GHANA NATIONAL COOLING PLAN

(FRAMEWORK FOR GREEN AND EFFICIENT COOLING)

Version 2.0

ENVIRONMENTAL PROTECTION AGENCY

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- Non-Governmental Organizations (GREDA, GIA, GHIE) etc.
- Importers (Flexi Space Limited, Electroland Limited) etc.
- Technicians and Engineers (NARWOA, RAAG) etc.
- Media (TV3, Ghana Broadcasting Cooperation) etc.

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ACRONYMS

AC	Air Conditioning
BAT	Best available technologies
CCAC	Climate and Clean Air Coalition
COMREF	Commercial refrigeration
COTVET	Council for Technical and Vocational Educational Training
CSIR	Council for Scientific and Industrial Research
DOMREF	Domestic refrigeration
DVLA	Driver, Vehicle and Licensing Authority
EC	Energy Commission
ECG	Electricity Company of Ghana
ECREE	Ecowas Center for Renewable and Energy Efficiency
EE	Energy Efficiency
EPA	Environmental Protection Agency
GEF	Global Environment Fund
GHG	Green House Gases
GHIE	Ghana Institution of Engineering
GIA	Ghana Institution of Architects
GRACD	Ghana Revenue Authority-Custom Division
GREDA	Ghana Real Estate Developers Association
GSA	Ghana Standards Authority
GSS	Ghana Statistical Service
GWP	Global Warming Potential
HC	Hydrocarbon
HFC	Hydrofluorocarbon
HPMP	Hydrochlorofluorocarbon Phase-out Management Plan
INDREF	Industrial Refrigeration
K-CEP	Kigali Cooling Efficiency Programme
KFM	Kigali First Movers
kW	kiloWatt
L. I	Legal Instrument
MAC	Mobile Air conditioning
MEPS	Minimum Energy Performance Standards
MESTIS	Ministry of Environment, Science, Technology and Innovations
MiDA	Millennium Development Authority
MOF	Ministry of Finance
$MTCO_{2\text{-eq}}$	Million Ton Carbon Dioxide Equivalent
NACODS	National Committee on Ozone Depleting Substances
NARWOA	National Air-conditioning of Refrigeration Workshop Owners Association
NCAP	National Cooling Action Plan
NCPC	National Cooling Plan Committee
NCP	National Cooling Plan
NDC	Nationally Determined Contributions
NEDCo	Northern Electricity Distribution Company
NOU	National Ozone Unit
PIR	Polyisocyanurate (foam)

PUR	Polyurethane (foam)
RAAG	Refrigeration and Airconditioning Engineers Association of Ghana
RAC	Refrigeration and Air Conditioning
RACHP	Refrigeration, Air Conditioning and Heat Pump
R & D	Research and Development
S & L	Standards and Labelling
STATAC	Stationary Air Conditioning
$TCO_{2\text{-eq}}$	Ton Carbon Dioxide Equivalent
TRANSREF	Transport refrigeration
TOR	Tons of Refrigeration
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VRV	Variable Refrigerant Volume (aka Variable Refrigerant Flow, VRF)

EXECUTIVE SUMMARY

Cooling is an indispensable service in Ghana's development. It is needed for food preservation, thermal comfort, healthcare, industrial processes, data rooms, research and many more applications.

The country's RAC sector, which offers cooling services had grown steadily in the last ten years propelled by nationwide electricity coverage, rapid urbanization, population growth, expanding middle class and rising incomes. This has also increased the sector's contribution to the national GHG emissions from both direct and indirect sources. High direct emission is caused by excessive leakage of high-GWP refrigerant used in the cooling equipment. Indirect emission is also high due to higher energy consumption resulting from the longer equipment running hours in the country's high ambient temperature, and the carbon intensity of electricity generation in Ghana.

Presented in Figures 1.2 to 1.3 are the RAC sector's energy consumption and total GHG emission taken from a study report in 2018 by the GIZ/EPA [1] to establish RAC Sector GHG Inventory for Ghana. Two important conclusions of the study, as can be seen from Figures 1.2 and 1.5 below, are the following:

- Energy demand for the RAC sector can increase steadily from 7.04 TWh in 2015 to 20.9 TWh in 2050 and corresponding GHG emissions can increase from 5.05 mT CO_2eq in 2015 to 12.8 mT CO_2eq in 2050, shown in a BAU scenario. Thus, transitioning to energy efficient RAC technologies using low GWP refrigerants such as hydrocarbons offers great potential savings in electricity use and total RAC GHG emissions.
- Unitary ACs, MACs and Domestic Refrigeration are the major contributors to current and future total RAC emissions with the unitary AC contributing the largest share of 100% of which 58% comes from split unit ACs. These three sub-sectors hold the biggest opportunity to achieve savings in the RAC sector energy use and GHG emissions.

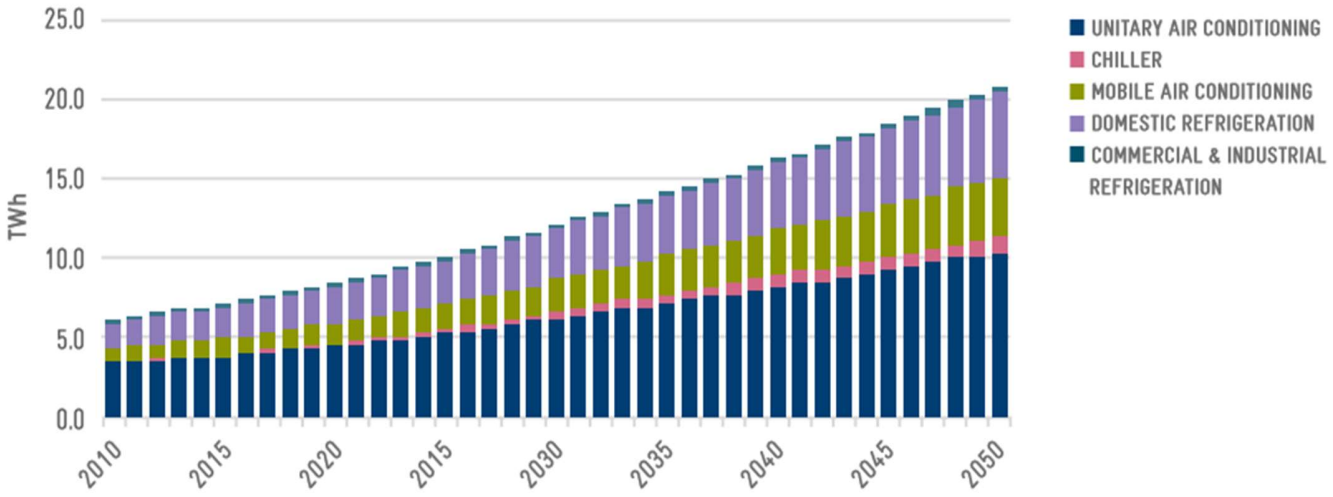

Figure 1.2: BAU projected energy consumption of RAC sector [1]

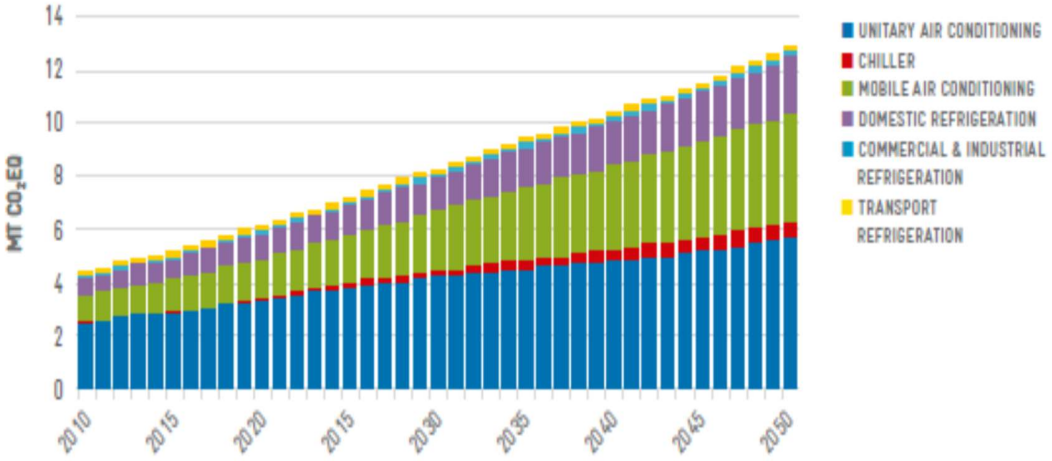

Figure 1.3: BAU projected total emission of RAC sector [1]

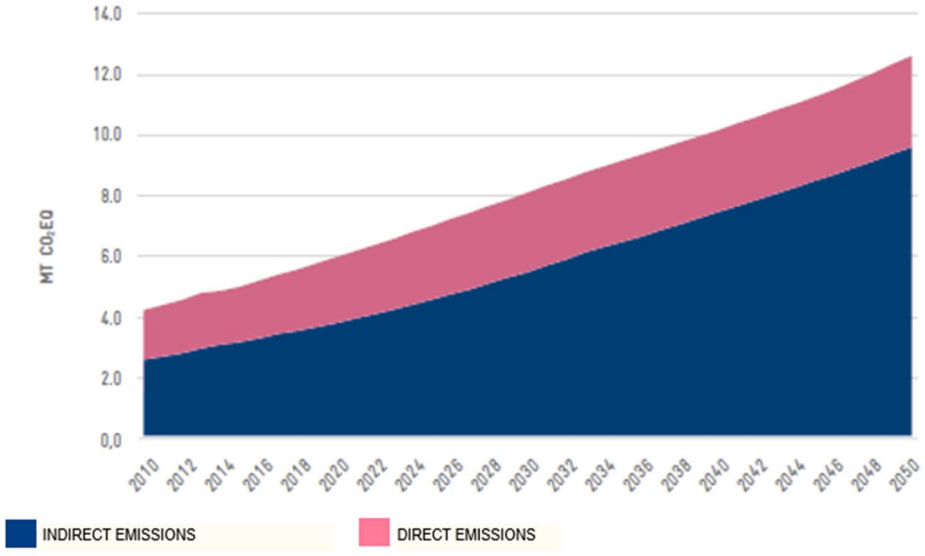

Figure 1.4: BAU projection of Direct (Pink) and Indirect (Black) emissions of RAC sector [1]

In the GIZ/EPA report [1] is also presented a technology gap analysis of Ghana's RAC sector which shows that, applying the right technical options that are available on the global market today, the sector's total emissions could be reduced from 8.2 Mt CO_2eq to 6.3 Mt CO_2eq by 2030 and from 12.8 Mt CO_2eq to 8.5 Mt CO_2eq by 2050 as illustrated in Figure 1.5.

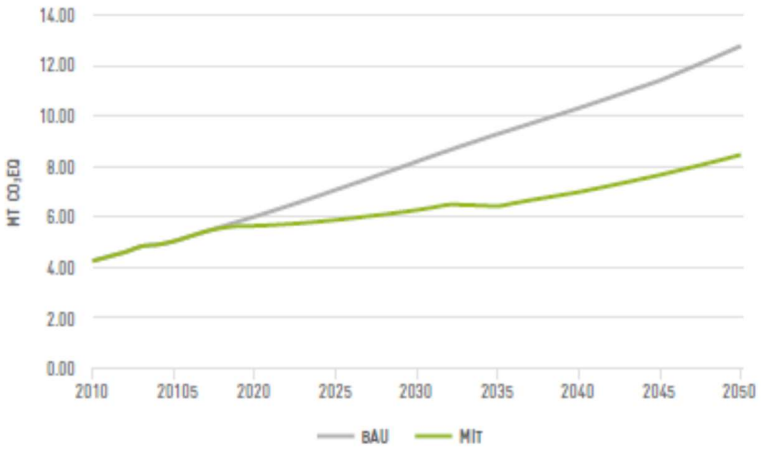

Figure 1.5: Comparison between BAU and Mitigation scenario for the RAC sector Total emission [1]

This document is a National Cooling Plan, NCP, aimed to serve as a roadmap to transform the country's RAC sector to best available technologies to achieve sustainable cooling that will support economic growth and reduce overall impact on the environment. The plan will help to support market-transformation programs such as MEPS, labelling and rebate schemes for high-efficiency and low-GWP cooling appliances. Actions under the NCP will be integrated with the HCFC phase-out and the HFC phase-down as well as other RAC activities geared towards achieving efficient and clean cooling.
The plan examines the state of each RAC sub-sector, identifies the deficiencies facing the sub-sector and present technical proposals to guide its transformation to clean and efficient cooling. The plan aims to bring together all cooling related stakeholders such as the Ministries, Academic Institutions, Professional bodies, Estate developers, Private sector, Financial Institutions, etc. to synergize and to transform the RAC industry to achieve clean and efficient cooling that will be affordable, sustainable and accessible to all.

Due to certain project limitations, the development of the first version of NCP (Version 1.0) could not cover the marine sub-sector at the time it was prepared which made the plan incomplete. To make up for this deficiency in the NCP , investigation has been conducted on the cooling systems in the marine sub-sector and proposals presented to transform the cooling systems to best available technologies to achieve sustainable cooling that will support economic growth of the sub-sector and reduce the overall impact on the environment. This updated version of the NCP (Version 2.0) covers the cooling systems in the Marine sub-sector.

The report on the marine sub-sector focused on identifying the types of refrigeration systems used in the sub-sector, the types of refrigerants used and the key challenges facing the sub-sector. Projects have also been proposed to address the key challenges in the sub-sector.

A Committee to manage the implementation of the National Cooling Plan has been proposed that will be supported by four Working Groups which will be tasked with specific responsibilities to help in pushing the NCP agenda.

Group 1 will be responsible for Finance and Legal, Group 2 for Capacity building, Research and Development, Group 3 Outreach, Communication and End - Users, and Group 4 for MEPS, Monitoring, Verification, Enforcement and Reporting, and Regional Collaboration.

