rapidly increase under warm temperature, and international organizations like the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) have developed detailed guidance on proper chilling and storage of milk to account for this.

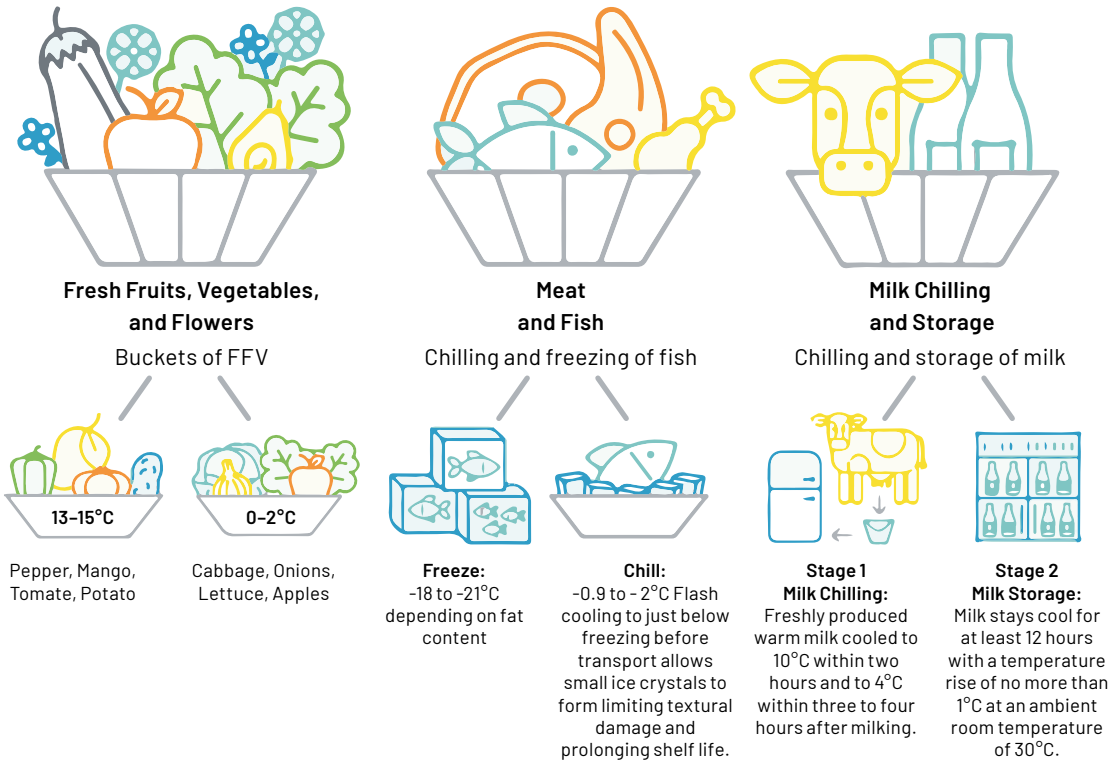


Figure 17: Types of cold chain in off-grid areasfor Kenya

36 Global Cold Chain Alliance. *http://www.gcca.org/about-us/the-cold-chain/*

In Kenya, 80% of farmers are small scale and approximately 30% of their produce is lost due to a lack of access to an adequate cold chain infrastructure. Due to economic constraints, farmers in Kenya cannot afford cooling solutions to reduce post-harvest losses. Initial findings from a market scoping study for agricultural cold chains in East Africa conducted by CLASP, show that the cold chain market in Kenya is in varied developmental stages relative to the end market. Typically the cold chain for produce for export markets is more developed in order to meet stringent export quality standards, while produce destined for the local market has limited investment in cold storage resulting in an underdeveloped cold chain (i.e. small, unstructured, fragmented and informal). A reason for this is the lack of awareness in the domestic market on the benefits of the cold chain and the lack of widespread consumer demand for safe, quality food backed by government enforcement of food safety regulations. The latter is also a disincentive for investments in cold storage for the local market.

There is limited information on the market size of the cold chain market in Kenya. There is also little data on available cold chain technologies and their technical performances (i.e., energy efficiency). The majority of the cold storage unit components are imported and there are a few distributors and assemblers of cold storage systems. Cold storage usage currently observed in off-grid areas is mainly supported by donor funds or programs. The costs of the cold storage technologies found in the market was high - for example, a 3T size off-grid cold storage unit costing as much as USD 20,000.

High electricity costs and sometimes interrupted power supply in the country provide a key opportunity for efficient cold storage solutions. The use of alternative power sources, such as generators, increases ongoing costs for aggregators and farmers, and power surges affect compressors and can lead to damage to on-grid units.

An expansion of cold storage solutions to more sectors and wider geographical usage will require interventions to reduce the high costs of systems and a means to ensure only energy efficient units are available in the market.

A pilot project funded by the German International Climate Initiative and carried out by GIZ on a sustainable fish coldstore in Kenya developed a handbook for the design, calculation and installation of a solar powered cold store using natural refrigerants.

5.2 Target

To overcome some of the challenges that technology providers currently face, the Kenya government can start by establishing policies spelling out clear and easy-to-follow legal procedures and requirements for businesses dealing with cold storage systems. Additional incentives, such as reduced import taxes, similar to those applied to off-grid refrigerators, could reduce the high upfront cost of cold storage systems (as of now, the Kenyan tax regulations do not exempt cold storage systems from VAT and import duty fees). Creating awareness on the benefits of an efficient cold chain infrastructure among consumers, manufacturers, farmers, traders, as well as policy makers, will be important to further propel the growth of the market sustainably. This will entail building confidence to invest in an otherwise unfamiliar new technology, allowing innovation and design of affordable and energy efficient cold storage technologies, facilitating smoother and easier business partnerships to enable market growth, and implementing policies conducive to the development of a sustainable cold chain market.

5.3 Enabling Actions

Short term actions

5.3.1 Action 3.1

Create an enabling environment for the cold chain market

One of the main barriers businesses dealing with cold storage systems face in Kenya is the lack of a streamlined process that supports setting up their operation: from basic information on how to set up a business to a full list of permits and registration requirements. A set of policies that spell out clear and easy-to-follow legal procedures and requirements for businesses dealing with cold storage systems, will be a first step in creating an enabling environment for cold chain stakeholders.

5.3.2 Action 3.2

Expand fiscal benefits to cold storage systems

Another barrier faced by cold storage equipment importers is the lack of clarity of the tax regime that applies to equipment for agricultural products. Lower import taxes have been applied with some success to off-grid refrigerators to improve affordability. A similar incentive, that reduces import taxes targeting specifically cold storage systems, could reduce high upfront costs. In order to allow for a more consistent application of the rules, this should be coupled with training for customs authorities.

5.3.3 Action 3.3

Raise awareness on the benefits of the cold chain

Creating awareness on the benefits of an efficient cold chain infrastructure among consumers, manufacturers, farmers, traders, as well as policy makers, will be important to further propel the growth of the market sustainably. This will entail building confidence to invest in an otherwise unfamiliar new technology, allowing innovation and design of affordable and energy efficient cold storage technologies, facilitating smoother and easier business partnerships to enable market growth, and implementing policies conducive to the development of a sustainable cold chain market.

