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FINAL REPORT

ON

PREPARATION OF CFC PHASE-OUT STRATEGY FOR REFRIGERATION AND AIR-CONDITIONING INDUSTRIES AND SERVICES IN NIGERIA

(UNIDO CONTRACT NO. 95/057/AV)

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A. EXECUTIVE SUMMARY

A1. BACKGROUND

A1.1 The Montreal Protocol was developed as an international reaction to limit the adverse effects of CFCs on the stratospheric ozone layer. At inception, the Protocol defined measures that signatory countries must take to limit production and consumption of Five CFC's and Three halons. The Protocol was later reviewed (in the London amendment) to include controls in ten more CFCs, CTC and methyl chloroforms.

A1.2 Nigeria participated actively in all negotiations leading to the Montreal Protocol. Infact, it is on record that Nigeria co-sponsored the resolution of Article 5 of the Protocol concerning the special needs of developing countries. The country signed and ratified the Protocol on 31st October 1988. By May 1994, the Protocol has been ratified by over 130 countries.

A1.3 Since becoming a member, the country has taken steps towards the protection of the ozone layer. These include, empowering FEPA, through the FEPA decree of 1988, to control environmentally harmful substances especially CFCs and Halons that are known to affect the ozone layer. Consequently, FEPA has been collaborating with relevant organizations such as the World Bank, UNIDO etc. in efforts geared towards implementing the Montreal Protocol. FEPA has also put in place an ozone office in the Abuja Head quarters.

A1.4 Under the Montreal Protocol, member countries established in 1990 an interim multilateral fund (now called Multilateral Fund) to assist qualified signatory developing countries meet incremental costs that may result from their

implementing the phase out provisions of the Protocol. Developing countries with ODS consumption of less than 0.3 Kg per capital (such as Nigeria) qualify to benefit from the fund. However, a prerequisite activity for obtaining financial assistance from the fund is the preparation of the country programme. The current effort sponsored by UNIDO is considered a vital input to the Nigerian country programme.

A1.5 This report titled "Preparation of CFC phase-out strategy for refrigeration and Airconditioning Industries and services in Nigeria" contains historical and current ODS use in Nigeria as well as unconstrained projection of ODS consumption to the year 2010. The report also include detailed consideration of alternative ODS Phase-out Scenarios, including estimates of incremental costs that are expected from a complete ODS phase-out. It also includes an assessment of the current recommendation of future policy framework and, action-plan for Nigeria Government including highlights of viable projects especially in the refrigeration and airconditioning sector for which the country may seek assistance from the Multilateral Fund.

A2. STRUCTURE OF ODS USE IN NIGERIA

A2.1 No company produces ODSs in Nigeria. The country's total ODS consumption is met through importations which is carried out by a limited number of companies with contacts in producing countries of Europe, USA and lately Asia. The total annual ODS consumption has been equated to the total ODS import.

A2.2 The total ODS import into Nigeria in 1994 is estimated at about 1157.0 ODP tonnes of which CFC-11 and CFC-12 account for about 85% (See Table A1).

TABLE A1: CONSUMPTION OF ODS IN NIGERIA IN 1994 BY SUBSTANCE

SUBSTANCES CONTROLLED BY THE MONTREAL PROTOCOL	CONSUMPTION IN METRIC TONNES	ODP FACTOR	CONSUMPTION IN ODP TONNES
GROUP I ANNEX A			
CFC - 11	206.7	1.0	206.7
CFC - 12	772.3	1.0	772.3
CFC - 114	7.2	1.0	7.2
CFC - 115	8.2	0.6	4.9
Sub-Total	**994.4**		**991.1**
GROUP II ANNEXE A			
Halon 1211	-	3.0	-
Halon 1301	3.5	10.0	35.0
Sub-Total	**3.5**		**35.0**
GROUP I ANNEX B	-	1.0	-
Sub-Total	-		-
GROUP II ANNEX B			
Carbon tetrachloride	96.0	- 1.1	105.6
Sub-Total	**96.0**		**105.6**
GROUP III ANNEX B			
1,1,1 -trichloromethane	254.0	0.1	25.4
Sub-Total	**254.0**		**25.4**
TOTAL	**1,347.9**		**1,157.1**

A2.3 The biggest end-user of ODS in Nigeria is the refrigeration and airconditioning sectors responsible for about 75% of the total ODP tonnes in 1994. Others include manufacture of flexible foams; aerosol production; fire fighting equipment, and industrial solvents. (See Figure A1)

A2.4 The domestic refrigerator and deep freezer sub-sectors use large quantities of CFC-11 and CFC-12. CFC-11 is used predominantly as foam blowing agent while CFC-12 is used for charging new appliances and/or servicing used ones. (See Table A2). Most Industrial refrigeration systems now use HCFC-22 as refrigerant while very few still use CFC-502.

