HFC Inventory

NIGERIA

2008-2014

Prepared by David Bola Omotosho
Implemented by the United Nations Development Programme (UNDP)
For the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants

2015

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Acronyms

A/C	*Air Conditioner*
ASYCUDA	*Automated System for Customs Data*
CFCs	*Chlorofluorocarbons*
CO_2	*Carbon Dioxide*
GWP	*Global Warming Potential*
GHGs	*Greenhouse Gases*
HCFCs	*Hydrochlorofluorocarbons*
HFCs	*Hydrofluorocarbons*
NAFDAC	*National Agency for Food and Drug Administration and Control*
NCS	*Nigeria Customs Service*
SLCPs	*Short-lived Climate Pollutants*
UN	*United Nations*
UNCTAD	*United Nations Conference on Trade and Development*
UNDP	*United Nations Development Programme*
UNEP	*United Nations Environment Programme*

Glossary

CFC: *Chlorofluorocarbon, hydrocarbons where the substitution of hydrogen atoms by chlorine or fluorine atoms is complete..*

Drop-in: *Retrofit of installation corresponding only to the change of refrigerant, without any other modifications (neither components, nor oil).*

Emissions (of refrigerant): *release to the atmosphere of refrigerant whatever the cause. The annual report on fluorinated refrigerant emissions is required by the UNFCCC (1992).*

HCFC: *Hydrochlorofluorocarbon; where the substitution of hydrogen atoms by chlorine or fluorine atoms is partial.*

HFC: *Hydrofluorocarbon, Chemicals that contain hydrogen, fluorine, and carbon. They do not deplete the ozone layer and have been used as substitutes for CFCs and HCFCs. Many HFCs are potent greenhouse gases*

GWP: *Global Warming Potential. A relative index that enables comparison of the climate effect of the emissions of various greenhouse gases (and other climate changing agents). CO2 is the reference molecule, its GWP is 1 whatever the integration horizon taking into account its lifetime in the atmosphere. The GWP of other molecules is a ratio to the GWP of CO2 that takes into account the atmospheric lifetime of the product and its absorption value in the infrared spectrum in the atmosphere.*

ODP: *Ozone Depleting Potential. The ODP is a ratio of the ozonicide capacity of one molecule to that of CFC-11 (because its measurements in the atmosphere were made in 1950). By definition, the CFC-11 ODP is 1. The scale is thus the capacity of a molecule to destroy a quantity of ozone molecules greater or smaller than the capacity of CFC-11destruction.*

SLCPs: *Short-lived climate pollutants: These are agents that have relatively short lifetime in the atmosphere but have a warming influence on climate.*

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Executive Summary

A use inventory, in any country, of Hydrofluorocarbons (HFCs) and their blends that presents the direction of use movements, is an essential and critical step towards grounds preparations for the phase down of the substances and/or any efforts aimed at the introduction of low-GWP alternatives. It is the realization of this that Nigeria, with funding assistance from the Climate and Clean Air Coalition (CCAC), takes this critical step, the result of which is expected to inform subsequent decisions by government on the issue. Nigeria is a member of the CCAC, whose main objective is to reduce Short Lived Climate Pollutants (SLCPs) of which the HFCs group of chemicals is one. Nigeria views this report as a way of contributing to the meeting of CCAC's objectives.

This section of the report summarises the background information, process, analysis and the findings of the study.

ES.1: Introduction

Short-lived Climate Pollutants (SLCPs)

Short-lived climate pollutants (SLCPs) are agents that have relatively short lifetime in the atmosphere but have a warming influence on climate. They are also dangerous air pollutants, with various negative impacts on human health, agriculture and ecosystems. Black carbon, methane and tropospheric ozone and hydrofluorocarbons (HFCs) are the major short-lived climate pollutants in the atmosphere. It has been estimated that "fast action to reduce these pollutants has the potential to slow down the warming expected by 2050 by as much as 0.5°C, as well as prevent over two million premature deaths each year and avoid annual crop losses of over 30 million tons."

Hydrofluorocarbons (HFCs)

HFCs are man-made greenhouse gases that are used in air conditioning, refrigeration, as solvents, foam blowing agents, fire suppressants and aerosols. They form one of the major substances used since the 1990s as replacements for chlorofluorocarbons (CFCs) under the Montreal Protocol on Substances that Deplete the Ozone Layer, and are also replacements for HCFCs in a number of applications. The global warming impact of HFCs is strong and if left unchecked, it is estimated that they could account for up to 20 percent of total climate pollution by 2050. This calls for action, which has led to the intervention of the Climate and Clean Air Coalition (CCAC).

The current study is one of the first six national inventory studies currently being undertaken with the support of the CCAC in Bangladesh, Chile, Colombia, Ghana, Indonesia and Nigeria.

Objectives of Study

The objectives of the exercise are as follow:

i) Establish the volume and trend of HFC consumption/Use in Nigeria with the aim of determining the opportunities and challenges of moving to low GWP substances.

ii) Examine channels of distribution of HFCs and HFC Mixtures in the country.

iii) Examine the existing and potential replacement substance candidates for HFCs in the country, with the aim of providing stakeholders with information/tools to plan for a possible phase down of high GWP HFCs.

iv) Examine opportunities and challenges presenting themselves for a shift from HFCs to low-GWP alternatives.

v) Examine the potential impacts of transition to low-GWP alternatives.

vi) Examine emission reduction efforts of HFC and HFC mixtures through policies, structures, and actions to ensure HFC emission reductions.

Methodology

The methodological approach of this study consists of:

- Study Kick-off meeting
- Desktop information gathering;
- Field data collection; and
- Data collation and analysis.

Data Sources

The import entry data used in this study was received from the Nigeria Customs' Automated System for Customs Data (ASYCUDA) and National Agency for Food and Drug Administration and Control (NAFDAC).

ES.2: Review of Existing and Potential Data Sources

Nigeria does not produce HFCs. As a result, all her requirements are imported, which makes the Nigeria Customs Service (NCS), National Agency for Food and Drug Administration and Control (NAFDAC) good and credible data sources for the current study.

Customs Import Data

The import entry data used in this study was got from the Nigeria Customs' Automated System for Customs Data (ASYCUDA). Import Entries got from the ASYCUDA system covered:

i. Hydrofluorocarbons with HS Code 2903.39;

ii. Hydrofluorocarbons mixtures with HS Code 3824.78;

iii. Ammonia with HS Code 2814.10;

iv. Butane/Iso Butane with HS Code 2901.10; and

v. Propane with HS Code 2711.12

Importers Data

Within the context of the study, an importer is a person or company who imports HFCs and HFC Mixtures either for the purpose of selling or be used directly by the entity. Importers have very poor record keeping systems, while those that have good records fear to release such for "fear of divulging their business secrets". All of these made it difficult to correlate importers-sourced data with those from the Customs Service.

Data from National Agency for Food and Drug Administration and Control (NAFDAC)

The National Agency for Food and Drug Administration and Control (NAFDAC) supplied data for the substances under study for 2010 – 2013 (Table ES.2.1). Data comparable to those were received from the Customs Service over the same period.

YEAR	HFC-134a (MT)
2010	566.82
2011	469.62
2012	578.96
2013	672.55

Table ES 2.1: Nigeria: HFC-134a Imports as obtained from NAFDAC, 2010 – 2013

ES 3: HFC and HFC Mixtures Inventory and Usage in Nigeria

Amounts and Trends of HFCs Use in Nigeria (2008 – 2014)

Table ES 3.1 and Fig. ES 3.1 show import data for pure HFCs from 2008-2014 in the country. The data showed that the only pure HFC imported was HFC-134a.[1] Between 2008 and 2014, about 5080.42 metric tonnes of HFC-134a were imported into the country, giving an annual average import of about 725.77 metric tonnes.

YEAR	HFC-134a (MT)
2008	0.59
2009	48.53
2010	2862.46
2011	589.47
2012	789.87
2013	671.03
2014	118.47

Table ES 3.1a: Nigeria: HFC-134a Imports, 2008 – 2014

[1] Since HFC-134a is the only pure HFC imported to Nigeria in the period under consideration, reference to HFC or HFCs (implying pure HFC/HFCs as against HFC as mixtures or blends) is presumed to refer to HFC-134a.

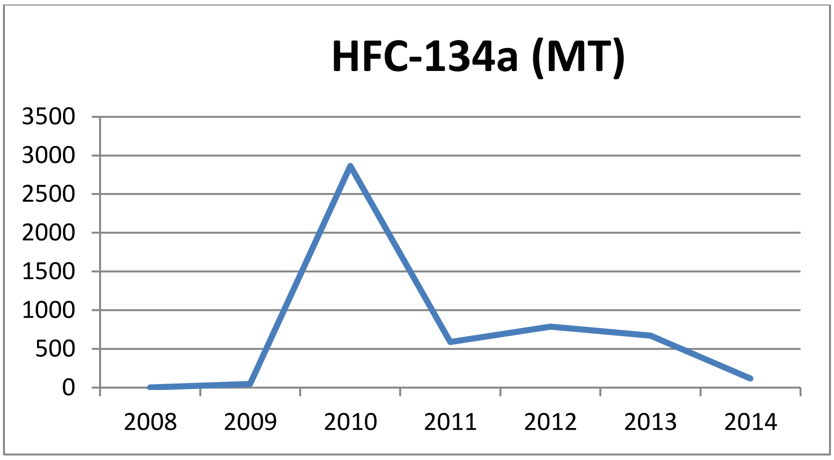

Fig. ES. 3.1a: Nigeria: HFC-134a Imports, 2008 - 2014

These also show a general downward trend in imports from a very high amount of 2,862 metric tonnes in 2010 to 589 metric tonnes in 2011, further down to 118.50 metric tonnes in 2014.

Some importers and end-users have attributed the huge 2010 imports to a probable reaction to 2010 as the final CFCs phase out year. With 2010 as the final CFC Phase out year for all countries, and with R-134a as the then most known replacement for R-12, some importers may have thought that the final phase out of R-12 may lead to a sudden rise in the price of its substitute, HFC-134a. This might have stampeded them to try to stockpile HFCs in that year, leading to a market glut resulting in decrease in import in subsequent years. It is good to note and understand that a major consideration on the part of importers is economic in terms of profits to be made. This must have been a major driving force behind the 2009/2010 ‘bump’. It also has to be realized that 134a became a replacement for R-12 not only in the domestic refrigeration sub-sector but also in the MAC sub-sector.

The above adduced reasons for the 2009/2010 “import spike” notwithstanding, further effort was made to even out the spike by comparing both the ASYCUDA and NAFDAC data for 2011 – 2013 for which data was available for both and use the result to “transform” the 2010 data.

On average, it was found that ASYCUDA consumption figures for those years were 20.6% higher than NAFDAC data. It was thus proposed to calculate a proxy data for the year 2010 based on the NAFDAC figure and to substitute it to the ASYCUDA 2010 figure.

<u>The new modified data set thus becomes:</u>

YEAR	HFC-134a (MT)
2008	0.59
2009	48.53
2010	683.4
2011	589.47
2012	789.87
2013	671.03
2014	118.47

Table ES 3.1b: Nigeria: HFC-134a Imports, 2008 – 2014 (adjusted for 2010)

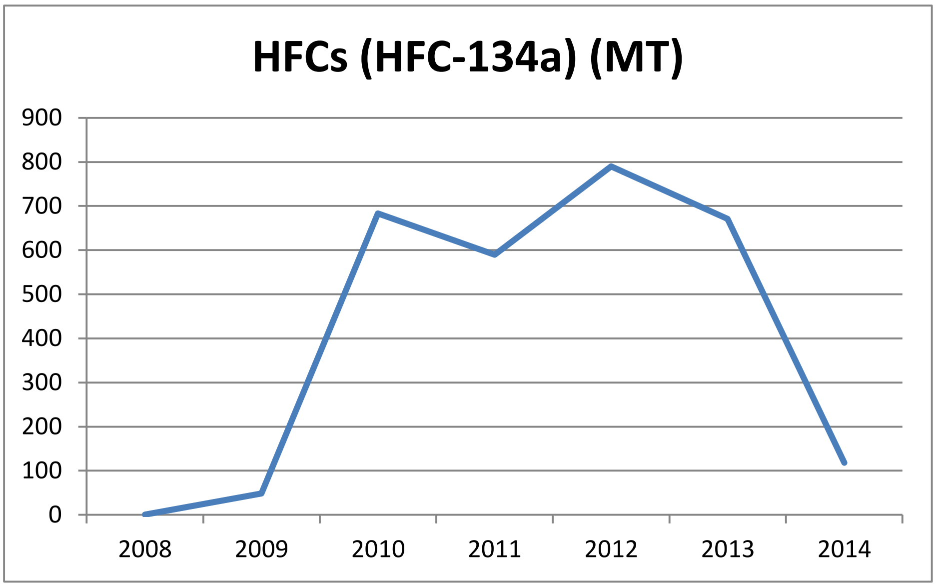

Fig. ES 3.1b: Nigeria: HFC-134a Imports, 2008 – 2014 (with adjusted figure for 2010 data point)

Amount and Trends of HFC Mixtures Use in Nigeria (2008 – 2014)

Table ES.3.2 shows HFC Mixtures use data from 2008-2014 in the country, which is also graphically shown in Fig.ES.3.2. Between 2008 and 2014, about 3994.10 metric tonnes of HFC Mixtures were imported into the country, resulting in an annual average import of about 570.59 metric tonnes.

YEAR	HFC MIXTURES (MT)
2008	0
2009	1027.27
2010	0
2011	0.03
2012	563.66
2013	1346.91
2014	1056.23

Table ES. 3.2: Nigeria: HFC Mixtures Imports, 2008 - 2014

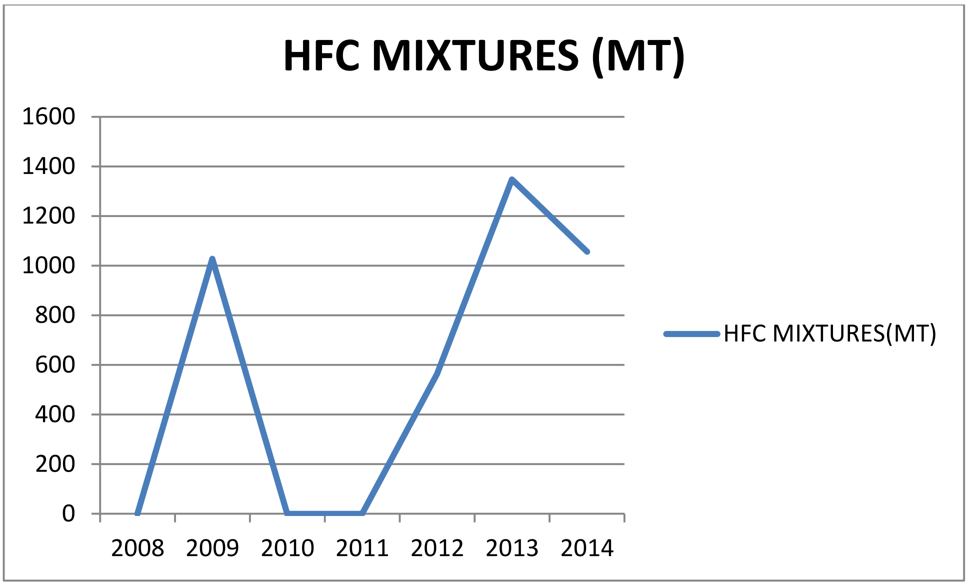

Fig. ES. 3.2: Nigeria: HFC Mixtures Imports, 2008 – 2014

HFC Mixtures imports between 2008 and 2014 do not exhibit any discernible downward or upward trend but an unpredictable undulating form over the seven years period.