Promote the sharing of lessons learned from the technical needs assessment carried out in three counties

- Involve all stakeholders at design stage of cold storage facilities
- Design cold stores with adjustable operation to accommodate several types of produce throughout the year
- Revise business models to cater to the abilities and the needs of users
- Set up produce markets with cold chain facilities

Medium-term actions

5.3.4 Action 3.4

Support research & development for technical solutions adapted to local conditions

Innovation in cold storage technologies is crucial to adjust to the needs and local conditions of customers in unique off- and weak- grid settings. Cold units must be designed to meet specific intended use cases as their performance requirements will differ by crop and geographic location, among other factors. Enhancing production of affordable and quality cold unit products will require building up the technical capacity, especially for locally based manufacturer and assembly companies. It will also require R&D investments into advanced technical designs, innovative component part materials that will lower cost, improve reliability, increase longevity and minimize harmful environmental impact of the resultant end cold unit product. Some of the avenues that can be employed to achieve this include:

- Hosting and sponsoring technical training workshops for manufacturers and other cold storage technical innovators
- Availing R&D funds and grants for innovative cold storage technology innovations
- Investing in facilities and equipment to support experimentation and quality testing of cold storage technological innovations
- Promote technology transfer to increase the access to innovative cold chain solution developed elsewhere
- Set up a research center for cold chain technology

5.3.5 Action 3.5

Promote access to innovative business models

The use of the pay-as-you-go (PAYG) business model in the off-grid appliance market is one of the factors that has enabled its growth.[37] PAYG can be described as an innovative business approach that combines credit, available emergent technologies (i.e. mobile phones & networks) and awareness of this technologies, to deliver a service that caters to both end-customer affordability and provides sufficient margins to fuel operational models that can scale. Furthermore, it can be easily adapted to suit different business operational contexts. Efforts should be made to promote invention or uptake of similar initiatives so as to grow and scale the still nascent agricultural cold chain market. Some of the suggested actions include:

- Support and fund business enabling innovations such as Internet of Things and software platforms, remote monitoring equipment, among others. A reliable and robust digital monitoring platform and equipment allows for effective management of products which leads to quality service delivery for clients and customers. This can be done through competitions and challenges.
- Hosting business to business networking activities as well as trade fairs to showcase upcoming innovative solutions in the marketplace.
- Creating intentional linkages between companies and partners/institutions with business management expertise for a training seminar for example.
- Undertake cold chain market assessments and analysis with the goal of publishing technical reports providing key insights into the informational gaps in the cold chain market critical for businesses to design and develop appropriate innovative solutions.

5.3.6 Action 3.6

Design finance models targeted at small-holder farmers

Access to finance can allow farmers an opportunity to boost their farming productivity through investment in necessary farm inputs and equipment which potentially would open them up to international/ export supply chains. Engaging with financial institutions and investors to provide and design financial products that are more easily accessible to small-holder farmers, who are often found in the weak and off grid areas, would be necessary. These financial incentives can take the form of:

- Implementing results based financing targeted on the consumer / demand-side
- Extending affordable agricultural asset financing packages
- Setting up lower interest rates for agricultural loans

6

PLANNING FOR FUTURE ADDITIONS TO NCAP

6 Planning for future additions to NCAP

As outlined in the introductory chapter, the present scope of the NCAP is a very good start to mitigate emissions from the RAC sector. It is however necessary to expand the scope of the NCAP in the future from the present focus on the appliance efficiency to managing cooling demand in an integrated fashion that encompasses urban planning and building design to reduce overall heat stress. Those nature-based options and passive cooling measures affects the need for AC appliances and especially reduce the cooling load and thus the energy consumption of RAC equipment. A further aspect to be considered in the future is the sustainable end-of-life management of cooling equipment as a way to reduce emissions.

To prepare for this wider scope, preparations need to start with the implementation of the current NCAP and include

1. Analysis of cooling demand that caters to the thermal comfort and productivity of the people in their homes, as well as in educational buildings, hospitals and work environment.

2. Screening of nature-based and passive cooling technology options their application potential in Kenya

3. Effective ways for promotion and support for the implementation of identified technology options

4. Develop concept for a sustainable end-of-life management of cooling equipment, which prevents the venting of the refrigerants and therefore reduces direct emissions

Material that can guide these tasks were produced by Sustainable Energy for All and its initiative for a cooling needs assessment for all[38]. The description of the tasks in the remainder of this chapter was informed by their work.

6.1 Analysis of cooling demand

Cooling demand is not limited to space cooling, but is essential for food security as well as health services. The description of the degree of unmet needs and the associated risk is required to inform future action. Available scorecards[39] help to frame the status quo and provide a means to track improvements. For Kenya, special focus lies on hot parts of the country such as the Northern counties, Easter counties or Coast counties as well as informal settlements and not only include residential buildings but also public buildings such as schools, hospitals and public institutions.

38 *https://www.seforall.org/data-stories/cooling-for-all-needs-assessment*
39 *https://www.seforall.org/system/files/2019-11/CoolingforAll_Needs-Assessment-Scorecard.pdf*

6.2 Nature-based and passive cooling technology options

Cooling demand management starts with urban planning and building design and should focus on keeping heat stress to a minimum. That means that e.g., planting trees in urban spaces does not only improve the air quality but also can reduce heat stress as plants have effects on the microclimate. While some of those measures need to be integrated within the design phase, others can also be applied to existing quarters and buildings, such as shading and reflective surfaces. *Table 7* provides a non-exhaustive list of possible nature-based and passive technology options that can be implemented during design and retrofit.

Principle	Examples	Retrofit	Building design	Urban planning
Shade	Umbrellas, overhangs, fins, external blinds, solar panels and plants as shades	x	x	
Insulation	Roof and wall insulation, insulated windows, insulated containers	x	x	
Reflection	Cool roofs, walls, vehicles, containers and other surfaces	x	x	x
Airflow	Natural ventilation, buildings or vehicle openings, exhaust		x	x
Water	Flowing water, mist, pools, rivers, lakes, oceans, heat sinks		x	
Plants	Ground cover, green roofs, green walls, shade trees	(x)	x	x
Earth	Earth tunnel, earth berm, heat sinks		x	x
Thermal	Thermal mass, thermal storage		x	x

Table 7: Nature-based and passive technology options, adapted from SEforAll 2020 [40]

6.3 Implementation plan for identified technology options

The implementation of nature-based and passive technology options requires the coordination of several actors that are involved in urban planning and building design. Know-how has to pair with regulatory framework conditions and available finance to make access to sustainable cooling for all possible.

Implementation will most probably include pilot projects, both for new buildings and living quarters as well as retrofits, combining passive cooling options with efficient active cooling appliances. Adequate financing, especially for lower in-come households is essential for the access to cooling. Such schemes should avoid high upfront cost and could be designed as "cooling as a service" programs or "on bill financing" schemes.

When it comes to sustainable urban planning and building design, cooling demand is only one aspect. The efficiency of other services (water, lighting, etc.) and the building material itself is similarly important and could be integrated to foster mitigation in the building sector.

The implementation plan require regular update to adequately respond to technology innovations.

38 2020 Chilling Prospects, Tracking sustainable cooling for all, Sustainable Energy for all, *https://www.seforall.org/chilling-prospects-2020*

6.4 System design and servicing to maintain energy efficiency

To promote energy efficiency in RAC equipment, efficient system design according to the expected cooling demand is required. Equally important is a policy to maintain the energy efficiency via an appropriate maintenance schedule that includes the review of temperature settings, filter cleaning as well as refrigerant leakage checks and timely repair of identified leaks.

Such maintenance should be carried out by certified technicians only. A maintenance schedule, defining minimum criteria and responsibilities of operators and technicians should be developed to be part of the next NCAP.

6.5 Development of concept for sustainable end-of-life management of cooling equipment

In order to prevent the refrigerants from being vented into the atmosphere at the end of the lifetime of the cooling equipment, a scheme for collection of old equipment and destruction or recycling of the refrigerant should be put into place. This requires infrastructure for the collection and treatment of the cooling equipment as well as incentives for the refrigerants to be collected instead of vented. Such a scheme would be especially relevant to capture high GWP and synthetic refrigerants to prevent their damaging effect on the climate. Those refrigerant groups are HCFCs, HFCs and HFOs, the latter because their break-down products are highly persistent chemicals that accumulate in the aquatic. To make such a system successful, incentives for refrigerant collection are recommended. Collection activities of (certified) technicians are key for the successful recovery of refrigerants. In the long-run, operators of equipment are to be held responsible to provide proof of the collection of refrigerants form their systems by certified technicians.

6.6 Enabling actions

6.6.1 Action 4.1

Analysis and revision of building codes

To initiate the process of mainstreaming passive cooling into building design, the analysis and revision of applying building codes for new and refurbished buildings is recommended to be included within the implementation of the present NCAP. This will also avoid the further lock-in of buildings that are poorly insulated and thus have a high cooling demand. The National Building Council is the responsible body to liaise with and take this further.

6.6.2 Action 4.2

Pilot projects

To increase the knowledge base and raise awareness for the potential of passive cooling and nature-based cooling, pilot projects could be implemented. The insights gained concerning the utilization of such options in modern urban planning can inform the broader uptake.

A specific measure that could be explored within a pilot is to deploy cool roofs, by applying white paint coatings. This increases the reflection rate of the incoming sunlight and thus reduces the heat up of the building and the surroundings.

6.6.3 Action 4.3

Preparatory analysis

The inclusion of the items listed in *subchapter 1 to 4* require thorough analysis and planning, which is recommended to commence with the implementation of this NCAP.

7

FINANCING

7 Financing

As the transition to energy efficient AND using natural refrigerants should be targeted together, the financing needs are also analysed in a combined fashion.

