Report of National Workshop

*Policy and Technology Recommendations for the RAC Sector in Mauritius*

Ministry of Social Security, National Solidarity, and Environment and Sustainable Development

*in collaboration with*

Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)

Le Sirius Labourdonnais Hotel
Port – Louis, Mauritius

12 June 2017
## Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>2.0</td>
<td>Objectives of the National Workshop</td>
<td>2</td>
</tr>
<tr>
<td>3.0</td>
<td>Programme of the Day</td>
<td>3</td>
</tr>
<tr>
<td>4.0</td>
<td><strong>Summary of Presentations</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.1 Presentation on “Status Quo Green Cooling Africa Initiative” by Ms.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Katharina ARNDT, GIZ Proklima</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2 Presentation on “Recap Inventory Process and Technology Gap Analysis – Mitigation Potential” by Mr Dietram OPPELT, Project Consultant, HEAT GmbH</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4.3 Policy Analysis, Recommendations and Discussions (by Mr Dietram Oppelt, HEAT GmbH)</td>
<td>6-7</td>
</tr>
<tr>
<td></td>
<td>4.4 Roadmap Refrigeration and Air Conditioning sector (by Mr Dietram Oppelt, HEAT GmbH)</td>
<td>8-9</td>
</tr>
<tr>
<td></td>
<td>4.5 Policy and Technology Recommendations for the Refrigeration and Air-conditioning Sector in Mauritius- Way forward and conclusions (by Philipp Denzinger, GIZ Proklima)</td>
<td>10</td>
</tr>
<tr>
<td>5.0</td>
<td>Discussions</td>
<td>11</td>
</tr>
<tr>
<td>6.0</td>
<td>Way forward and Recommendations</td>
<td>12</td>
</tr>
<tr>
<td>7.0</td>
<td><strong>Annexes</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I – Speech of Hon. Etienne SINATAMBOU, Minister of Social Security, National Solidarity, and Environment and Sustainable Development</td>
<td>13-17</td>
</tr>
<tr>
<td></td>
<td>II – List of participants</td>
<td>18-21</td>
</tr>
<tr>
<td></td>
<td>III – Presentation on “Status Quo Green Cooling Africa Initiative”</td>
<td>22-25</td>
</tr>
<tr>
<td></td>
<td>IV - Presentation on “Recap Inventory Process and Technology Gap Analysis – Mitigation Potential”</td>
<td>26-32</td>
</tr>
<tr>
<td></td>
<td>V - Presentation on “Policy Analysis, Recommendations &amp; Discussion”</td>
<td>33-38</td>
</tr>
<tr>
<td></td>
<td>VI - Presentation on “Technology Roadmap &amp; Discussion”</td>
<td>39-44</td>
</tr>
<tr>
<td></td>
<td>VII - Way forward and conclusions</td>
<td>45-47</td>
</tr>
<tr>
<td></td>
<td>VIII – Photos of the workshop</td>
<td>48-51</td>
</tr>
</tbody>
</table>
1.0 Introduction

The Green Cooling Initiative for Africa (GCAI), set up under the Climate Technology Centre and Network (CTCN) of the United Nations Framework Convention on Climate Change, is a regional project comprising four African countries namely; Mauritius, Ghana, Kenya and Namibia. The objective of this initiative is to enable participating countries to have the necessary information and tools for a transformational change in the refrigeration and air-conditioning sector.

The Ministry of Social Security, National Solidarity, and Environment and Sustainable Development, in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), had conducted a National Ozone Depleting Substances Alternative comprehensive inventory for the refrigeration and air conditioning (RAC) sector in Mauritius during the months of July to September 2016. The findings of the survey were presented to local stakeholders in November 2016.

The national workshop was held on Monday 12 June 2017 to inform national stakeholders about policy and technology recommendations for promotion of a climate-friendly refrigeration and air-conditioning development pathway in the the RAC sector in Mauritius.

2.0 Objectives of the National Workshop

- To identify technology needs, country specific barriers and requirements for formulation of a roadmap to promote green cooling while considering legislation update, technology transfer, capacity building and sensitisation and awareness campaigns.
- To promote natural refrigerants including: carbon dioxide, ammonia and hydrocarbons in replacement of Ozone Depleting and Global Warming Technologies.
- To bring-relevant stakeholders, ministries, institutions, private sector together and jointly develop a policy strategy for Mauritius
## 3.0 Programme of the Day

<table>
<thead>
<tr>
<th>S/N</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Opening remarks by <strong>Mrs. D. LAN NG</strong>, Director of Environment, Ministry of Social Security, National Solidarity, and Environment and Sustainable Development</td>
</tr>
<tr>
<td>ii.</td>
<td>Address by <strong>Mr. Philipp DENZINGER</strong>, Project Manager, GIZ Proklima</td>
</tr>
<tr>
<td>iii.</td>
<td>Address by <strong>Hon. Etienne SINATAMBOU</strong>, Minister of Social Security, National Solidarity, and Environment and Sustainable Development</td>
</tr>
<tr>
<td>iv.</td>
<td>Introduction of Participants</td>
</tr>
<tr>
<td>v.</td>
<td>Presentation on “Status Quo Green Cooling Africa Initiative” by <strong>Ms. Katharina ARNDT</strong>, GIZ Proklima</td>
</tr>
<tr>
<td>vi.</td>
<td>Presentation on “Recap Inventory Process and Technology Gap Analysis – Mitigation Potential” by <strong>Mr Dietram OPPELT</strong>, Project Consultant, HEAT GmbH</td>
</tr>
<tr>
<td>vii.</td>
<td>Presentation on “Policy Analysis, Recommendations &amp; Discussion” by <strong>Mr Dietram OPPELT</strong>, Project Consultant, HEAT GmbH</td>
</tr>
<tr>
<td>viii.</td>
<td>Presentation on “Technology Roadmap &amp; Discussion” by <strong>Mr Dietram OPPELT</strong>, Project Consultant, HEAT GmbH</td>
</tr>
<tr>
<td>ix.</td>
<td>Conclusions, Recommendations &amp; Way Forward by <strong>Mr. Philipp Denzinger</strong>, Project Manager, GIZ Proklima</td>
</tr>
<tr>
<td>x.</td>
<td>Closing Remarks by <strong>Dr. R. K. Foolmaun</strong>, Divisional Environment Officer, Ministry of Social Security, National Solidarity, and Environment and Sustainable Development</td>
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</tbody>
</table>
4.0 Summary of PowerPoint presentations

4.1 Presentation on “Status Quo Green Cooling Africa Initiative” by Ms. Katharina ARNDT, GIZ Proklima

The first presentation was made by Ms K. Arndt of GIZ Proklima. She gave an overview of the role of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (ltd.) to promote sustainable development projects in more than 130 countries worldwide. She added that a reduction of 10,000 ODP t and 100 Million tons CO2eq were achieved through 240 projects implemented in 40 partner countries in 20 years.