FIG. A1: PERCENTAGE USE OF ODS BY SECTOR IN NIGERIA (1994)

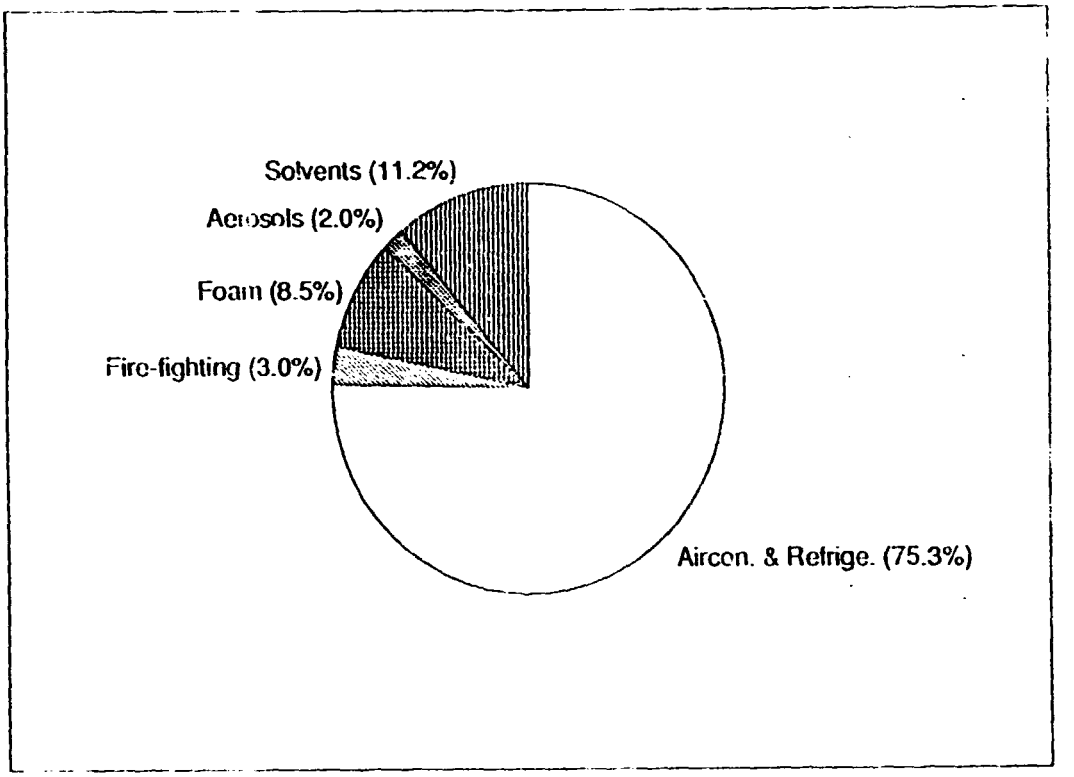


TABLE A2: STRUCTURE OF ODS CONSUMPTION IN NIGERIA BY TYPE AND APPLICATION

USER SECTOR	SUBSTANCE	APPLICATION
(A) REFRIGERATION		
(i) DOMESTIC REFRIGERATORS & DEEP FREEZERS	CFC-12	- REFRIGERANT & SERVICING & MAINTENANCE
	CFC-11	- FOAMING
(ii) COMMERCIAL & INDUSTRIAL	CFC-12 CFC-502	- REFRIGERANT AND SYSTEM FLUSHING
	CFC-11 HCFC-22	- SYSTEM FLUSHING - REFRIGERANT & SYSTEM FLUSHING
(B) AIR-CONDITIONING		
(i) DOMESTIC AND COMMERCIAL	CFC-11	- REFRIGERANT AND SYSTEM FLUSHING
	CFC-12	- REFRIGERANT
(ii) MOBILE AIR-CONDITIONING (CARS)	CFC-12	- REFRIGERANT - MAINTENANCE AND SERVICING.
(C) FOAM BLOWING	CFC-11	- BLOWING AGENT FOR FOAM.
(D) AEROSOLS	CFC-12	- PROPELLANTS
(E) FIRE-FIGHTING	HALON-1301	- FIRE EXTINGUISHER.

A2.5 The Car air-conditioning sub-sector is responsible for the largest consumption of the total CFC-12 consumed in the refrigeration and air conditioning sector in the last few years. With an estimated 650,000 air-conditioned cars in 1994, about 366 metric tonnes of CFC-12 was estimated to have been consumed in initial charge up and servicing of airconditioned cars in Nigeria in that year. The major servicing requirements being topping up needs, leakages and/or compressor failures. Domestic and Commercial Air-conditioning sub-sector has virtually shifted from the use of CFC to the use HCFC-22 as refrigerant.

A2.6 The foam industry in Nigeria still use large quantity of CFC-11 as blowing agent. However, the quantity consumed has been decreasing in the last few years due partly to the partial shift to non-ODS alternatives (such as methylene chloride) and partly due to the economic downturn witnessed across the country within this period. The sector accounts for about 9% of total ODS use in 1994.

A2.7 The use of ODS as Aerosol in cosmetics industry in Nigeria is fast becoming a thing of the past as most companies now use unstenched LPG. In 1994, for example the sector was responsible for only about 2 percent of total ODS consumption. However, some major market-movers within the industry are still undecided about making the switch. The high capital investments and product acceptability by the public are some of the hindrances cited.