For the accelerated transition towards climate friendly and energy efficient, green RAC appliances the funding needs for the implementation of the NCAP must be met. The relevant stakeholder for the RAC sector to be included are resellers and end users. In addition, Kenya has a small manufacturing base who assembles commercial display cabinets. Those manufacturers require support to meet energy efficiency standards of their appliances and adopt low-GWP refrigerants, when such requirements are introduced on a national level.

Table 8 outlines the funding need for the key subsectors addressed in the NCAP. The proposal is to establish supportive financing to address about 10-20% of the annual sales volume of each key subsector through targeted low-interest concessional loan financing and/or Green Public Procurement. The underlying assumption is that a significant proportion of the market will take up on alternative low-carbon technologies and create a pull effect for the larger market to follow.

For the UAC and the commercial refrigeration subsector, Green Cooling alternatives still have current market penetrations of less than 10%. Accordingly, by 2025, this NCAP suggests covering at least 20% of the projected annual sales volume through concessional loan financing. This targeted climate financing is suggested to support the market promotion of low-GWP alternatives to eventually reach a higher market penetration of 50-100%.

Domestic refrigerators already have a substantially higher market penetration of natural low-GWP refrigerants (R600a). Different from the other subsectors, domestic refrigeration requires less supportive financing for the transition to low-GWP refrigerants, as this change is already underway. Financial support for domestic refrigerators focuses on the introduction of a mandatory and fully enforced labelling scheme combined with financing (low-interest) support for top-labelled products, targeting the top 20% fraction of the product classes. Here, consumer concessional loan schemes should mainly create and sustain a promotional pull effect for the market to strive to high-EE, addressing about 20% of the annual market.

The NCAP also suggests the introduction and enforcement of mandatory labels for commercial refrigeration appliances combined with concessional financing schemes to promote top-labelled classes.

Table 8: Overview funding needs and financing options

Subsector/ application	Key end-users	Funding Needs 2020/ 2025 (annually)	Building design
UAC / Energy efficient AC appliances with low-GWP refrigerants	**Retail customers** and government buildings with room ACs	Financing volume: 6.5 to 30 Mio USD targeting about 5% (2020) and 20% (2025) of the market **Technical assistance:** 0.6 to 3 Mio USD	Low-interest rate financing programmes linked to consumer financing; Government: Green Public Procurement;
Commercial refrigeration/ **Energy efficient standalone and condensing units with low-GWP refrigerants**	Operators of mini-/ supermarkets/ standalone units	Financing volume: 16 to 74 Mio USD targeting 5% (2020) and 20% (2025) of the market **Technical assistance:** 2.5 to 6 Mio USD	Low-interest rate financing programmes linked to commercial loan financing;
Domestic refrigeration/ **Energy efficient domestic refrigerators with low-GWP refrigerants**	Retail customers	Financing volume: 6.5 to 30 Mio USD targeting 5% (2020) and 20% (2025) of the market **Technical assistance:** 0.6 to 3 Mio USD	Low-interest rate financing programmes linked to consumer financing;

Developing a resource mobilisation strategy based on the information provided in this chapter is of utmost importance to enable the implementation of the NCAP.

7.1 Financing Schemes

In principal, the suggested financing scheme can play an important role to accelerate the promotion of Green Cooling appliances by:

- Initial market introduction of new RAC appliances with low-GWP refrigerants and high-EE until such products reach a sufficiently high market penetration
- Continuous financing of top-labelled products (once this instrument has been established as outlined) to create a permanent pull effect towards introduction of appliances with high-EE

The financing scheme, eventually to reach the whole market, should be well designed and accompanied with a technical assistance programme, covering the four strategies outlined in the *previous chapter*.

The target groups can be differentiated in retail customers, mainly for room ACs and refrigerators, and commercial end users. The appropriate instruments for retail customers are low-interest financing schemes linked to low-interest financing of products at the point of sale, (usually, large department stores or specialised resellers of electronic appliances) to overcome the higher upfront cost barrier by spreading the initial costs over time. Some of these tools include consumer finance, green mortgages, and pay-go. The latter is fairly common throughout Sub-Saharan Africa, where companies selling solar home systems offer pay-as-you-go financing to customers who are usually unable to afford the upfront cost of these systems. In West Africa, another relevant example of consumer finance programs is the recently launched ECOWAS Refrigerators and Air Conditioners Initiative (ECOFRIDGES), where financial institution offer a mechanism that enables customers to purchase energy-efficient and climate-friendly air conditioners and refrigerators, providing flexible payment terms.[41]

Commercial financing schemes are addressed to commercial end users. For the effective introduction of such schemes, the initial focus can be on large end user groups.

Climate financing actions can be differentiated in:

- unilateral or local financing (both public and private)
- supported international financing, through international climate financing organisations, public or private
- credited financing, as also further outlined in Articles 6.2 and 6.4 of the Paris Agreement (United Nations, 2015)

Credited international funding will not be further described in these chapters, as the Clean Development Mechanism currently lacks market relevance to represent a tangible financing option and the new credit financing mechanisms, as they may emerge from the Paris Agreement (Art. 6), still lack of sufficiently specific implementation guidelines. However, such financing schemes could emerge as interesting financing options in the future.

Chapter 7.2 explores the options meeting the funding needs at the national level through public funds. *Chapter 7.3* outlines the involvement of the private sector in cooperation with government programmes and conclusively, key elements of a funding proposal linked to international institutions for supported international financing, in *Chapter 7.4*.

41 *https://www.ghanaweb.com/GhanaHomePage/business/Govt-to-conserve-465GWh-in-next-decade-with-introduction-of-ECOFRIDGES-1092019*

7.2 Financing options through local public organisation

Regarding local financing, Green Public Procurement, can be a very effective, relatively uncomplicated and easy to implement measure to locally initiate the transition to Green Cooling alternatives. Government entities can demonstrate early action and act as a role model for actors in the private sector. The existing government procurement budgets can be used for the funding of measures.

The procurement requirements for RAC appliances can be altered, so that only RAC appliances meeting MEPS and using low-GWP refrigerants (with a GWP < 10) can be eligible. There are several implementation options, i.e. to start the programme in a certain test region or to initially focus on certain appliances only, i.e. chillers and (light) industrial refrigeration.

The government can require procurement officers to procure products from an approved product list. For the RAC sector, these lists can specify refrigeration and AC appliances using natural refrigerants with a GWP <10 and meeting international best practices (such as identified in the technology gap analysis). To allow a smooth transition from conventional to more climate-friendly products, the procurement requirements can be gradually increased, i.e. with phase-in steps from 25%, 50%, 75% to 100%.

Other feasible measures which show an affordable administrative complexity, and which do not require extensive scale, can be a tax and/or rebate scheme, i.e. on certain refrigerants. Also, levies could be established on the electricity consumption and to feed a national EE fund. The EE fund would be used in turn to provide incentives only for top-labelled products. International concessional funding could be established initially for the introduction of such sustainable, national financing schemes.

The taxation of HFC refrigerants are ideally based on their GWP content. As nearly all high-GWP refrigerants and pre-charged refrigerants in RAC appliances are imported, such taxes can be raised at the time of import. The funds raised can be effectively diverted into incentive schemes to promote green RAC appliances, such as in Green Public Procurement schemes. The higher charges for high-GWP refrigerants and rebates for low-GWP refrigerants will signal market participants to accelerate the transit to low-GWP options. Such transitions can take place well ahead of the first mitigation step of 10% in 2029 as it has been agreed in the Kigali Amendment.

7.3 Private sector engagement

While *Chapter 7.2* mainly referred to public funding and the public-sector engagement, this chapter deals with the important involvement of the private sector in Kenya to take ownership in the targeted shift towards Green Cooling technologies and to engage in public-private-partnerships.

The transition towards climate-friendly and EE RAC appliances is a clear trend, underlined by more and more countries globally adopting MEPS and labelling and the Kigali Amendment determining the transition from HFCs to low-GWP refrigerants in the RAC sector.

Private companies investing in the change early will profit from gaining a competitive edge and avoid investing in the wrong technologies or technologies requiring further change in the future, instead of directly leapfrogging towards Green Cooling technologies.

The involvement and the commitment of private sector companies in the RAC sector, such as resellers of RAC appliances and end users, in particular commercial companies, such as supermarket operators, operators of vessels in the fishing sector or companies purchasing and operating AC of buildings, are important for the success of both local and internationally supported financing and funding programmes.