She described the Green Cooling Africa Initiative (GCAI) which was set up under the Climate Technology Centre and Network (CTCN) of the United Nations Framework Convention on Climate Change. This project is being undertaken in 4 African countries including Mauritius, to promote climate-friendly and energy-efficient cooling technologies through Technology transfer, Training Capacity building and Policy advice.

She highlighted the benefits of Green Cooling technologies

- Environmental protection (Emission reduction - less waste, recovery of valuable raw materials and less pollution and toxic waste)
- Economic development (Energy saving, increased competitiveness, energy and cost savings)
- Social development (Improved living conditions & employment, qualification and certification of local technicians and availability allows for CSR - green brands)

Finally she explained the objectives of the National workshop which is a continuity of the workshop which was held in November 2016 based on the survey on alternatives to ODS being used in the refrigeration and air-conditioning sector.
4.2 Presentation on “Recap Inventory Process and Technology Gap Analysis – Mitigation Potential” by Mr Dietram OPPELT, Project Consultant, HEAT GmbH

The second presentation was made by Mr Oppelt and focused mainly on the inventory process for the ODS alternatives, projected emissions and mitigation potentials in the RAC sector.

He informed that in Mauritius for the year 2016, the RAC sector accounted to about 40% of total energy consumption whereby some 2.65 TWh was used in the RAC sector.

He stated that to come up with mitigation potentials to decrease direct emissions (through leakages of high GWP refrigerants) and indirect emissions (burning of fossil fuels to produce electricity), it is important to quantify the consumption of refrigerants in the RAC sector.

In this respect, he gave an overview of the survey which was conducted in Mauritius from July to September 2017 where it was deduced that there has been a constant increase in the number of RAC equipment on the market. He explained the methodology adopted for conducting the survey and the different sectors that were targeted.

Mr Oppelt highlighted that in Mauritius, Unitary Air Conditioning systems are the largest contributor in RAC emissions (Mt CO2eq) compared to other sectors:

- Unitary Air Conditioning - 53%
- Industrial Refrigeration - 9%
- Commercial Refrigeration - 10%
- Domestic Refrigeration - 5%
- Mobile Air Conditioning - 21%
- Chiller - 2%

Finally, options for replacement of Hydrochlorofluorocarbons (HFCs) were presented in the different sectors such as split air conditioners (eg: Hydrocarbon - HC290 as replacement for HFC-410A), domestic refrigeration systems (eg: Hydrocarbon - HC600a as replacement for HFC-134a) and commercial refrigeration (eg: HC 290 & R744 as replacement for HFC-134a, HFC-404a). Scenarios in terms of emissions reduction were shown in the different sectors with adoption of climate friendly refrigerants.
4.3 Policy Analysis, Recommendations and Discussions (by Mr Dietram Oppelt, HEAT GmbH)

The objectives of the third session were to review the current existing policies and standards and to identify the main regulatory barriers.

The consultant gave an overview of the present situation with respect to use, monitoring of the different refrigerants used. It was highlighted that the ban as from 1st January 2013 was not on importation of HCFC refrigerants but on importation of equipment using HCFC. It was also pointed out that all the information on imports of HFC is being compiled at the level of the National Ozone Unit.

The issue of the energy policies for the Refrigeration and Air Conditioning sector was lengthily discussed. The GHG reduction as per the INDC, the long term Energy Strategy (2009-2015), Energy efficiency with focus on building, the New Energy Efficiency Regulations (2015) and Action Plan (2014) were reviewed.

The Consultant highlighted the four main barriers as far as adoption of ozone friendly and climate friendly technology within the RAC sector is concerned. These are:

i. higher investment cost for higher energy efficiency,
ii. lack of awareness and end-user not informed about life cycle costs,
iii. lack of ready-made solutions and especially of technical expert knowledge for large systems, and
iv. the issue of safety measures, and lack of practice in handling of flammable refrigerants.

However, it was pointed out that adoption of climate friendly technologies have long term sustainable benefits especially in terms of energy, greenhouse gas emission, and cost benefits. Main barriers to overcome are feedback mechanism between manufacturer and supplier, knowledge transfer through training programmes, setting up or updating of existing regulation/policy and creating demand for clean technologies by end-users.

The Consultant discussed on the different techniques that need to be adopted to ease adoption of new sustainable technologies. Discussion was focussed on the Push and Pull Method which consist of:

(1) Push: Reducing the use of least sustainable product by setting up of appropriate regulation/polices/disincentive
(2) Driving the market towards greater sustainability using tools like Eco design, Energy label, Green Procurement, and eco-label amongst others
(3) Pull: Engaging in development of new and more sustainable products.
With regards to Minimum Energy Performance Standard (MEPS) the consultant highlighted that there is basically 5 steps to set up the energy efficiency path way and comprised:

1. Mapping and benchmarking- Important to compare and benchmark COPs of local RAC with that at international level.
2. Combined MEPS and Labels- bench marking and comparing labels of the different types of RAC equipment to that with other countries
3. Setting of MEPS- Need to understand that product with low upfront cost and having lower Energy efficiency as compared to Minimum Energy Performance Standard need to be banned from the market given it high operating cost for the end users.
4. Energy Efficiency labeling- Need to have a proper labeling system that will promote sales of the most energy efficient appliances
5. Monitoring, Verification and Enforcement (MVE) – The importance of monitoring of the different equipment, verification by independent testing institute and enforcement against manufacturer if product is not as per standard.
4.4 Roadmap Refrigeration and Air Conditioning sector (by Mr Dietram Oppelt, HEAT GmbH)

The Consultant stressed that the mitigation potential of greenhouse gas emission from the Refrigeration and Air Conditioning Sector is high if appropriate measures are taken. In case of a Business as Usual scenario the cumulative GHG emission from 2010 to 2015 would amount to 190 Mt CO₂ eq. However, with appropriate mitigation measures, the cumulative GHG emission would be 144 Mt CO₂ eq. However, there are various barriers that need to overcome in view to put in place a proper mechanism in the RAC sector to be able to achieve the goal set.