Composite Use of HFC-134a and HFC Mixtures in Nigeria (2008 – 2014)

Considering both HFC-134a and HFC Mixtures together shows that a total of 9,074.52 metric tonnes of both were imported into the country between 2008 and 2014, giving an average annual import of about 1,296.36 metric tonnes.

A **composite trend analysis** of both is shown in Table ES.3.3 and Fig.ES.3.3. It is essential to note that the composite trend shows an irregular pattern, taking a downward direction from 2013.

YEARS	HFC-134a (MT)	HFC MIXTURES (MT)	COMPOSITE
2008	0.59	0	0.59
2009	48.53	1027.27	1075.8
2010	2862.46	0	2862.46
2011	589.47	0.03	589.5
2012	789.87	563.66	1353.53
2013	671.03	1346.91	2017.94
2014	118.47	1056.23	1174.7

Table ES. 3.3: HFCs (HFC-134a) and HFC Mixtures Imports, 2008 - 2014

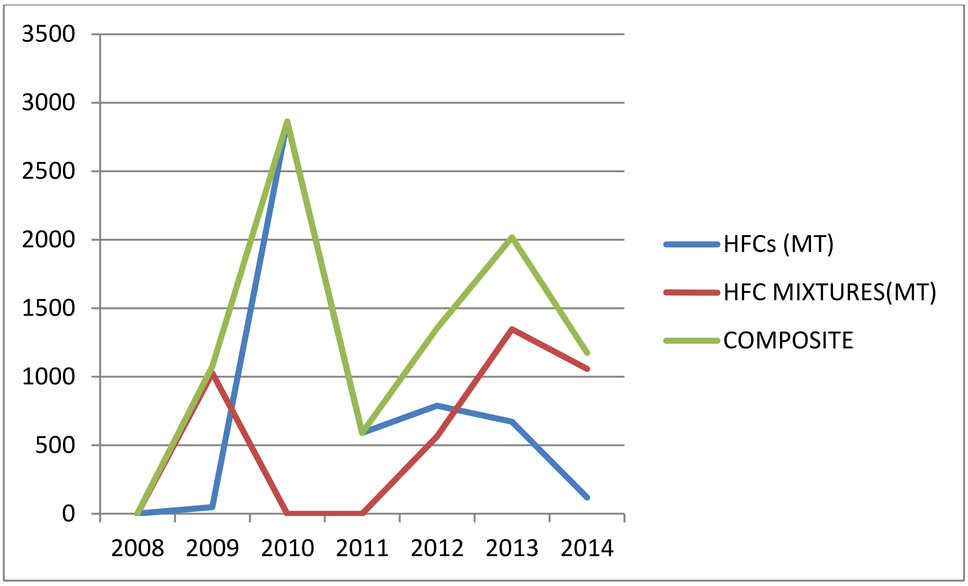

Fig. ES. 3.3: HFC-134a and HFC Mixtures Imports, 2008 - 2014

Prices of HFCs and HFC Mixtures

In view of its importance as a decision making tool, the prices of R-134a and R-410A were examined, the result of which are shown in Table ES.3.4 and Fig. ES.3.4, which show a steady decrease in price per Kg for R-410A, while the price of R-134a rose sharply in 2012 and taking a downward trend since 2013.

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
	₦	₦	₦	₦	₦	₦	₦
R-134a	-	1,325.5	1,323.5	1,400.0	3,000.0	2,500.0	2,350.0
R-410A	-	1,950.0	1,950.0	1,800.0	1,726.0	1,492.0	1,400.0

Table ES. 3.4 HFCs (134a) & HFC Mixtures (410A): Prices per Kg, 2008 – 2014 (in Nairas)

1 U.S $ = ₦ 160 (2014)

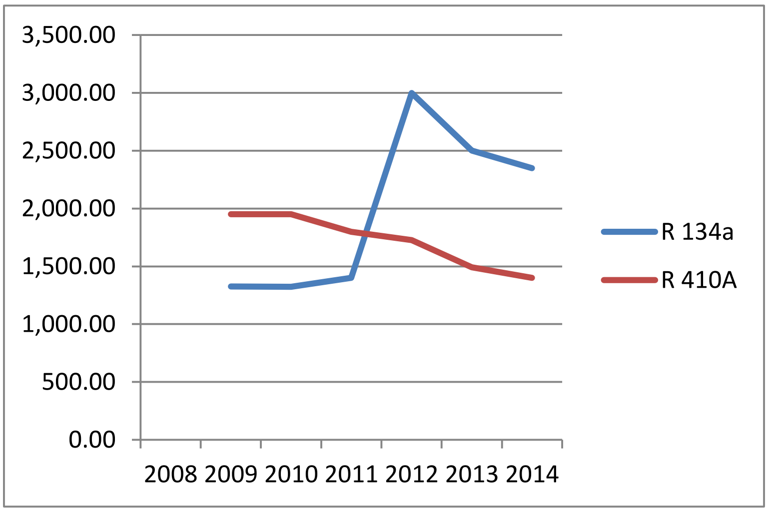

Fig. ES. 3.4: HFCs (134a) & HFC Mixtures (410A) Prices per Kg, 2008 - 2014

HFCs (HFC-134a) and HFC Mixtures Growth Projections

From recent trends it is observed that future changes in HFC-134a and HFC Mixtures are highly uncertain. The multiplicity of factors that may influence future consumption patterns do not make predictions in this direction easy.

With a simple use projection analysis under some assumptions the future use projects of HFC-134a and HFC Mixtures are shown in Figs.ES.3.5 and ES.3.6.

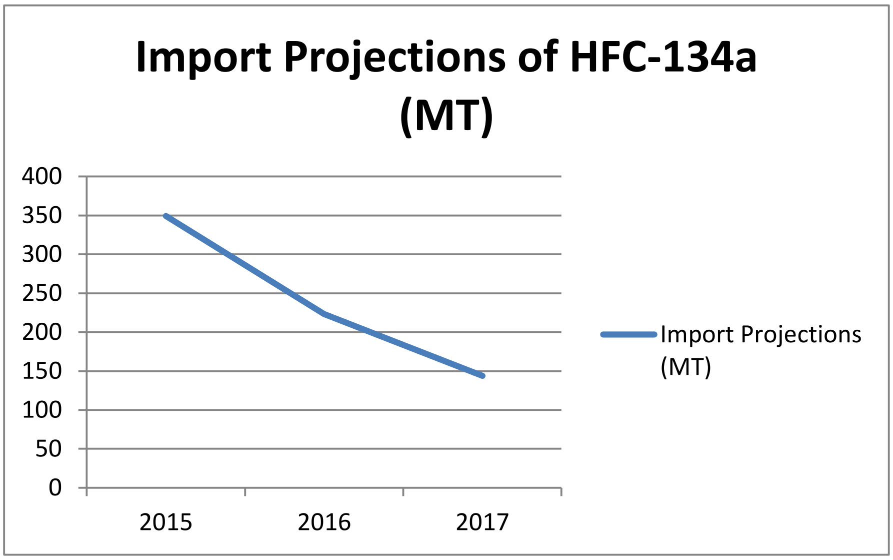

Fig. ES. 3.5: Nigeria: HFC Imports Projection (HFC-134a), 2015 and 2017

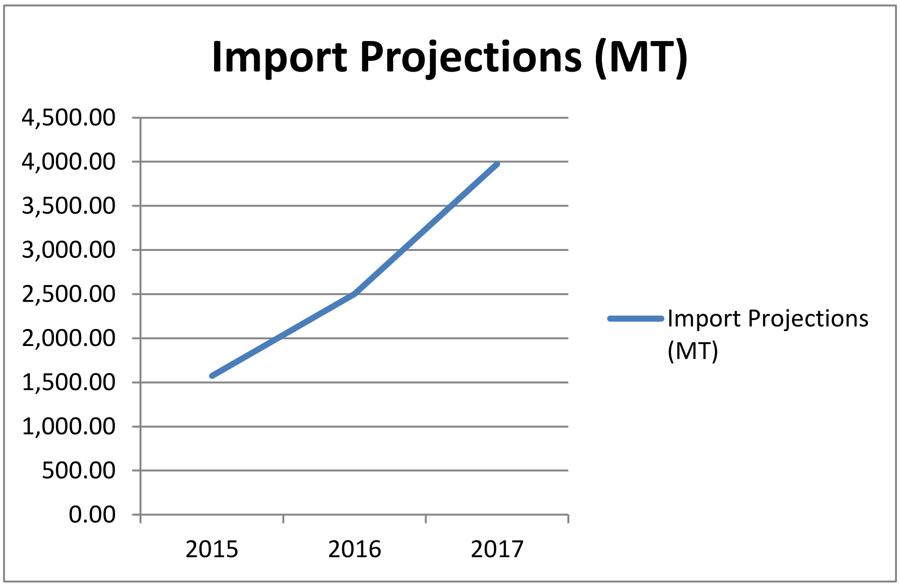

Fig.ES. 3.6: Nigeria: HFC Mixtures Imports Projections, 2015 and 2017

Distribution Channels

The distribution channels for both HFC-134a and HFC Mixtures in Nigeria consist of importers to end users: importers to retailers to end users; and importers to themselves (end User-importers).

ES.4: Low GWP Alternatives

Low GWP Alternatives available in Nigeria for the replacement of HFCs include hydrocarbons, ammonia and water which are examined in this section.

Hydrocarbons

Hydrocarbons currently in use in Nigeria are butane, Isobutane and Propane, the use patterns of which are as shown in Table ES.4.1, Fig. ES. 4.1 and Table ES.4.2, Fig.ES.4.2

YEAR	BUTANE/ISO BUT (MT)
2008	1572.20
2009	31711.67
2010	2433.41
2011	2496.37
2012	772.67
2013	1853.58
2014	2350.05

Table ES. 4.1: Nigeria: Butane and Isobutane Imports, 2008 – 2014

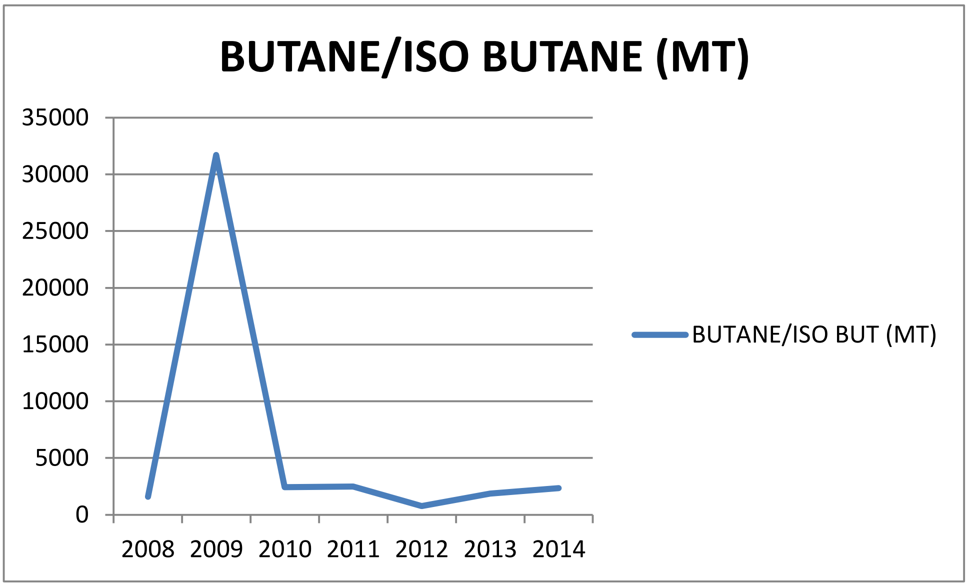

Fig ES.4.1: Nigeria: Butane and Isobutane Imports, 2008 - 2014

YEAR	PROPANE (MT)
2008	347411.68
2009	15.87
2010	27.19
2011	14.56
2012	10.02
2013	41.47
2014	26.42

Table ES.4.2: Nigeria: Propane (R-290) Imports, 2008 - 2014

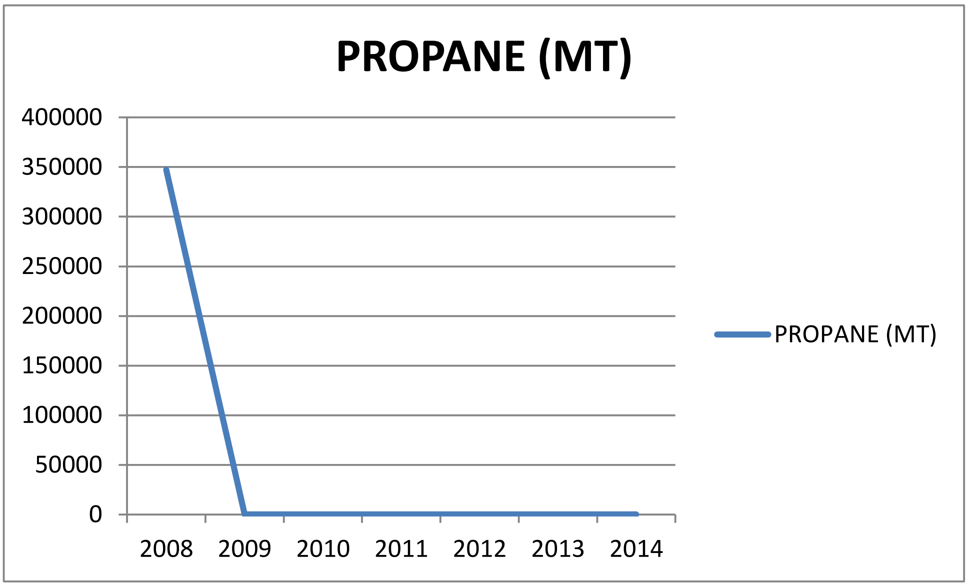

Fig ES.4.2: Nigeria: Propane (R-290) Imports, 2008 - 2014

Ammonia

Table ES.4.3 and Fig. ES.4.3 show ammonia import data from 2008-2014 in the country, which exhibit a general drop from 2011. It is only big companies such as Guiness Nig Plc and Van Milk which are able to deal with the safety issues involved with its use that use ammonia in their production systems.