Regarding local bank financing, there is an increasing global trend towards socially-responsible financing through commercial banks. Banks realise that particularly long-term financing, especially of their corporate customers, is more sustainable and additionally more profitable if the environmental and climate integrity of the financing is considered. It is recommendable that banks are educated regarding their loan programmes to include evaluation criteria which consider the climate impact of RAC appliances. Furthermore, local banks can play an important role as partner banks in cooperation.

Potential options for cooperation between the commercial RAC sector stakeholders in Kenya and banks are:

- Green loan financing schemes with resellers:
  In contrast to many other countries, few Kenyan resellers of household appliances offer lease payments to purchase appliances or instalments instead of upfront payments. With high interest rates[42], loan programmes with concessional loans can potentially lower the refinancing costs significantly. Through such financing schemes customers could better afford appliances with lower total costs of ownership through lower operating costs and higher EE but possibly higher upfront costs. Concessional loan programmes of local banks can be refinanced with international donor loan programmes, i.e. from the African Development Bank.

- Green loan financing schemes with commercial end users of RAC appliances:
  With improved EE, Green Cooling appliances offer energy savings over time. If such appliances have higher upfront costs, end users are often holding back from buying such appliances, even if the higher upfront cost can be amortised within a few years through energy savings. This financing barrier can be bridged through targeted financing programs where loans are offered at concessional terms to local correspondence, private banks. Loans are then provided at concessional terms to commercial end users.

Target end users in Kenya:

- building sector with office buildings, hospitals and hotels;
- cold store operators i.e. in the horticulture sector and fish processing industries;
- supermarket sector with convenient stores, supermarket and hypermarkets.

42 *http://www.tradingeconomics.com/Kenya/interest-rate*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7.4 Financing options through international and regional institutions

International supportive climate financing targets the financing of additional measures beyond the common practice. There is no clear set of rules to define what such additional efforts constitute. It is rather the decision of each donor to determine the funding requirement.

A list of requirements to be met in general and specifically for the RAC sector to appeal the interest of international donors, is given below. These requirements need to be met for the design and implementation of financing and funding schemes addressing the transformation of the RAC sector towards energy efficient and climate-friendly applications:

General requirements:

- **Transformational change:** The funding proposals need to outline the intended scope. Ideally, the scope covers both (a) the transition to high-EE with a robust regime on MEPS and labelling (b) and the accelerated transition to low-GWP refrigerants

- **Ownership of government and private institutions in Kenya:** The participation of key RAC stakeholders from the beginning will be important for a successful implementation programme. Eligible beneficiaries of concession loans or funding programmes should provide a clear commitment as well as tangible and verifiable action towards Green Cooling technologies.

- **Monitoring, Reporting and Verification (MRV):** International donors regularly require the tracking of measures and their mitigation impact. The proposed tracking of mitigation action should follow the same Tier 2 methodology of the Intergovernmental Panel on Climate Change (IPCC) guidelines on GHG inventories.

RAC sector specific requirements:

- **Thorough understanding of the baseline and future projection of BAU emissions and mitigation options.** The mitigation options need to be based on alternative RAC technologies suitable for Kenya's RAC sector. The relevant inventory and the emission pathways are part of this NCAP.

- Transition to best practice RAC technologies suitable for the RAC sector in Kenya. Such technologies were identified in the Technology Gap Analysis.

- Transition to best practice RAC policies suitable for the RAC sector in Kenya. Such policies were presented in *Chapter 7*.

- **Establishment of a clear and well-established Strategy** showing a sustained path towards Green Cooling technologies as presented here.

Request for providing the funding and financing can be presented to the relevant instruments of regional and international donors. *Table 9* outlines some relevant donors and their programmes.

Table 9: Overview of relevant international and regional funding and financing organisations

Institutions	Funding programmes / features
Green Climate Fund (GCF)	Under the UNFCCC stronger linkages between its financing mechanisms, particularly the GCF and GEF, and its technology mechanism are to be sought. There are several options to request support from GCF. The National Treasury has outlined the following areas with a focus on energy efficiency in its GEF strategy: energy efficiency in public buildings, energy efficiency in industry. The GCF has also approved financial support to three private financing facilities with potential extensions to energy efficiency (GEEREF, Deutsche Bank)[43]. Such funding may also be applied for financing of activities suggested in this roadmap. In 2017, Kenya issued a National Green Climate Fund Strategy[44].
Global Environmental Facility (GEF)	Similar to the GCF, the GEF is requested to support activities which are strengthening the cooperation on technology and technology transfer. The technology gap analysis and the technology focus areas of the roadmap can serve as a basis to request technology transfer and cooperation related funds from the GEF.
Multilateral Fund (MLF)	With the Kigali Amendment, parties of the Montreal Protocol have agreed to release "fast start" financing for transition from HFCs to low-GWP refrigerants[45]. The proposals made in this NCAP fully support the objectives of the fast track funding to lower GHG emissions from the RAC sector through transition to low-GWP refrigerants and the enhancement of EE.
NAMA Facility	In the past, the German-UK NAMA facility has financed RAC related requests, i.e. in Thailand[46] and Colombia[47]. Activities suggested under this roadmap or in a regional context might be eligible for the financing under the NAMA facility.
African Development Bank	As a multilateral development bank, the African Development Bank, has a dedicated programme on climate financing . The bank offers loans and grant based components, i.e. under its African Climate Change Fund[49], which might serve to finance elements suggested under this roadmap.
Joint Credit Mechanism	Facilitates the diffusion of leading low-carbon technologies, products, systems, services and infrastructure as well as the implementation of mitigation actions. Led by the government of Japan, it contributes to the ultimate objective of the UNFCCC by facilitating global actions for GHG emission reductions or removals.
Abu Dhabi Fund for Development	ADFD's mission is to help developing countries achieve sustainable economic growth and reduce poverty. To do so, it provides concessionary financial resources in the form of sovereign loans that satisfy the concessional conditions in accordance with the requirements of the Organisation for Economic Co-operation and Development (OECD).

43 See *https://www.greenclimate.fund/documents/20182/574760/Funding_proposal_-_FP027_-_DB_-_Benin__Kenya__Namibia__Nigeria_and_Tanzania.pdf/cb8cb141-2453-4eaa-874b-cba4fb9bd2da (last accessed 26.01.2017)*

44 *http://www.gcfreadinessprogramme.org/sites/default/files/GCF%20Coordination%20Strategy%20Report.pdf*