He added that the barriers can be removed with the setting up of appropriate strategies, namely:

(1) Increase energy efficiency by making energy use transparent, informing end-users about life-cycle costs, banning inefficient products from the market and providing incentives to accelerate market. These can be achieved by the setting Minimum energy performance standards (MEPS), setting labeling requirements, naming responsible institutions to verify labels and define sanctions for infringements, taxing equipment depending on energy efficiency, setting up of a Green public procurement of Green RAC appliances, setting up of putting in place new for old exchange scheme amongst others.

(2) Transit to low GWP refrigerants by providing the market with guidance that low GWP refrigerants are politically favored. This can be achieved by favoring systems using low-GWP refrigerants by lower import tax or similar incentives banning or tax high-GWP refrigerants in systems where alternatives exist and defining (or adopting) safety standards for flammable refrigerants to allow sufficiently high charge sizes.

(3) Ensure proper installation and servicing to maintain safety and energy efficiency by the establishment of a framework conditions for a safe uptake of flammable/toxic refrigerants and Improving skills within technicians and increase awareness for containment. The measures that can be adopted are adopting international safety standards, establishing compulsory QCR scheme for technicians which would include Training and qualify technicians according to standard and preparation of a Register of certified technicians

(4) Establish a robust Measurement, Reporting and Verification (MRV) system by the setting up of data base of RAC equipment sales to monitor the effects of other measures and provide metrics for any bankable project which could be achieved by
introducing a data base where all importers need to report imported equipment including brand, model capacity, EER, refrigerant and initial charge

One of the main aspects that determine the success of the above measures is availability of adequate funds. The potential funding sources could be from either local public organisation (Green public procurement and Tax and rebate schemes) or private sector engagement (Green loan financing schemes with resellers and Green loan financing schemes with commercial end users of RAC appliances). The different sources of funding programmes for instance the Green Climate Fund, Global Environment Facility, Multilateral Fund, NAMA facility and the African Development Bank and their requirements were also discussed.
4.5 Policy and Technology Recommendations for the Refrigeration and Air-conditioning Sector in Mauritius- Way forward and conclusions by Philipp Denzinger, GIZ Proklima

The Consultant informed that all feedback received during workshop and mission will be reflected in final report and same will be shared with all stakeholders. He added that additional policy and technical recommendations would also be integrated.

He pointed out that the Policy Analysis and Roadmap prepared would of high importance as the latter would be used to provide basis for the following:

- decision on concrete steps to mitigate emissions in RAC,
- provision of input for the Nationally Determined Contributions (NDC) of Mauritius,
- discussing and developing potential funding proposals.
5.0 Discussion

Discussions were held with regards to standards to be adopted for Mauritius for natural refrigerants such as hydrocarbons, carbon dioxide and ammonia. It was pointed out that Mauritius is adopting ISO standards instead of EU standards following recommendations of the Mauritius Standard Bureau. The MSB is presently working this standard.

Clarifications were provided to stakeholders on the rationale of the ODS alternative survey namely on the targeted groups, sample size and data collection (primary and secondary). It was highlighted that the survey involved only big facilities such as buildings, cold rooms, hotels, supermarkets, hospitals and clinics, maintenance companies, vehicle sector amongst others. The quantification of household unitary ACs was obtained from statistics office and customs department.

Stakeholders voiced out their concern regarding the replacement of HFCs (refrigerant and equipment). The importers showed their apprehension with regards to the storage of flammable refrigerants such as hydrocarbons, exiting controls and trained personnel for handling of these refrigerants in the maintenance and operation sector. It was pointed out by representatives of GIZ that there is need to have the appropriate legislative framework (policy and regulations) and skilled technicians for handling of the refrigerants. Representatives of UDM and MITD informed that their training institutions regularly carry out training for technicians on the use of natural refrigerants. UDM has also been equipped with a CO2-ammonia cascade system which is used for training and demonstration purposes.

The consultant recommended that it is more practical to go for new equipment instead of retrofitting of HFCs based equipment with hydrocarbons due to safety aspects and leakages.

Discussions were also held with regards to factors in terms of financial assistance that could be extended to encourage climate friendly technologies. It was noted that many consumers are influenced by the price of the products. In this respect, incentives and sensitization campaigns must be done to promote use of environmentally friendly products.
6.0 Way forward and recommendations

The consultant informed that Financial expert of HEAT GmbH would be conducting interviews with different stakeholders between 12 June and 16 June 2017 in Mauritius and would provide relevant information with regards to sources of funding and the funding mechanism. The latter will prepare a report which would be shared with relevant national stakeholders to enable tapping of the funds. He however pointed out that further negotiation would be required with the funding institutions.

Some Potential donors for projects are:

- Green Climate Fund (GCF)
- Global Environment Facility (GEF)
- Nationally Appropriate Mitigation Actions (NAMA)
- Montreal Protocol: Multilateral Fund (MLF): Kigali Cooling Efficiency Program (K-CEP)
- European Union/Commission
- Bilateral: French Government

He pointed out the Inventory in the RAC Sector which has been recently carried out is a very important tool for acquiring funds from funding agencies. He gave the example of Thailand whereby the Inventory and Data collection was completed in early 2013. A NAMA proposal was submitted to funding agencies in mid-2013 and a fund of 15 million Euros was sanctioned. He added that Mauritius also could adopt the same strategy to tap funds from financial agencies.

Furthermore, the data from the RAC Inventory, the Technology Road Map and policy measures that would be worked out during the workshop could be used in the implementation plan of the national climate policy such as the Nationally Determined Contribution which was prepared prior to the Paris Agreement.

He assured that GIZ would continue to support Mauritius with the implementation of the current HPMP and future HFC phase down plan (trainings, certification, standards, demonstration, etc.)

He further added that Synergies will be drawn from other projects in the RAC and energy sector to support the implementation of the current HPMP and future HFC phase down plan, for instance the GEF Project Proposal: Realising Energy Savings and Climate Benefits of Implementing Mandatory Energy Auditing in Coordination with HCFC Phase-out and HFC Avoidance.
Annex 1: Speeches
Refrigeration and Air-Conditioning Inventory
Workshop Green Cooling Africa Initiative

Key Note Address by

Hon. Etienne SINATAMBOU
Minister of Social Security, National Solidarity, and Environment and Sustainable Development

Le Serius Labourdonnais Hotel, Port Louis

Monday 12 June 2017
Permanent Secretary, Mrs N.D Goorah
Director of Environment, Mrs D. Lan Ng,
Representatives of GIZ Proklima Team namely
Mr. Philipp Denzinger, Project Manager
Ms. Katharina Arndt, Junior Project Manager

Distinguished guests,
Dear participants,
Ladies and Gentlemen,

Good Morning,

1. It gives me a great pleasure to be in your midst this morning for the opening ceremony of the National Workshop for the refrigeration and air-conditioning sector.