YEAR	AMMONIA (MT)
2008	11457.97
2009	8313.51
2010	13529.48
2011	40.40
2012	10.31
2013	21.88
2014	592.81

Table ES.4.3: Nigeria: Ammonia Imports, 2008 – 2014

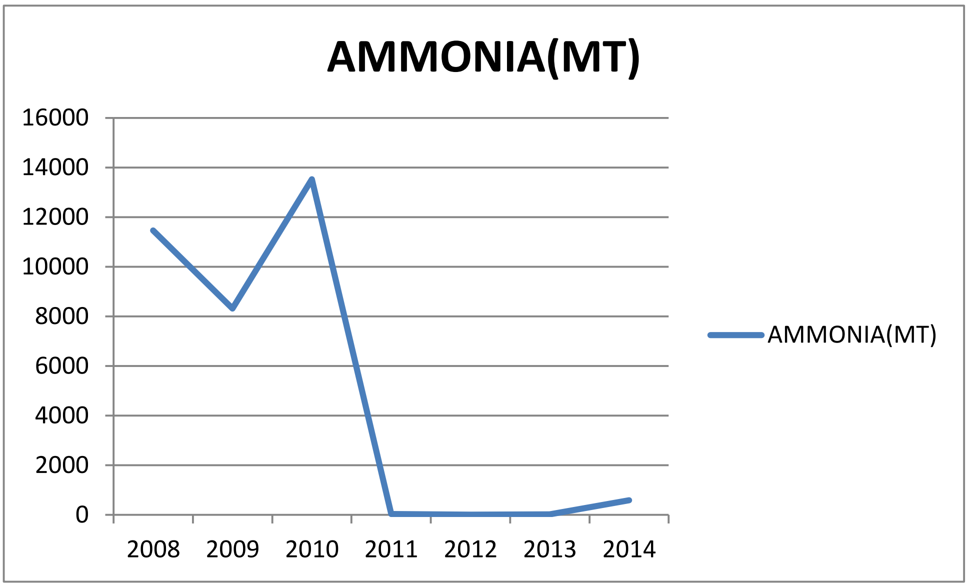

Fig ES.4.3: Nigeria: Ammonia Imports, 2008 - 2014

Water

Though we have no statistical data on volume of use, we know that the Automotive Component Industries Ltd (ACI), Kaduna, uses a water-based system for the production of vehicle seats.

Price Structures of HFCs, HFC Mixtures and some Low GWP Alternatives

An attempt was also made to compare the prices of HFC and HFC Mixtures with low GWP alternatives, the results of which are shown in Table ES.4.4 and Fig. ES.4.4.

A close examination of both Table 4.8 and Fig 4.8 shows that the prices of both HFC-134a and HFC Mixtures (R-410A) are generally higher than the low GWP alternatives. Also the prices of the alternatives seem to be reducing faster than for HFC and Mixtures. These observations are generally good for a shift from HFC to alternatives, all other things being equal.

	Prices in Naira (₦) Per Kg.						
Chemicals	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
R-134a	-	1,325.5	1,323.5	1,400.0	3,000.0	2,500.0	2,350.0
R-410A	-	1,950.0	1,950.0	1,800.0	1,726.0	1,492.0	1,400.0
R-600	1,250	1,200	1,200	900	900	800	800
R-600a	1600	1550	1500	1500	1,400	1,300	1,300
R-290	740	720	700	500	500	400	400

Table ES.4.4: ***Prices of HFC, HFC Mixtures and some Low GWP Alternatives*** **available in Nigeria (2008 – 2014)**

1 U.S $ = N 160 (2014)

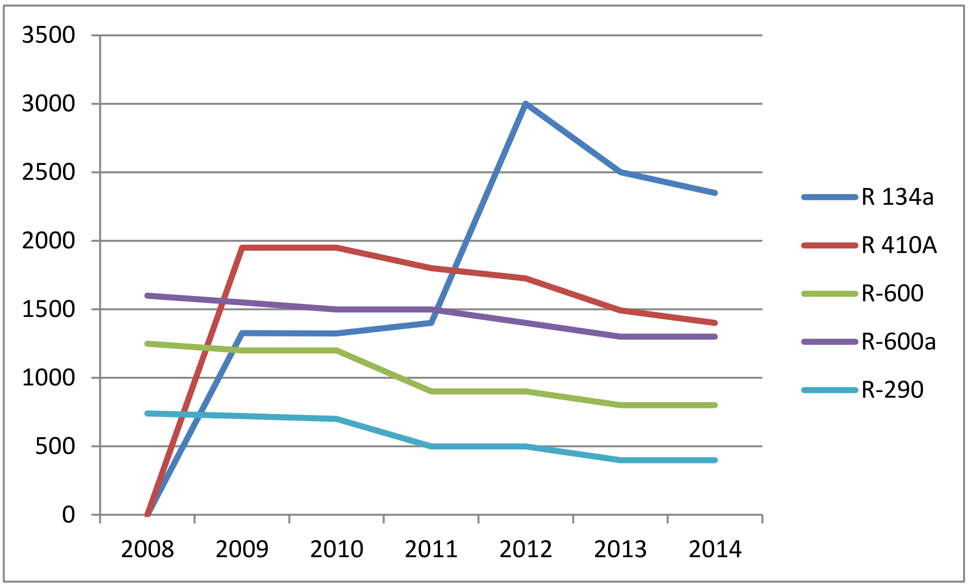

Table ES.4.4: ***Price trends of HFC, HFC Mixtures and some Low GWP Alternatives*** **available in Nigeria (2008 – 2014)**

Opportunities and Challenges

There are opportunities and challenges presenting themselves for a transition from HFCs to low GWP alternatives in the country.

Opportunities

A process is on-going for the local production of Hydrocarbon refrigerants in the country. A similar move is also on-going in the establishment of a system house for methyl formate used for foam blowing purposes. Coupled with these some big companies such as Unilever Nig. Pls are voluntarily transiting to the use of natural refrigerants such as ammonia and hydrocarbons. All of these present great opportunities for a shift from HFC and HFC Mixtures to other low GWP and ozone-friendly alternatives not only in Nigeria but the countries of the West African sub-region and even beyond.

Challenges

There are also challenges to the adoption of low-GWP alternatives in Nigeria which include: Safety Risks occasioned by Flammability of hydrocarbons and Toxicity Issues related to ammonia; the insufficient technical know-how in many instances in companies, as well as lack of practical skills among technicians; and "technology change fatigue" for those have just recently completed their transition from CFCs and HCFCs to HFCs. All of these post barriers to move from HFCs to low-GWP alternatives.

Potential Impacts of Transition to Low-GWP Alternatives

A transition from HFCs to low-GWP alternatives in Nigeria will positively influence a similar move by countries of the West African sub-region. However, the local cost of transition is likely to divert resources away from other pressing social and environmental needs of the people.

HFCs and HFC Mixtures Emission Reduction

Emission reduction could be a worthwhile effort prior to a shift from HFCs to low GWP alternatives. Strategies such as putting in place policies that support emission reduction, institutionalization of "best practices" among technicians and use of design and technology advancement to achieve HFC emission reductions can be applied.

ES. 5: Policies, Structures and Actions to ensure HFC Emissions Reduction

Policies, Structures and actions that may need to be undertaken in order to ensure HFC emission reduction in Nigeria may include:

- Putting in place legal and policy structures that will promote HFC phase down activities;
- Putting in place an HFC Phase Down Plan;
- Achieving emission reduction through containment control (e.g. through obligatory leakage checks)
- Providing Phase down funding assistance similar to what is being obtained for ODS phase out under the Montreal Protocol;
- Use of an import licensing and monitoring system which can take advantage of the existing ODS import licensing and monitoring system;
- Providing technical support and training;
- Carrying out Public awareness; and
- Using fiscal controls such as subsidies and tax rebates.

ES.6: Summary of Findings and Conclusions

Summary of Findings

The analysis undertaken leads to the following findings:

- Import of HFCs into Nigeria between 2008 and 2014 totals about 5080.42 metric tonnes, giving an annual average import of about 725.77 metric tonnes.
- The import trend for pure HFCs (HFC-134a), for the current study period, is very difficult to establish because it oscillates from year to year, sometimes very steeply.
- HFC Mixtures import into Nigeria between 2008 and 2014 was about 3,994.10 metric tonnes, resulting in an annual average of about 570.59 metric tonnes.
- Similar to the case of HFC-134a, the import trend, for HFC Mixtures, during the current study period, is also difficult to establish because it oscillates from year to year also, sometimes very steeply.
- The import into Nigeria of both pure HFCs and HFC Mixtures between 2008 and 2014 was in the total amount of 9,074.52 metric tonnes, which gives an average annual import of about 1,296.36 metric tonnes.

- Estimating the future imports of both pure HFCs and HFC Mixtures was a very difficult task. This notwithstanding, future import estimates under some assumptions point towards a **decreasing import trend** for pure HFCs and an **increasing import trend** for HFC Mixtures, based on the analysis of past trends.

- Prices of pure HFCs and HFC Mixtures as well as low GWP alternatives in the Nigerian market have been decreasing over the years since 2008, with the prices of low GWP alternatives generally lower than those of pure HFCs and HFC Mixtures.

- Three types of HFC distribution channels exist in the country, which include: importers to end users; importers to retailers to end users; and end-user importers.

- Several low GWP alternatives for the replacement of HFCs are available and in use in Nigeria, which include: hydrocarbon refrigerants; butane/isobutene; propane; ammonia; and water.

- Opportunities presenting themselves in Nigeria for a transition from HFCs to low GWP alternatives include: production of hydrocarbon refrigerants in the country; big companies such as Unilever phasing out the use of HFCs voluntarily; and local system house for Methyl Formate by Vitapur.

- There are Challenges attached to the adoption of low GWP alternatives in the country which include safety risks occasioned by the flammability and toxicity of some low GWP alternatives; Insufficient technical know-how on the part of key stakeholders and technology change fatigue by companies using HFCs.

- There are policies, legal, structures; and actions to be considered in order to ensure HFC emission reduction.

Conclusions

The prospect for a quick and smooth transition from HFCs to low GWP alternatives in Nigeria is very high. HFC consumption continues to show a downward trend, while some low GWP alternatives are already available and in use in the country. Another big advantage is the policy of the Government to support local production of HC and a system house for Methyl Formate. The successful accomplishment of these projects will surely assist in the move away from HFC use in the country. Also, big multi-national companies like Unilever are currently promoting a move away from HFCs, thereby presenting a good prospect for a mass transition. The prospect will however need to be driven by the right policies; legal framework; institutional structures and actions.

Chapter 1 Introduction

This report presents estimates of the use of HFCs and HFC Mixtures in Nigeria for the years 2008 to 2014. A summary of these use estimates is shown in Table 3.1 and Table 3.4. The report also discusses estimates of low-GWP alternatives available in the country over the same period presented in Tables 4.1, Table 4.3 and Table 4.5.

1.1 Background

1.1.1 Short-lived Climate Pollutants (SLCPs)

Short-lived climate pollutants (SLCPs) are agents that have relatively short lifetime in the atmosphere but have a warming influence on climate. They are in fact the most important anthropogenic contributors to global greenhouse effect after CO2. SLCPs are also dangerous air pollutants, with various negative impacts on human health, agriculture and ecosystems. Black carbon, methane and tropospheric ozone are the major short-lived climate pollutants in the atmosphere. Other short-lived climate pollutants include some hydrofluorocarbons (HFCs).

Key SLCPs, and many HFCs, are responsible for a substantial fraction of near term climate change, which have very potent and large impacts in sensitive regions of the world. It has been estimated that "fast action to reduce these pollutants has the potential to slow down the warming expected by 2050 by as much as 0.5°C, as well as prevent over two million premature deaths each year and avoid annual crop losses of over 30 million tons." (CCAC, 2012)

1.1.2 Hydrofluorocarbons (HFCs)

HFCs are man-made greenhouse gases that are used in air conditioning, refrigeration, as solvents, foam blowing agents, fire suppressants and aerosols. They form one of the major substances used since the 1990s as replacements for chlorofluorocarbons (CFCs) under the Montreal Protocol on Substances that Deplete the Ozone Layer and are also replacements for HCFCs in a number of applications. Many HFCs remain in the atmosphere for less than 15 years. Although the amount of HFCs present in the atmosphere is said to represent a very small proportion of the current total greenhouse gases, being less than one percent, their global warming impact is strong. If their use is left unchecked, it is estimated that they could account for up to 20 percent of total climate pollution by 2050.

HFCs, which do not deplete the Ozone Layer, came into global commercial use as a replacement for Ozone Depleting Substances (ODSs). Their presence in the atmosphere therefore came as a result of their being used to comply with the provisions of the Montreal Protocol. They have widespread applications in refrigeration and air-conditioning; as foam blowing agents; aerosols and in fire protection systems. Scientific atmospheric observations show that the presence of HFCs in the atmosphere is increasing. For example, HFC-134a is said to have increased by about 10% per year from 2006 to 2012 (US EPA, 2014).

Although replacing ozone depleting substances with HFCs helps to protect the ozone layer, increasing use and consequently emissions of high-GWP HFCs are likely to undermine the very significant climate benefits achieved by ODS phase-out. This situation surely calls for action, which has led to the intervention of the Climate and Clean Air Coalition (CCAC).

1.1.3 Climate and Clean Air Coalition (CCAC) Intervention

Recognizing that mitigation of the impacts of SLCPs is critical in the near term, some countries got together to address the issue in a coordinated manner by the formation of the Climate and Clean Air Coalition (CCAC) to Reduce Short Lived Climate Pollutants. Formed in 2012, CCAC seeks to bring together an international network of policymakers, industry, intergovernmental organizations, and civil society to promote the use of low-GWP alternatives and also make concerted efforts to remove barriers to this. The CCAC undertakes this by providing a platform for cooperative activities between governments, the private sector, and other stakeholders that promote climate-friendly alternatives to high GWP HFCs across a wide variety of sectors, including air-conditioning, refrigeration, and foam-blowing. The **"Promotion of HFC Alternative Technology and Standards"** therefore becomes one of CCAC's focal areas of intervention. Under this, the CCAC "aims for high-level engagement that supports developing and deploying climate-friendly energy efficient alternatives and technologies, minimizing HFC leaks through responsible management, and encouraging recovery, recycling, reclamation, and eventual destruction of high-GWP HFCs. The initiative will cover all major sectors of HFC use, and partners can include food retailers, builders, chemical producers and re-claimers, equipment manufacturers, technicians, and international organizations, standard setting organizations, non-governmental organizations and governments." (CCAC, 2012)

Activities in this core area started with CCAC's efforts with capacity building and developing national level inventories. Through these it seeks to understand where and how HFCs are currently and anticipated to be used as well as the latest information on a range of low-GWP alternatives. These are expected to help in creating an enabling environment for change. Using this as a spring board, the CCAC then intends to explore opportunities to support demonstration projects aimed at validating and spurring commercialization of technologies that reduce the use and emissions of high-GWP alternatives. The current study is one of the first six national inventory studies currently being undertaken with the support of the CCAC in Bangladesh, Chile, Colombia, Ghana, Indonesia and Nigeria.