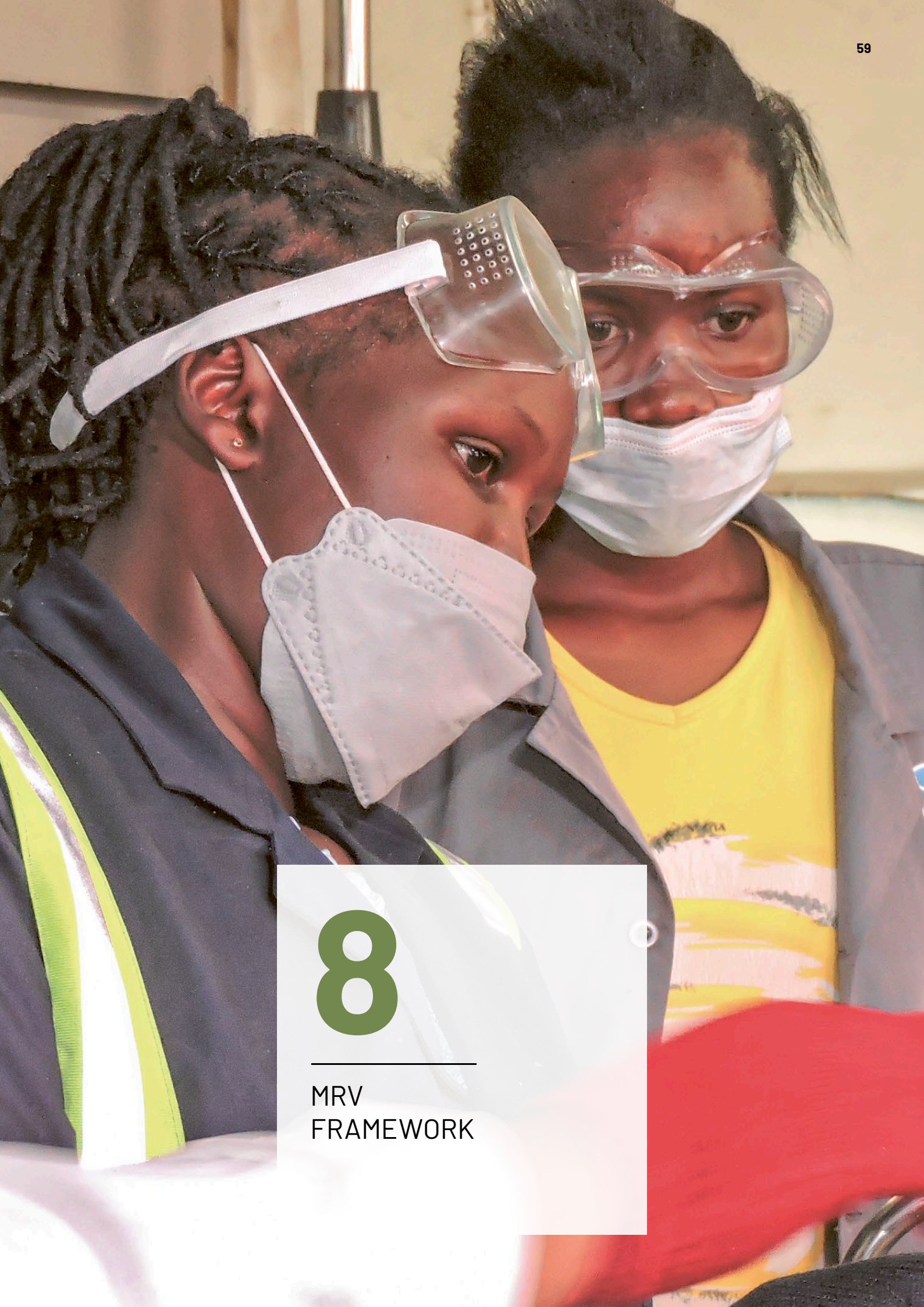
45 *https://www.nrdc.org/experts/david-doniger/countries-adopt-kigali-amendment-phase-down-hfcs, last accessed 10.05.2017*

46 *http://www.nama-facility.org/projects/thailand-refrigeration-and-air-conditioning-nama/ , last accessed 10.05.2017*

47 *http://www.nama-facility.org/projects/colombia-nama-for-the-domestic-refrigeration-sector/, last accessed 10.05.2017*

48 *https://www.afdb.org/en/cop21/climate-finance/, last accessed 10.05.2017*

49 *https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/africa-climate-change-fund/ ,last accessed 10.05.2017*



8

MRV FRAMEWORK

8 MRV Framework

Another strategic step towards a climate-friendly Kenyan RAC sector is the development and implementation of a Measurement, Reporting & Verification (MRV) system in order to track the effects of adopted policy measures. This aims to collect activity data of the RAC sector to be integrated into the GHG inventory process. For detailed knowledge of equipment in use, it is important to know what is sold in the country. For a country heavily relying on imports such as Kenya, it might be sufficient to closely monitor imports and exports of equipment. Best practice is a database of sold RAC equipment including selected technical parameters such as cooling capacity, EE metric, labelling class (if applicable), initial charge and contained refrigerant. Setting up such a comprehensive database requires an institutional framework, defining reporting obligations for all market participants. Nevertheless, it is a powerful information source, once established.

Kenya has already started this process for two product groups: split ACs and domestic refrigerators. As mentioned before, information on some additional elements should be recorded, such as the refrigerant and its amount contained in the product. More product groups, such as commercial stand-alone units, condensing units and larger AC systems should be added in medium term.

Effects on refrigerant usage can be traced from established refrigerant consumption reporting to the Montreal Protocol. This information can be further disaggregated making use of data that was and still is collected during the implementation of the HCFC phase-out management plan and now again in the course of the preparation of the Kigali implementation plan (KIP). The information collected for the KIP usually covers refrigerant use on a subsector level. Collection of information on energy use at the same time is recommended, as the same stakeholders can provide this information. Data collection should be organized in a fashion that can be updated annually, establishing data collection routines from various sources.

Potential national partners for this strategy include the Kenya Revenue Authority, the Kenyan National Bureau of Statistics, HVAC Kenya, the Kenyan Industrial Research and Development Institute (KIRDI) and the Ministry of Environment Climate Change and Forestry.

To keep track of the progress of the national cooling plan, milestones should be defined early in the process and the progress towards its achievement evaluated on regular intervals. Our proposal for an action plan is presented in *Chapter 9.3*.

9

ACTION PLAN

9 Action plan

9.1 Institutional Framework

The institutions in Kenya that are relevant to the NCAP are shown in *Figure 18*, while their roles and relevance to the NCAP are described in *Table 10*.

Figure 18: Kenyan institutions relevant to the National Cooling Action Plan

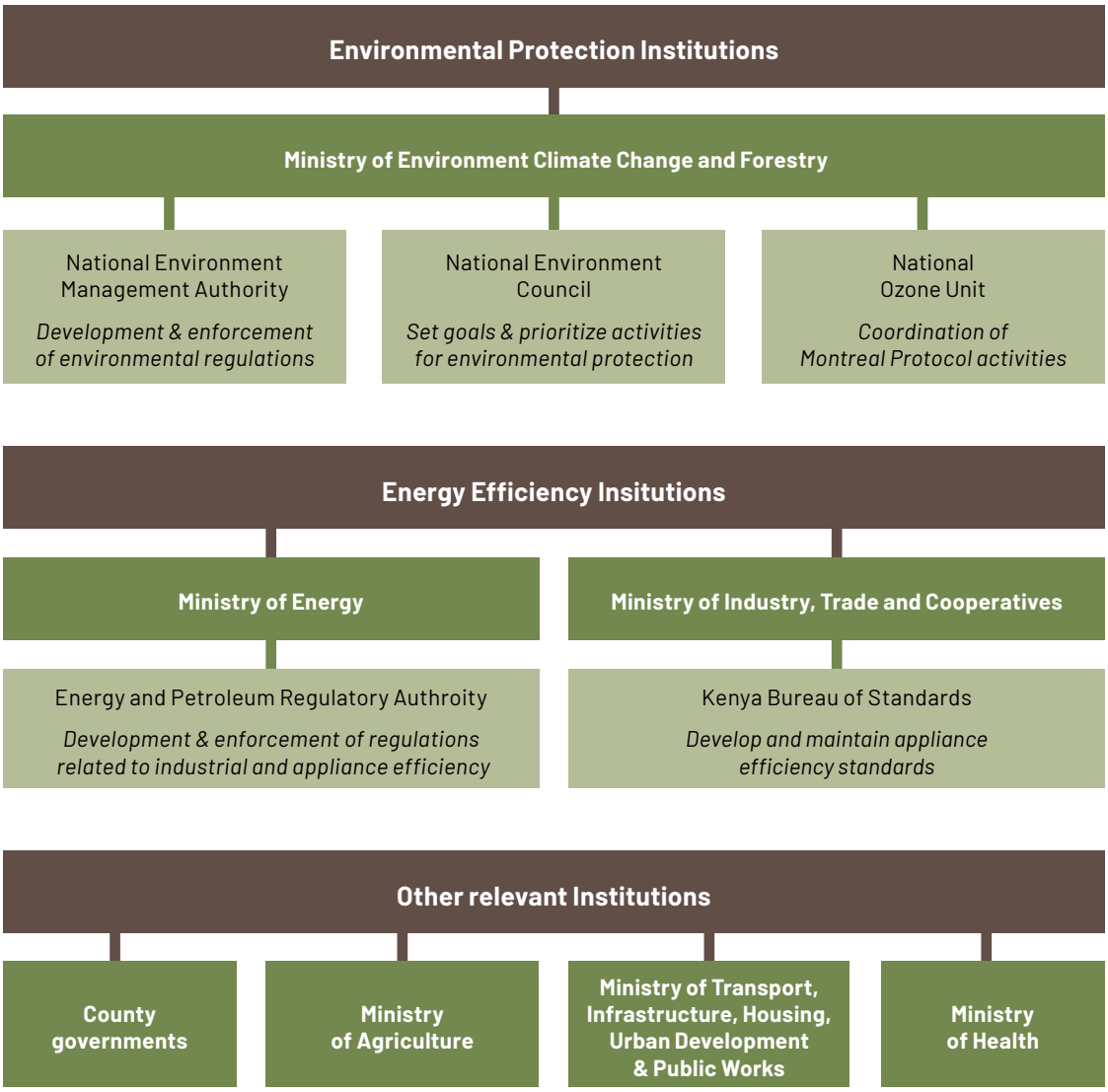


Table 10: Mandates and roles of relevant institutions to the National Cooling Action Plan