A number of NCP projects have been proposed for implementation covering the following eight thematic areas:

a. Assessment of RAC EE Technologies
b. Establishment of MEPS and Labelling System
c. Training and Capacity Building
d. Assessment of Funding and Financial Mechanisms for Market Transformation
e. Market Monitoring, Verifications and Enforcement
f. Outreach and Communication
g. Opportunities of Regional Collaboration
h. Waste Management

1.0 INTRODUCTION

1.1 Project framework

Ghana has ratified the Montreal Protocol and all its amendments including the Kigali Amendment. Ghana is also signatory to the UNFCCC (United Nations Framework Convention on Climate Change) and has put in place actions to mitigate global warming and adapt to climate change. A National Climate Change Committee (NCCC) has been formed and a National Climate Action Plan (NCAP) has been developed that outlines the robust measures needed to address the challenges posed by climate change and climate vulnerability. Ghana has also put in place an implementation plan for its NDC, including the RAC sector mitigation action, signifying her commitment to fight climate change.

Ghana is also strongly committed to cooling energy efficiency but, in common with Article 5 countries, faces significant barriers to the implementation of energy efficiency projects for the transformation of the cooling systems market, (such as absence of minimum energy performance standards and labelling). Against this background, the UNDP in partnership with the EPA and the Energy Commission (EC) carried out a project to assess the feasibility of a rebate scheme for the AC sector. The project is aligned with the KCEP Window 2, "Policies, Standards and Programs", and is expected to support the Government of Ghana to achieve the Outcome 1 on Policy, Standards and the Outcome 2: "High-efficiency technology increases its market penetration in target markets" of the K-CEP Strategic Plan.

A follow up to the rebate project is the development of a National Cooling Plan, NCP, to establish a framework to drive the RAC sector's rapid transition to high performance cooling equipment, thereby linking Montreal Protocol to climate protection efforts, taking into consideration energy efficiency and HFC phase-down in order to mitigate greenhouse gas emissions, and support the country's Sustainable Development Goals.

Due to certain project limitations, the development of the first version of *NCP* (Version 1.0) *could not cover the marine sub-sector at the time it was prepared which made the plan incomplete.* To make up for this deficiency in the NCP, *investigation has been conducted on the cooling systems in the marine sub-sector, and proposals presented to transform the cooling systems to best available technologies to achieve sustainable cooling that will support economic growth of the sub-sector and reduce the overall impact on the environment.* This updated version of the NCP (Version 2.0) covers the cooling systems in the Marine sub-sector.

1.2 Importance of cooling to Ghana's development

Cooling plays an indispensable role in the country's development. It is needed for food preservation, thermal comfort, healthcare, industrial processes, data rooms, research and many more applications. Ghana being a tropical country with high ambient temperature, cooling is needed, and the need it will increase in the future, for the nation to adapt to increasing temperature due to climate change.

Presently, there are several state-initiated developmental actions that will add to the push for more cooling. For example, for the national campaign "Planting for Food and Jobs", intended to produce more food to feed the expanding population and create jobs for the youth to succeed, will require refrigeration input to check postharvest losses which is a perennial problem that confronts the nation's agricultural sector. There is also the national agenda to digitize the economy which will require computer room air conditioning (CRAC) for the server/data rooms nationwide that will be the backbone for the ICT transformation. A third initiative is the programme of industrial transformation which targeted value addition to the country's agricultural produce to move the nation away from exporting traditional raw produce. This is expected to boost industrial activity that will require process cooling, as it is already being felt in the local processing of cocoa beans.

These and many similar developmental initiatives underscore the relevance of cooling as a vital developmental necessity.

1.3 Country background

1.3.1 Geographical location of Ghana and climatic conditions

Ghana is a West African country located near the equator. Ghana shares a coast of 540km with the Gulf of Guinea, directly at the Atlantic Ocean. Ghana borders Cote d'Ivoire in the west, Burkina Faso in the north and Togo in the east (Figure 1.1). Ghana covers a total land area of 239,000 sq. km.

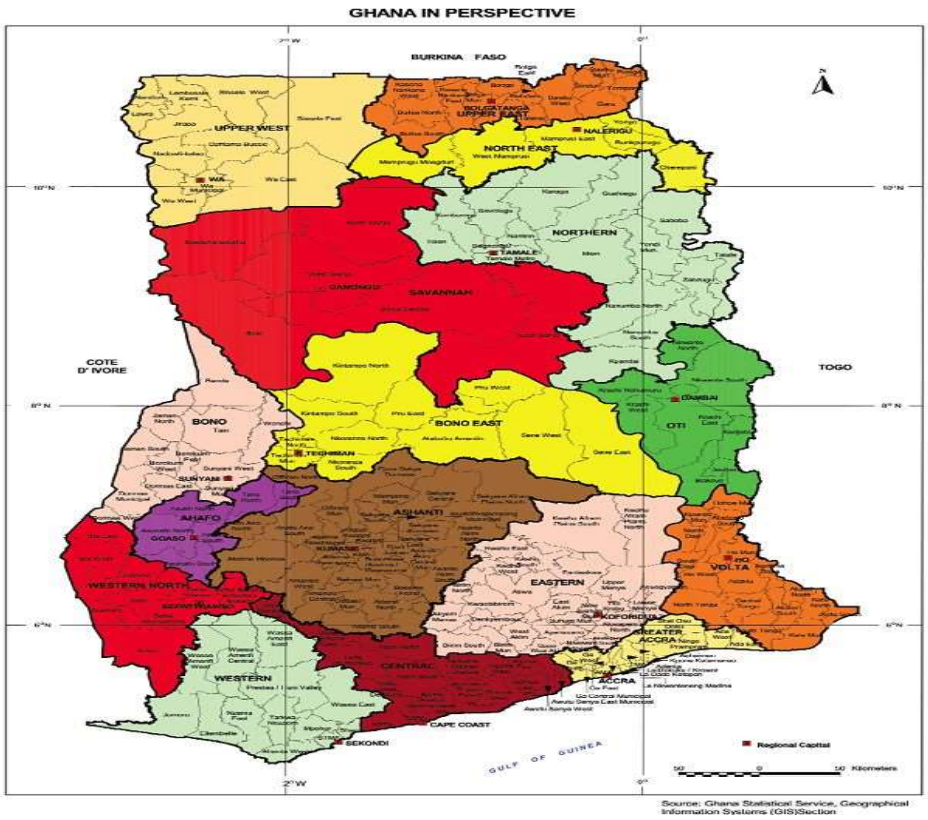

Figure 1.1: Map of Ghana

1.3.2 Population and economic situation

Ghana has an estimated population of 28.3 million (GSS, 2016, based on a census in 2010) [2], with a relatively high annual population growth rate of 2.4 % compared to 1.6 % for other lower-middle income countries, but in line with the 2.5 % average for Sub-Saharan Africa. Ghana is divided into 16 administrative regions. The country has a diverse rich resource base that includes gold, timber, cocoa, diamond, bauxite and manganese. The economy is traditionally oriented towards agriculture, contributing immensely to the gross domestic product (GDP) and small domestic trading.

1.4 RAC sector classification

The country RAC sector can be classified according to equipment type as shown in Table 1.1. Alternative classification based on Refrigeration application and Air Conditioning application is shown in Table 1.2. This RAC classification accounts only for the land-based cooling activities and does not cover cooling onboard fishing boats and other marine vessels.

Cooling is provided using refrigeration based largely on synthetic refrigerants, the exception being ammonia plants used for large cooling loads in industry and a limited number of large cold stores, and the hydrocarbons R600a which is dominating application in domestic fridges and freezers today, and R-290 that it is used in some split unit ACs . Other methods of cooling that are not refrigeration equipment-based are mechanical ventilation (fans, etc.), which is a cheaper and widely used means of providing thermal comfort in buildings generally, and industrial cooling processes using water and cooling tower system.
Passive cooling such as natural ventilation and shading is also another method of providing cooling in buildings which are convenient means in areas that lack access to electricity.

Table 1.1: Classification of Ghana's RAC sector according to equipment type

Sub-sector		Equipment type
Refrigeration	Domestic ref.	Fridge, Freezer & combined Fridge/Freezer
	Commercial & Industrial ref.	Stand-alone unit (display cabinet, dispenser unit)
		Condensing unit (cold stores, supermarkets, industry)
		Centralised system (cold stores, supermarkets)
		Process chiller
	Transport ref.	Refrigerator trucks/trailers
	Marine ref.	Ashore-based ice plants
		Onboard cooling systems
Air Conditioning	Unitary AC (Stationary)	Self-contained (window) unit
		Single Split unit (non-ducted, ducted)
		Multi split (VRV/VRF)
		Rooftop packaged (ducted)
	Chiller	Comfort AC Chiller
	Mobile AC (MAC)	Small vehicle AC (Saloon car, light commercial)
		Large vehicle AC (bus)

Table 1.2: Classification of RAC sector according to application

Sub-sector	Application	Application scope
Refrigeration	Food Refrigeration	Domestic
		Commercial: cold stores, supermarkets, etc.
		Transport
		Marine
	Industrial Ref.	Industrial process
Air Conditioning	Comfort AC	Space cooling: buildings
		Mobile AC (MAC)
	Industrial AC	Processes (temperature and humidity control), etc.

1.5 RAC sector key institutions, Legal and Regulatory Framework

1.5.1 NACODS

Under the Action Plan for the control and management of ODS, a National Committee on Ozone Depleting Substances (NACODS) was formed to serve as an advisory body for the NOU/EPA on all ODS related matters and advises on policy requirements, legislation, programmes of action, research, institutional strengthening and also enlist the collaboration of other Government Departments and private sectors in the ODS control and management.

The membership of the NACODS is the following:

- Ministry of Environment, Science & Technology and Innovations
- Ministry of Trade and Industry
- Ministry of Food and Agriculture
- Ghana Meteorological Agency
- Representative from the Universities
- Factories Inspectorate Department
- Friends of the Earth – Ghana (NGO)
- Council for Scientific & Industrial Research (CSIR)
- UNDP – Ghana
- Ghana Association of Industries
- Ghana Revenue Authority- Customs Division
- Legal Officer, EPA (Co-opted)
- Ministry of Finance
- National Air-conditioning & Ref. Workshop Owners Association (NARWOA).
- National Committee on Improved Refrigeration Services (Co-Opted)
- Chemicals Control & Management Centre (Co-Opted)
- Ghana Standard Authority (GSA)
- Ministry of Works and Housing
- Ghana Institution of Engineering (GHIE)
- Ghana Institution of Architects (GIA)
- Ghana Standard Authority (GSA)

However, since the marine sub-sector is part of the NCP, it is proposed that the Ministry of fisheries and aquaculture/ Fisheries Commission should be made a member of NACODS.

1.5.2 Existing policy framework and controls

Several control measures and legislation have been put in place in the country to manage and regulate ODS consumption, which after the KA, will extend to HFC phase-down:

a. Collaboration with Ghana Revenue Authority-Customs Division

Customs controls entry of goods into the country at all entry points (by sea, air and land). This makes Customs a very strategic partner of the NOU/EPA in the control and management of imports of ODS into the country. To facilitate this role, the NOU frequently organizes training seminars and programmes for Customs officials to acquaint them with the background knowledge and create awareness in the control and monitoring of entry of refrigerants in general at the entry points.

b. Legal Framework

Ghana has instituted laws that allow state agencies such as the EPA and Customs to control and regulate certain aspects of import-export trade to protect the public from exposure to harmful substances and products. The following laws relate to the management of ODS consumption in the country:

i. Export and Import Act, 1995 (Act 503).
ii. Customs Act, 2015(ACT 891)
iii. Environmental Protection Agency Act, 1994 (Act 490).
iv. Management of Ozone Depleting Substances and Products Regulations, 2005 (LI 1812).
v. Energy Commission - Energy Efficiency Regulation, 2008 (LI 1932).

Details of the above laws are given in Annex 2.1

1.6 RAC sector GHG emissions

The country's RAC sector has grown steadily in the past years propelled by several growth factors such as nationwide electricity coverage, rapid urbanization, population growth, expanding middle class and rising incomes. This has also increased the sector's contribution to the national GHG emissions, from both direct and indirect sources. The direct emission is high due to the high leakage of high-GWP refrigerant in the working lifespan of the RAC equipment. Indirect emission is also high because RAC equipment ran for longer hours and consume more energy in Ghana's high ambient temperature, and because of the carbon intensity of electricity generation in Ghana (section 4.3).
Presented Figures 1.2 to 1.3 are the RAC sector's energy consumption and GHG emissions taken from a study report in 2018 by the GIZ/EPA [1] to establish RAC Sector GHG Inventory for Ghana. The GIZ/EPA study did not cover the marine sub-sector.

Two important outcomes from the study as can be seen from the two Figures, 1.2 and 1.5, are the following:

- Energy demand for the RAC sector can increase steadily from 7.04 TWh in 2015 to 20.9 TWh in 2050 and corresponding GHG emissions can increase from 5.05 mT CO_2eq in 2015 to 12.8 mT CO_2eq in 2050, shown in a BAU scenario. Thus, transitioning to energy efficient RAC technologies using low GWP refrigerants, such as hydrocarbons, offers great potential savings in electricity use and total RAC GHG emissions.
- Unitary ACs, MACs and Domestic Refrigeration are the major contributors to current and future total RAC emissions with the unitary AC contributing the largest share of 100% of which 58% comes from split unit ACs.
- BAU projection of direct and indirect emissions, presented in figure 1.4, shows that in 2050, around 70% of total emissions would be indirect emissions (energy consumption) and 30% direct (refrigerant emissions), stressing the importance of a strategy to increase energy efficiency.