2. I am given to understand that today's workshop is a follow-up of the workshop held last November whereby preliminary findings of the comprehensive inventory conducted on ozone depleting substances alternatives in the refrigeration and air-conditioning sector, were presented.

3. You will surely recall that the National Ozone Depleting Substances Alternative Survey was undertaken, during the months of July to September 2016. The targeted groups consisted mainly of the importers, supermarkets, cold rooms, hospitals, clinics, hotels, transport sector, maintenance sector and buildings. The main objectives of this important inventory or survey were to:
   a. quantity the amount of ozone depleting substance alternatives, hydrofluorocarbons, in particular, used in the refrigeration and air conditioning sector in Mauritius;
   b. establish the consumption patterns over the past years; and
   c. predict the future scenarios or consumption trend for Mauritius.

I note with satisfaction that many of you were involved in this inventory and I seize this opportunity to thank you for providing valuable data. Moreover, I am also informed that this survey would not have been possible without the support of the Climate Technology Centre and Network (CTCN) of the United Nations Framework Convention on Climate Change, HEAT International and indeed our privileged partner down the years, the Gesellschaft für Internationale Zusammenarbeit (GIZ), GIZ proklima. These institutions are gratefully acknowledged.
Ladies and Gentlemen

4. The National Ozone Depleting Substances Alternative Survey was undertaken, as a first step of the Green Cooling Africa Initiative, (GCAI). The aim of this initiative is for Africa to embark on a climate-friendly refrigeration and air-conditioning development pathway. Consequently, Mauritius, along with three other African countries, namely Ghana, Namibia and Kenya, are privileged under this initiative to: develop a clear understanding on how the cooling sector contributes to their national energy consumption and the total greenhouse gas emissions, resulting from the refrigeration and air conditioning (RAC) sector and chart a roadmap to promote green cooling. The roadmap would comprise: legislation update, technology transfer, capacity building, awareness campaigns, amongst others.

5. Given that we have already conducted the National inventory, the next move is to assess the Technology needs through gap analysis between currently used technologies and internationally available best technology options. Both, inventories and gap analysis would then serve as base for suitable policies recommendation in order to promote green cooling technologies. Today's workshop will essentially focus on policies and technology recommendations for the RAC sector in Mauritius.

Ladies and Gentlemen

6. It is worth noting that, since its adherence to the Montreal Protocol in 1992, Mauritius has been playing a very active role in the fight against the use of ozone depleting substances. In anticipation of the Kigali Amendment, Mauritius has been proactively promoting the use of natural refrigerants namely: carbon dioxide, ammonia and hydrocarbons in replacement of Ozone Depleting and Global Warming refrigerants.

7. You will recall that Mauritius were among the first parties to propose the phasing-down of hydrofluorocarbons (HFCs) under the Montreal Protocol. These refrigerants were introduced as a substitute to the high global warming and ozone depleting chlorofluorocarbons. HFCs on the other hand, being ozone friendly are unfortunately with high global warming potentials. Consequently, their replacement are undisputable.

8. After various negotiations at international level, the Meeting of Parties of the Montreal Protocol have finally accepted to phase down HFCs under the landmark Kigali amendment - the first African amendment of the Montreal protocol. Mauritius,
along with other African countries and China will start their freeze of HFCs as from 2024. The baseline for the phase down will be the year 2020-2022.

9. With the coming into force of the Kigali amendment, Mauritius will now prepare its strategy and action plan to start the freeze of the import of hydrofluorocarbons as from the year 2024. The action plan would include regulations for phasing down hydrofluorocarbons-based equipment, introduction of a quota system, the phase-down schedule, training and certification of technicians, amongst others.

Ladies and Gentlemen,

10. I am confident that the national workshop will help us to pave our way for developing feasible and appropriate national as well as regional strategies for adoption of green cooling technologies. I thus really look forward for suitable policies and recommendations for incorporation in our strategy and action plan to chart a roadmap for promoting green cooling technologies in Mauritius.

11. Last but not least, let me once again convey my sincere gratitude to all of you and to the GIZ Proklima for holding this national workshop. I would also like to thank GIZ for choosing Mauritius to hold the regional workshop and the two days training for the regional ozone officers as from tomorrow.

12. With this note, I thank you for your kind attention and I have now the pleasure to declare this workshop officially open.
# Annex II: List of participants

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<th>Name</th>
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<td>BHOYROO Hemraj</td>
<td>Acting Senior Consumer Affairs Officer M/Industry, Commerce and Consumer Protection</td>
<td>Atchia Building Suffren Street Port Louis</td>
<td>2068070 2113010</td>
<td><a href="mailto:hhoyroo@gmail.com">hhoyroo@gmail.com</a></td>
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<td>Registrar Dangerous Chemical Control Board</td>
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<td>Manager Port Environment Mauritius Ports Authority</td>
<td>Mer Rouge Port Louis</td>
<td>2065500</td>
<td><a href="mailto:brughooputh@mauport.com">brughooputh@mauport.com</a></td>
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<td>Lecturer Université des Mascareignes</td>
<td>La Concorde Street Rose Hill</td>
<td>57920598 4660444 4663774</td>
<td><a href="mailto:dsooben@udm.ac.mu">dsooben@udm.ac.mu</a></td>
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<td>18</td>
<td>SOOKUN Haridar</td>
<td>Consultant Soft Sustainable Services (Mauritius)</td>
<td>Royal Road, St Julien d’Hotman</td>
<td>57869007</td>
<td><a href="mailto:sookunvarun@gmail.com">sookunvarun@gmail.com</a></td>
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<td>Ag. Head Engineering Unit Mauritius Standards Bureau</td>
<td>Villa Rd Moka</td>
<td>433 3648</td>
<td><a href="mailto:lchummunbhujohory@msb.inet.mu">lchummunbhujohory@msb.inet.mu</a></td>
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<td>20</td>
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ANNEX III

Presentation on “Status Quo Green Cooling Africa Initiative”
Green Cooling Africa Initiative (GCAI)

Background and Status Quo

Katharina Arndt
GIZ Proklima

Port Louis, June 12, 2017

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (Ltd.) is

- an international cooperation enterprise for sustainable development with worldwide operations, established in 1975.
- operates throughout Germany and in more than 130 countries worldwide.
- more than 16,500 staff members around the globe, some 70% of whom are employed locally as national personnel.

Promotion on climate-friendly and energy-efficient cooling technologies

Climate Technology Center & Network (CTCN)

- CTCN aims to address barriers that hinder the development and transfer of climate technologies, and to thereby help create an enabling environment.