1.2 Objectives of Study

The objectives of the exercise are as follow:

i) Establish the volume and trend of HFC consumption/Use in Nigeria with the aim of determining the opportunities and challenges of moving to low GWP substances.

ii) Examine channels of distribution of HFCs and Mixtures in the country.

iii) Examine the existing and potential replacement substance candidates for HFCs in the country, with the aim of providing stakeholders with information/tools to plan for a possible phase down of high GWP HFCs.

iv) Examine opportunities and challenges presenting themselves for a shift from HFCs to low-GWP alternatives.

v) Examine the potential impacts of transition to low-GWP alternatives.

vi) Examine HFCs and HFC mixtures emission reduction efforts through policies, structures, and actions to ensure HFCs emission reductions.

1.3 Methodology

The methodological approach of this study has been dictated by the set objectives as considered in the preceding section and consists of:

- Study Kick-off meeting
- Desktop information gathering;
- Field data collection and Validation; and
- Data collation and analysis.

1.3.1 Study Kick-off Meeting

At the commencement of the study, a meeting took place between the consultant and staffers of the Federal Ministry of Environment managing the project. The Ministry made available the list of importers on its register to the Consultant, which actually informed the field data collection task undertaken by the Consultant. The Ministry and the consultants also concluded arrangements on a meeting with importers in Lagos.

1.3.2 Desktop Information Gathering

In order to put the study within its proper global context general information was collected on the study, which included:

- Information on short-lived climate pollutants and the Climate and Clean Coalition;
- General background information on HFCs and mixtures;
- Information on Low GWP alternatives; and
- Information on Montreal Protocol projects in Nigeria that converted to HFCs during the CFCs phase-out years.

1.3.3 Field Data Collection

The study relies very much on the import data received from the Nigeria Customs Service, supported with information received from chemical importers during a meeting held in Lagos on the amount of HFCs imported by them between 2010 and 2013, as well as the data got from the National Agency for Food and Drug Administration and Control (NAFDAC). These sources will be discussed in greater details in Chapter 2 of this report.

1.3.4 Data Analysis

The data collected from various sources are presented in tabular form, from where the consultants analyzed and presented the report in graphical forms using pie charts, graphs and bar charts.

1.4 Structure of the Report

The study was set in proper context in **Chapter 1** with a brief discussion of background information on short-lived climate pollutants; HFCs; climate and clean air coalition (CCAC); the study's objectives and methodology. These are followed in **Chapter 2** with a review of existing and potential data sources. **Chapter 3** deals with the inventory of HFCs and HFC mixtures in the country, while **Chapter 4** considers Low-GWP alternatives in use in the country and the opportunities and challenges to shift to low-GWP alternatives. **Chapter 5** discusses the issues that will ensure HFCs emission reduction. The report concludes in **Chapter 6** with a brief summary of the study's findings and conclusions.

Chapter 2: Review of Existing and Potential Data Sources

The integrity and reliability of any inventory study depend to a great extent on the data source. This is why efforts have been put to getting the data used from authentic sources. Nigeria does not produce HFCs. As a result, all her requirements are imported, which makes the Nigeria Customs Service (NCS), National Agency for Food and Drug Administration and Control (NAFDAC) and importers of the substances as good and credible data sources for the current study. These three sources will be reviewed in the sections that follow.

2.1 Customs Import Data

The import entry data used in this study was got from the Nigeria Customs' Automated System for Customs Data (ASYCUDA). This is a computerized data management system designed by the United Nations Conference on Trade and Development (UNCTAD) for international trade and transport operations. The system allows for the electronic processing of declarations, risk management, transit operations and expedited clearance of goods, in addition to collecting timely and accurate statistical data for fiscal and trade policy objectives.

UNCTAD developed and implemented the first version of ASYCUDA in three West African countries, of which Nigeria is one, between 1981 and 1984, to compile foreign trade statistics. Since then the system is said to have undergone three major upgrades, taking advantage of innovation in computer hardware, programming language and software technology.

The second version (1985-95) introduced Local Area Network and provided a more powerful data transaction capacity through the use of file servers. It implemented the fully automated processing of Customs clearance including declaration, manifest, cash and accounting, and warehousing. The third version (ASYCUDA++, 1992 to present) added Customs modules and functionalities, such as direct trader input, risk management, transit monitoring, and submissions of declarations by Customs brokers via the Internet.

The data source for the current study therefore meets the requirements of international data entries' best practices.

Import Entries got from the ASYCUDA system covered:

vi. Hydrofluorocarbons with HS Code 2903.39;

vii. Hydrofluorocarbons mixtures with HS Code 3824.78;

viii. Ammonia with HS Code 2814.10;

ix. Butane/Iso Butane with HS Code 2901.10; and

x. Propane with HS Code 2711.12

The initial entries received covered 2010 – 2013 when the study started in 2014. In January 2015, in an attempt to make the findings of the study more robust, another set of entries for the same set of substances was got to cover 2008 – 2014. When compared with other data sources as discussed below in section 2.2 and 2.3, the ASYCUDA data source seems to be most complete. Also, being from an automated system, the data seems to be very reliable. In view of these, the more recent entries got from this source, and as discussed in Chapter 3, form the bedrock of our consideration in this study.

2.2 Importers Data

Within the context of the study, an importer is a person or company who imports HFCs and HFC Mixtures either for the purpose of selling or be used directly by the entity.

An importers' meeting was held in Lagos in July, 2014. Those that attended the meeting are shown in Table 2.1. They were requested to fill a form relating to the volume of HFCs, HFC Mixtures and their low-GWP alternatives imported by them between 2010 and 2013. On analysis, the information supplied by the importers was scanty and not as comprehensive as the import entries got from the Customs Service ASYCUDA system. The problem with data from this source is that some known big importers failed to come for the meeting and did not provide the requested data. Another issue is that most of the importers have very poor record keeping systems, while those that have good records fear to release such for "fear of divulging their business secrets". All of these made it difficult to correlate importers-sourced data with those from the Customs Service.

S/N	Importers
1	Obijah Complex Ltd
2	Jokean Ventures (Nig.).
3	Bro. Cele Company Ltd
4	Apex Trust Nig. Ltd
5	Deik Kemy Investment Ltd
6	Chumyke Integrated service Ltd
7	Chinedu Obodoeji
8	Ugwuman & Associate Ltd
9	FrankJen Global Solutions Ltd
10	Orisice Nig. Ltd.
11	Peakdom Cooling Equipment Ltd.
12	Ecason Mrk Co. Ltd
13	Andy Zol Inv. Ltd
14	MacJocbiz.com
15	Taps Nig. Ltd
16	Yovel Concept Ltd
17	Vickvicano (Nig.) Ltd.
18	Agastorm Ltd
19	Frank chukunere.
20	Donfrez Int'l Ltd.
21	Lobocool Int'l ltd.
22	Don Chimex Ventures.
23	AB cool Eify Ent. Ltd
24	Sunner Precision Ideal Ltd
25	K.C Facilities Ltd

Table 2.1: Importers present at the July, 2014 meeting

2.3 Data from National Agency for Food and Drug Administration and Control (NAFDAC)

The National Agency for Food and Drug Administration and Control (NAFDAC), was established by Decree No. 15 of 1993. A parastatal of the Federal Ministry of Health, the Agency has mandate to regulate and control quality standards for Foods, drugs, Cosmetics, Medical Devices, Chemicals, Detergents and packaged water imported, manufactured locally and distributed in Nigeria. By virtue of this decree and by virtue of being physically present at the Ports, the Agency along with its mainstream food and drugs have been regulating some industrial chemicals, which makes the Agency a source for data on some industrial chemical.

In 2014, at the first attempt of obtaining raw data for this study, it was not possible to get the required data from NAFDAC. However in the second attempt, NAFDAC supplied data for the substances under study for 2010 – 2013 (Table 2.2). It should be noted that unlike ODSs, HFCs and HFC mixtures do not currently have any import restrictions placed on them. As a result, the level of surveillance on their importation may not be as high as those for ODSs, which may limit the fullness or completeness of the information we may get on them from NAFDAC.

YEAR	HFC (MT)
2010	566.82
2011	469.62
2012	578.96
2013	672.55

Table 2.2: Nigeria: HFC Imports as obtained from NAFDAC, 2010 – 2013

A close examination of both Tables 2.2 and 3.1 shows that the entries for 2011-2013 in both tables are very close and quite comparable. However, in view of the fact that the ASYCUDA data covers more years, our consideration in the next Chapter will rely on this source for our analysis. The data for year 2010 will be discussed separately in the following Chapter.

Chapter 3: HFCs and HFC Mixtures Inventory and Usage in Nigeria

This section sets out and discusses the inventory of HFCs use in Nigeria. As hinted earlier, the consideration in this section relies very much on the data obtained from the Nigeria Customs' Automated Systems for Customs Data (ASYCUDA++). This is about the most reliable import data source in the country as noted by a 2006 ODS consumption verification study, "…in view of recent development, the ASYCUDA system is considered as a very reliable source of import data. The data could be relied upon more than what was obtained from the importers, being more comprehensive in content and scope…" Our consideration provides an estimated inventory of both HFCs and HFC mixtures, using import data entries from 2008-2014.

As described earlier in Chapter 1, Hydrofluorocarbons (HFCs) are organic compounds that contain hydrogen and fluorine atoms. These substances came to be used first in Nigeria in the 1990s as replacements refrigerants for Chlorofluorocarbons (CFCs) such as R-12 and Hydrochlorofluorocarbons (HCFCs) such as R-22. The commonest HFC on the Nigeria market is R-134a used in refrigeration, especially in mobile air-conditioning, stationary air-conditioning, domestic refrigeration, and transport. (*As expressed elsewhere HFC-134a is the sole pure HFC used in Nigeria, hence HFC or HFCs in this section is presumed to refer to HFC-134a)*

The most common blend in the country is R-410A, which comes in different names as Puron, Suva 410A, Genetron AZ20, Forane 410A, or Klea 66. It is a blend of HFC-32 and HFC-125 in 50/50 percent by weight.

R-410A is being used as a replacement for R-22 by some air-conditioning manufacturing outfits.

In the sections that follow we shall examine the trend of HFC-134a and HFC Mixtures use in the country.

3.1 Amount and Trends of HFCs Use in Nigeria (2008 – 2014)

Table 3.1 shows HFC-134a use data from 2008-2014 in the country as obtained from the Customs Service ASYCUDA. This is also graphically shown in Fig. 3.1. Between 2008 and 2014, about 5080.42 metric tonnes of HFC-134a were imported into the country, giving an annual average import of about 725.77 metric tonnes.

YEAR	HFC-134a (MT)
2008	0.59
2009	48.53
2010	2862.46
2011	589.47
2012	789.87
2013	671.03
2014	118.47

Table 3.1a: Nigeria: HFC-134a Imports, 2008 – 2014

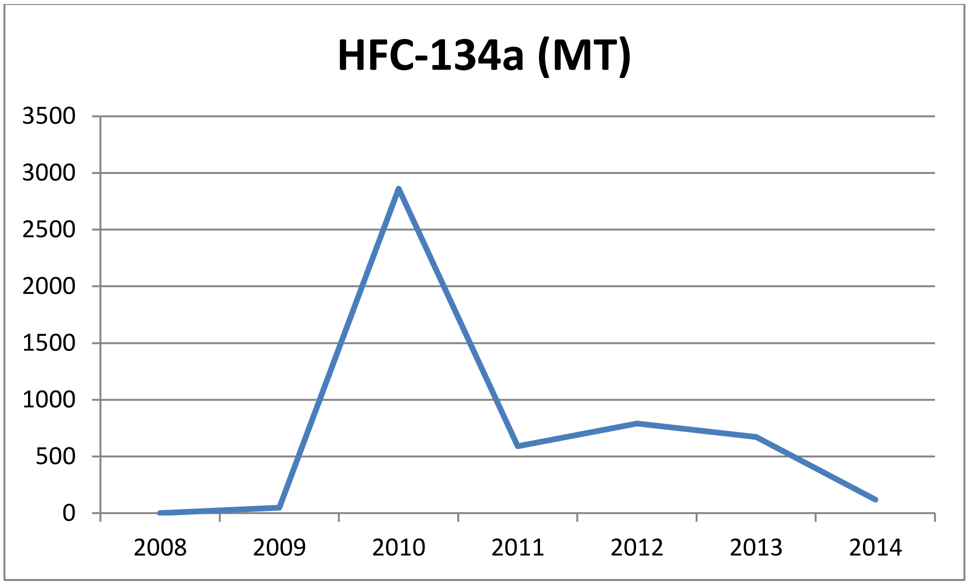

Fig. 3.1a: Nigeria: HFC-134a Imports, 2008 - 2014

A close examination of the Table 3.1 and Fig.3.1 shows a value of only 0.59 metric tonnes of imports of this substance in 2008, a time R-134a was just coming into the Nigerian market for the replacement of CFC-12 (R-12) in refrigeration application. This rose to about 48.53 metric tonnes in 2009 and to a record high of 2,862 metric tonnes in 2010, and plunges to 589 metric tonnes in 2011, a decrease of nearly 80%. The figure rose to 789.87 metric tonnes in 2012 dropping again by 15% to 671.03 metric tonnes in 2013 and finally to about 118.50 metric tonnes in 2014.

To complement this information, it seems relevant to indicate here the import data for HCFCs during that period (please note these are Article 7 data figures, which exclude HCFCs contained in pre-blended polyols):

YEAR	HCFCs (MT)
2009	5071
2010	5718
2011	6280
2012	7101
2013	4984
2014	4532

Some importers and end-users have linked the huge 2010 imports to a probable reaction to 2010 being the final CFCs phase out year. With 2010 as the final CFC Phase out year for all Article 5 (developing) countries, and with R-134a as the then most known replacement for R-12, some importers may have thought that the final phase out of R-12 may lead to a sudden rise in the price of its substitute, HFC-134a. This might have stampeded them to try to stockpile HFC-134a in that year, leading to a market glut resulting in decrease in import in subsequent years. It has to be understood that a major consideration on the part of importers is economic in terms of profits to be made. This must have been a major consideration for what happened 2009/2010. It also has to be realized that 134a became a replacement for R-12 not only in the domestic refrigeration sub-sector but also in the MAC sub-sector.

It seems however that part of the abnormality of the steep increase in 2010 just cannot be explained by the reasons mentioned in the paragraph above.

The above adduced reasons for the 2009/2010 "import spike" notwithstanding, further effort was made to even out the spike by comparing both the ASYCUDA and NAFDAC data for 2011 – 2013 for which data was available for both and use the result to "transform" the 2010 data

What is striking is that this steep increase in 2010 HFC 134a consumption is not noted in the NAFDAC data, which confirms the doubts about ASYCUDA data for that year. As a consequence, the authors of this report have proposed to calculate, over the comparable years of data, the average difference between ASYCUDA and NAFDAC data (this is for the years 2011-2013). On average, it was found that ASYCUDA consumption figures for those years were 20.6% higher than NAFDAC data. It was thus proposed to calculate a proxy data for the year 2010 based on the NAFDAC figure and to substitute it to the ASYCUDA 2010 figure.