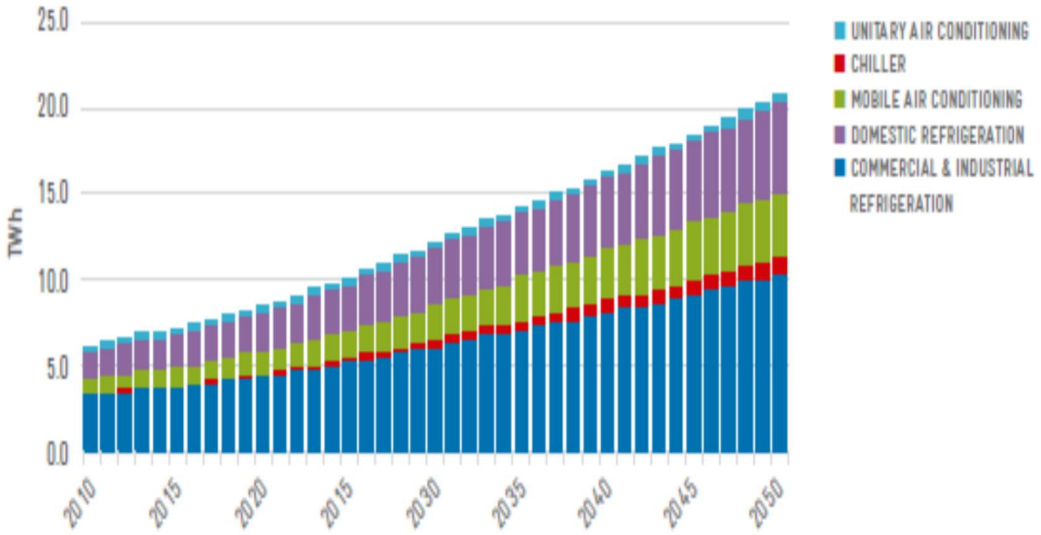

Figure 1.2: BAU projection of energy consumption of RAC sector [1]

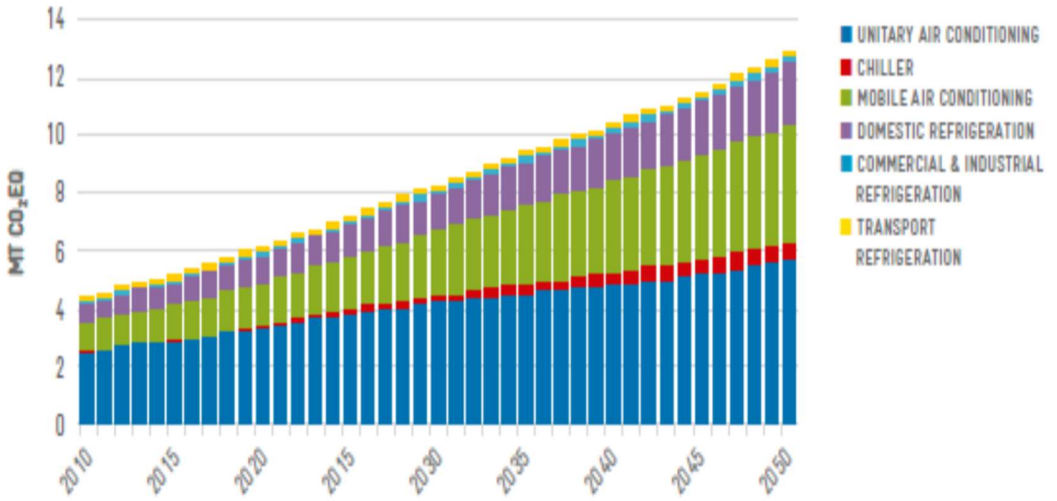

Figure 1.3: BAU projection of total emission of RAC sector [1]

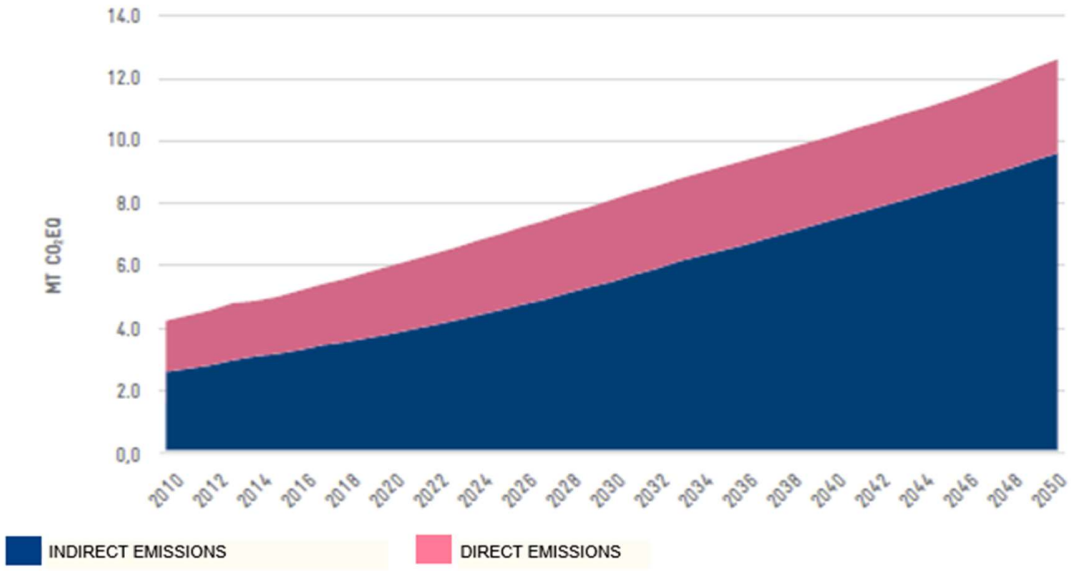

Figure 1.4: BAU projection of Direct (Pink) and Indirect (Black) emissions of RAC sector [1]

Considering the improvement of the energy efficiency, in the GIZ/EPA study [1] it is presented a technology gap analysis of RAC sector which shows that, applying the right technical options that are available on the world market today, the sector's total emissions could be reduced, considering the BAU baseline, from 8.2 Mt CO_2eq to 6.3 Mt CO_2eq by 2030 and from 12.8 Mt CO_2eq to 8.5 Mt CO_2eq by 2050, as it is illustrated in Figure 1.5.

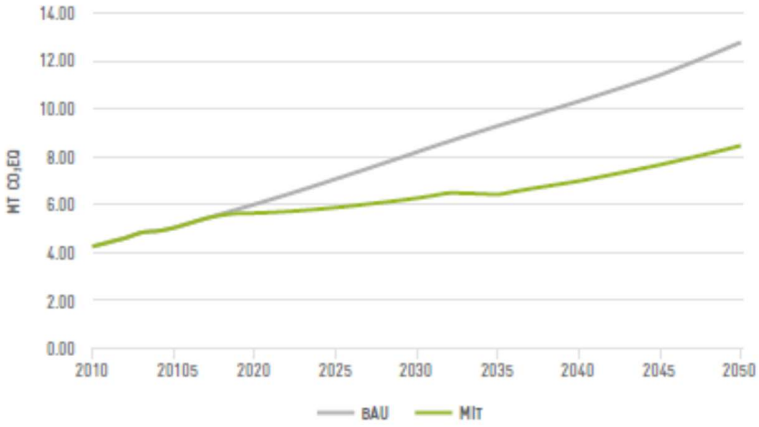

Figure 1.5: Comparison between BAU and Mitigation scenario for the RAC sector Total emission [1]

b. Marine sub-sector GHG

Table1.3 and 1.4 shows the direct and indirect emissions respectively.

Table 1.3: Direct emissions for marine sub-sector refrigeration systems

Industrial Vessel	
Refrigerant	**Value (TCO_{2-eq})**
R717	0
R22	15,041
R502	4,117
Ice Making Facilities	
Refrigerant	**Value (TCO_{2-eq})**
R717	0
R22	1,875
R404A	1,664

Table 1.4: Indirect emissions for marine sub-sector refrigeration systems

Industrial Vessel	
Refrigerant	**Value (TCO_{2-eq})**
R717	54,027
R22	16
R502	2
Ice Making Facilities	
Refrigerant	**Value (TCO_{2-eq})**
R717	328
R22	522
R404A	297

1.7 National Cooling Plan, NCP

1.7.1 Importance and benefit of NCP

The inevitable growth in national cooling demand over the coming years, as illustrated above, will lead to drastic increase in RAC sector energy use and total GHG emission in a BAU scenario which will defeat the national fight against global warming. The NCP is a roadmap that can help to transform the country's RAC sector to best available technologies (BAT) to achieve sustainable cooling that will support economic growth and reduce overall impact on environment.

The plan will help to support market-transformation programs such as MEPS, labelling and rebate schemes for high-efficiency and low-GWP cooling appliances. Actions under the NCP will be integrated with the HCFC phase-out and the HFC phase-down as well as other RAC activities all geared towards achieving efficient and clean cooling. The NCP will also encourage the use of passive cooling methods such as shading, natural ventilation, cool roof technology, etc. to reduce electricity use for thermal comfort cooling.

The NCP will help to make cooling accessible, affordable and sustainable which will benefit the country's sustainable development agenda. Affordable cooling will, for example, allow AC end-users to derive full

cooling satisfaction from their equipment without worrying about unaffordable high electricity bill which has today led to a trend of self-imposed restricted use of ACs by end-users.

1.7.2 Scope of the NCP and Methodology

The NCP first reviews the state of each RAC sub-sector and recommends mitigation strategies that could transform it to deliver clean and efficient cooling. The plan also examines the RAC supply chain, the electricity sector and existing energy efficiency regulations and consumption reduction targets for the RAC sector.

To ensure transparency and accountability the NCP will adopt the Global Energy Fund (GEF) Methodology for calculating baseline and project emissions to ensure projects align with Ghana's Nationally Determined Contributions (NDC) in the RAC Sector.

The plan further presents proposals to manage the successful implementation of the NCP followed by cooling projects that will be undertaken to aid in transitioning the RAC sector to energy efficient cooling technologies using low-GWP refrigerants.

2.0 PROPOSALS TO ACHIEVE CLEAN AND EFFICIENT COOLING

2.1 Domestic refrigeration

i. Current state and projected growth

Domestic refrigeration (Domref) is the fastest growing RAC sub-sector, propelled by a successful nationwide electricity coverage and resulted in increasing urbanization, among other factors. Besides its traditional role as a domestic appliance, it is also serving a commercial role in the sale of chilled drinking water, 500ml sachet and 500ml to 100ml bottle locally referred to as pure water, which has become a bustling commercial activity in every town in the country.

Survey carried out in [1] estimates the stock of refrigerators in the country to be over 6 million units in 2015, predicted to grow to 23 million in 2050 (Figure 2.1)

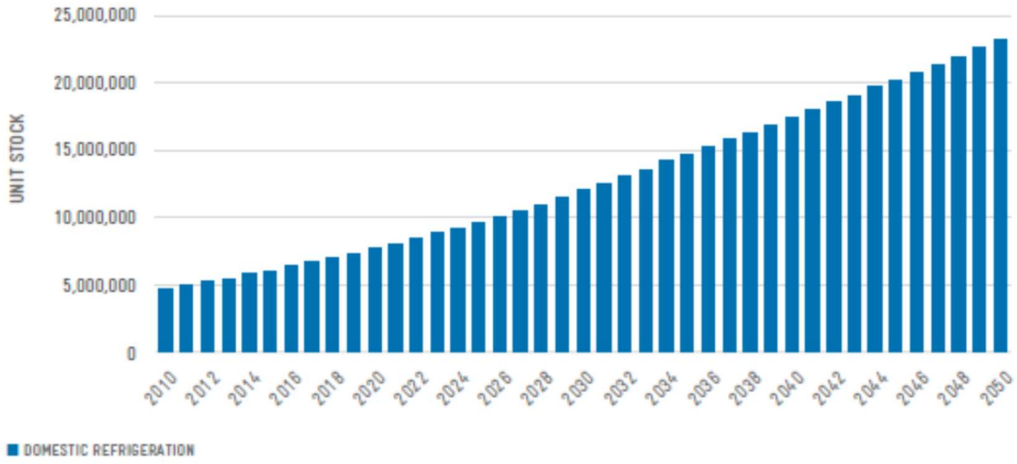

Figure 2.1: Projected growth of Domestic Refrigeration stock [1]

ii. Proposals for improvement

The Domref sub-sector has already seen considerable transformation towards clean and efficient cooling. Today, globally, R-600a refrigerators has overtaken R-134a versions in new refrigerator units on the market and inverter compressors are increasingly been used on new units in certain regions. The survey carried out under [1] showed that the end-user refrigerant distribution stood at 63% for R-134a and 37% for R-600a refrigerators indicating that there is the potential to improve the energy efficiency in the sub-sector by replacing outdated fridges and this is what the ECOFRIDGE project seeks to do.

The ECOFRIDGE project, which is a U4E initiative supported by K-CEP, is partnering with the governments of Ghana and Senegal to use innovative financial mechanisms to facilitate the replacement of outdated refrigerators (and air conditioners). The project is founded on the fact that outdated refrigerators and air conditioners consume 2 to 3 times the amount of energy used by efficient options available today and they often contain refrigerant gases that are harmful to the environment.

End-user education for proper use and care of refrigerators can also complement the transformation to clean and efficient cooling. For example, defective door seal result in air infiltration which increases cooling load and causes reduced cooling capacity from ice build-up on cooling coils. As a result, the refrigerator runs continuously and consumes more energy. Continuous public education on this and similar end-user responsibilities will benefit the end-user and the national cause to reduce emissions.

2.2 Commercial refrigeration

i. Current state and projected growth

The commercial refrigeration (Comref) sub-sector covers cooling equipment in the shops and supermarkets on one hand and the commercial cold stores on the other. This sub-sector has also experienced considerable growth over the years as illustrated in Figure 2.2, driven mainly by shops and supermarkets fitted with standalone units such as drink dispensers and display cabinets which have become a common feature in the growing urban landscape across the country. The refrigerant in these units are typically R-134a and R-600a in the standalone units and R-404A in the condensing units.