Overview

- GIZ and Proklima International
- Green Cooling Africa Initiative (GCAI)
- Objectives of the Workshop
What is Green Cooling?

- Aiming at a reduction of emissions from the cooling sectors, Green Cooling combines three approaches:
  - promoting natural refrigerants,
  - maximising energy efficiency,
  - fostering a sustainable approach to private and commercial energy consumption.
- Green Cooling helps to save energy and protect the environment and climate.

The benefits for introducing Green Cooling technologies

- **Environmental protection**
  - Emission reduction; less waste
  - Recovery of valuable raw materials
  - Less pollution and toxic waste
- **Economic development**
  - Energy saving (less subsidies)
  - Increased competitiveness
  - Energy and cost savings
- **Social development**
  - Improved living conditions & employment
  - Qualification and certification of local technicians
  - Availability allows for CSR (green brands)

Green Cooling Africa Initiative (GCAI)

- **Countries:** Mauritius, Namibia (CTCN-funded)
  - Ghana, Kenya (BMUB-funded)
- **Timeframe:** 2016-2017
- **Objective:** To enable participating countries to have the necessary information (i.e. inventory) and tools (i.e. policy and technology options), to create a shift in the cooling sector to more sustainable technology options.
Objectives of the Initiative

- To comply with current and future international and national regulations and policy (e.g. MP, UNFCCC)
- To protect the climate and support efficient energy use
- To identify and apply for funding to implement further activities and actions

"Low Hanging Fruit"
RAC Subsectors with high emission reduction potential

Objectives of the workshop

- To present the findings of the policy analysis and technology roadmap
- To present and discuss adequate policy measures supporting a low mitigation pathway for the Mauritian RAC sector
- To identify country specific barriers and requirements
- To include the feedback of all relevant stakeholders
- To bring-relevant stakeholders, ministries, institutions, private sector together and jointly develop a policy strategy for Mauritius

Thank you!
Any questions?

Contact:
Katharina.Arndt@giz.de
GIZ Proklima
ANNEX IV

Presentation on “Recap Inventory Process and Technology Gap Analysis – Mitigation Potential”
Green Cooling Africa Initiative (GCAI) 
Recap GHG inventory and technology gap analysis 
Refrigeration and air conditioning sector

Mauritius Dietram Oppelt HEAT GmbH
Port Louis, 12th June 2017

Agenda

Inventory: the process and subsector coverage

Inventory: the stock and sales data

Inventory: the projected emissions and mitigation potentials

Significance of the subsectors – technology Gap

Inventory: The main subsectors

Air Conditioning

Centralised Units
Centralizes AC A refrigeration systems big supermarkets

Commercial Refrigeration
Stand alone Units Foods stores display cabinets, freezers, bottle coolers

Domestic Refrigeration
Household refrigerators

Domestic Refrigeration

Mobile AC

Car AC A/C in cars

Large Vehicles A/C in buses

Trucks, Trains, Containers Vessels

Transport Refrigeration

Industrial Refrigeration
Centralised systems / Stand alone units / Condensing units / process chillers Food processing, industrial processes
Agenda

Inventory: the process and subsector coverage

Inventory: the stock and sales data

Inventory: the projected emissions and mitigation potentials

Significance of the subsectors – technology Gap

Definition of RAC sub-sectors and systems for refrigeration and air-conditioning

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<thead>
<tr>
<th>Subsector</th>
<th>Systems</th>
<th>Data sources</th>
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<td>Self-contained air conditioners</td>
<td>Customs data, 16 questionnaires, workshop feedback</td>
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<td>Split air conditioners</td>
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<td></td>
<td>Ducted split air conditioners</td>
<td></td>
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<td></td>
<td>Rooftop ducted</td>
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<td></td>
<td>Multi-splits</td>
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<td>Chillers</td>
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<td>1 questionnaire</td>
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<td>Process chillers</td>
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<td>Mobile Air Conditioning</td>
<td>Car air conditioning</td>
<td>Registered cars and estimate via SCI Global database</td>
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<td>Customs data for stand-alone, questionnaires for stand-alone and centralized systems for supermarkets</td>
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<td>Condensing units</td>
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<tr>
<td></td>
<td>Centralized systems for supermarkets</td>
<td></td>
</tr>
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</table>

Unitary air-conditioning and AC Chiller: Sales 2016: ~60,000

![Graph showing unitary air-conditioning and AC chiller sales 2016]

Unitary air-conditioning and AC Chiller: Stock 2016: ~350,000

![Graph showing unitary air-conditioning and AC chiller stock 2016]

Average technical parameters for Unitary AC and AC chiller

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Definition of RAC sub-sectors and systems for refrigeration and air-conditioning

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28
Commercial refrigeration: Sales 2016: ~7,500

Commercial Refrigeration: Stock 2016: ~55,000

Technical parameters for commercial refrigeration*

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* Average values
** Default estimate (GCI)

Total emission – sum of indirect and direct emissions

Indirect emissions (electricity consumption from fossil fuels)

Direct emissions refrigerants (HCFC, HFC) leakages, high GWP

Energy consumption of the RAC sector (business as usual)

- Total energy consumption of Mauritian RAC sector in 2018: 2,65 TWh
- Contribution of RAC sector to overall energy consumption: ~40%

Agenda

- Inventory: the process and subsector coverage
- Inventory: the stock and sales data
- Inventory: the projected emissions and mitigation potentials
- Significance of the subsectors – technology Gap
• Total emission of Mauritius in 2015: 6 MtCO₂ (CAIT climate data)
• Contribution of RAC emissions to overall GHG emissions: ~ 40%

Share of RAC emissions (Mt CO₂eq) in 2016

Key subsectors:
- Unitary AC
- MAC
- Commercial refrigeration

Inventory: the process and subsector coverage

Inventory: the stock and sales data

Inventory: the projected emissions and mitigation potentials

Significance of the subsectors – technology Gap

Projected growth of RAC emissions by subsector

Share of UAC emissions in 2016 (~53% of all RAC emissions)

Share of alternative technologies in the RAC sector

<table>
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<td>CO₂, hydrocarbons</td>
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<td>Stationary air conditioning</td>
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<td>Foams</td>
<td>CO₂, hydrocarbons</td>
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</table>
Split residential air conditioners –
Comparison of technology in Mauritius to international best practice

Mauritius:
- Refrigerants: EER/COP:
  - Only high GWP refrigerants in use: HFC-410A
  - Only high GWP refrigerants in sales: HFC-410A

Green Cooling alternative:
- Refrigerant: HC-290
  - EER/COP: 12.9
  - SEER: 6.8 [W/W]
  - Inverter technology!