Institutions	Mandate	Role in NCAP
Ministry of Environment and Forestry	Is mandated, inter alia, to undertake national environmental policy and management, protection and conservation of the natural environment and pollution control	Coordinate the development and implementation of the NCAP and act as custodian of the whole process
Ministry of Energy	Responsible for policy formulation in the energy sector	Coordinate the implementation of the NCAP as it relates to Energy Efficiency
Ministry of Industry, Trade and Cooperatives	Responsible for industrialization and trade policy	Negotiate incentives for green cooling; incentivize manufacturing to support the transition to greener refrigerants
National Treasury and Planning	Responsible for managing Kenya's National and County Levels of Government Finances	Give tax incentives to green cooling
Ministry of Agriculture	Mandate is to formulate agriculture policy and oversee its implementation	Support the development of green agricultural cold chains
Ministry of Transport, Infrastructure, Housing, Urban Development & Public Works	Among its objectives is to develop and enforce regulations and standards to ensure safe, secure and efficient transport and infrastructure systems	Support green cold chain or refrigerated transportation for agricultural and health care products
Ministry of Health	Formulates health policy and oversees implementation	Support health cold chains for vaccines and medicines
Ministry of Education	Defines vocational training curricula and examination	Design of Qualification, Certification and Registration (QCR) system for RAC technicians
National Environmental Management Authority (NEMA)	It seeks to ensure a clean, healthy, and sustainable environment in Kenya through the supervision and coordination of all matters relating to the environment	Develop and enforce regulations limiting emissions into the environment by refrigerants
National Environment Council	Set goals & prioritize activities for environmental protection	Inter-ministerial coordination on policies supporting the NCAP
National Ozone Unit	Coordination of Montreal Protocol activities	Oversee the transition to natural refrigerants
Energy and Petroleum Regulatory Authority	Is responsible for economic and technical regulation of the energy sector and its mandate includes, inter alia, the enforcement and review of regulations and the management of electric power tariffs and tariff structures	Participate in development and enforcement of standards and labels related to energy efficiency of the sector
National Building Council	Formulates building policy and oversees implementation	Take a leading role in the revision of buildings codes for improved insulation and lower cooling demand
KEBS	The government agency responsible for the development of standards, metrology, conformity assessment, training, and certification services.	Development and enforcement of standards and labels for the cooling sector
County Governments	Their overarching mandate is to facilitate social-economic development at the devolved unit level	Initiate and/or support implementation of green cooling projects at the counties

9.2 Policy and Regulatory framework

As referenced in *Table 1, Table 2, Table 4,* there are a number of regulation and polices that are particularly relevant to the cooling context in Kenya. For energy efficiency, Kenya is already committed to reducing energy consumption and greenhouse gas emissions per the NDC under the Paris Agreement.

Future NDC updates will require more detail on a per measure level to fulfill the Enhanced Transparency Framework (ETF) that need to cover "information to track progress" of the NDC implementation. Overall targets might be supported by sectoral targets and measurable indicators. The NCAP could be included as a measure under NDC. That means that it requires a formal baseline (e.g. BAU emissions as provided in the RAC inventory), targets and measurable indicators to track progress. The outlined MRV framework (*Chapter 8*) can also serve this purpose. Tracking progress also aids the regular updating of the NCAP to ensure that it has the desired impact.

For refrigerants, Kenya is committed to phasing out HCFCs by 2030 under the Montreal Amendment to the Montreal Protocol and is expected to ratify the Kigali Amendment to the Montreal Protocol in 2022, thereby committing to a phasedown of HFCs.

Regarding energy efficiency standards and labels for room ACs and refrigerators, two appliance types that are currently regulated by EPRA, the key regulations are:

- KS 2463:2019 - Non-ducted air conditioners — testing and rating performance
- KS 2464-2:2020 - Performance of household electrical appliances- Refrigerating appliances Part 2: Minimum energy performance standard

For additional information on the various regulations relevant to cooling, refer to Annex A.

9.3 Timeline & Responsibilities

Actions to Increase Access to Sustainable Cooling for All Kenyans		Responsible Agency	Timeline
Objective 1:	***Accelerate market transformation affordable, high efficiency cooling appliance and equipment***		
Action 1.1 –	Raise ambition of efficiency standards for ACs and refrigerators		
	Revision for the AC and refrigerator MEPS	KAM, EPRA and KEBS	Initiate in 2023
Action 1.2 –	Promote awareness on energy labels and benefits for cooling products		
	Continue end-user consumer awareness	EPRA	Ongoing
	Promote awareness on cooling value chain Importer-Retailer, service industry	EPRA, KAM, MECC&F, MITI, HEVAC	2023
Action 1.3 –	Strengthen compliance and enforcement to safeguard benefits of standards and labels Develop an existing framework for compliance	NEMA, AND MECC&F and other key stakeholder (Energy advisory) EPRA	2023
Action 1.4 –	Promote bulk and government procurement programs		
	Green public procurement guidelines	National Treasury and Planning (PPOA)	2023
	Bulk procurement; buyer's clubs	MITI and Traders	2023
Action 1.5 –	Implement favorable fiscal policies for high efficiency products	National treasury& Planning, KRA MECC&F, MITI	2023
Action 1.6 –	Expand S&L program to cover end-uses with growing energy demand S&L for Refrigerant	MECC&F, KENAS EPRA, KEBS, NEMA and other key stakeholders depending on end-use	2023 forward
Objective 2:	***Transition the cooling sector to natural refrigerants with low global warming potential***		
Action 2.1 –	Ratify Kigali Amendment	Ministry of Environment Climate Change and Forestry	2023
Action 2.2 –	Awareness raising for the application of natural refrigerants		2023 and beyond
Action 2.3 –	Ban high GWP refrigerants in selected product groups	Ministry of Environment Climate Change and Forestry	2022–2023
Action 2.4 –	Qualification, Certification and Registration of HVAC-R engineers and technicians on energy efficiency and environmentally friendly refrigerants	Ministry of Education	Ongoing, system in place in 2025
Objective 3:	***Improve agricultural cold chains***		
Action 4.1 –	Create an enabling environment for the cold chain market	Ministry of Environment Climate Change and Forestry	2023
Action 4.2 –	Expand fiscal benefits to cold storage systems	National Treasury and Planning	2023
Action 4.3 –	Raise awareness on the benefits of the cold chain	Ministry of Agriculture	2023
Action 4.4 –	Support research & development for technical solutions adapted to local conditions	National Treasury and Planning International donors and programs	2023 onwards
Action 4.5 –	Design finance models targeted at small-holder farmers	Ministry of Industry Trade and Investment, MECC&F, Financial institutions & investors	2023 onwards
Action 4.6 –	Promote access to innovative business models	Ministry of Industry Trade and Investment & Financial institutions	2023 onwards
Action 5.1 –	Analysis and revision of building codes	National Construction Authority	2022 onwards
Action 5.2 –	Pilot projects for nature-based and passive cooling options	Ministry of Environment Climate Change and Forestry	2023–updated NCAP
Action 5.3 –	Preparatory analysis for future additions to the NCAP	Ministry of Environment Climate Change and Forestry- NOU	2023–updated NCAP
Develop a resource mobilisation strategy to gain access to funds for implementation of the NCAP		National Treasury and Planning	2023 onwards
Implement MRV framework		Ministry of Environment Climate Change and Forestry, EPRA, KEBS, KRA, KENTRADE	2023 onwards

10

GHG PROJECTIONS

10 GHG Projections

The emission savings in the whole RAC sector of the proposed measures until 2050 are shown in the following figures. *Figure 19* shows the emission development over time. It is apparent that the proposed actions have a tangible effect until 2030, when projected growing equipment sales cause an upward emission trend. This means that the cooling strategy – as all measures combatting climate change require regular update and strengthening to include opportunities arising from advancing technology.

Figure 19: Projected RAC sector emissions for the business as usual scenario and all measures applied in this paper (RDM).