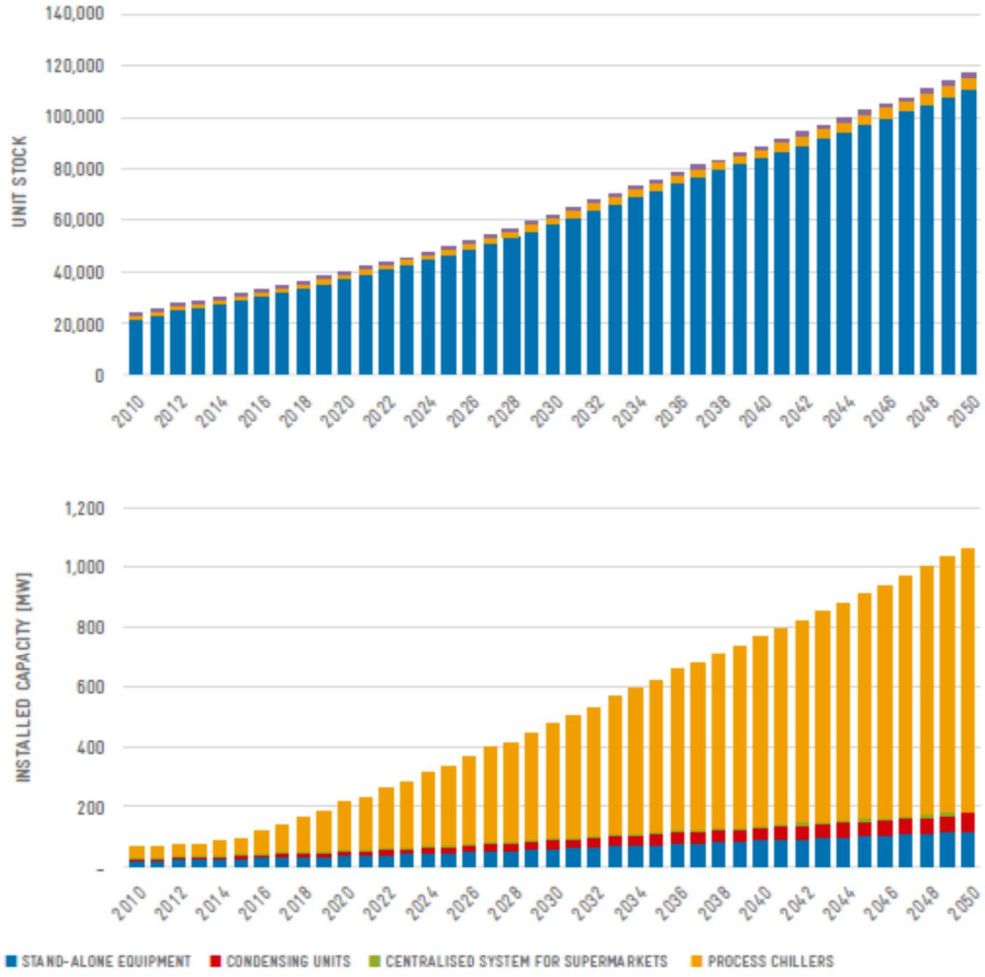

Figure 2.2: Projected growth of Commercial and Industrial Refrigeration stock [1]

The commercial cold stores comprise of the large frozen depots located in the Tema fishing harbour enclave and the smaller capacity cold stores scattered all over the regions including those serving the hotels and large catering institutions. Their cooling units are predominantly condensing units operating largely with R-404A and a few with R-507A. A few cold stores in the regions operate with R-22 condensing units. The morgues in the country also operate with similar condensing unit as the cold stores.

The large cold stores (frozen depots) in the country are concentrated in the Tema fishing harbour enclave which is the centre of local fishing activity as well as frozen fish and chicken imports. The cold stores, of diverse storage capacities ranging from 1,800 kW (~500 TOR) to over 21,000 kW (~6,000 TOR), are also largely equipped with air-cooled condensing units operating largely with R-404A and a few with R-507A. Prior to the 1990s, central water-cooled ammonia plants dominated the cold stores in the fishing harbour enclave. When the condensing unit cooling system was introduced into the cold store market in the 1990s, it virtually knocked out the centralized ammonia plant from the cold store market because of its lower first cost. Today, however, ammonia plants are gradually making a steady comeback into the large cold stores market due to its lower operating cost in energy use and maintenance.

Traditionally, cold stores were insulated in the past with field-applied polysterene slabs which was manufactured by a local company. In-situ polyurethane (PUR) insulation was introduced about the same time as the condensing unit's entry to the Tema cold stores. Today, prefabricated sandwiched PUR and polyisocyanurate (PIR) panels are increasingly being used for new cold stores and have proven to be a better insulation envelope than the in-situ PUR foam which are known to fail after few years in service.

ii. Proposals for improvement

There are many opportunities to transform the Comref sub-sector to clean and efficient cooling.

Reducing Direct emission:

- Select HC (hydrocarbon) refrigerant for the standalone and condensing units, and water-cooled ammonia plants for the large cold stores.
- Reduce refrigerant leakage by following approved erection procedure and install refrigerant detectors to warn of leakage.
- Improve maintenance practice by training technician.

Improving efficiency:

- Select energy efficient technology – system such as inverter technology for standalone units and display cabinets and water-cooled ammonia plants for large cold stores.
- Use prefabricated PIR insulation panels which have better insulation and fire resistant than PUR
- Minimize air infiltration into cold rooms by providing refrigerated airlock (anteroom) and similar intervention
- Ensure proper door management
- Improve maintenance practice by training technician (this shall include good housekeeping and keeping good operating log on plant).

2.3 Transport refrigeration

i. Current state and projected growth

Transport refrigeration (Transref) is an important link in the cold chain for preserving food, medicine and other perishable commodities. In Ghana, this sub-sector has remained greatly underutilized, with the exception of the ice cream industry and a few others.

Fan Milk Limited, a local manufacturer of frozen ice cream and other milk products since the 1960s operates a fleet of Transref trailers and vans to distribute their frozen products nationwide and to the West African sub-region. A second entrant to the ice cream production, Frosty Bite, also operates a fleet of Transref vehicles for the same purpose. A third company, Blue Sky Limited, that produces freshly-squeezed fruit juices and fresh-cut fruits in country since 1998 also operates a fleet of Transref trailers and vans for nationwide distribution as well as transporting to the airport for airfreighting to overseas markets.

Also emerging on the market are Transref mini-vans that are patronized by pharmaceutical companies, caterers, shopping malls, etc.

Atlantic Climate Control Ltd, a local agent of Thermoking, commenced installing Thermoking refrigeration units on trucks in the country for about a decade now but the business is yet to pick up significantly.

One area of the national food supply chain where Transref is visibly deficient is in the distribution of frozen fish and chicken, which are largely imported due to weak local production. Cartoned imports that are bulk stored in the ship's cargo holds are discharged onto open trailers and transported to the cold store exposed to the hot ambient which represents the first break in the cold chain. Increasingly, the frozen imports, especially chicken, may be shipped in reefer containers in which case offloading the containers to the cold stores does not pose temperature upset to the frozen foods significantly. From the cold stores, the frozen foods are transported to marketing centres nationwide in insulated non-refrigerated vans which represents a major break in the cold chain. In the 1970s, the State Fishing Corporation (SFC) operated a fleet of Transref trailers for transporting frozen fish from their cold store depots in Tema to their retail cold stores in all the regional capitals. With the collapse of the SFC in the 1980s also collapsed their Transref fleet.

Notwithstanding its limited application in the country today, the Transref sub-sector is projected to grow as shown in Figure 2.3 [1]. As the economy develops and the population expands, more food will be needed and Transref will play a vital role in the cold chain to secure food safety and prevent economic loss. Every year, farmers in the country face heavy postharvest losses as perishables such as tomatoes, watermelons, mangoes, etc. go to waste due to market glut. Pack houses will be needed to check postharvest losses and Transref will play an important role to convey the produce from the pack houses under temperature-controlled condition to the local market as well as for overseas export. This will also be a major boost to the ongoing state-initiated Planting for Food and Jobs which led to high food production in 2019 but suffered severe postharvest losses.

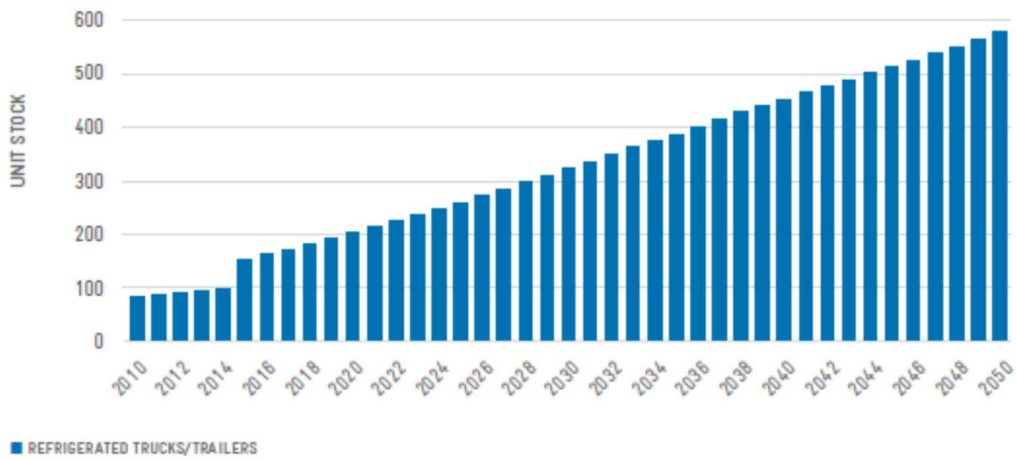

Figure 2.3: Projected growth of Transport Refrigeration stock [1]

R-134a and R-404A are the predominant refrigerant in the Transref sub-sector in the country, which for the projected growth occurring in a BAU scenario will lead to increased GHG emissions.
Transref vehicles, like MACs, are exposed to the bad road conditions in the country which can cause higher leakage rates as well as frequent breakdowns and accelerated ageing of the cooling system thereby reducing efficiency and consequently causing higher energy use.

Similarly, as for the MAC sub-sector, it is difficult to regulate the emission from the Transref sub-sector based only on national regulations because the technology used is organized by the global automotive industry.

ii. Proposals for improvement

There are many opportunities to transform the Transref sector to clean and efficient cooling. Presently, all Transref vehicles are imported hence achieving clean and efficient cooling in the sub-sector will rest, first and foremost, on selecting the best available Transref technology and secondly on the establishment of good maintenance practices.

Reducing Direct emission:

- Select natural or low-GWP synthetic refrigerant: in recommending HC refrigerant, it is assumed that ongoing research and development efforts will resolve flammability issues with mobile HC application in the near future. Other natural refrigerant such as carbon dioxide or synthetic low-GWP refrigerant can also be considered if they offer attractive energy efficiency.
- Reduce refrigerant leakage - select technologies that are less prone to leakages such as hermetic compressors, etc.
- Improve maintenance practice by training technician.

Improving efficiency:

- Select energy efficient Transref technology – good insulation and energy-efficient refrigeration system such as with compressor speed control technology (inverter).
- Improve maintenance practice
- Repair insulation defects
- Use cargo loading dock to minimize cold loss.

2.4 Industrial refrigeration

i. Current state and projected growth

The big users of industrial refrigeration (Indref) in the country are the two breweries, (Accra Brewery Limited and Guinness Ghana Limited) processing factories such as Nestle, Unilever and diverse cocoa processing companies. In addition to these there are a number of thermoplastic industries that use small capacity chillers, etc. for their production process. Refrigeration systems vary, from large capacity central ammonia plants with water-cooled chillers in the breweries, and the large processing factories, to low capacity chiller units operating with HFCs for small cooling load applications. Growth rate of the sub-sector is presented combined with the Comref in Figure 2.2.

It is noted that the local subsidiaries of multinational companies, such as Unilever and Nestle, have their cooling systems usually decided by their mother companies. It is therefore reasonable to expect that transformation to clean and efficient cooling will be addressed from the headquarters for all subsidiaries to comply with. In any case, the following recommendations will still apply for the Indref generally.

iii. Proposals for improvement

Reducing Direct emission:

- Select natural or low-GWP synthetic refrigerant: ammonia or low-GWP refrigerants (e.g. R1234yf)
- Reduce refrigerant leakage
- Improve maintenance practice by training technicians.

Improving efficiency:

- Select energy efficient Indref technology –and energy-efficient cooling system such as cooling tower or evaporative condenser.
- Insulation – promote good insulation of cold surfaces (pipes, vessels, etc.)
- Improve maintenance practice by training technicians.

2.5 Stationary Air Conditioning, STATAC

i. Current state and projected growth

Comfort air conditioning of indoor work places and residences has become a standard quality of modern lifestyle which has propelled STATAC as a fast growing RAC sub-sector and the one with the highest energy consumption. The sub-sector is dominated by unitary AC of which the single split has the largest market share. In [1], the stock of AC non-ducted units in Ghana was estimated to be 1,328,531 in 2010 and annual sales of 137,492 for the same year. The report further estimates the annual growth factors in percentage for the units to be 4.42 % in 2016 – 2030 and decline to 2.21% in 2031 – 2050. Inverter single split unit is now available in country today and though its first cost is higher than the fixed speed version, they are becoming increasingly popular for the low running cost.

R-410A and R-22 refrigerants dominate the units on the market. R-22 units continue to be patronized because they are cheaper both in the cost of the units and the gas compared to R-410A. The stock of R-22 split unit ACs in the country is very high. This was confirmed by a survey conducted on 106 units over the country this year of which 68% were found to be R-22 units and the remainder R-410A units [5]. Under the implementation of the HPMP, over 10,000 existing R-22 single split units have been converted to R-290. New R-290 fixed speed units have also been introduced on the local market through a collaboration between EPA and GIZ and this is expected to grow in the years ahead.