Domestic Refrigeration–
Comparison of technology in Mauritius to international best practice

- Refrigerants in use: HFC-134a, HFC-600a
- Refrigerant distribution in sales: 20% HFC-134a, 80% HC-600a
- Energy efficiency average COP = 2.55

Green Cooling alternative:
- Refrigerant: 100% HC-600a
- EE: 139 kWh/year

Commercial Refrigeration - standalone equipment
Comparison of technology in Mauritius to international best practice

Mauritius:
- Refrigerants in use: HFC-134a, HFC-404a, HC-600a
- Refrigerant distribution in sales: 77% HFC-134a, 17% HFC-404a, 6% HC-600a
- Energy efficiency average COP = 3.3

Green Cooling alternative:
- Refrigerant: HC-290, R744
  - EE: over 3.5

Mitigation potential for split ACs

Mitigation potential for domestic refrigeration subsector

Mitigation potential for standalone units
Commercial Refrigeration – condensing units
Comparison of technology in Mauritius to international best practice

Mauritius:
- Refrigerants in use: HFC-410a, HFC-404a
- Refrigerant distribution in sales: 95% HFC-410a, 5% HFC-404a
- Energy efficiency average COP = 3.2

Green Cooling alternative (for smaller capacities):
- Refrigerant: HC-290, R744
- EE: EER/COP: 3.5

Mitigation potential for the RAC sector
Up to 27% lower emissions under BAU by 2030

THANK YOU

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Internet: www.giz.de/proklima
www.heat-international.de
ANNEX V

Presentation on “Policy Analysis, Recommendations & Discussion”
Green Cooling Africa Initiative (GCAI)  
Policy Analysis  
refrigeration and air conditioning sector

Mauritius
Dietram Oppelt  
HEAT GmbH
Port Louis, June 2017

**Agenda**

- Method and objective
- Status quo
- Barriers
- Recommendations for key subsectors

### Method and objective

- review of current policies and standards
- identification of key regulatory barriers

identify possible leverage points to effectively influence the RAC sector towards a more sustainable selection of technologies

### Status quo - Refrigerants

- The import of ODS refrigerants is monitored (Montreal Protocol obligation)
- HPMP introduced a ban on HCFCs as from January 1st, 2013
- INDC conditional goal: 30% GHG reduction by 2030
- No reporting on where the refrigerants are used and if they are collected for reuse or destruction.
- HFCs are currently not monitored
- While technician trainings on refrigerant handling exist for fluorinated substances, for natural refrigerants they are still sparse
- No nationally adopted safety standards yet, they are being developed by NOU
Status quo – Energy Efficiency

- Energy policies for the RAC sector are in an early stage of their development compared to international best practices.
- Mauritian energy policy mainly puts their focus so far on the inclusion of renewable energy sources in the energy mix and off-grid electricity supply.
  - Energy target of 10% reduction until 2025 as compared to 2008
  - Energy efficiency focus on buildings, tourism and electrical appliances

Barriers – a definition

- Barriers are hindrances that stand in the way of the smooth implementation of different technical options, which produce in the long-term sustainable benefits that outweigh the costs and avoid or limit the emissions of greenhouse gases.
  - Manufacturer/ supplier related barriers
  - Knowledge related barriers
  - Regulatory matters/ Policy/ Standard related barriers
  - End user related barriers

Key barriers

- Higher investment cost for higher energy efficiency
- Lack of awareness, end-user not informed about life-cycle costs
- Lack of ready-made solutions and especially of technical expert knowledge for large systems (additional safety measures)
- Lack of practice in handling of flammable refrigerants

Agenda

Method and objective

Status quo

Barriers

Recommendations for key subsectors

Barriers

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<tr>
<th>Barriers</th>
<th>Manufacturer/supplier related barriers</th>
<th>Knowledge related barriers (training and certification requirements)</th>
<th>Regulator matters/standard related barriers</th>
<th>End user related barriers (information and incentives)</th>
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Agenda

Method and aim

Status quo

Barriers

Recommendations for key subsectors
Push and Pull Measures

- Cut out the least sustainable products
- Drive the existing market towards greater sustainability
- Engage development of new, more sustainable products

<table>
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<th>PULL</th>
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</thead>
<tbody>
<tr>
<td>Eco-Design</td>
<td>Energy-label</td>
</tr>
<tr>
<td>Energy-label</td>
<td>Green public procurement</td>
</tr>
<tr>
<td>Green public procurement</td>
<td>Eco-label</td>
</tr>
</tbody>
</table>

Sustainability

Background information on MEPS setting

5 step energy efficiency pathway

1. Mapping and benchmarking
2. Combined MEPS and Labels
4. Energy efficiency labelling
5. Monitoring, Verification and Enforcement (MVE)

International benchmarking of EE
Example: EU benchmarking of ComRef Standalones

Regional benchmarking of MEPS for split AC

<table>
<thead>
<tr>
<th>Country</th>
<th>Trailing</th>
<th>Korea</th>
<th>SEER</th>
<th>SEER</th>
<th>SEER</th>
<th>SEER</th>
<th>SEER</th>
</tr>
</thead>
<tbody>
<tr>
<td>EER</td>
<td>2.62</td>
<td>3.54</td>
<td>3.67</td>
<td>3.67</td>
<td>3.64</td>
<td>3.64</td>
<td>3.20</td>
</tr>
<tr>
<td>SEER 1</td>
<td>5.40</td>
<td>5.00</td>
<td>4.30</td>
<td>5.40</td>
<td>5.00</td>
<td>4.30</td>
<td>5.40</td>
</tr>
<tr>
<td>SEER II</td>
<td>4.40</td>
<td>4.00</td>
<td>3.90</td>
<td>5.10</td>
<td>4.40</td>
<td>3.90</td>
<td>5.10</td>
</tr>
<tr>
<td>SEER III</td>
<td>4.40</td>
<td>4.00</td>
<td>3.90</td>
<td>5.10</td>
<td>4.40</td>
<td>3.90</td>
<td>5.10</td>
</tr>
</tbody>
</table>

Source: HEAT, 2015

Comparison: EER and Seasonal Energy Efficiency Ratio which takes the running hours of ACs into account. Japan uses Annual Performance Factor (APF) which is similar to SEER.
Products with
- EE < MEPS
- Low upfront investments costs
- High energy operating costs
- Need to be banned from the market high costs for the economy and end users

HEPS setting
- Top category for the best max 5% products
- Lowest label category (lowest 5%) if market share falls below threshold ban
- Lowest category = MEPS
- Regular review (i.e. every 2 years)