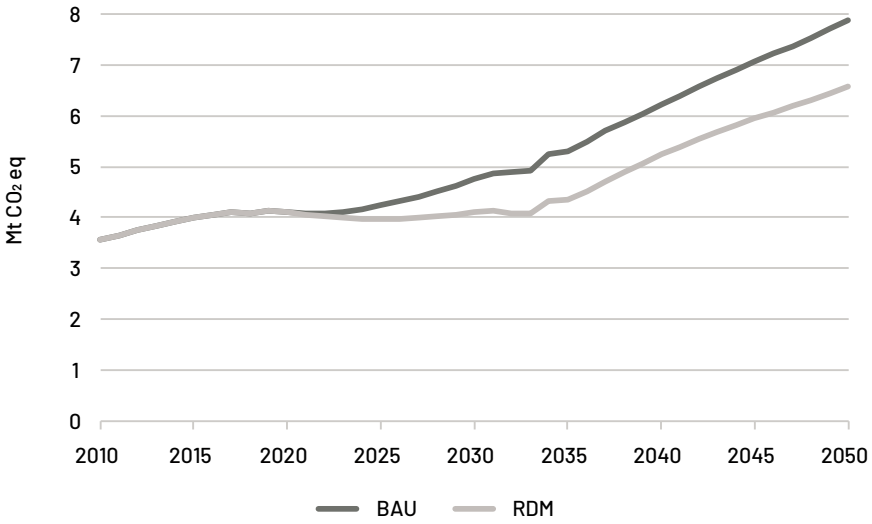
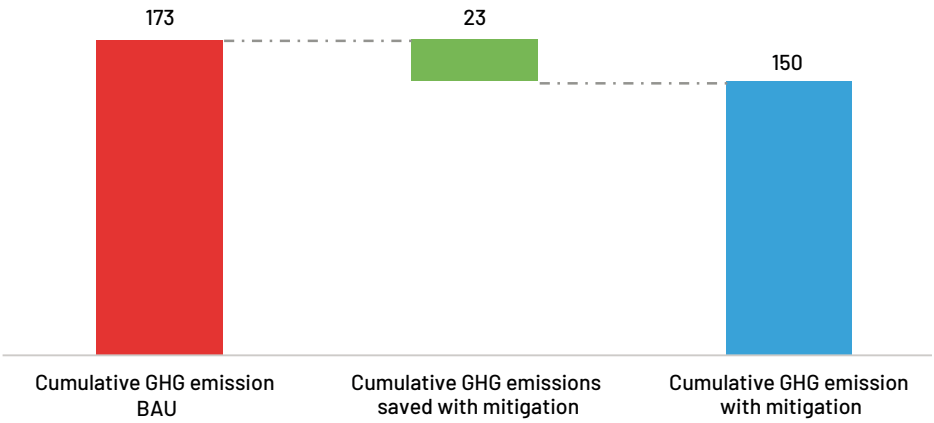


Figure 20: Cumulative emission savings from the RAC sector until 2050



11

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12

ANNEXES

12 Annexes

12.1 Annex A: Policy and Regulatory Instruments

This annex provides some details of the instruments put in place by the Government of Kenya that influence action on sustainable cooling. The instruments are on both energy efficiency, which impact the energy performance of cooling systems, and environmental protection, which are mostly about refrigerants.

Energy Efficiency

Kenya National Energy Efficiency and Conservation Strategy
The energy efficiency strategy was launched in September 2020. It seeks to ensure energy efficiency contributes to Kenya's Nationally Determined Contributions and achievement of the Sustainable Development Goal 7 - Ensure access to affordable, reliable, sustainable and modern energy for all. It identifies development and implementation of minimum energy performance standards (MEPS) for household appliances as the key action to reducing energy consumption of households. It recognizes the NCAP as an avenue for achieving sustainable cooling through energy efficiency of cooling appliances and the use of low GWP refrigerants.

The Energy Act 2019
Under this act, The Energy Regulatory Commission is now replaced by the Energy and Petroleum Regulatory Authority (EPRA) and the Cabinet Secretary is given the power to prescribe energy efficiency and conservation building codes for efficient use of energy and its conservation in buildings. The Secretary is tasked with amending the energy efficiency and conservation codes that exist in consultation with other statutory authorities, and to coordinate the development and implementation of a national energy efficiency and conservation action plan, in consultation with relevant authorities and other stakeholders. EPRA is also tasked with establishing and enforcing minimum energy performance standards for appliances and accredited laboratories for energy efficiency. The authority is already working to promote energy efficient cooling by registering refrigerators and air conditioners that are compliant with the MEPS and by popularizing energy labels.

The Appliances' Energy Performance & Labelling Regulations, 2016
Kenya currently has a standards and labelling (S&L) program which is enforced under the Appliances' Energy Performance and Labelling Regulations. Kenya published the first minimum energy performance standards and labelling requirements in 2013. These regulations cover ACs, refrigerators, three-phase cage induction motors, double-capped fluorescent lamps, ballasts for fluorescent lamps, and compact fluorescent lamps.

Figure 21: The Kenya room air conditioner label

The current Kenyan standard for air conditioners - KS 2463:2019 - Non-ducted air conditioners — testing and rating performance - applies to single-split air conditioners and sets the MEPS level at an energy efficiency ratio (EER) of 3.1 W/W. The superseded standard from 2013 became mandatory for all imports in 2017 and for all units sold in the country in 2018. These standards were then revised in 2019 to make them more appropriate for the Kenyan climate.

The current domestic refrigerator standards - KS 2464-2:2020 - Performance of household electrical appliances- Refrigerating appliances Part 2: Minimum energy performance standard sets out the minimum energy performance (i.e. the maximum energy consumption) of domestic refrigerators imported, manufactured or sold in Kenya. This standard superseded the earlier one, 2464-2:2013 by adopting an international test method for measuring the performance of the refrigerators and setting more ambitious minimum energy performance standards. In 2019, Kenya adopted the international test method KS/IEC 62552:2015 – Parts 1, 2 &3.

These regulations require all products covered by the S&L program to be registered by the EPRA. This means that all importers or manufacturers have to first register new AC and domestic refrigerator models that they intend to import and sell in Kenya.

The regulations also require that all ACs and domestic refrigerators covered by the minimum energy performance standards (MEPS) have an energy label affixed to them at the point of sale. The Kenya energy efficiency label is a 5-star label that contains information on:

1. The efficiency of the appliance on a scale of 1 to 5 with 1 star being the least efficient and 5 star being the most efficient. *Figure 21* below, shows a 4-star AC.

2. The energy efficiency level. In *Figure 21*, the efficiency level of the room AC is 3.11 W/W. For refrigerators, the amount shown would be the energy consumption in kilowatt-hours per year.

3. The model-specific details and product registration details. These help the consumer confirm that the label affixed on the appliance is the label approved for the particular product model. For instance, the appliance registration license number given by the regulator, EPRA, can be confirmed with the details on the appliance registration database published on the EPRA website.

Energy Management Regulation, 2012 (now under revision)
The Energy Management Regulations of 2012 requires all commercial and industrial energy users consuming more than 180,000 kWh per annum of energy to undertake an energy audit. The results of these audits are expected to catalyze the market transformation towards more energy efficient systems in the facilities that adopted the recommendations of these audits. The designated facilities are required to implement at least 50% of the energy audit recommendations within three years.

National Building Regulations 2015
The building industry in Kenya was for long regulated by the 1958 Building Code which did not take into consideration energy efficiency in buildings. The NBR 2015 requires all new buildings or alterations and extensions to existing buildings to make provision for adequate natural lighting, natural cooling and natural ventilation. It calls for passive and natural cooling methods to be considered as part of overall energy efficiency in buildings whereby environmental design should follow the fundamental steps of prevention of heat gain and the provision of cooling (heat dissipation). Provision of cooling should include the natural removal of any heat gains from outside, internally generated heat from people, lighting, equipment and any other processes within the building through the various forms of natural ventilation.

In addition, Kenya is currently in the process of adopting EN Eurocodes[50] by 2021 which take building energy efficiency into account.

Environmental protection

National Climate Change Action Plan II 2018–2022
This NCCAP II is Kenya's second action plan on climate change. The plan identifies energy efficiency as a key action to mitigating climate change. Under strategic objective 7a, it specifically identifies minimum energy performance standards as a way to improve energy efficiency. Additionally, under strategic objective 2 of "increasing food and nutrition security", the first action involves improving crop productivity with the goal to reduce agricultural pre- and post-harvest losses from 40% to 15% by June 2023. Access to agricultural cold chain by farmers is key to reducing post-harvest losses and would help in achieving this goal.