The multi-split system, Variable Refrigerant Volume (VRV), has become popular for small to complex buildings due to its centralized outdoor location and the energy efficient inverter technology. This has severely reduced the popularity of chiller AC systems that used to dominate medium to large commercial buildings in the past. Chiller AC system is perceived to be complex in design, operation and maintenance among most local AC practitioners.

Shown in Figure 2.4 is the projected growth of STATAC. In a BAU scenario, this will increase total GHG emission.

ii. Proposals for improvement

Reducing Direct emission:

- Refrigerant - select HC refrigerant split units, select low GWP refrigerant (R1234yf, etc.) chillers for the large AC systems.
- Reduce refrigerant leakage by following approved installation procedure.
- Improve maintenance practice by training technicians.

Improving efficiency:

- Design new buildings with reduced cooling loads - utilize cool roof technology, shading and using low U- value materials.
- Select energy efficient cooling technology – inverter split units with HC refrigerant for small load and low GWP refrigerant (R1234yf, etc.) chillers for the large AC systems.
- Reduce losses in standby or off loads.
- All public buildings must operate at a mandatory minimum (coldest) temperature of 24ºC.
- Minimize outdoor air infiltration by installing air curtains at doorways.
- Improve maintenance practice by training technician.

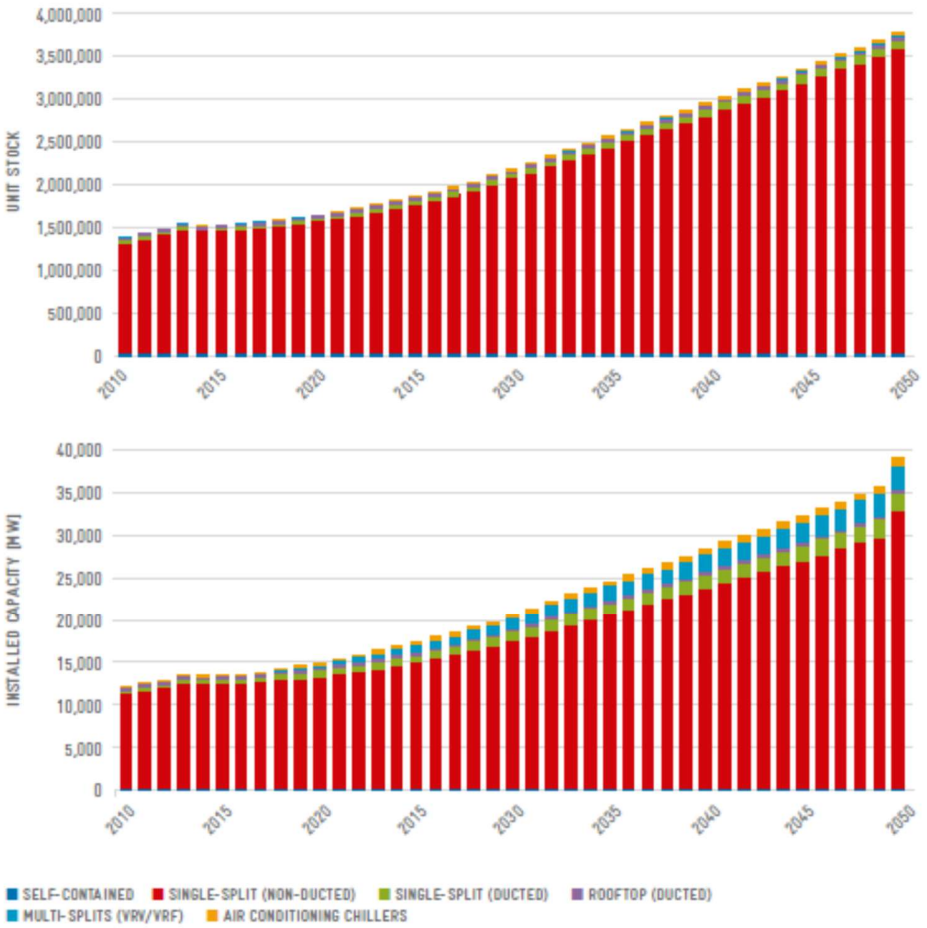

Figure 2.4: Projected growth of STATAC stock [1]

2.6 Mobile AC, MAC

i. Current state and projected growth

The MAC sector is a rapidly growing sub-sector. Vehicle population is reported by the DVLA (Driver, Vehicle and Licensing Authority, Ghana) the vehicle per population ratio in Ghana has been growing steadily from about 50 vehicles per 1,000 population in 2010, to about 70 vehicles per 1,000 population in 2015 which is also an indication of how the MAC sector is growing in the country though many of the cars do not have functioning ACs. It is reported in Vehicle Population in Ghana and Regional Statistic, [4] the total number of registered vehicles population in Ghana in 2015 stood at approximately 1,952,564.

The dominant refrigerant in the sector is R-134a though a few new saloon cars imported into the country lately are fitted with R-1234yf MACs which today is several times more expensive than R-134a. MACs ply on the same poor road conditions as Transref and leakage rate is unusually very high.

ii. Proposals for improvement

Reducing Direct emission:

- Refrigerant – Use of R-1234yf (HC may be a future option if flammability concern for mobile use is addressed).
- Reduce refrigerant leakage by ensuring system is adequately tightened up.
- Improve maintenance practice by training technicians.

Improving efficiency:

- Use window shades to reduce direct solar loads.
- Operate AC fans at low speeds.
- Check frequently for refrigerant loss (under-charged).
- Improve maintenance practice by training technician.

2.7 Marine sub-sector

i. Current state and projected growth

The cooling system in the local marine sub-sector is limited to fishing activity after the collapse of the national Black Star Line which was a major backbone for the nation's maritime sector. The fishing sector too has seen the collapse of many Ghanaian-owned companies that used to own several fishing vessels and were actively engaged in fishing. Today, importation of frozen fish, chicken and other frozen seafoods has become the leading activity in the Tema fishing harbour enclave and only a few Ghanaian-owned fishing companies are actively engaged in fishing

The cooling system in the marine sub-sector comprise of ashore-based ice making plants and refrigeration systems on board the fishing vessels.

a. Ice making facilities

Ashore-based ice making plants serve as a major backbone for catch preservation on board the inshore fishing vessels that lack onboard refrigeration plant. It also serves artisanal canoe fisheries by providing ice to the significant number of canoes that are fitted with insulated ice boxes for undertaking fishing trips lasting several days.

Commercial ice production is capital intensive and unprofitable on a small scale. This is the main challenge in providing ice plants to support artisanal and inshore fisheries scattered along the entire national coastline. As a result, only a few ice making plants serving the fishing communities exist today. These are located in

the Western, Central and Greater Accra regions with the Western region dominating in the quantities. The Volta region has no ice plant serving the fishing community.

Three refrigerants are used in the existing ice plants, namely, R22, R404A and R717, with R22 plants dominating [10].

b. Industrial Fishing Vessels

Industrial fishing vessels have onboard refrigeration system for catch preservation, usually by freezing or keeping in chilled brine. As a result, they are able to stay at sea for longer periods. Three refrigerants used in the onboard refrigeration systems are R22, R502 and R717 (ammonia) with R717 dominating followed by R22.

Besides using refrigerants R22 and R502, which are both earmarked for eventual phase-out under the Montreal Protocol due to their harmful effects on the ozone layer, refrigeration plants on the majority of fishing vessels were found to be old, saddled with breakdown repairs and suffered high refrigerant leakage. There is therefore the urgent need to transform the refrigeration systems in the sector to best available technologies such as ammonia plants to achieve high efficiency and low-GWP sustainable cooling.

ii. Proposals for improvement

Reducing Direct emission:

- Refrigerant – select natural refrigerant systems such as R717 to replace existing synthetic refrigerants systems (natural refrigerant zero GWP).
- Reduce refrigerant leakage by ensuring system is adequately tightened up.
- Improve maintenance practice by training technicians.

Improving efficiency:

- Select energy efficient technology for ice making facilities and cooling plants onboard vessels.
- Insulation – ensure all cold surfaces (pipes, vessels, etc.) are well insulated to check cold leaks.
- Improve maintenance practice by training technician (this shall include good housekeeping and keeping good operating log on plant).

3.0 RAC SECTOR SUPPLY CHAIN

3.1 Training of RAC servicing personnel

Training of RAC technicians in the country falls under three (3) categories: formal, semi-formal and informal. Under the Formal system, training is done under two levels, namely, Technical Institute level and the University level. At the Technical Institute, training is run for three years leading to the award of Mechanics of Refrigeration and Air Conditioning Certificate. At the Technical Universities (formerly Polytechnics), training is run for three years leading to the award of a Higher National Diploma (HND).

Semi-Formal training is apprenticeship training of formally educated students, in the RAC sector, by companies/ workshops. A Certificate of apprenticeship is provided on successful completion of the training.

Informal apprenticeship training involves training of persons that do not possess any formal training in the RAC sector. They pursue apprenticeship for as many years as possible and do pass out when they have acquired sufficient knowledge to be able to work on their own as RAC technicians.

There is currently no Certification program for RAC technicians in Ghana. The EPA (NOU) is however working closely with the Council for Technical and Vocational Educational Training (COTVET) with funding under the HPMP programs to establish one. Training and certification of RAC service staff is crucial to improve their practice and contribute to reduce RAC GHG emissions by preventing or minimizing refrigerant leakage from equipment.

Since the beginning of the Montreal Protocol campaign, the EPA has been actively organizing training workshops for RAC technicians under the umbrella of NARWOA to keep the members actively abreast with the issues involved and the technological trends in the RAC industry. Presently, under the HPMP implementation, the EPA has been organizing training for the technicians on hydrocarbon technology and involved them on Refrigerant Recovery Recycling Projects (RRRP).

3.2 RAC associations

There are two RAC associations in the country, NARWOA and RAAG. NARWOA was formed in 1988 to organize the RAC practitioners to serve as the vehicle to seek the support of the government and its international development partners to receive training and stay abreast with the RAC technological trends evolving from the Montreal Protocol. It has a membership of over 5,000 and has a branch in all the regions of the country.
RAAG was formed a couple of years ago with the aim to give voice to the RAC industry and ensure professionalism in RAC practice in the country. One of its key objectives is to cooperate with the government to halt import of fake and second hand RAC equipment and parts into the country.

3.3 Equipment and refrigerant suppliers

There are over fourteen firmly established companies that import RAC equipment into the country. Domref and StatAC have the largest number of dealers among the lot. One company dominates the Comref activity and supplies condensing units and in-situ PUR foam for cold store construction. Apart from the less-patronized efforts by Atlantic Climate to install Thermoking cooling units on vans in the country, there is no firmly established company that supplies Transref vehicles into the country. The three main users of Transref earlier mentioned organize their own purchases from overseas suppliers. A few of the fourteen RAC companies supply process chillers for Indref but the RAC equipment and parts needed by the multinational companies are usually organized from their overseas head office.

MACs arrive into the country pre-installed in vehicles and apart from servicing workshops, there is no established importer of new MAC equipment and parts.

3.4 Waste management

Even though e-waste (electronic waste) companies existed there was no association linking them together. In order to link their activities; the E-waste Round Table Association was formed in 2019. The E-waste management companies are involved with the collection and reuse or recycling of e-waste parts. The e-waste includes Television, AC's, Fridges, Phones etc.

Some of the key companies that deal in waste from the RAC sector are Nelplast Ghana Ltd, Polytex Ltd, City Waste Management Limited, Zoom Lion Ghana Limited, Foundries, Tema Steel, Rider Steel and Ferro Fabrics. They recycle the plastic and metal components of old AC units for products such as plastic pavement blocks, iron rods etc.

Banned refrigerants is the major waste component of the RAC sector that is currently very difficult to manage since there is no refrigerant destruction/disposal plant in the country. Banned refrigerants once recovered is canned and stored. When financing is made available, it is transported outside the country for incineration. The National Ozone Unit, under the Environmental protection agency, is currently pushing for such a plant to be built in the country.

3.5 Finance

Some financial Institutions (FI's) currently have mechanisms for their customers to purchase e-products (electronic products). The FI's prefer to work with their customers so they minimize the risk of non-payment. The products include split AC's and fridges. Ecobank and Fidelity Bank are the two that run such e-product promotions for their customers. Their e-product promotion is however not linked to energy efficiency. Thus, banks will have to be educated and supported to link energy efficiency to their e-product promotions.
Most banks are also open to efficient energy projects in terms of fund management and administration.
Thus, any National Cooling Plan project that will promote the purchase of ACs and fridges is likely to win the support of the Banks in the country.

4.0 ELECTRICITY SECTOR OVERVIEW

4.1 Stakeholders in electricity sector

The electricity sector in Ghana can be grouped under five headings; Policy and Regulatory, Generation, Transmission, Distribution institutions and Consumers as shown in Figure 4.1. Whereas the Ministry of Energy provides policy directions to drive the sector, Energy Commission and the Public Utilities Regulatory Commission provide technical and economic regulations to the sector respectively. Ghana Grid Company is responsible for the National Interconnected Transmission System (NITS) and transmits electricity from generation facilities managed by Volta River Authority and other Independent Power Producers (IPP) from distribution to consumers through the Electricity Company of Ghana (ECG), Northern Electricity Distribution Company (NEDCo).