Data for 2010: NAFDAC data for 2010 (566,8) x 1.206 = <u>683.4 MT.</u>

<u>The new modified data set thus becomes:</u>

YEAR	HFC-134a (MT)
2008	0.59
2009	48.53
2010	683.4
2011	589.47
2012	789.87
2013	671.03
2014	118.47

Table 3.1b: Nigeria: HFC-134a Imports, 2008 – 2014 (adjusted for 2010)

The graph representing this data set with modified data for 2010 follows:

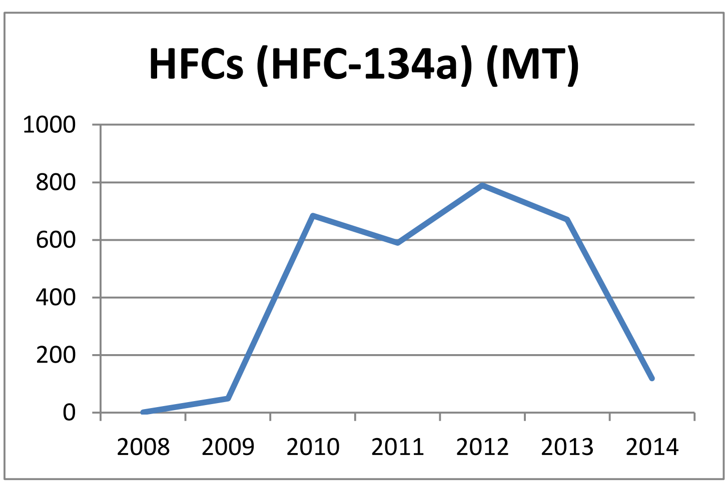

Fig. 3.1b: Nigeria: HFC-134a Imports, 2008 – 2014 (with adjusted figure for 2010 data point)

From its very high level in 2010-2012, the general direction of HFC-134a import has been towards the downward trend. This is in part due to the introduction, into the Nigerian market, of other non-HFC-based alternatives, including non-fluorinated alternatives. For example, practitioners in the refrigeration sector suggest that the import and use of HC-based equipment from Europe have increased from 2010 to date. The **continuation of the current trend seems to announce a possible use-shift from HFCs to other low-GWP alternatives in the country.** However, it has to be noted that the decrease in 2014 also seems to be abnormally steep. When NAFADAC data becomes available 2014 HFC consumption, it may be important to compare it with the ASYCUDA data again to consider a modified data point for 2014.

3.2 Application Areas of HFCs in Nigeria

The areas of application for HFCs are Domestic, Offices, Industrial, Commercial, Mobile A/C, transport and shipping. The current study has not been able to determine the proportion of use for each of these, which may need to be further explored in future.

3.3 Major Importers of HFCs in Nigeria

In view of the fact that any planned future HFC phase-down activities will have to be undertaken in collaboration with the importers and end-users of the product, care has been taken to document most of the importers of HFCs in the country. Many of these importers are end users of the product. It is also interesting to note that of the 69 importers from the ASYCUDA list, just ten (10) of them account for about 78% of all HFC Imports as shown in Table 3.2 and Fig.3.2. The short list will assist in any future activities with importers of HFCs by concentrating on this small number.

S/N	Importers of HFCs
1	Advance logistics service ltd
2	Agastom
3	Donfrez Int Ltd
4	Elins Nig ltd
5	Jiskever Ltd
6	Jokean Ventures
7	Metra Impex Ltd
8	Seafood Products Ltd
9	Soncheb Investment Co. Ltd
10	VTR Production Ltd
	Total

Table 3.2: The Ten Major HFC Importers in Nigeria.

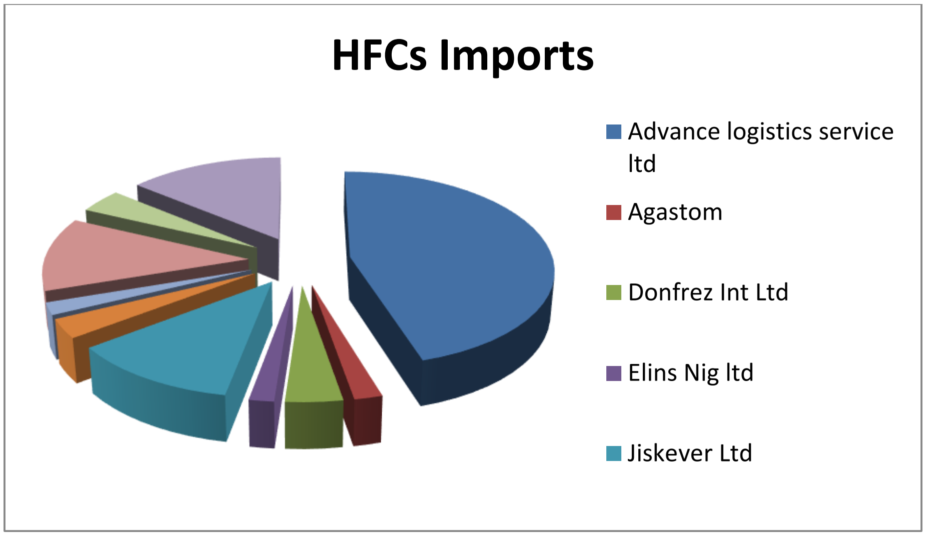

Fig 3.2: The Ten Major HFC Importers.

3.4 Amount and Trends of HFC Mixtures Use in Nigeria (2008 – 2014)

Table 3.3 shows HFC Mixtures use data from 2008-2014 in the country, which is also graphically shown in Fig.3.3. Between 2008 and 2014, about 3994.10 metric tonnes of HFC Mixtures were imported into the country, resulting in an annual average import of about 570.59 metric tonnes.

YEAR	HFC MIXTURES (MT)
2008	0
2009	1027.27
2010	0
2011	0.03
2012	563.66
2013	1346.91
2014	1056.23

Table 3.3: Nigeria: HFC Mixtures Imports, 2008 - 2014

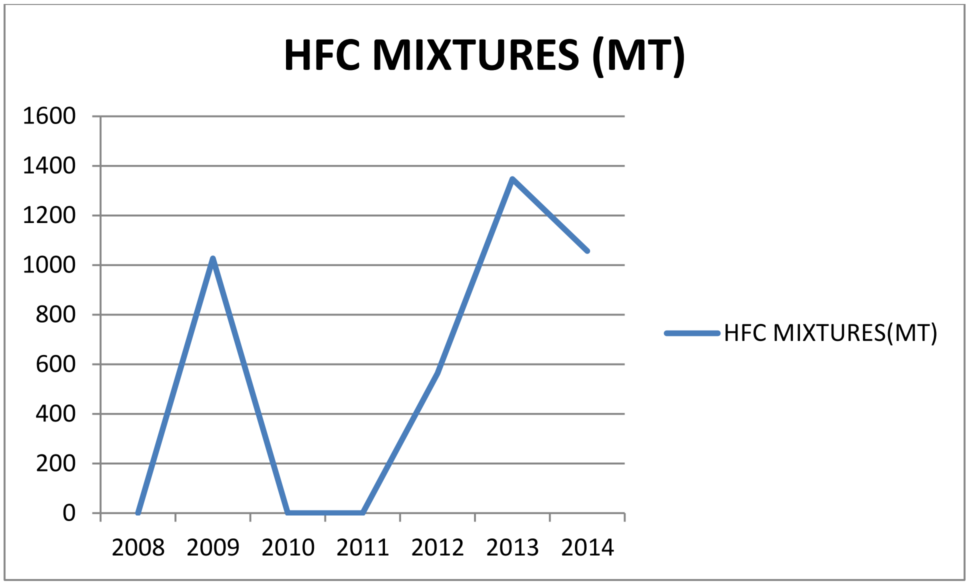

Fig. 3.3: Nigeria: HFC Mixtures Imports, 2008 – 2014

A close look at Table 3.4 and Fig. 3.4 shows a situation of zero importation of HFC-Mixtures in 2008 followed by a high importation figure of 1027.27 in 2009 and plunging back to zero in 2010. From this the country recorded a mere 0.03 metric tonnes in 2011 from where it rose to 563.66 and 1,346.91 metric tonnes in 2012 and 2013 respectively and finally 1056.23 metric tonnes in 2014. The imports as examined therefore do not exhibit any discernible downward or upward trend but an unpredictable undulating form over the seven years period. It is very difficult to explain why imports were null or quasi-null in 2010-11. Additional enquiry into these years of data may need to be undertaken in the future to understand better the long-term trends.

3.5 Composite Use of HFC-134a and HFC Mixtures in Nigeria (2008 – 2014)

Considering both HFC-134a and HFC Mixtures together shows that a total of 9,074.52 metric tonnes of both were imported into the country between 2008 and 2014, giving an average annual import of about 1,296.36 metric tonnes.

A **composite trend analysis** of both HFC-134a and HFC Mixtures was undertaken to see if there is a correlation between them. A close examination of both Table 3.4 and Fig. 3.4 shows an inverse relationship between the two in which imports of mixtures go up when the imports of HFCs are down and vice-versa. For example in 2009 when the import of HFCs was low, those for HFC Mixtures went up. In 2010 when the import of HFC-134a was highest, the import of HFC Mixtures was zero. It is essential to note that the composite trend also shows an irregular pattern, taking a downward direction from 2013.

YEAR	HFC-134a (MT)	HFC MIXTURES (MT)	COMPOSITE
2008	0.59	0	0.59
2009	48.53	1027.27	1075.8
2010	2862.46	0	2862.46
2011	589.47	0.03	589.5
2012	789.87	563.66	1353.53
2013	671.03	1346.91	2017.94
2014	118.47	1056.23	1174.7

Table 3.4: HFC-134a and HFC Mixtures Composite Imports, 2008 – 2014

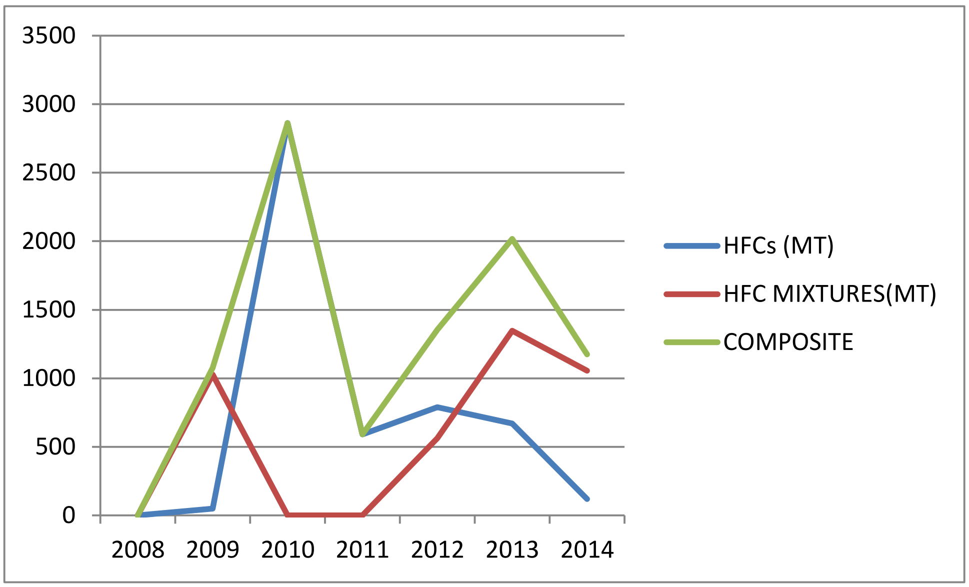

Fig. 3.4: HFC-134a and HFC Mixtures Composite Imports, 2008 - 2014

For this composite series, it is also difficult to identify trends. Please note that for these trends, the original ASYCUDA time series for HFC 134a has been used rather than the one using a modified figure for 2010.

Also, it should be underlined that mixtures containing HFCs (specifically R-410 which is specifically mentioned in this Inventory – other mixtures are much more costly) cannot be used in all applications instead of HFC-134a – so one should not assume that a reduction in HFC134a consumption can be completely compensated by an increase in HFC mixtures imports.

3.6 Prices of HFC-134a and HFC Mixtures.

Pricing could be a very potent tool to encourage or discourage the use or adoption of any product. All other things being equal, high prices will discourage use or adoption while low prices will promote use or adoption. It is within this context that attempt was made to examine the current price structures of HFCs (HFC-134a), HFC Mixtures and their low-GWP alternatives in the Nigerian market. In this section, we shall examine the price structure of HFCs (HFC-134a) and HFC Mixtures while the price structures for alternatives will be examined in chapter 4.

	2008	2009	2010	2011	2012	2013	2014
	₦	₦	₦	₦	₦	₦	₦
HFC-134a	-	1,325.5	1,323.5	1,400.0	3,000.0	2,500.0	2,350.0
R-410A	-	1,950.0	1,950.0	1,800.0	1,726.0	1,492.0	1,400.0

Table 3.5 HFCs (134a) & HFC Mixtures (410A): Prices per Kg, 2008 - 2014

1 U.S $ = ₦ 160 (2014)

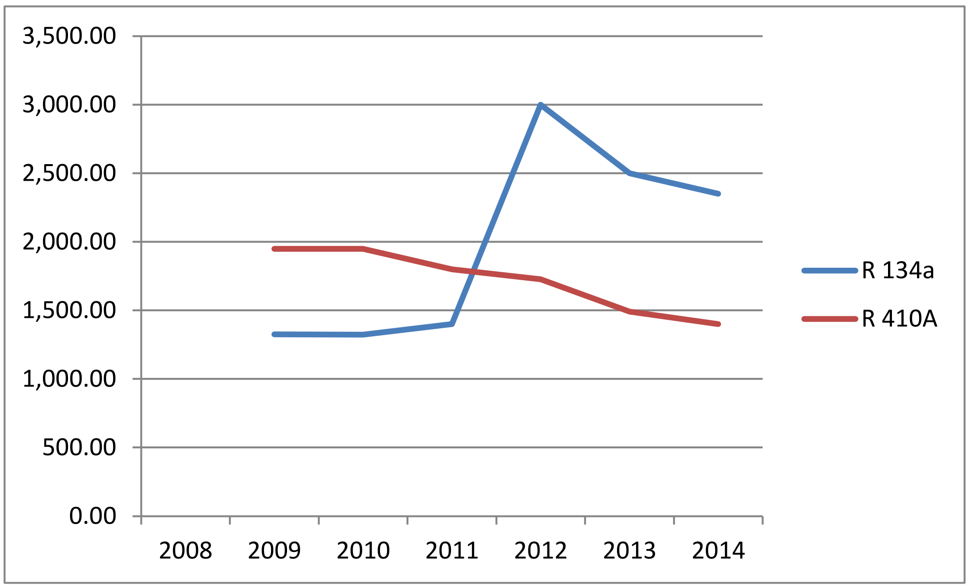

Fig. 3.5: HFCs (134a) & HFC Mixtures (410A) Prices per Kg, 2008 - 2014

Table 3.5 and Fig.3.5 show that R-410A has maintained a steady decrease in price per Kg from 2009 to 2014. On the other hand the price per kg of HFC-134a rose slightly in 2011 from its 2009 and 2010 price, after which it rose steeply in 2012 and made a fall in 2013 and continued this in 2014. Working on the prices of these through incentives and dis-incentive mechanisms may assist in the task of phasing down their use. The price trends shown above may point in the direction to go.