50 The EN Eurocodes are a set of 10 European standards that regulate the design of buildings and other civil engineering works. They have been adopted in other countries outside the European Union.

National Adaptation Plan 2015–2030
This climate change adaptation plan identifies energy efficiency as one of the medium-term actions that will help increase the resilience of energy systems to climate change. Another key action involves enhancing the resilience of the agricultural value chain. Although not explicitly mentioned, improved access to agricultural cold chains, would be one of the "climate smart" solutions that enable this envisioned increased agricultural value chain resilience by reducing post-harvest losses.

National Environmental Policy, 2013
The National environmental policy, 2013 *chapter 5.9* discusses energy use and energy efficiency broadly. The policy sets the broad agenda for environmental protection through energy efficiency and conservation.

Ratification of international agreements related to environmental protection
HCFCs and HFCs are substances controlled by the Montreal Protocol adopted in 1987 and subsequent amendments. In 2007, the countries party to the protocol decided to accelerate the HCFC phase-out schedule; developed countries agreed to phase out HCFCs completely by 2020 and developing countries by 2030.[51] In 2016, the parties to the Montreal Protocol agreed under the Kigali Amendment to begin phase-down of HFCs in 2019 for developed countries and a freeze in consumption in 2024 for Article 5, Group 1 countries like Kenya.[52]

Kenya has ratified four out of the five amendments to the Montreal Protocol and is in the process of ratifying the Kigali Amendment.

Table 11: Kenya's status of ratification of the Montreal Protocol Convention and its subsequent amendments.

Convention / Protocol / Amendments	Date of Ratification / Accession / Acceptance / Approval
Montreal Protocol on Substances that Deplete the Ozone Layer	November 1988
London Amendment to the Montreal Protocol (1990)	September 1994
Copenhagen Amendment to the Montreal Protocol (1993)	September 1994
Montreal Amendment to the Montreal Protocol (1997)	July 2000
Beijing Amendment to the Montreal Protocol (1999)	October 2013
Kigali Amendment to the Montreal Protocol (2016)	Process of ratification commenced in January 2017. Currently awaiting signature by the Cabinet Secretary.

Environmental Management and Coordination (Controlled Substances) Regulations, 2007
To provide the legal framework to support the phase-down of ozone-depleting substances, Kenya passed the Environmental Management and Coordination (Controlled Substances) Regulations in 2007. The regulations control the importation, manufacture and use of ODS by requiring that any person/entity that wishes to import or manufacture these substances gets a license from the National Energy Management Authority (NEMA). However, the regulations do not cover ozone depleting substances (ODS) contained in cooling appliances. This enabled the continued importation of ACs containing R-22 (a HCFC) without the licensing requirement. NEMA is currently in the process of revising these regulations.

HCFC phase-down management plan
As a signatory to the Montreal Protocol, Kenya is implementing the HCFC-phase down schedule as shown in *Table 12* below. Kenya is already on an accelerated path to phasing out HCFCs with the Ministry of Environment targeting to phase these substances completely by 2026 ahead of the 2030 schedule.

51 UN Environment. OzonAction. *https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol*
52 International Institute of Refrigeration. Summary Sheet: The Kigali Amendment to the Montreal Protocol. *http://www.iifiir.org/userfiles/file/webfiles/regulation_files/Synth%C3%A8se_Kigali_EN.pdf*
52 Source: Ministry of Environment Climate Change and Forestry, National Ozone Unit

Base level average	2009 –2010
Montreal Protocol on Substances that Deplete the Ozone Layer	November 1988
London Amendment to the Montreal Protocol (1990)	September 1994
Copenhagen Amendment to the Montreal Protocol (1993)	September 1994
Montreal Amendment to the Montreal Protocol (1997)	July 2000
Beijing Amendment to the Montreal Protocol (1999)	October 2013
Kigali Amendment to the Montreal Protocol (2016)	Process of ratification commenced in January 2017. Currently awaiting signature by the Cabinet Secretary.

Table 12: Kenya's HCFC phase-down management plan (HPMP)

Environmental Management and Coordination (E-Waste Management Regulations), 2013
Under these regulations, the National Environmental Management Authority (NEMA) is tasked with: registration and licensing of producers, providing licenses for recyclers and monitoring these to ensure that the standards set in the licenses are upheld.

12.2 Annex B: Subsector Definitions

The following subsectors are covered by GIZ' RAC inventory and projection. Subsectors printed in italics are analyzed in detail by CLASP.

Air conditioning equipment

Subsector	Product group	Description
Unitary air conditioning	Self-contained	› All components of the system are located within one housing › Examples are window or "through-the-wall" units, portable air conditioners
	Split residential and commercial (duct-less)	› The systems consist of two elements: (1) the condenser unit containing the compressor mounted outside the room and (2) the indoor unit (evaporator) supplying cooled air to the room. Both units are connected via refrigerant piping (duct-less split) › Residential units: applied in private households Commercial units: applied in offices or other commercial buildings › This product group refers to "single" split systems, i.e., one indoor unit is connected to one outdoor unit. Please, when reporting unit numbers, avoid double counting and regard systems as a whole.
	Ducted split, residential and commercial	› Systems consist of an outdoor unit (condenser) containing the compressor which is connected to an indoor unit (evaporator) to blow cooled air through a pre-installed duct system. › Residential units: applied in private households › Commercial units: applied in offices or other commercial buildings › Ducted splits are mainly used to cool multiple rooms in larger buildings (incl. houses).
	Rooftop ducted	› Single refrigerating system mounted on the roof of a building from where ducting leads to the interior of the building and cool air is blown through.
	Multi-split, VRF/ VRV	› Multi-splits: similar to ductless single-split systems (residential/commercial single splits, see above), although usually up to 5 indoor units can be connected to one outdoor unit. › VRF/VRV (variable refrigerant flow/volume) systems: Type of multi-split system where a 2-digit number of indoor units can be connected to one outdoor unit. Used in mid-size office buildings and commercial facilities. › When reporting unit numbers (multi-splits, VRF/VRV), please refer to outdoor units alone
Chiller, Air Conditioning	Chillers (AC)	› AC chillers usually function by using a liquid for cooling (usually water) in a conventional refrigeration cycle. This water is then distributed to cooling - and sometimes heating - coils within the building. › AC chillers are mainly applied for commercial and light-industrial purposes.
Mobile air conditioning	Small: Passenger cars, light commercial vehicle, Pick-up, SUV	› Air conditioning in all types of vehicles, such as passenger cars, trucks or buses. Manysingle evaporator system is used.
	Large: Busses, Trains, etc	

Refrigeration equipment

Subsector	Product group	Description
Domestic refrigeration	Refrigerator/ freezer	› The subsector includes the combination of refrigerators and freezers as well as single household refrigerators and freezers
Commercial refrigeration	Stand-alone	› "plug-in" units built into one housing (self- contained refrigeration systems) › Examples: vending machines, ice cream freezers and beverage coolers
	Condensing unit	› These refrigerating systems are often used in small shops such as bakeries, butcheries or small supermarkets. › The "condensing unit" holds one to two compressors, the condenser and a receiver and is usually connected via piping to small commercial equipment located in the sales area, i.e., cooling equipment such as display cases or cold rooms. The unit usually comes pre-assembled.
	Centralised systems (for supermarkets)	› Used in larger supermarkets (sales are greater than 400 square meters). › Operates with a pack of several parallel working compressors located in a separate machinery room. This pack is connected to separately installed condensers outside the building. › The system is assembled on-site
Industrial refrigeration	Stand-alone (integral) unit	› "plug-in" units built into one housing (self- contained refrigeration systems) › Examples: industrial ice-makers
	Condensing unit	› The "condensing unit" holds one to two compressors, the condenser and a receiver and is usually connected via piping to small commercial equipment located in the sales area, i.e., cooling equipment such as display cases or cold rooms. The unit usually comes pre-assembled. Example: cold storage facilities
	Centralised systems	› Operates with a pack of several parallel working compressors located in a separate machinery room. This pack is connected to separately installed condensers outside the building. The system is assembled on-site
	Chillers, Process	› Chillers used for cooling (heating) in industrial refrigeration, including process cooling, cold storage, electronic fabrication, moulding, etc. Typically, the same technology as chillers used for air conditioning.
Transport Refrigeration	Trailer, van, truck	› Covers refrigeration equipment that is required during the transportation of goods on roads by trucks and trailers (but also by trains, ships or in airborne containers). › Per road vehicle, usually one refrigeration unit is installed.

Notes

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