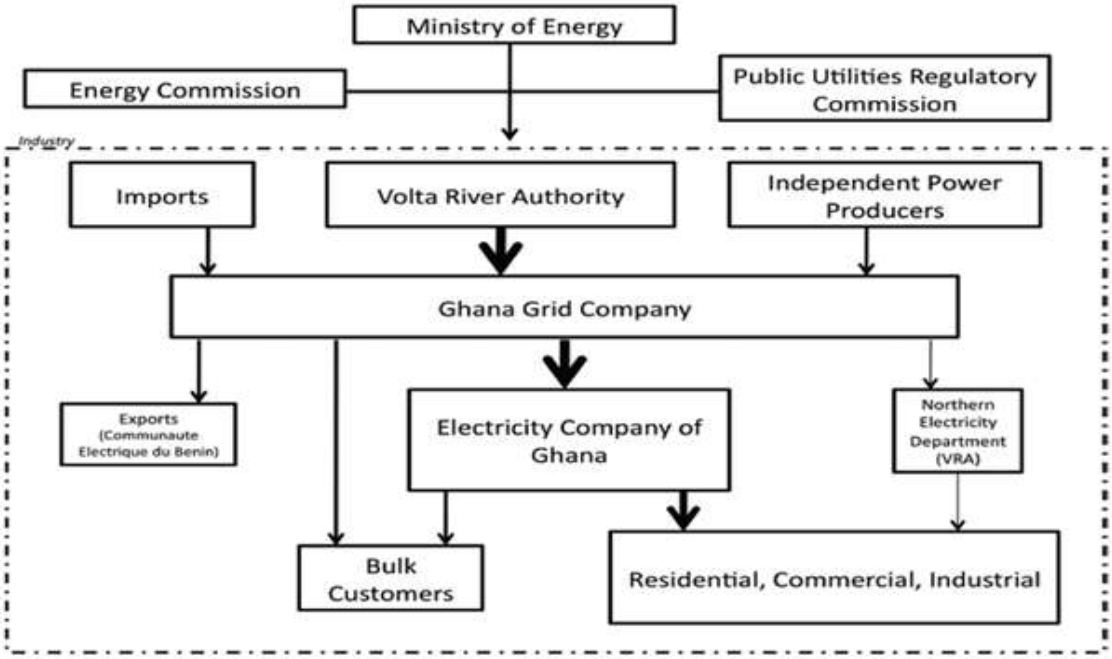

Figure 4.1: Stakeholders in Ghana's Electricity Sector

4.2 Installed generation capacity and emission profile

Ghana's peak electricity demand has doubled over the last decade from 1,423 MW in 2009 to 2,525 MW in 2018 (Energy Commission, 2019). However, during the same period, the installed generation capacity has increased by 250 %, from 1,970 MW in 2009 to 4,889 MW in 2018 (Energy Commission, 2019) [6].
The country is currently experiencing an over capacity with installed generation capacity almost two times the peak power demand as at the end of 2018, as shown in Figure 4.2. This is adversely affecting the energy sector, since capacity charges are being incurred for the power plants that are not producing as a result of the low peak demand.

As Ghana has hydropower generation, carbon intensity of generation was pegged at 0.39 kg/kWh in 2017 which was less than the global average [1]. The carbon intensity will be higher today due to additional thermal power stations coming into stream.

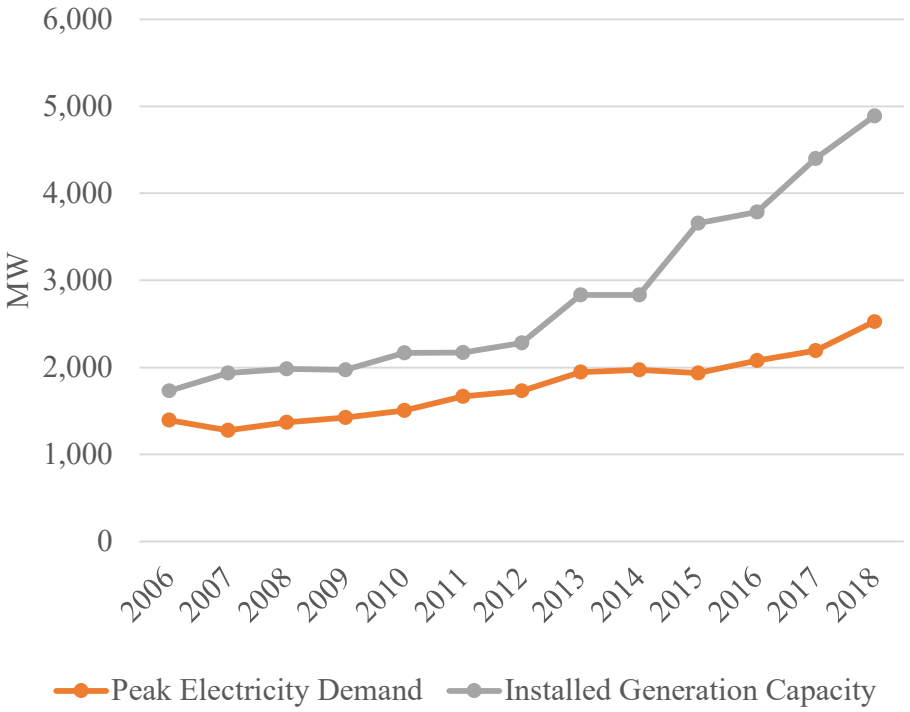

Figure 4.2: Peak demand and installed generation capacity

4.3 Energy demand and supply

Ghana's electricity access rate stood at 84.3 % as at December 2018 (Figure 4.3), a 22 % increase from the 2009 rate of 62 % (Energy Commission, 2019) [6]. All urban areas had access to electricity and 67 % of rural areas had access to electricity as of the end of the December 2019. The Government of Ghana is working towards achieving universal access to electricity by the year 2020.

The supply of electricity in Ghana has been from three main sources; thermal, hydro and renewable. The electricity generation mix stood at 62.75 % -Thermal, 37.04 % - Hydro and 0.21 % - Renewable as at the end of 2018 (Energy Commission, 2019) [7].

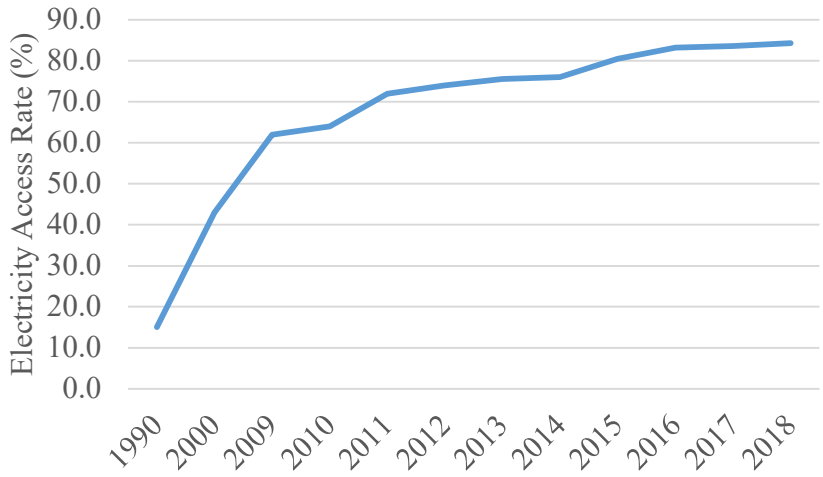

Figure 4.3: Ghana's Electricity access rate

4.4 Electricity regulations

The electricity sector in Ghana is regulated by the Energy Commission (EC) and the Public Utilities Regulatory Commission (PURC). The EC's main objective is to regulate and manage the utilization of energy resources in Ghana and to coordinate all policies related to these. The commission is responsible for granting licenses to public utilities for the transmission, wholesale supply, distribution and sale of electricity in Ghana.

4.5 Existing national plans and targets

The Strategic National Energy Plan (SNEP), developed by the Energy Commission in 2006, has been the main national plan for the energy sector with targets to be achieved by the year 2020. The plan addresses issues that cut across the entire energy sector including renewable energy and energy efficiency. Others include the Ghana National Climate Change Policy and Ghana National Climate Adaptation Strategy.

4.6 Energy efficiency regulation

The Energy Commission, as the energy regulator, is responsible for developing regulation, planning and setting policy procedures that address energy issues in the country. The commission is therefore the starting point for developing and enforcing legislation to enhance energy efficiency in the country.
The Energy Foundation is another agency responsible for energy efficiency matters in Ghana. It is a public–private partnership institution established to promote sustainable development of energy resources and efficient consumption of energy in all of its forms. Its main responsibilities include educating consumers about the rights and responsibilities of consumers on energy conservation and the benefits of energy efficiency. The Energy Foundation has done this through public education campaigns, educational programmes and seminars.
The Energy Commission of Ghana, the Ghana Standards Authority together with the Customs Division of the Ghana Revenue Authority are responsible for the enforcement of energy efficiency standards in Ghana.

The Energy Efficiency Regulation 2008 (LI 1932), introduced as part of the campaign to flush out inefficient appliances from the market, prohibits the importation and sale of used air conditioners, used refrigerators, used freezers and used combination refrigerator / freezer, among other products. At the time of the introduction of the LI, these used RAC appliances were estimated to be causing about 30 % loss in electricity consumption. Used fridges, used freezers, etc. imported into the country were invariably appliances operating with CFC gases that had been discarded in the developed countries where consumption of the ODS had already been phased-out. The ban, therefore, does not only contribute to saving the environment by reduced carbon emission and eliminating additional introduction of CFC-based products into the country but also saves energy.

4.7 Existing energy efficiency/consumption reduction targets for the RAC sector

The Energy Efficiency Standard and Labels for Room Air Conditioners, introduced in 2005, is the first attempt by the Energy Commission and partners to introduce energy efficiency programme in the country's RAC sector.
This initiative, which was expected to save about 950 GWh of energy per year by 2020, ensures that AC equipment need to have a minimum Energy Efficiency Ratio (EER) of 2.8 (Watt of cooling per Watt of electricity input) (Energy Commission, 2006) [9].

The Energy Commission implemented another programme to replace old inefficient refrigerators with more efficient ones. In 2012 when the programme was launched, it was estimated that the removal of 50,000 inefficient refrigerators over a 3-year-programme had the potential to save the country up to 27,000 MWh per year. The project is reported to have saved 400 GWh of electricity, 1.1 million tonnes of carbon dioxide equivalent and recovered 1500 kg of CFC gas.

A major cause of concern for MEPS in the country is that it has not been revised since was it created 14 years ago. Good international practice is that countries review their mandatory Standards and Labels rating 2 years on the average. The review of the Star ratings ensures a country gets up to speed with improvement of its AC units per technological improvements across the globe. The study carried out on 106 split non-ducted units in the country showed that majority of the units had their EER very close to the minimum star rating of 2.8 even though higher EER energy efficient units are available on the market today. Review of the MEPS under the NCP will be a crucial driving force to transition the RAC Sector to best available technologies.

5.0 MANAGEMENT OF THE NATIONAL COOLING PLAN

5.1 Introduction

A proper management setup will be necessary for effective implementation of the NCP. It is proposed to form a management committee to be known as National Cooling Plan Committee, NCPC, to manage the NCP implementation. Members of the NCPC will be carved out of NACOD which is an existing advisory body to the NOU/EPA on all ODS related matters and related policy requirements, legislation, and programmes of action, etc. Most of the key stakeholders relevant to the NCP are members of NACOD and will possess the expertise and experience to push the NCP agenda. Other stakeholders whose expertise will be deemed necessary for the NCP agenda but are not members of NACOD will be co-opted into the NCPC.
It is proposed the following NCP structure:

- The NCPC will be headed by an Executive Committee, ExCom, which will report directly to the EPA/NOU.
- ExCom will be supported by four Working Groups, whose members shall all be members of the NCPC.
- NCP Working Group responsibilities: Group 1 – Finance and Legal; Group 2 - Capacity building, Research and Development (R&D; Group 3 - MEPS, Monitoring, Verification and Enforcement, Regional Collaboration; Group 4 – Outreach, Communication and End-Users.
- The ExCom and each working group will have a chair person, secretary and organizer and other members appointed by the NOU/EPA
- The core mandate of the Working Group is to ensure that NCP projects are implemented, reviewed and updated from time to time.

Each grouping would comprise of representatives from the government, public agencies, the private sector, Industry Associations and NGOs, and Academic / Training Institutions. Proposed Implementation Structure is shown in Figure 5.1

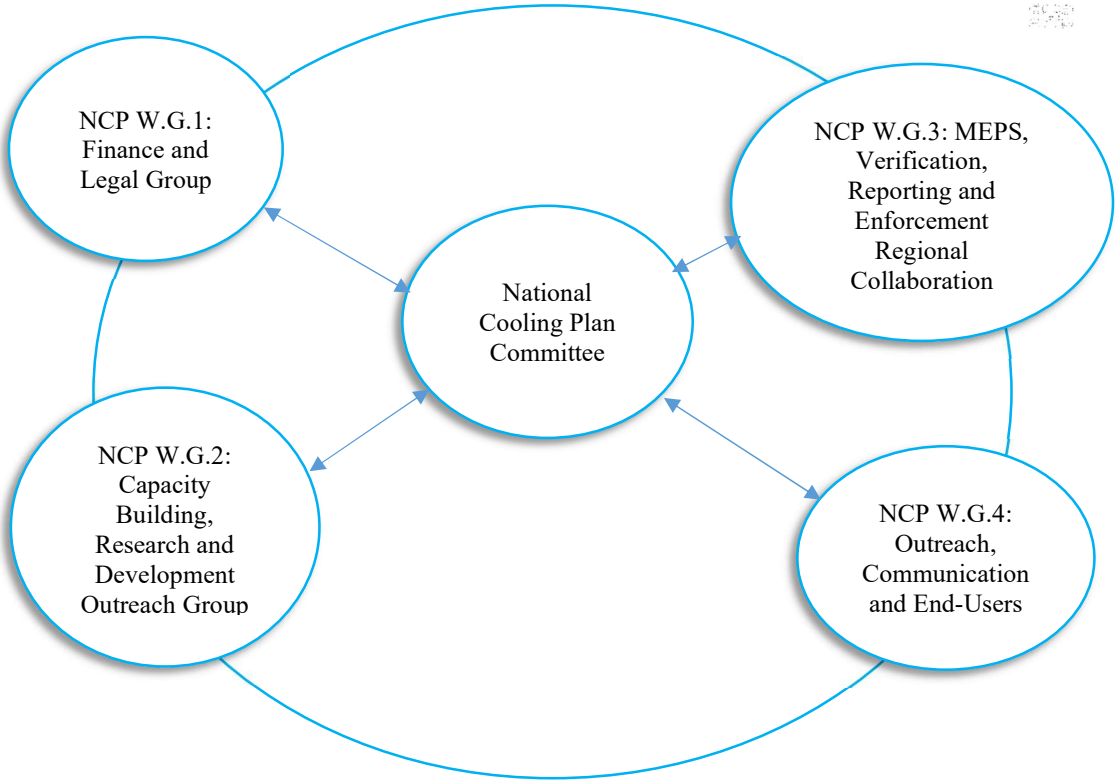

Figure 5.1: NCP Proposed Implementation Structure

5.2 Meetings of the NCPC and the four working groups

It is proposed following meeting schedules which may also be revised by the NCPC in consultation with the NOU-EPA members and the EPA as may be deemed to be necessary:

- ExCom will meet semi-annually to oversee the progress of works of the 4 Working Groups.
- The four working groups will meet quarterly to review their mandatory scope of works and verify whether they are on track or not.
- A quarterly report will be submitted by each of the four working groups to the ExCom for review.