3.7 HFCs and HFC Mixtures Growth Projections.

Having an idea of the nature of future growth or otherwise of the substances under consideration will go a long way in assisting on the preparation of any future phase-down plan. It is on account of this that effort has been made in this section to estimate future growth in HFC-134a and HFC Mixtures use in the country.

From recent trends it is observed that future changes in HFCs and HFC Mixtures are highly uncertain. The multiplicity of factors that may influence future consumption patterns do not make predictions in this direction easy. These may be economic, technological, political or social in nature. Among economic factors is the general income level. Currently in Nigeria the debate is on-going on the need to increase wages nationwide, the outcome of which may influence appliance purchase as well as material to support their maintenance.

Changes in future expectations may also affect future consumption. Expectation of emergency and fear of shortage may affect its imports either negatively or positively. Aware of the above and other factors, the study adopts a simple growth trend analysis to estimate the immediate future use of HFCs and HFC mixtures in the country.

The task is accomplished by extrapolating the recent growth trend to the immediate future, 2015 to 2017. By using the observed annual growth rates from 2008 to 2014, we extrapolate for the years 2015, 2016 and 2017.

3.7.1 HFCs (HFC-134a) Growth Projection

Actual import figures obtained for the years under study are quite irregular and do not display any trend. This makes prediction of future consumption very difficult. This not withstanding an attempt will be made to predict future consumption based on past consumption, the limitations of which should be recognized.

The annual Percentage variations in 2009 and 2010 are so huge that the consultant felt these should not be used to derive the average growth rate, thereby leaving us with only figures for years 2011 to 2014.

YEAR	HFC-134a (MT)	ANNUAL % CHANGE
2008	0.59	-
2009	48.53	+8,125%
2010	2862.46	+5,798%
2011	589.47	-79.4%
2012	789.87	+34%
2013	671.03	-15%
2014	118.47	-82%

Table 3.6: Annual Percentage Change in HFC-134a Imports (2008 – 2014).

Using the figures for 2011 – 2014 in Table 3.7, the **average growth** rate is calculated as follows:

i. Derivation of average annual growth rate= 34% + -15% + -82%) /3 = -21%

ii. The base year figure for the projection is also taken as the average of 2011 – 2014 imports. That is: (589.47+ 789.87+ 671.03+118.47)/ 4 = 542.21 MT. With this as the base, the annual decrease rate of -21% applied for years 2015, 2016 and 2017 gives the forecast imports for the years as shown in Table 3.7, the trend of which is graphically shown in Fig 3.6

Year	Base (Average, 2011-2014)	2015	2016	2017
Import Projections (MT)	**542.21**	428.35	338.40	267.33

Table 3.7: Nigeria: HFC-134a Imports Projection, 2015 and 2017

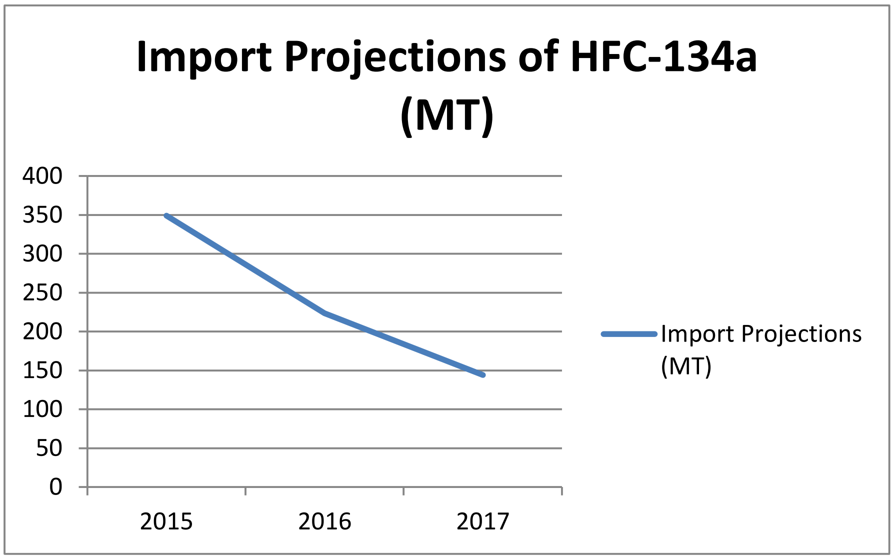

Fig.3.6: Nigeria: HFC-134a Imports Projection, 2015 and 2017

Given that import of HFCs is actually import of HFC-134a refrigerant which has application mainly in the domestic refrigeration sector and in some commercial refrigeration equipment where there is rapidly growing use of hydrocarbon refrigerant alternatives, the projection would appear to reflect potential future use pattern of the refrigerant. The establishment of a refrigerant grade hydrocarbon facility funded under the HPMP could facilitate the shift from HFC-134a to hydrocarbons given the easier availability, efficiency as well as economic and environmental advantages of the latter.

On the other hand, especially taken against the background of the current HCFC phase-out, where tonnes of HCFCs are expected to be phased out to be replaced by alternatives, including HFCs, the resulting consumption figures could be considered by some analysts to be very conservative, expecting HFC-134a to play a greater role as an alternative refrigerant.

However, since the above considerations are only predictions, their realization could be subject to future course of events.

3.7.2 HFC Mixtures Growth Projection

The increase and decrease of 2009 and 2010 even out. The variation between 2011 and 2013 is so huge (over 8000%) that such could not be used in projecting to the future. These situations leave us with variation percentages between 2012 and 2014.

YEAR	HFC MIXTURES (MT)	ANNUAL % CHANGE
2008	0	-
2009	1027.27	-
2010	0	-
2011	0.03	-
2012	563.66	-
2013	1346.91	+138.96%
2014	1056.23	-21.58%

Table 3.8: Annual Percentage Change in HFC Mixtures (2008 – 2014).

Using these as shown in Table 3.8, the **average growth** rate is calculated as follows:

i. Derivation of average annual growth rate = (138.96% -21.58%) /2 = 58.69%

ii. The base year figure for the projection is also taken as the average of 2012 – 2014 imports. That is: (563.66+1346.91+1056.23)/ 3 = 988.93MT. With this as the base, the annual increase rate estimate of 58.69% applied for years 2015, 2016 and 2017 gives the forecast imports for the years as shown in Table 3.9, the trend of which is graphically shown in Fig 3.7

	Base (Average, 2012-2014)	**2015**	**2016**	**2017**
Import Projections	**988.93 MT**	1,572.39 MT	2,500.11 MT	3,975.18 MT

Table 3.9: Nigeria: HFC Mixtures Imports Projection, 2015 and 2017

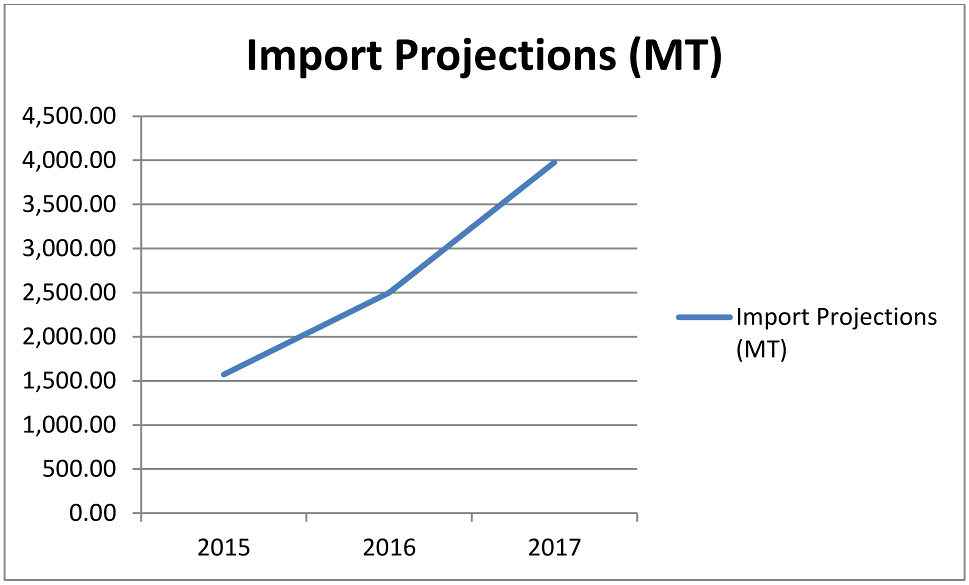

Fig. 3.7: Nigeria: HFC Mixtures Imports Projection, 2015 and 2017

3.8 Distribution Channels

A distribution channel is the path through which goods or services move from origin to the final consumer. In general, the length of the channel is said to be directly related to the price of a product. The longer it is the higher the price is likely to be. As we observed in an earlier section of this report, all other things being equal, high prices will discourage use or adoption of alternative low-GWP chemicals, while low prices will promote use or adoption. It is within this context that attempt was made to examine the distribution channels for HFCs. Also, in any planned HFC phase-down activity, it is very important to know the different hands the products get through before reaching the final end-user. Three channel types exist for the distribution of imported HFCs in Nigeria, which are briefly examined below.

3.8.1 Importers to End Users

This a situation in which an importer of the subject chemical sends the product directly to end-users, which are usually manufacturers of products in which HFCs are used. There are several of these.

3.8.2 Importers to Retailers to End Users

This is a situation in which the importer sells to a retailer, who in turn sells to the final user. The retailers usually buy in bulk and then split the bulk to sell in smaller quantities to end-users. This is the common channel for end user technicians. Some of the well-to-do technicians act as retailers to their fellow technicians.

3.8.3 End User Importers

There are some end-users that import directly. These are usually big companies such as Haier / Thermocool and Nigeria Engineering Works (NEW).

Fig. 3.8 shows the three different channels of distribution.

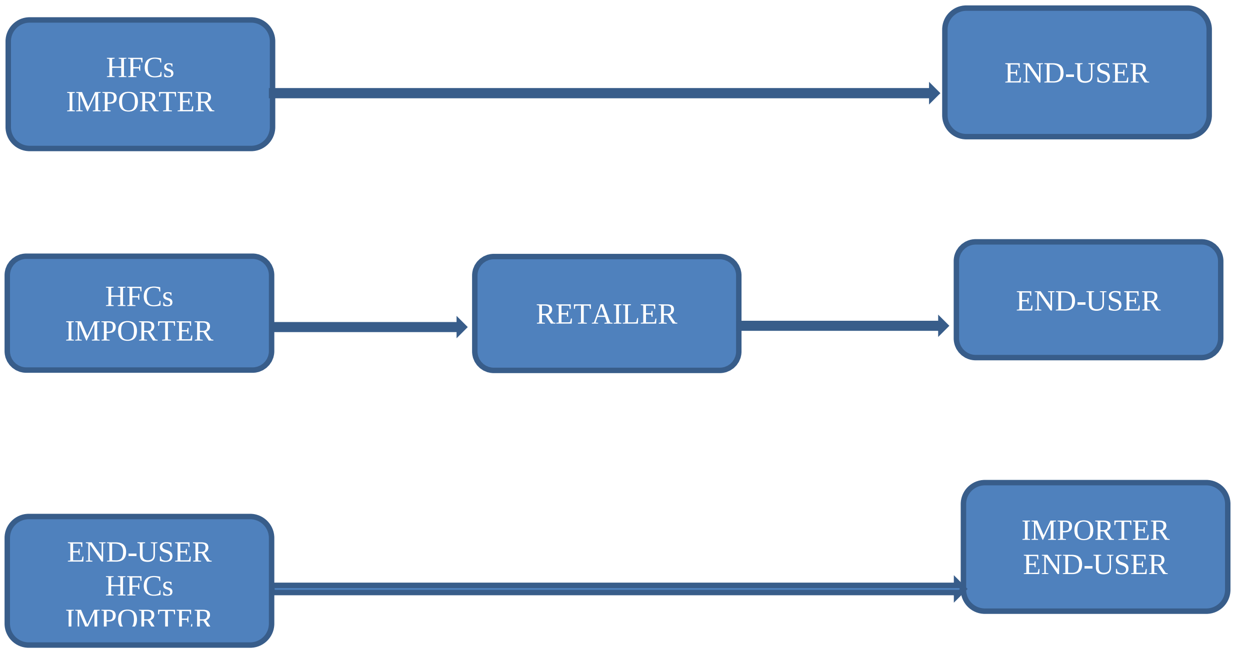

Fig. 3.8: Channels of HFC Distribution

Chapter 4: Low GWP Alternatives

Several low GWP Alternatives are available for the replacement of HFCs which are already in use in many parts of the world. In this chapter we shall examine those that are already in the Nigeria market and these include hydrocarbons, ammonia and water. In discussing them we shall examine their use trends and price structures as we did for HFCs in the preceding chapter, except for water systems on which we do not currently have statistical data. We will also examine the local opportunities and challenges that the low GWP alternatives present.

4.1 Trends in Use of Low GWP Alternatives in Nigeria (2010 – 2013)

4.1.1 Hydrocarbons

An hydrocarbon is “an organic compound containing only carbon and hydrogen. Hydrocarbons are often referred to as “natural refrigerants.” Natural refrigerants are substances that occur in nature which can be used in refrigerators and air-conditioners. They do not harm the ozone layer and have limited climate impact. They are also said to be cheaper and more energy efficient than their synthetic counterparts. Hydrocarbon types currently in use for refrigeration purposes in Nigeria include butane and isobutane.

4.1.1.1 Butane and Isobutane

Isobutane (R-600a) systems contain 40 percent less refrigerant charge than HFC-134a systems. As much as 95% of HFC-134a systems in European domestic refrigeration may have been replaced by isobutane. Many of the new domestic refrigeration in Nigeria carry European standards labels. As a result, isobutane is becoming widely used in the country. In view of the fact that Butane and Isobutane carry the same HS Codes, the data got from the Customs Service lumped the two together, which is why the two are being considered together here.

Table 4.1 shows butane and isobutane use data from 2008-2014 in the country, which is also graphically shown in Fig.4.1.

YEAR	BUTANE/ISOBUTANE (MT)
2008	1572.20
2009	31711.67
2010	2433.41
2011	2496.37
2012	772.67
2013	1853.58
2014	2350.05

Table 4.1: Nigeria: Butane and Isobutane Imports, 2008 – 2014

An examination of Table 4.1 and Fig.4.1 shows a figure of 1,572.2 metric tonnes of imports of Butane and Isobutane in 2008, which dramatically increased to 31,711.67 metric tonnes in 2009, a staggering increase of 1917%. The figure plunged down by 92% to 2433.41 metric tonnes in 2010, maintaining around the same figure the following year and raising again to 1853.58 metric tonnes and 2350.10 metric tonnes in 2013 and 2014 respectively, all of which are graphically shown in Fig. 4.1.