Market transformation benefits
- Monitoring
  - Certification obligation for all manufacturers (both for MEPS and Label)
  - COP reporting according to uniform standards
  - Reporting, registration in central database and Internet publication
- Verification
  - Independent random test
  - Testing at independent testing institute
- Enforcement
  - If test fails, repeat test paid by manufacturer until test passes or product taken from the market (EU) or penalty, fine per product and immediate removal from the market if tolerances exceeded (either for new products or for all products historically sold)
Unitary Air Conditioning – Smaller systems

- Green alternatives presently or very soon available
- Labels/Minimum Energy Performances Standard (MEPS)
- Balance higher investment cost by some kind of subsidy (e.g. Import tax levy, …)
- Ban high GWP refrigerants?
  - Avoid uptake of HFCs in unit stock
  - Reduce conversion cost/ HFC demand for servicing under Kigali amendment HFC Phase-down

Commercial refrigeration – Stand-alone units

- Green alternatives available (Coca-Cola, Pepsi, etc. are committed to only use natural refrigerants in their promotion beverage coolers)
- Inform about life-cycle costs
- MEPS/labels?
- Ban high GWP refrigerants?
  - Avoid uptake of HFCs in unit stock
  - Reduce conversion cost/ HFC demand for servicing under Kigali amendment HFC Phase-down

Domestic refrigeration

- Green alternatives available
- Labels/MEPS
- Balance the higher investment cost for higher energy efficiency
  - Import tax levy
  - End-user grant
- Ban high GWP refrigerants

Unitary Air Conditioning – Larger systems

- No ready-made alternatives available
- Demonstration projects
- Green public procurement
- Financial incentive

Commercial refrigeration – Condensing units

- Ready-made alternatives available for smaller charge sizes, more options under development for EU market
- Training for technicians
- Inform about life-cycle costs

THANK YOU

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Internet: www.giz.de/proklima
www.heat-international.de
ANNEX VI

Presentation on “Technology Roadmap & Discussion”
Green Cooling Africa Initiative (GCAI) 
Roadmap
Refrigeration and air conditioning sector

Mauritius
Dietram Oppelt
HEAT GmbH
Port Louis, June 2017

Agenda
Recap: Potential mitigation and barriers
Four strategies
Mitigation potential
Funding

Mitigation Potential (Mt CO₂eq)
cumulative from 2010 to 2050

Recap: Potential mitigation and barriers
Four strategies
Mitigation potential
Funding
Four strategies

1. Increase energy efficiency
2. Transit to low GWP refrigerants
3. Ensure proper installation and servicing to maintain safety and energy efficiency
4. Establish a robust Measurement, Reporting and Verification (MRV) system

Increase energy efficiency

**Strategy**
- Make energy use transparent
- Inform end-users about life-cycle costs
- **Ban inefficient products from the market**
- Provide incentives to accelerate market

**Measures**
- **Set Minimum energy performance standards (MEPS)**
- Set labelling requirements
- Name responsible institutions to verify labels and define sanctions for infringements
- Import tax depending on energy efficiency
- Green public procurement of Green RAC appliances
- New for old scheme
- Grant to balance higher investment costs

Increase energy efficiency

**Strategy**
- Provide market with guidance that low GWP refrigerants are politically favoured

**Measures**
- Favour systems using low-GWP refrigerants by lower import tax or similar incentives
- **Ban or tax high-GWP refrigerants** in systems where alternatives exist
- Define (or adopt) safety standards for flammable refrigerants to allow sufficiently high charge sizes

Transition to low GWP refrigerants (roadmap recommendation on GWP thresholds)

<table>
<thead>
<tr>
<th>Product group</th>
<th>GWP threshold</th>
<th>Year of prohibition EU-F-gas regulation</th>
<th>Year of prohibition Mauritian roadmap scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-contained ACs</td>
<td>150</td>
<td>2020</td>
<td>2020</td>
</tr>
<tr>
<td>Split ACs (below 3 kg charge)</td>
<td>750</td>
<td>2025</td>
<td>2025</td>
</tr>
<tr>
<td>Domestic refrigeration</td>
<td>150</td>
<td>2015</td>
<td>2020</td>
</tr>
<tr>
<td>Commercial stand-alone units</td>
<td>2500</td>
<td>2020</td>
<td>2020</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>2022</td>
<td>2025</td>
</tr>
</tbody>
</table>

Ensuring proper installation and servicing to maintain safety and energy efficiency

**Strategy**
- Establish framework conditions for a safe uptake of flammable/toxic refrigerants
- Improve skills within technicians
- Increase awareness for containment
Ensuring proper installation and servicing to maintain safety and energy efficiency

**Measures**
- Expand training content to cover the safe use of natural refrigerants
- Include design options for energy efficiency
- Adopt international **safety standards**
- Establish compulsory **QCR scheme for technicians**:
  - Train and qualify technicians according to standard
  - Certify qualified technicians
  - Register technicians

**Milestones – Unitary AC – smaller systems**

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MEPS: EER=3.0</td>
<td>Labelling scheme is operational</td>
<td>Strengthen MEPS: EER=3.3</td>
</tr>
<tr>
<td>2</td>
<td>Ban units using refrigerants with GWP above 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Database recording sales incl. technical parameters is functional</td>
<td>Review functionality and coverage of database</td>
<td></td>
</tr>
</tbody>
</table>

**Milestones – Unitary AC – larger systems**

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MEPS: EER=3.5</td>
<td>Labelling scheme is operational</td>
<td>Strengthen MEPS: EER=4.0</td>
</tr>
<tr>
<td>2</td>
<td>Ban units with charges sizes below 3 kg using refrigerants with GWP above 750</td>
<td>Ban units with charges sizes below 3 kg using refrigerants with GWP above 90</td>
<td>Review MEPS (EER 4.3 about equal to SEER 7.5)</td>
</tr>
<tr>
<td>4</td>
<td>Database recording sales incl. technical parameters is functional</td>
<td>Review functionality and coverage of database</td>
<td></td>
</tr>
</tbody>
</table>

**Milestones – Domestic Refrigeration**

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MEPS: EER equivalent to annual energy use = 235 kWh</td>
<td>Labelling scheme is operational</td>
<td>Strengthen MEPS: EER equivalent to annual energy use = 210 kWh</td>
</tr>
<tr>
<td>2</td>
<td>Ban units using refrigerants with GWP above 150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Database recording sales incl. technical parameters is functional</td>
<td>Review functionality and coverage of database</td>
<td></td>
</tr>
</tbody>
</table>