Table 5.1 shows the proposed implementation structure with roles and responsibilities by key institutions.

Table 5.1: NCP Proposed Implementation Structure with their roles and responsibilities

ExCom & Working Group	Composition	Roles and Responsibilities
Executive Committee	Members from the Four working groups	• Overseeing the works and progress of works of the four working groups
Working Group 1 – Finance and Legal	MOF, EC, EPA, MOF, Importers, Banks, Parliament, Attorney General Office, GIZ, UNDP	• Assessment of funding and financial mechanisms for the market transformation • Overseeing all legal sections of the NCP
Working Group 2 - Capacity Building, Research and Development	Academics, Media, Technicians and Engineers, GHIE, GIA, GREDA, Green Building Council, Energy Foundation, ECG, NEDCo, Ministry of Agriculture, Meteorological Agency, CSIR, MiDA, MESTIS, GIZ, Ministry of Fisheries and aquaculture/ Fisheries Commission	• Capacity development and training, and thus would be involved in the development of curricula and amendments to the Occupational Standards used for training RAC technicians.
Working Group 3 MEPS, Monitoring, Verification and Enforcement (MVE) Reporting and Regional Collaboration work	GSA, GRA-Customs Division, NOU, EC, Security Agencies, Shippers Authority, Ministry of Works and Housing, Ministry of Trade and Industry, Ministry of Fisheries and aquaculture/ Fisheries Commission	• Development of the minimum energy performance standards and their respective system for labelling. • Market monitoring, verification and enforcement activities, and the assessment of EE RAC technologies.
Working Group 4 - Outreach and Communication and End- Users	Media, EPA/NOU, EC	• Outreach and communications at the local and regional level.

6.0 NATIONAL COOLING PLAN PROJECTS

The national cooling plan proposes projects that will be implemented to ensure the realization of the objectives under the plan. Key existing or newly proposed projects that are central to the NCP will also be brought onboard the NCP projects. Projects under the NCP will be organized under the following eight (8) thematic headings:

- Assessment of RAC EE Technologies
- Establishment of MEPS and Labelling Systems
- Training and Capacity Building
- Assessment of Funding and Financial Mechanisms for Market Transformation
- Market Monitoring, Verifications and Enforcement
- Outreach and Communication
- Opportunities of Regional Collaboration
- Waste Management

6.1 Assessment of RAC EE technologies

It is important to identify the availability of RAC energy efficient technologies and future market trends combining low-GWP refrigerants and efficient performance and to assess their benefits and barriers. This will help to develop actions to drive the adoption and to facilitate the penetration of energy efficient and sustainable technologies (R&D, market introduction incentives).
The objectives of this project are: establishment of an inventory of current and available energy efficient and sustainable cooling technologies; formulate recommendations for diffusion of low-GWP and energy efficient technology-based equipment and assess the opportunities to reduce cooling needs (e.g. shading, natural ventilation, coatings, and dress codes), right-sizing of equipment, proper installation and maintenance considerations.

Key Existing Projects:

1. Efficient Air– Conditioning Programme in Ghana (KCEP), 2018
2. Ghana's Greenhouse Gas Inventory and Technology Gap Analysis for the Refrigeration and Air Conditioning Sector, 2017
3. Simplified Procedure for Estimating AC Cooling Load in Ghana (Sizing of Equipment), 2010
4. Race to Retrofit and Renewable Program (MiDA), 2018-2020

New Projects:

1. Using Solar AC with DC power as alternative way of cooling in building
2. Using Desiccant cooling systems in ACs to attain energy efficiency
3. Design of pack houses for perishable produce including off-grid/renewable pack houses
4. Design of centralized Ice production for coastal fishing communities

Table 6.1: Summary of New RAC EE Technology Project

Item	Project Area: Assessment of Refrigeration and Air Conditioning Energy Efficiency Technologies	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Using Solar AC with DC power as alternative way of cooling in building	CSRI		X	X	X		18,000
A.2	Using desiccant cooling systems in ACs to attain energy efficiency	KNUST		X	X	X	X	40,000
A.3	Design of pack houses for perishable produce including off-grid/renewable pack houses	KNUST			X	X	X	55,000
A.4	Design of centralized Ice production for coastal fishing communities	Accra/ Takoradi Technical Universities			X	X	X	45,000
	Total							158,000.00

6.2 Establishment of MEPS and labelling system

The objectives of this project are; reviewing regulatory mechanisms in the country and internationally, including minimum energy performance standards (MEPS); define the RAC applications that will be targeted by MEPs in the country; and design the MEPs for the chosen applications in line with international best practices.

Minimum Energy Performance Standard, MEPS, are an effective regulatory instrument to drive the increase of product efficiencies. They are very effective policy measures, especially for small RAC appliances, such as refrigerators and air conditioners.

Energy labelling of products and MEPs are important parts of an energy efficiency program. Several countries have implemented energy labelling systems for domestic refrigerators and air conditioner units. One of the challenges of energy labelling is the testing and verification process to ensure that the stated levels are true and have been verified.
To support the establishment of MEPS, MiDA is building a testing laboratory for GSA to carry out their work more effectively and efficiently. This testing laboratory will be used to test both RAC systems as well as electrical and electronic appliances.

The proposed priority matrix for MEPS and Labels is shown in Table 6.3. This provides guidance on critical RAC sectors which need attention based on the 5-year lifespan of the National Cooling Plan.

Key Existing Projects
1. Air Conditioning Testing Facility by Millennium Development Authority (MiDA)

New Projects

1. Development of an LI on MEPS for VRV's, AC Chillers and Split Ducted Units, frozen cold stores
2. Reviewing of Ghana Building Code to include Certification of Building that are energy efficient and use low-GWP refrigerants such as LEEDS or EDGE Certification
3. Building of an AC Testing Facility for VRV's, AC Chillers and Split Ducted Units
4. Reviewing of MEPS every five years for Split non ducted, VRV's, AC Chillers and Split ducted units
5. Development of an LI on Labels for VRV's, Chillers and Split Ducted Unit

Table 6.2: Summary of New MEPS and Labelling Systems project

Item	Project Area: Establishment of Minimum Energy Performance Standards (MEPS) and Labelling Systems	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Development of an LI on MEPS for VRV's, Chillers and Split Ducted Units	EC, GSA	X	X	X	X	X	500,000.00
A.2	Development of an LI on MEPS for frozen cold stores	EC, GSA			X	X	X	500,000.00
A.3	Reviewing of Ghana Building Code to include Certification of Building that are energy efficient and use low-GWP refrigerants such as LEED or EDGE Certification	MWRWH, NA DMO, CSIR					X	50,000.00
A.4	Building of an AC Testing Facility for VRV's, Chillers and Split Ducted Units	GSA, EC, MiDA	X	X	X	X	X	10,000,000.00
A.5	Reviewing of MEPS every five years for Split non ducted, VRV's, Chillers and Split ducted units	EC, GSA	X					50,000.00
A.6	Establishing a 10 ton per day ammonia ice making facility in the Volta region, as a start up	Ministry of Fisheries and aquaculture/ Fisheries Commission, EPA-NOU, EC, UNDP		X	X	X	X	174,000
Total								11,274,000

Table 6.3: Proposed priority matrix for MEPS and Labelling Systems

PRIORITY MATRIX FOR MEPS & LABELS					
SECTOR	**YEAR**				
	2021	**2022**	**2023**	**2024**	**2025**
AIR CONDITIONING					
Unitary air conditioning (Stationary AC)					
i. Single split (ducted)					
ii. Multi-split (VRV/VRF)					
Air conditioning Chillers (Stationary AC)					
i. AC Chillers					
REFRIGERATION					
Commercial/industrial refrigerator					
i. Stand-alone equipment (e.g. display units, package units)					
ii. Condensing units					
iii. Centralized systems (e.g. cold stores, supermarkets)					
iv. Process chillers					

Note:

Plaining Stage

Completing Stage

6.4 Training and capacity building

In order to strengthen the coordination between the NOU and energy groups to provide the needed conditions to integrate EE in future HFC phasedown management plans, activities for building institutional capacity and training are essential. They can include activities related to the design and implementation of MEPS and labels, involving the data collection, labelling, monitoring, and verification and enforcement activities.
In the servicing sector, EE technologies based on the use of low-GWP refrigerants requires capacity building and training actions to address the specific issues related to installation, operation and maintenance of low-GWP refrigerant based equipment, in addition to safety aspects related to the use of flammable refrigerants.
The main characteristics of the low-GWP refrigerants that will drive the actions for capacity building and technician training are: flammability; toxicity; higher pressure and blends with temperature glide.
The objectives of this project are to develop capacity building and training for: ozone and energy policy makers; refrigerator and air conditioner small and medium-sized enterprises and the service sector.

Key Existing Project

1. HPMP Sage I training for Technicians and Custom officers.
2. MiDA Sustainable Energy training programme for Professionals, Engineers and Technicians.

New Projects

1. Training for Technicians (RAC sector); Domestic Ref. and Split AC's and others like VRV's, Chillers and Split ducted units.

2. Assessment of Training Schools in the RAC Sector to ensure NCP is inculcated in their curricula
3. Design of Certification Program for RAC Professional at different levels
4. Training for Architects, Mechanical and Electrical Engineers to include the use of low GWP refrigerants in their design
5. Training for Media Houses on climate change related issues
6. Energy Modelling and Simulation Training for Built Environment professionals

Table 6.4: Summary of Research, Capacity building and Training projects

Item	Project Area: Research, Capacity Building and Training	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Training for Technicians (NARWOA); Domestic Ref. and Split AC's and others like VRV's, Chillers and Split ducted units	EPA	X	X	X	X	X	1,000,000.00
A.2	Needs Assessment of Training Schools in the RAC Sector to ensure NCP is inculcated in their curricula	UNDA, EPA, EC	X	X	X			500,000.00
A.3	Design of Certification Program for RAC Professional at different levels	EPA, EC	X	X	X			200,000.00
A.4	Training for Architects, Mechanical and Electrical Engineers to include the use of low GWP refrigerants in their design (e.g. chillers)	UNDA, EPA, EC	X	X	X	X	X	500,000.00
A.5	Training for Media Houses on climate change related issues	EPA, EC	X	X	X	X	X	300,000.00
A.6	Energy Modelling and Building Simulation training for Built Environment professionals	EPA, EC	X	X	X	X	X	200,000.00
A.7	Workshops to engage stakeholders and ice making facilities owners on the need to replace existing HCFCs refrigeration systems to ammonia refrigeration systems.	Min. of Fisheries, EPA-NOU, EC, UNDP	X			X		20,000.00
A.8	Formation of Ice Producers Association to champion the needs and progress of their facilities	Min. of Fisheries, EPA-NOU, EC, UNDP	X	X	X	X	X	20,000.00
A.9	Workshops to engage industrial vessels associations on the need to change all HCFCs refrigeration systems to environmentally friendly ones such as ammonia	Min. of Fisheries, EPA-NOU, EC, UNDP	X		X		X	30,000.00
A.10	Establishment of data base for ice making facilities	Min. of Fisheries, EPA-NOU, EC, UNDP	X	X				100,000.00
	Total							2,870,000.00

6.5 Assessment of funding and financial mechanisms for market transformation

To support market competitiveness of alternative systems it is important for the NCP finance working group to assess existing funding and financial mechanisms and to develop and implement new measures for funding and financial support.
This includes funding and financing schemes to bridge higher upfront costs of alternative systems with lower operating costs due to energy savings. Global funding, resources and guidance to be assessed include GIZ, K-CEP, GEF, GCF, etc.
The objectives under this project are: assessment of existing financial mechanism(s) to help incentivize the market introduction and deployment of high-performance products; development of specific financial mechanisms and actions for a comprehensive market transformation program, and how it can be funded

Key Existing/Past Project
1. Rebate scheme for retrofitting Fridges, 2011 - 2015
2. Kigali First Movers Project (Air Conditioning Rebate Scheme)
3. ECOFRIDGES Project (Green on Wage financing)

KFM Project
KFM seeks to effectively and sustainably provide a financing mechanism in the cooling sector to support the project countries (Indonesia, Costa Rica, Ghana) in achieving mitigation efforts that also contributing to their National Determined Contribution (NDC) under the United Nation Framework Convention on Climate Change (UNFCCC). The project is targeting pushing low- GWP and energy efficient split non-ducted units to the Ghanaian Market. The fund allocated for the KFM project is $6 million USD dollars. The KFM project is currently at the preliminary stages involving stakeholder engagement.

ECOFRIDGE Project
Key components of the Project include a new financial mechanism under development by the Basel Agency for Sustainable Energy with anticipated financing by the African Development Bank that will make it more affordable for households to replace old and inefficient split AC's and Refrigerators for those that are energy efficient and use low-GWP refrigerants. The fund allocated for the ECOFRIDGE project is $13 million USD dollars.

New Projects:
1. Retrofitting of R22 Condensing Units, in cold stores, with low-GWP and energy efficient refrigerants as a demonstration project.