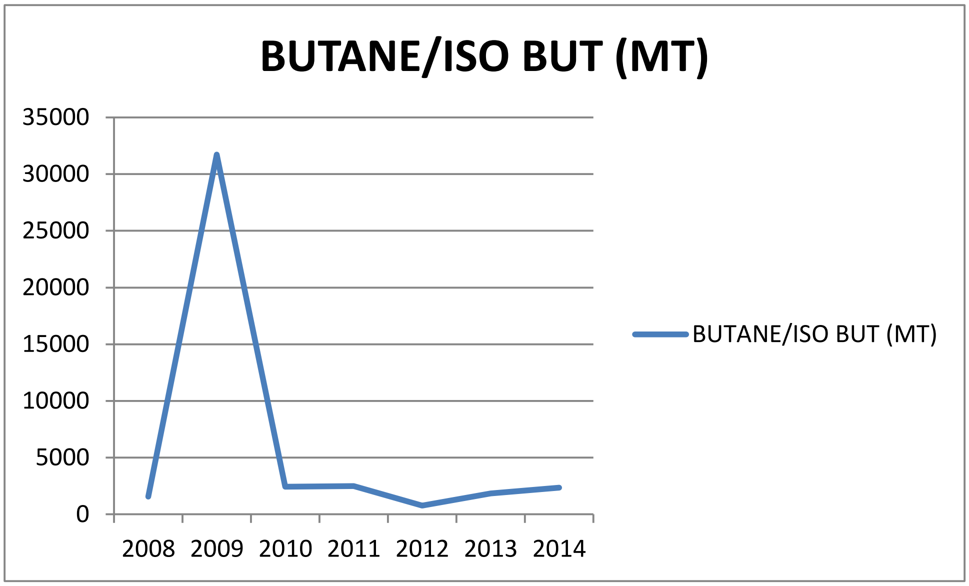

Fig. 4.1: Nigeria: Butane and Isobutane Imports, 2008 - 2014

It should be noted that butane and isobutane are not solely used as refrigerants in the country. Other application areas include gasoline blending as a fuel gas and propellant for aerosol cans and foam products.

4.1.1.2 Propane (R-290)

Propane is a 3-carbon alkane with the molecular formula C_3H_8. It is a gas that can be compressed to liquid and a by-product of natural gas processing and petroleum refining. Propane is non-ozone depleting and has a very low GWP which is only 3.3 times the GWP of carbon dioxide.

The analysis here uses the import data in respect of R-290 got from the Customs Service from 2008 to 2014. Table 4.3 shows R-290 import data from 2008 - 2014 in the country, which is also graphically shown in Fig. 4.3.

YEAR	PROPANE (MT)
2008	347411.68
2009	15.87
2010	27.19
2011	14.56
2012	10.02
2013	41.47
2014	26.42

Table 4.2: Nigeria: Propane (R-290) Imports, 2008 – 2014

An examination of Table 4.3 and Fig.4.3 shows a huge import of 347,411.68 metric tonnes of R-290 in 2008, which plunged to 15.87 metric tonnes in 2009. Imports rose a little to 27.20 metric tonnes in 2010 after which it dropped to 14.56 and 10.02 metric tonnes in 2011 and 2012 respectively. It rose again to 41.47 metric tonnes in 2013 and down to 26.42 metric tonnes in 2014.

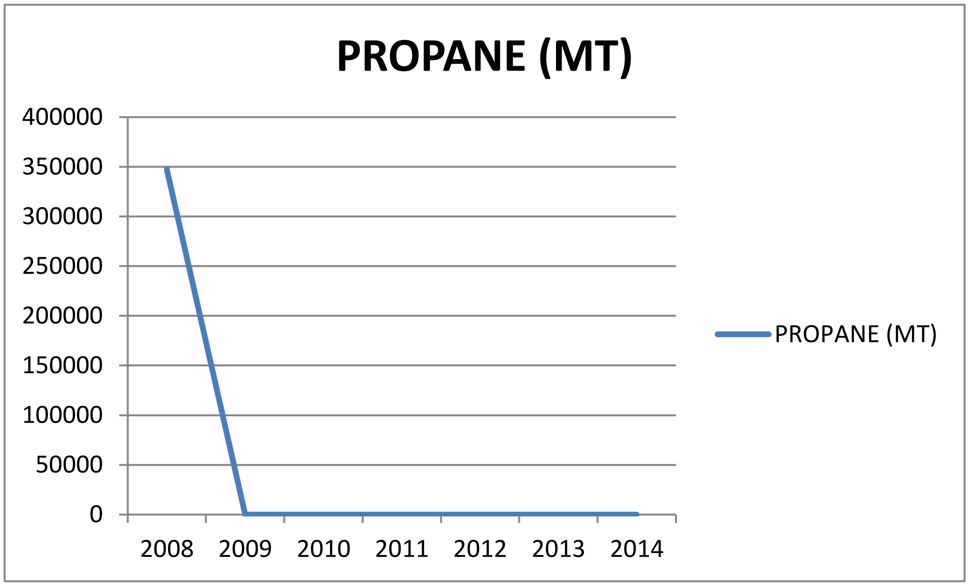

Fig 4.2: Nigeria: Propane (R-290) Imports, 2008 - 2014

It should be noted that now, Propane could be locally sourced which might have accounted for the low import figures from 2009 onwards. It should also be noted that like butane and isobutane, propane is not solely used as refrigerants in the country. Other application areas include domestic, industrial and motor fueling.

4.1.2 Ammonia

Ammonia is a compound of nitrogen and hydrogen with the formula NH_3.

Ammonia is mainly used in agriculture as fertilizer. It is used as a refrigerant gas, for purification of water supplies, and in the manufacture of plastics, explosives, textiles, pesticides, dyes and other chemicals and of course it is used as a refrigerant gas. As with hydrocarbons, Ammonia is also classified as a natural refrigerant.

Table 4.3 shows ammonia import data from 2008-2014 in the country, which is also graphically shown in Fig.4.3.

YEAR	AMMONIA (MT)
2008	11457.97
2009	8313.51
2010	13529.48
2011	40.40
2012	10.31
2013	21.88
2014	592.81

Table 4.3: Nigeria: Ammonia Imports, 2008 - 2014

A look at Table 4.5 and Fig.4.5 shows an entry of 11,457.97 metric tonnes of imports of this substance, which made a drop to 8,313.51 metric tonnes in 2009, a decrease of about 27.40%. The figure made another rise to 13,529.48 metric tonnes in 2010, a rise of 62.74%, drastically reducing in 2011, 2012 and 2013 to less than 50 metric tonnes and finally rising to 592.81 metric tonnes in 2014.

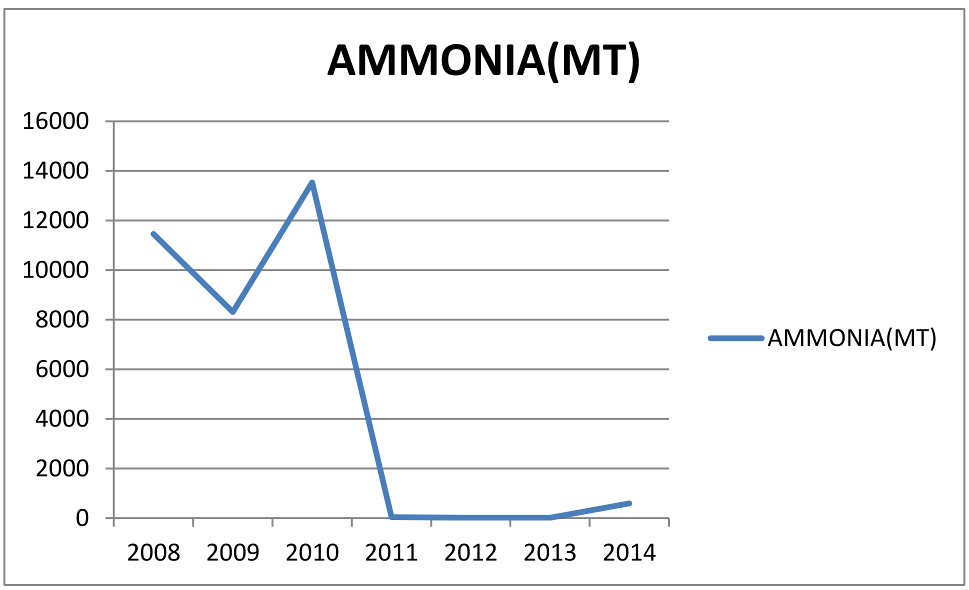

Fig 4.3: Nigeria: Ammonia Imports, 2008 - 2014

As it is with some of the chemicals we have examined in this study, we are unable to explain the huge difference in ammonia import from a huge 13,529.48 metric tonnes import in 2010 to less than 50 metric tonnes in the three years that followed.

Ammonia is a very good refrigerant, but toxic and carrying a risk of explosion. It is only big companies such as Guiness Nig Plc and Fan Milk which are able to deal with the safety issues involved with its use that use ammonia in their production systems.

It should also be noted that Ammonia is not only used as refrigerant, but has other application areas, such as agriculture.

4.1.3 Water

A low GWP alternative that presents itself in Nigeria is **water**. Often described as the long term solution blowing agent, water is not flammable, has zero ODP and low GWP. It is also cheap

but has limitations for both foam processing and final foam properties.

Though foam density is substantially higher, good adhesion and foam surface quality are more difficult to achieve.

Though we have no statistical data on volume of use, we know that the Automotive Component Industries Ltd (ACI), Kaduna uses a water-based system for the production of vehicle seats. The company was assisted under the Montreal Protocol to use water as its blowing agent. The prospect for the use of water as blowing agent seems very bright in Nigeria.

4.2 Price Structures of some Low GWP Alternatives

On a general premise, the price of a commodity may determine how much of the commodity is consumed. This makes "pricing" therefore a very potent tool for controlling the use of a product. It comes very important then to know the price structures of low GWP alternatives in the country. Table 4.4 below shows the prices of a few of the low GWP alternatives available on the Nigerian market, from 2008 to 2014. The price trends for the alternatives come out as shown in Fig 4.7.

Chemicals	**Prices in Naira (₦) Per Kg.**						
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
R-600	1,250	1,200	1,200	900	900	800	800
R-600a	1600	1550	1500	1500	1,400	1,300	1,300
R-290	740	720	700	500	500	400	400

Table 4.4: ***Prices of some Low GWP Alternatives*** **available in Nigeria**

1 U.S $ = N 160 (2014)

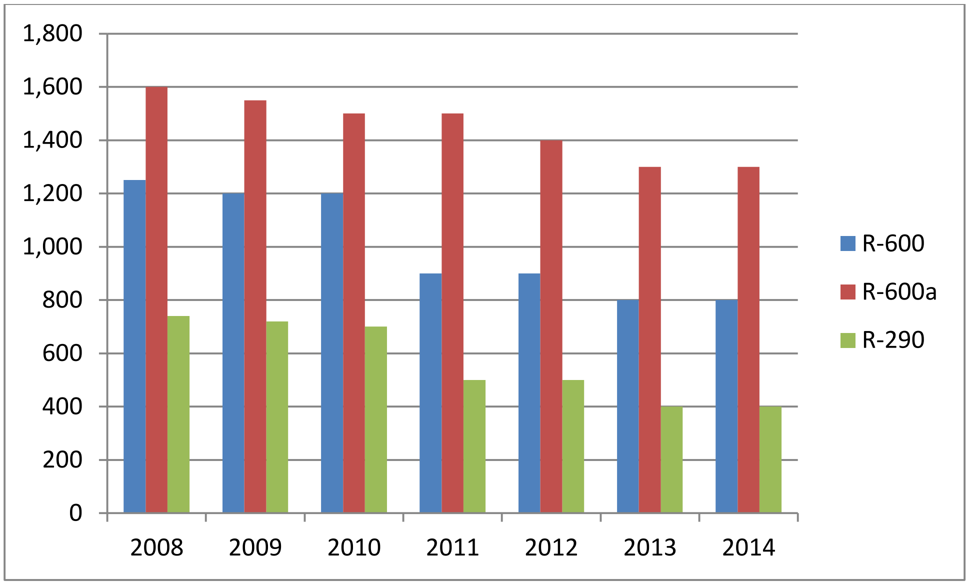

Fig. 4.4: ***Prices of some Low GWP Alternatives*** **available in Nigeria**

A look at Fig 4.4 shows that R600a carries the highest price tag followed by R600, with R290 carrying the lowest price tag. In general, all the alternatives show downward trends in prices between 2008 and 2014.

An attempt was also made to compare the prices of HFC and HFC Mixtures with low GWP alternatives as shown in table 4.5 and Fig 4.5.

A close examination of both Table 4.8 and Fig 4.8 shows that the prices of both HFC-134a and HFC Mixtures R-410A are generally higher than the low GWP alternatives. Also the prices of the alternatives seem to be falling faster than for HFC and Mixtures. These observations are generally good for a shift from HFC to alternatives, all other things being equal.

Chemicals	**Prices in Naira (₦) Per Kg.**						
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
R 134a	-	1,325	1,323	1,400	3,000	2,500	2,350
R 410A	-	1,950	1,950	1,800	1,726	1,492	1,400
R-600	1,250	1,200	1,200	900	900	800	800
R-600a	1600	1550	1500	1500	1,400	1,300	1,300
R-290	740	720	700	500	500	400	400

Table 4.5: ***Prices of HFC-134a, HFC Mixture (R-410A) and some Low GWP Alternatives*** **available in** ***Nigeria (2008 – 2014).*** 1 U.S $ = N 160 (2014)

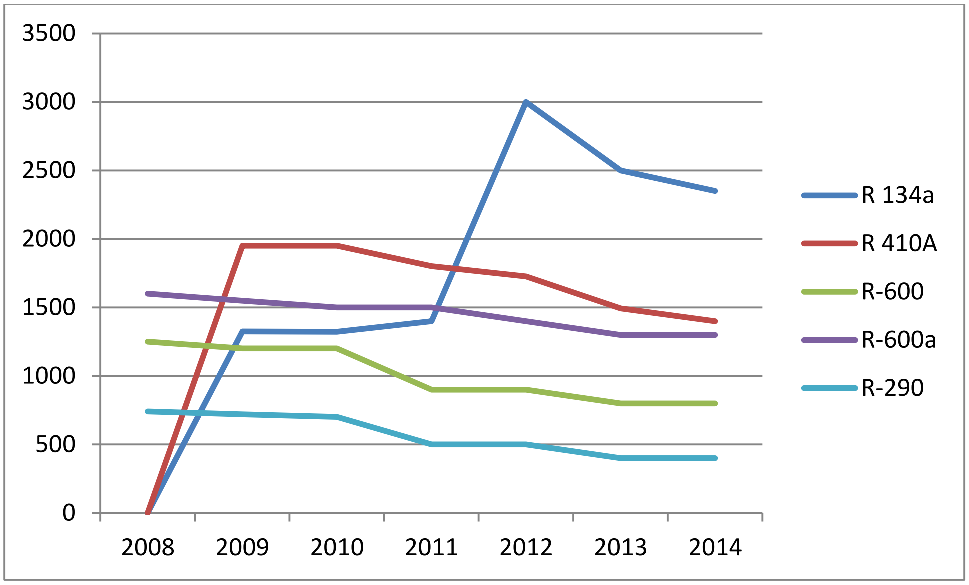

Fig. 4.5: ***Price trends of HFC-134a, HFC Mixture (R-410A) and some Low GWP Alternatives*** **available in *Nigeria (2008 – 2014)***

4.3 Opportunities and Challenges

In the immediate sections that follow we shall examine the opportunities and challenges that present themselves for a transition from HFCs to low GWP alternatives in the country. These will surely help in any future HFC phase-down plan for the country.