**Establishment of a Measurement, Reporting and Verification (MRV) system**

**Strategy**
- Set up of **data base** of RAC equipment sales to monitor the effects of other measures and provide metrics for any bankable project

**Measures**
- Introduce a database where all importers need to report imported equipment including brand, model capacity, EER, refrigerant and initial charge

**Milestones – Commercial Refrigeration**

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MEPS: EER equivalent to annual energy use = 1720 kWh</td>
<td>Labelling scheme is operational</td>
<td>Strengthen MEPS: EER equivalent to annual energy use = 1570 kWh</td>
</tr>
<tr>
<td>2</td>
<td>Ban units using refrigerants with GWP above 2500</td>
<td>Ban units using refrigerants with GWP above 150</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Database recording sales incl. technical parameters is functional</td>
<td>Review functionality and coverage of database</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incentive for high EE</td>
<td>Established guidelines for Green Public procurement of AC equipment</td>
<td>MEPS apply</td>
</tr>
<tr>
<td>2</td>
<td>Incentive for low GWP refrigerant</td>
<td>Choice of refrigerant included in guidelines for Green Public procurement of AC equipment</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Service and EOL emissions are decreasing due to better training</td>
<td>Annual service emission factor = 5%, EOL emission factor = 50%</td>
<td></td>
</tr>
</tbody>
</table>
### Funding needs

<table>
<thead>
<tr>
<th>Key end users</th>
<th>Funding Needs 2020/2023 (annually)</th>
<th>Financing Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unitary AC</td>
<td>Retail customers and government buildings with room ACs</td>
<td>Financing volume: 1.2 to 2.6 Mio USD targeting about 20% of the market</td>
</tr>
<tr>
<td></td>
<td>Technical assistance: 0.3 to 0.6 Mio USD</td>
<td></td>
</tr>
<tr>
<td>Commercial refrigeration</td>
<td>Operators of mini-supermarkets/standalone units</td>
<td>Financing volume: 0.8 to 2.6 Mio USD targeting about 20% of the market</td>
</tr>
<tr>
<td></td>
<td>Technical assistance: 0.2 to 0.6 Mio USD</td>
<td></td>
</tr>
<tr>
<td>Domestic refrigeration</td>
<td>Retail customers</td>
<td>Financing volume: 6 to 15 Mio USD targeting about 10% of the market</td>
</tr>
<tr>
<td></td>
<td>Technical assistance: 0.6 Mio USD</td>
<td></td>
</tr>
</tbody>
</table>

### Potential funding sources

#### Financing options through local public organisation
- Green public procurement
- Tax and rebate schemes

#### Private sector engagement
- Green loan financing schemes with resellers
- Green loan financing schemes with commercial end users of RAC appliances

### Financing options through international and regional institutions

#### General requirements
- **Transformational change**: Ideally, the scope covers both (a) the transition to high energy efficiency with a robust regime on MEPS and labelling (b) and the accelerated phase-down of HFCs and the phase-in of low GWP natural refrigerants
- **Ownership of government and private institutions in Mauritius**: The participation of key RAC stakeholders from the beginning is important for a successful implementation programme. Eligible beneficiaries of concession loans or funding programmes should have a clear commitment with tangible and verifiable actions towards Green RAC technologies.
- **Monitoring, review and verification (MRV)**: International donors regularly require the tracking of measures and their mitigation impact.

### Funding programmes / features

- **Green Climate Fund (GCF)**: Under the UNFCCC, stronger linkages between its financing mechanisms, particularly the GCF, and its technology mechanism are to be sought. There are several options to request support from GCF.
- **Global Environment 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 (MIF)**: With the Kigali Amendment, parties of the Montreal Protocol have agreed to release “fast start” financing for transition from HFCs to low GWP refrigerants. The proposals made in this roadmap 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 energy efficiency.
- **NAMA Facility**: In the past, the German-UK NAMA facility has financed RAC related requests, e.g. in Thailand and Colombia. 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, e.g. under its African Climate Change Fund, which might serve to finance elements suggested under this roadmap.
ANNEX VII

Way forward and conclusions
Way forward: Bankable funding proposal

- Financial expert is conducting interviews this week in Mauritius (please support) and will provide ideas for bankable funding proposal
- Report will be shared with relevant national stakeholders
- However, further development will be required

Potential donors for bankable projects

- Green Climate Fund (GCF)
- Global Environment Facility (GEF)
- Nationally Appropriate Mitigation Actions (NAMA)
- Montreal Protocol: Multilateral Fund (MLF): Kigali Cooling Efficiency Program (K-CEP)
- European Union/Commission
- Bilateral: French Government, etc.

Way forward: After the project

- Technology roadmap and policy measures will provide an implementation plan for the national climate policy (NDC)
- GIZ will support the implementation under the current HPMP and future HFC phase down plan (trainings, certification, standards, demonstration, etc.)
- Synergies will be drawn from other projects in the RAC and energy sector to support the implementation
  - e.g. GEF Project Proposal: Realising Energy Savings and Climate Benefits of Implementing Mandatory Energy Auditing in Coordination with HCFC Phase-out and HFC Avoidance (MAURITIUS)
**Conclusions**

- Project will contribute to comply with national and international policy and regulations (NDC, low carbon development strategy, energy efficiency act, long term energy strategy, technology action plan, climate change bill, Montreal Protocol, UNFCCC, SDGs)
- Mauritius will be able to scope with the strong growth of RAC equipment and its energy demand (financial savings)
- Results also support the regional technology roadmap (GCAI regional workshop held this week in Mauritius)
- The gained project experiences and outcomes will be presented as a best practice example to regional and international audience

**Thanks to:**

- All stakeholders that are supporting this project
- All participants that participated at this workshop
- The hon. Minister, Director of Environment, NOU, Climate Change Division, Minister of Social Security, National Solidarity, and Environment and Sustainable Development
- All other ministries and institutions
- All importers, servicing companies and end users
- All Consultants involved
- The Climate Technology Centre and Network for funding this project.

**Questions?**

**Contact:**

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GIZ Proklima International
www.green-cooling-initiative.org
ANNEX VIII

Photographs of the event
Group photo of participants with Hon. Etienne SINATAMBOU, Minister of Social Security, National Solidarity, and Environment and Sustainable Development

Opening remarks by Mrs. D. LAN NG, Director of Environment, Ministry of Social Security, National Solidarity, and Environment and Sustainable Development
Address by Mr. Philipp DENZINGER, Project Manager, GIZ Proklima

Address by Hon. Etienne SINATAMBOU, Minister of Social Security, National Solidarity, and Environment and Sustainable Development