Table 6.5: Summary of New Funding and Financial mechanisms for market projects

Item	Project Area: Assessment of Funding and Financial Mechanisms for Market Transformation	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Retrofitting of R-22 Condensing Units, in cold stores, with low-GWP refrigerants as a demonstration project	GIZ, EPA, EC	X	X	X	X		80,000.00
	Total							80,000.00

6.6 Market monitoring, verification, enforcement and reporting

It is fundamental for the success of an NCP to develop a data collection and analysis capacity to include information needed to incorporate EE into HCFC phase-out and HFC phase-down planning, and support program evaluation and monitoring. These activities will also help to assess opportunities, identify mechanisms, inform prioritization of sectors and interventions, and develop strategies and roadmaps.

The objectives under this project are: data collection and analysis; definition of national testing and certification procedures, training inspectors, monitoring proper labelling, and coordination on enforcement; input into Nationally Determined Contributions and input for reporting into Sustainable Development Goals (SDGs) progress**.**

Key Existing Project

1. Energy Efficient Database and Application (APP) (Inventory/Data collection on Energy Efficiency of RAC appliances), 2017

New Projects

1. Equipping Customs officers with HC refrigerant identifier kits (30 no.)
2. Equipping NOU/EC with Energy Meters for verification of energy consumption (10 no., 3 Phase and 10no., 1 Phase)
3. Calculation and Verification of Baseline and Project Emissions with GEF Methodology by an External Consultant

Table 6.6: Summary of Market monitoring, verification and enforcement project

Item	Project Area: Market Monitoring, Verification and Enforcement	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Equipping Customs officers with HC refrigerant Identifier Kits	EPA, EC, GSA	X		X		X	225,000.00
A.2	Equipping NOU/EC with Energy Meters for verification energy consumption of appliances	EPA, EC, GSA		X	X	X	X	150,000.00
A.3	Calculation and Verification of Baseline and Project Emissions with GEF Methodology by an External Consultant	EPA, EC, UNDP		X				100,000.00
	Total							475,000.00

6.7 Outreach and communications and end-users

The success of the NCP is directly related to the communication of its goals and projects to the targeted communities, involving public communications campaigns directly to servicing companies, and consumers. The objectives for this project are: preparing industry, retailers and servicing for compliance (MEPs, labelling, EE targets etc. and development of campaigns to educate the public on the labels.

New Projects

1. Project Documentary on the NCP
2. Project public campaigns through TV and Radio talk shows and write-ups on the NCP in the Print Media

Table 6.7: Summary of New Outreach and communications projects

Item	Project Area: Outreach and Communications	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Project Documentary on the NCP	EPA, EC, Media	X	X				100,000.00
A.2	Project public campaigns through TV and Radio talk shows and write-ups on the NCP in the Print Media	EPA, EC, Media	X	X	X	X	X	400,000.00
	Total							500,000.00

6.8 Opportunities for regional collaboration

Harmonizing MEPS among countries with similar usage and energy cost conditions across the same product categories can help with verification and compliance.
Harmonized measurement standards facilitate the work of market surveillance authorities because only one test is required and used across different markets, hence avoiding test duplication. It increases the comparability of products among regions and the transparency of the market.
The objectives for this section are: assess regional engagement opportunities; development of a system enabling to work with neighboring countries on data sharing, mutual recognition of product testing results, market monitoring, training.

Key Existing Projects

As a country some opportunities have been harnessed in terms of regional collaboration through the following initiatives:

1. West Africa Energy Cooling Initiative
2. West Clean Energy Eco-fridge Project
3. ECOWAS Center for Renewable and Energy Efficiency (ECREE) project initiated by ECOWAS

All these initiatives are to bring regional countries together to work on common goal towards energy efficiency and related green environment projects.

New Project

1. Project to Harmonise MEPS in the RAC Sector across West Africa

Table 6.8: Summary of Opportunities for regional collaboration

Item	Project Area: Opportunities for regional collaboration	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Project to Harmonise MEPS in the RAC Sector Across West Africa	EPA, EC, UNDP		X				1,000,000.00
	Total							1,000,000.00

6.9 Waste management

For the NCP to be effective and efficient, the waste management part of the project must also be looked at. The management of waste is very essential, since it would look at how the waste refrigerant and inefficient RAC appliances can be managed to avoid the depletion of the ozone layer and degradation of the environment. Thus, the NCP needs to consider these projects as stated below.

Key Existing Project: Nil

New Projects
1. Refrigerant Destruction Plant
2. Collection and Transportation of inefficient RAC appliances and waste refrigerant to waste plant

Table 6.9: Summary of Waste management projects

Item	Project Area: Market Monitoring, Verification and Enforcement	Implementing Body/Parties	Project Duration					Cost, $
			2021	2022	2023	2024	2025	
A	Planned/ Proposed Projects							
A.1	Refrigerant Destruction Plant	EPA, EC, GSA, MiDA			X	X		800,000.00
A.2	Collection and Transportation of inefficient RAC appliances and waste refrigerant to waste plant	EPA, EC	X	X	X	X	X	200,000.00
	Total							1,000,000.00

6.10 National cooling plan projects budget

Table 6.10: Estimated Budget for the National Cooling Plan Projects

NCP Project	
RAC EE Technology Project	158,000.00
Establishment of MEPS and Labelling System projects	11,274,000.00
Research, Capacity building and Training projects	2,870,000.00
Funding and Financial Mechanisms for Market projects	80,000.00
Market Monitoring, Verification and Enforcement project	475,000.00
New Outreach and communications Projects	500,000.00
Opportunities for Regional Collaboration	1,000,000.00
Waste Management Projects	1,000,000.00
Sub Total 1	**17,357,000.00**
Contingency (10%)	**1,735,700.00**
Grand Total	**19,092,700.00**

7.0 CONCLUSION

The NCP offers the nation a great opportunity to transition the RAC sector to best available clean and energy-efficient technology that will be affordable, sustainable and accessible to all and be in line with the nation's sustainable development goals and commitment to fight climate change. This will assist in the country's development including eliminating postharvest losses to secure food supply to the expanding population and help to drive up the IT revolution in the country.

The DomRef and STATAC sub-sectors hold the greatest potential for the nation to achieve considerable GHG emission reductions through transitioning to energy efficient technologies using low-GWP refrigerants which are available options on the world market today. The technology gap presented in [1] has shown that choosing the right technical options for the RAC sub-sectors can help to achieve significant reduction in future total emission of the sector that will support the fight against climate change.

The main stumbling block to achieving this potential is the relatively high initial cost of the energy efficient technologies using environmentally friendly refrigerants. Hopefully, financial opportunities to support transitioning to clean and efficient cooling technologies are possible as demonstrated in the example of the ECOFRIDGES initiative to retire inefficient fridges and ACs.

The fish stock in the local marine waters has become much depleted from several years of over-fishing and this has created a booming industry in frozen foods importation to the detriment of local production. It is therefore not foreseen any massive growth in onboard refrigeration systems in the local fishing sector in the immediate future. Establishing centralized ice production plants at vantage points along the entire stretch of the national coastline can go a long way to support artisanal fishing which is the major economic activity of the numerous communities spanning the coastline.

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ANNEX

Annex 1: Existing policy framework and controls

The following provides a brief outline of the controls and legislation in Ghana with respect to the RAC sector:

a. *Collaboration with Ghana Customs*

Customs controls entry of goods into the country at all entry points (by sea, air and land). This makes Customs a very strategic partner of the NOU/EPA in the control and management of imports of ODS into the country. To facilitate this role, the NOU frequently organizes training seminars and programmes for Customs officials to acquaint them with the background knowledge and create awareness in the control and monitoring of entry of refrigerants in general at the entry points. In addition, officers of the NOU pay regular visits to the country's border post to sensitize the Customs officials to carry out control and monitoring of ODS entry.

b. *Legal Framework*

Ghana has instituted laws that allow state agencies such as the EPA and Customs to control and regulate certain aspects of import-export trade to protect the public from exposure to harmful substances and products. The following laws relate to the management of ODS consumption in the country:

i. Export and Import Act, 1995 (Act 503).
ii. CUSTOMS ACT (AS AMENDED) 2015, (ACT 891)
iii. Environmental Protection Agency Act, 1994 (Act 490).
iv. Management of Ozone Depleting Substances and Products Regulations, 2005 (LI 1812).
v. Energy Commission - Energy Efficiency Regulation, 2008 (LI 1932).

i. *Export and Import Act, 1995 (Act 503)*

By this Act, the Minister of Trade and Industry is empowered to prohibit or restrict the exportation or importation of any goods such as ODS import management. Although Ghana operates a liberalized foreign trade regime that requires no import licenses, the Act ensure that this trade occurs within certain regulatory boundaries. The high points of this trade regime are the following:

- No license is required to import goods
- Imports for commercial purposes should be covered by an Import Declaration Form, IDF;
- All commercial goods are subject to local inspection to ensure quality, quantity and price and other specifications;
- All commercial goods are to be covered by Final Classification and Validation Report. The Minister may by Regulations exempt goods from Inspection and Final Classification and Valuation Report.
- Importer shall comply with other enactments e.g. Permit, license or certificate.

Another aspect of the Export and Import Act that facilitates the regulation of ODS imports is the requirement that the IDF must be completed and submitted to the appropriate agencies, which include
(a) the Commissioner of Customs
(b) the Inspector to be appointed by the Minister and
(c) any other agency specified on the form.

ii. *CUSTOMS ACT 2015, (ACT 891)*

The CUSTOMS ACT, 2015(ACT 891) acts as an omnibus law on import and export trade and could be used to address regulatory requirements of any of the agencies where such agency lacks adequate legal backing to do so. There are provisions in the Customs Act (As Amended) 2015, (ACT 891) that deal with infringements which may not be specifically covered in the EPA laws or laws of similar regulatory agencies.

Example of such infringement is given under Section 138 “Concealment of goods” which deals with concealment of imported or exported goods in a manner calculated to deceive the officers of customs. For control of ODS import, this law is very relevant for dealing with such offences as false labeling of cylinders carrying banned or controlled refrigerants in order to outwit officers.

iii. *EPA Act, 1994 (Act 490*)

The Environmental Protection Act, 1994 maps the mandate, functions, structure and funding of the EPA. The mandate of the EPA includes formulating environmental policy and making recommendations for the protection of the environment. Among the several functions of the EPA stated under Section 2 are the following that relate to the control of ODS consumption:

- 2(a). Advice the Minister in the formulation of policies on all aspects of the environment and in particular make recommendations for the protection of the environment.
- 2(h). Prescribe standards and guidelines relating to air, water, land and other forms of environmental pollution including the discharge of wastes and the control of toxic substances"

Also, under Section 28 (1), “The Minister may on the advice of the Board by legislative instrument make regulations for the purpose of giving effect to the provisions of this Act”.

iv. Management of ODSs and Products Regulations, 2005 (LI 1812)

The Management of ODSs and Products Regulations, 2005 (LI 1812) was enacted to enable the country to control ODS import in order to meet its obligations under the Montreal Protocol, namely, that of progressive phase-out of the ODS consumption. The Regulations specify the scope of restrictions on imports/exports, permits to be applied for and issued for the import/export of the controlled substances and products and “offences and penalties”.
Controlled products, defined in Schedule I to the Regulations include

- Automobile and truck containing units
- Domestic and commercial RAC equipment when containing controlled substances as a refrigerant or insulating material of the product.
- Insulation boards, panels and pipe covers

Controlled substances defined in Schedule II to the Regulations include all the substances now controlled under the Montreal Protocol, including HCFCs.

Other provisions under the regulations include “Register of Permits” whereby the Executive Director is enjoined to keep a register of all holders of permits and “Reporting Procedures” which make it an obligation for all importers to submit reports on the type and quantities of controlled substances imported during the year. All these procedures and regulations that have been put in place are intended to make it possible for the NOU/EPA to compile accurate records of imports of ODS including HCFCs.

v. Energy Commission - Energy Efficiency Regulation, 2008 (LI 1932).

In October 2008, the Minister of Energy, empowered by the Energy Commission Act 541, promulgated the Energy Efficiency Regulation 2008 (LI 1932) which prohibited importation and sale of used air conditioner, used refrigerator, used freezer and used combination refrigerator/freezer, among other products. The full effect of the LI came into effect on 1st January 2012.
This LI was introduce done as a part of the campaign to flush out inefficient appliances from the market which at the time was estimated by the Energy Commission to be causing about 30% waste in electricity consumption. Used fridges, used freezers, etc. imported into the country were invariably appliances operating on CFC gases that had been discarded in the developed countries where consumption of the ODS had already been phased-out. Thus, the ban contributed to saving the environment by reduced carbon emission from banning energy-inefficient appliances and also eliminating additional introduction of CFC-based products into the country.

vi. *Other mechanisms to control ODS import.*

Other mechanism and administrative procedures have been put in place to control and monitor importation of ODS, Ref.3. One example is the Chemicals Control and Management Centre (CCMC) of the Environmental Protection Agency (EPA). The NOU is one of the 3 main departments of the CCMC.

Per its core mandate under the EPA Act 490, the CCMC/NOU is able to control the importation of refrigerants in general and ODS in particular through a structured mechanism that involves the registration of all importers and dealers of controlled chemicals, issuance of license and the renewal of their licenses on annual basis.

An umbrella association of dealers facilitates the interaction between the NOU and all importers, dealers and service providers. These entities have been given quota of importation which they are not supposed to exceed and no new entities are admitted to be given permit to import restricted refrigerants.

Through the mechanism of licensing, the NOU is able to monitor imports and product movement on the market at the end of each year in order to review the quota given to the importer.

Currently, per the LI regulating the goods containing or produced with ODS, an importer who imports without the requisite licenses is made to re-export the goods at their own cost. ODS recovered from recycle and recovery centres are bottled and depending on the level of purity are recycled to minimize import or are stored for export to an Article 2 country for destruction. Sanctions are also in place for violation of the regulations and laws.