4.3.1 Opportunities

4.3.1.1 Hydrocarbon Production in Nigeria

Nigeria had relied on imported refrigerants to support its refrigeration and air-conditioning sector. Currently an opportunity is unfolding itself that will enable the country to produce HC as refrigerant. This is a great opportunity for the phase down of HFC and HFC blends in the country.

Pamaque Nig. Ltd, in collaboration with the Government of the Federal Republic of Nigeria, and with co-funding support from the Multilateral Fund of the Montreal Protocol on Substances that Deplete the Ozone Layer, is undertaking a "Demonstration Project for the Production and Safe use of Hydrocarbons in Refrigeration Servicing Applications in Nigeria" (as part of the HCFC Phase out Management Plan). The demonstration project consists of the design, construction and start-up of a pilot distillation and bottling unit for hydrocarbon refrigerants from locally produced Liquid Petroleum Gas (LPG). The project which has passed the trial stage will have as products R-600; R-600a; R-290; R1270 and a blend of 50/50 of R-600a and R-290. The products are planned to be introduced to the Nigerian market in 2015. This will help any future HFCs phase down programme not only in Nigeria but also in the West African sub region.

4.3.1.2 Big Companies Phasing Down

Some big companies are already taking self-driven initiatives to phase down HFCs. An example is Unilever, favoring natural refrigerants. Unilever in Nigeria holds a large proportion of the ice cream market share. This company's production facilities in Nigeria may have converted to the use of natural refrigerants as attested to by Thomas Lingard, the global advocacy director of Unilever who said that "almost all our production facilities and cold stores already use ammonia in their refrigeration systems…." Also for the point-of-sale ice cream cabinets he said "since 2004, we have been rolling out new climate-friendly freezers using an HC refrigerant." (UNEP, 2012).

4.3.1.3 Local Production of Methyl Formate-based foam.

As with refrigerants, Nigeria had hither-to relied on imported foam-blowing agents for rigid foam production. An opportunity has also appeared on the horizon in this respect. Currently VITAPUR, a subsidiary of VITAFOAM Plc, in collaboration with the Government of the Federal Republic of Nigeria, and with co-funding support from the Multilateral Fund of the Montreal Protocol on Substances that Deplete the Ozone Layer, is setting up a System House for the production of Methyl Formate-based foam in the country. Methyl Formate is non-ozone depleting and has a low GWP. The project which will be commissioned in 2015 presents great opportunities for a shift from the use of HFC-based foam blowing agents, such as HFC-245fa and HFC-365mfc to a low GWP alternative, not only for Nigeria but also for countries of the West African sub-region.

4.3.2 Challenges

There are challenges to the adoption of low-GWP alternatives in Nigeria, some of which are discussed in this section.

4.3.2.1 Safety Risks occasioned by Flammability and Toxicity Issues:

The issue of high flammability for hydrocarbon and toxicity for ammonia are issues of concern for their widespread adoption in Nigeria bearing in mind the likely low level of the education of the workforce in facilities that will use these substances. The ability to keep to required technical standard of safe handling of the substances is low, which increases the risk factor. With hydrocarbons however, technicians can be trained on how to handle substances safely.

4.3.2.2 Technical Know-how

Insufficient technical know-how in many instances in companies, a lack of practical skills among technicians, may stand as a barrier. Information dissemination, through training courses for technicians and technical staff may help with this challenge.

4.3.2.3 Technology Change Fatigue

Many of the end user companies that may need to convert from HFCs have just completed change over to a new technology occasioned by the move away from ODS-based processes. For some of them the change took several years. This experience may stand as barrier for another conversion, for some may be wary of undertaking another conversion that may last some years.

4.4 Potential Impacts of Transition to Low-GWP Alternatives

A transition from HFCs to low-GWP alternatives in Nigeria will undoubtedly contribute to the lessening of HFC loading in the atmosphere, thereby helping climate. A shift by Nigeria is likely to influence similar shifts by other West African countries. The countries are already showing interest in the successful completion of the prototype HC production system in Nigeria. This positive influence is likely to go beyond the West African sub-region, for example a Northern African country has expressed interest in the Nigeria project and has visited the production facility.

4.5 HFC and HFC Mixtures Emission Reduction

A prelude action to switching to HFC substitutes is the taking of measures that will help to reduce HFC emissions. In the considerations that follow, we shall examine some emissions reduction strategies. These may in fact be considered for implementation long before putting in place a full-fledged HFC Phase-down plan.

4.5.1 Emission Reductions through Policies

Any emission reduction strategy or action will rely on a good policy base for such strategies or action to thrive and stand the test of time. In view of this the government would need to promote policies that support emission reduction programmes and activities.

4.5.2 Emission Reductions through Best Practices

The sectors that are most likely to lead to any meaningful emission reduction gains are the refrigeration and air-conditioning sectors. Key to success in this lies in the adoption and institutionalization of “best-practices” in the daily professional engagements of technicians. Fundamental to this is training: the technicians will need to be well trained.

A solid foundation has been laid for this in Nigeria during the CFC Phase Out years, and now through the HCFC Phase Out Management plan.

The elaborate technicians training programme, which lasted from 2006 to 2011 started with the designation of 26 training centres in the nation for the training programme. In a train-the trainer programme in 2006 and 2007 a set of trainers were trained in ‘good refrigeration management practices” by an international trainer from the Heat, Refrigeration and Air conditioning Institute (HRAI) of Canada. The objectives of the training-the-trainers workshops which attracted participants from the designated training centres were to:

- increase participant awareness on Ozone Layer depletion and ODS issues.
- provide information on the proposed regulation on ODS phase out.
- introduce and demonstrate procedures that eliminate refrigerant emissions during preventive and unscheduled maintenance.
- provide hands-on training on retrofitting CFC-12 based domestic refrigerators to operate on Hydrocarbon blends.

- provide basic refrigeration tools to enable practice good refrigerant management.
- stimulate development of a network for information sharing throughout the sector.
- certify participants complete the training.

The train-the-trainers programme was followed thereafter with the training of about 4155 refrigeration practitioners in 2008; 5000 in 2009, and 540 in 2010/11. This makes a total of over 9,600 technicians trained in "good refrigeration practices". The training centres are still intact, are useful for the implementation of the HPMP, and would serve a "best practices" technician programme under an HFC emission reduction programme.

4.5.3. Emission Reductions through Design and Technology Advancements

There is great scope in Nigeria for the use of design and technology advancement to achieve HFC emission reduction. For example, evolution of environmentally friendly design and use of locally based materials that will require less cooling in residential and office quarters will lead to less reliance on mechanical cooling using HFCs and HFC Mixtures. There are signs that such designs and trial of materials are already surfacing, with prospects for HFC emission reduction gains. The advancement of this could be government policy-driven.

Chapter 5: Policies, Structures and Actions to ensure HFC Emissions Reduction

In this section we would briefly examine Policies, Structures and actions that may need to be undertaken in order to ensure HFC emission reduction in Nigeria. The discussion draws, in particular, from the experience gained in the implementation of the National CFC Phase Out Plan in the Country between 2002 and 2010, which had been adjudged one of the best in Africa.

5.1 Emission Reductions through Policies and Legislation

For a change to the use of low GWP alternatives that will eventually lead to HFC emission reduction, there will be the need to put in place legal and policy structures that will promote HFC phase down activities. Currently there are no legal restrictions or control on the importation of HFCs into the country. The process for the imposition of restrictions and import control often takes time to conclude. This is why the process has to start as early as practicable. In this the role of advocacy should not be under rated. This will surely help in influencing changes in policies and legislation. The Federal Ministry of Environment has a leadership role to play in ensuring that necessary actions are undertaken to hasten the move to a change from HFC use to other low GWP alternatives.

5.2 Putting in place an HFC Phase Down Plan.

The putting in place of a national phase down plan should be one of the first steps to be taken by the country. The plan should lay down the activities to be undertaken to phase down the use of HFCs in the country. It should serve as a road map to lead the country from where it is now with HFC consumption to where it intends to go with HFC phase down. The plans should endeavor to involve all stakeholders in its preparation.

5.3 Achieving emission reduction through containment control (e.g. through obligatory leakage checks)

One of the successful policy approaches in other countries in managing HFCs and particularly in the European Union has been the containment control of HFCs in equipment. Building on the positive experiences tested in other countries to reduce the impact of HFCs, this could be considered in Nigeria.

Nigeria is in the process of amending the Ozone regulation to give consideration to HFC issues. The regulation could prescribe “containment control” through mandatory leakage checks requirement. This will go a long way to help reduce emission through leakage minimization.

5.4 Phase Down Funding Assistance

The huge success recorded in the implementation of CFC phase out programmes in the developing world in the nineties and first decade of the millennium was in part due to the funding mechanism adopted by the Multilateral Fund of the Montreal Protocol. Under this arrangement funding was made available to developing countries for agreed incremental costs associated with ODS Phase Out through the Multilateral Fund of the Montreal Protocol.

Provision of funding assistance to developing countries for them to fulfill their binding phase out obligations is a strong pillar of this “proven model”. A similar mechanism applied to HFC phase down will make manufacturers in the developing countries to respond favourably to the goals of HFC Phase down.

5.5 Import Licensing and Monitoring System.

The import licensing and monitoring system was one of the major instruments of import control employed under the Montreal Protocol. It was successfully used during the CFC phase out years and is still in use under the current HCFC phase out dispensation. This instrument of import control will still be useful in any HFC phase down effort.

5.6 Technical Support and Training

Enterprises billed for phase down would need to be technically supported in the process of phase down. This can in-fact reduce the pains that constitute “conversion fatigue”. This was ingeniously used in the foam sector to assist investment projects beneficiaries to develop formulations for ODS alternatives. It has been noted that this support was responsible for the huge success recorded in the rapid phase out of HCFC-11 in the Foam sector.

As hinted earlier, technicians will need to be trained on how to safely handle hydrocarbons because of the safety issue concerns about this substance.

5.7 Public Awareness

In implementing any phase down activity in the country, public awareness raising will play a central role. Any awareness raising effort will find the trade associations quite useful.

5.8 Fiscal Controls

The subsidies and taxation concepts could be used to advantage to help transition to low-GWP alternatives in the country. Subsidies are measures that keep prices for consumers below market levels or for producers above market levels or reduce costs for consumers and producers. These were used to advantage in phasing out CFCs in the country. Every fiscal year the Government set import taxes that has to be paid on imported goods. Goods intended to be discouraged are given high taxes while those that intended to be encouraged are given low taxes and in some cases no tax at all. This could be used to advantage to help promote low GWP alternatives and discourage the use of HFCs. Subsidies may also be given to promote solutions based on low-GWP options.

Government may also wish to provide subsidies for activities that lead to emission reduction, which could come in various forms.

Chapter 6: Summary of Findings and Conclusions

6.1: Summary of Findings

In line with the objectives of the study, the consultants used HFC import data entries obtained from the ASYCUDA system of the Nigeria Customs Service for 2008 to 2014, authenticated on occasion with NAFDAC's data, to undertake an inventory of HFCs, HFC Mixtures and low GWP alternatives available on the Nigeria market. The analysis undertaken leads to the following findings:

a. Import of HFCs into Nigeria between 2008 and 2014, which is solely HFC-134a, totaled about 5080.42 metric tonnes, giving an annual average import of about 725.77 metric tonnes.

b. The imports trend for HFCs (HFC-134a), for the current study period, is very difficult to establish because it oscillates from year to year, sometimes very steeply.

c. Import of HFC Mixtures into Nigeria between 2008 and 2014 was about 3,994.10 metric tonnes, resulting in an annual average of about 570.59 metric tonnes.

d. Similar to the case of HFCs, the imports trend, for HFC Mixtures, during the current study period, is also difficult to establish because it oscillates from year to year, also, sometimes very steeply.

e. The imports into Nigeria of both HFCs and HFC Mixtures between 2008 and 2014 was in the total amount of 9,074.52 metric tonnes, which gives an average annual imports of about 1,296.36 metric tonnes.

f. Estimating the future imports of both HFCs and HFC Mixtures was a very difficult task. This notwithstanding, future import estimates under some assumptions points towards a decreasing import trend for HFCs and an increasing import trend for HFC Mixtures, based on the analysis of past trends.

g. Prices of HFCs (HFC-134a) and HFC Mixtures as well as low GWP alternatives in the Nigerian market have been decreasing over the years since 2008, with the prices of low GWP alternatives generally lower than those of the HFC-134a and HFC Mixtures.

h. Three types of HFCs distribution channels exist in the country, which include: importers to end users; importers to retailers to end users; and end-user importers.

i. Several low GWP alternatives for the replacement of HFCs and HFC Mixtures are available and in use in Nigeria, which include: hydrocarbon refrigerants (butane/isobutane; propane); ammonia; and water.

j. Opportunities presenting themselves in Nigeria for a transition from HFC use to low GWP alternatives include: production of hydrocarbon refrigerants in the country; big companies such as Unilever phasing out the use of HFCs voluntarily; and local system house for Methyl Formate by Vitapur.

k. Challenges to the adoption of low GWP alternatives in the country include:

- safety risks occasioned by the flammability and toxicity of some low GWP alternatives

- Insufficient technical know-how on the part of key stakeholders
- Technology change fatigue by companies using HFCs.

l. Policies, structures; and actions to ensure HFCs emission reduction examined in the study include:

  - Emission reduction through policies and legislations
  - Putting in place an HFC Phase Down Plan
  - Providing Phase Down Funding assistance
  - HFCs import licensing and monitoring system
  - Provision of Technical support and training
  - Public awareness; and
  - Use of fiscal control mechanisms

6.2: Conclusions

It can be inferred from the above discussions that though some challenges may present themselves, the prospect for a quick and smooth transition from high-GWP HFCs to low GWP alternatives in Nigeria is very high. HFC consumption continues to show a downward trend, while some low GWP alternatives are already available and in use in the country. Another big advantage is the policy of the Government to support local production of HC and Methyl Formate. The successful accomplishment of these projects will surely assist in the move away from HFC use in the country. Also, big multi-national companies like Unilever are currently promoting a move away from HFCs, thereby presenting a good prospect for a mass transition. In the face of some challenges that present themselves, the prospect for a shift away from HFC use will need to be driven by the right policies; legal framework; institutional structures and actions.

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