A2.8 Use of industrial solvents is now limited to two chemicals namely, methyl chloroform (MCF) and carbon tetrachloride. They are used mainly as degreasers and as paint removals. It has been estimated that about 1000 liter per day of ozone depleting solvents was consumed in the country in 1994, representing about 11 percent of total ODS consumption in that year.

A2.9 The fire protection sector still use limited quantity of Halon-1301 in stationary equipments while the use of Halon-1211 in transportable equipment is almost phased out due partly to prohibitive prices and partly to the awareness of ozone depleting properties of these substances. It is expected that the industry would make complete switch to non-ODS alternatives (such as FM-200) as soon as production of Halons are stopped or when they become more scarce or too expensive.

A3 Study Methodology

A3.1 The task was subdivided into 3 phases; namely (i) field survey and data analysis (ii) evaluation of existing framework and response by user industry to ODS phase-out plan and (iii) formulation/development of a National ODS phase-out action plan and time table.

A3.2 In tackling the first phase, a comprehensive field survey of ODS importing companies and user industry was carried out using prepared questionnaire. Here emphasis was laid on data collection in the Lagos area since Lagos is not only the main entry port for ODS import into Nigeria, it also accounts for over 70% of ODS consumption in the country . In addition, sampled survey were also carried out in a few selected sources in the Northern and Eastern part of the country. Although the study covered all the relevant sections of the economy, emphasis have been laid given our terms of reference, on the refrigeration and airconditioning sectors.

A3.4 The strategy adopted in the second phase of the project is to carry out field survey of secondary sources of information. Such sources include governmental and non-governmental bodies such as FEPA, National Agency for Food and Drug Administration and Control (NAFDAC) and Manufacturer Association of Nigerian (MAN). The really big

ODS user industry were consulted on issues concerning workable and mutually benefitting framework for ODS phase out. Discussions were also held with top officials of FEPA in order to obtain relevant information and to discuss issues concerning governmental framework for ODS programme.

A3.5 The last phase of the project involved development of future ODS consumption Scenarios based on current patterns and expected trends in the user industry using a computer based electronic spreadsheet. Based on the outcome of this exercise, a national action plan is developed and a time table of the action-plan is then formulated.

A3.6 An interim report was completed around mid-April 1995 and copies were sent to UNIDO Headquarters in Vienna and FEPA headquarters in Abuja. The report was discussed with officials of FEPA and feedbacks from both UNIDO and FEPA were carefully considered and incorporated into the preparation of this Final Report.

A4 Critical Assumptions

A4.1 The most plausible substitution techniques identified and utilized in the formulation of the ODS phase-out Scenarios include; retrofitting of existing manufacturing/assembly facilities to produce non-ODS equipment; improved servicing and maintenance of equipment; retrofitting of existing equipment with non-ODS components; and recovery/recycling of ODS during equipment servicing. Costs estimates for each of these techniques were generated from information contained in the UNEP Technical Options Report of December 1991, and from other available country study reports.

A4.2 These cost estimates were used as inputs to calculate the incremental cost of each of the Scenario analysed. The incremental cost calculation was based on a cost simulation programme implemented on a Microsoft Excel spreadsheet.

The spreadsheet simulation allows the user to analyse net incremental costs and benefits (in terms of ODS consumption phased-out over the period 1994 - 2010) of alternative phase out Scenarios. Since the model employs a simulation technique, the user is expected to have as input well prepared Scenarios of developments in each sector. The option with the minimum incremental cost per kilogram of ODS phased-out between the period 1994-2010 is then considered to be the preferred one.

A4.3 Incremental cost calculation for Nigeria consist of the following three elements:

User costs, i.e cost incurred at the level of the manufacturers of ODS-using products, which consist of incremental capital and operations costs and a factor to cater for other costs such as those associated with adaptation to the new technology.

Consumer costs, i.e incremental cost incurred by the final consumers of the end-products, e.g refrigerator owners, as a result of the phase-out of ODS using equipment, resulting in forced early replacement of domestic refrigerators and freezers,and extra cost of purchasing CFC-free equipment.

Government costs, especially those required for institutional strengthening to ensure effective implementation of the Protocol.

A5 The Phase-Out Scenarios Considered

A5.1 Two phase out Scenarios have been analysed in this study. These are:

(a) An allowable phase-out Scenario that postpones the ODS phase-Out until the latest possible date allowed by the Montreal Protocol.

(b) An accelerated phase out Scenario, in which the speed of the phase-out programmed is increased to ensure compliance at a date earlier than the 2010 mandated by the Protocol.

A5.2 In the first Scenario, the ODS phase-out programme is allowed to follow the full utilization of the 10 year delay provision in the Protocol. For the second Scenario, the complete phase-out of ODSs and transition to ODS substitutes is accomplished over the period 1994-2008.

A6 ODS Consumption Profiles of the Unconstrained Demand

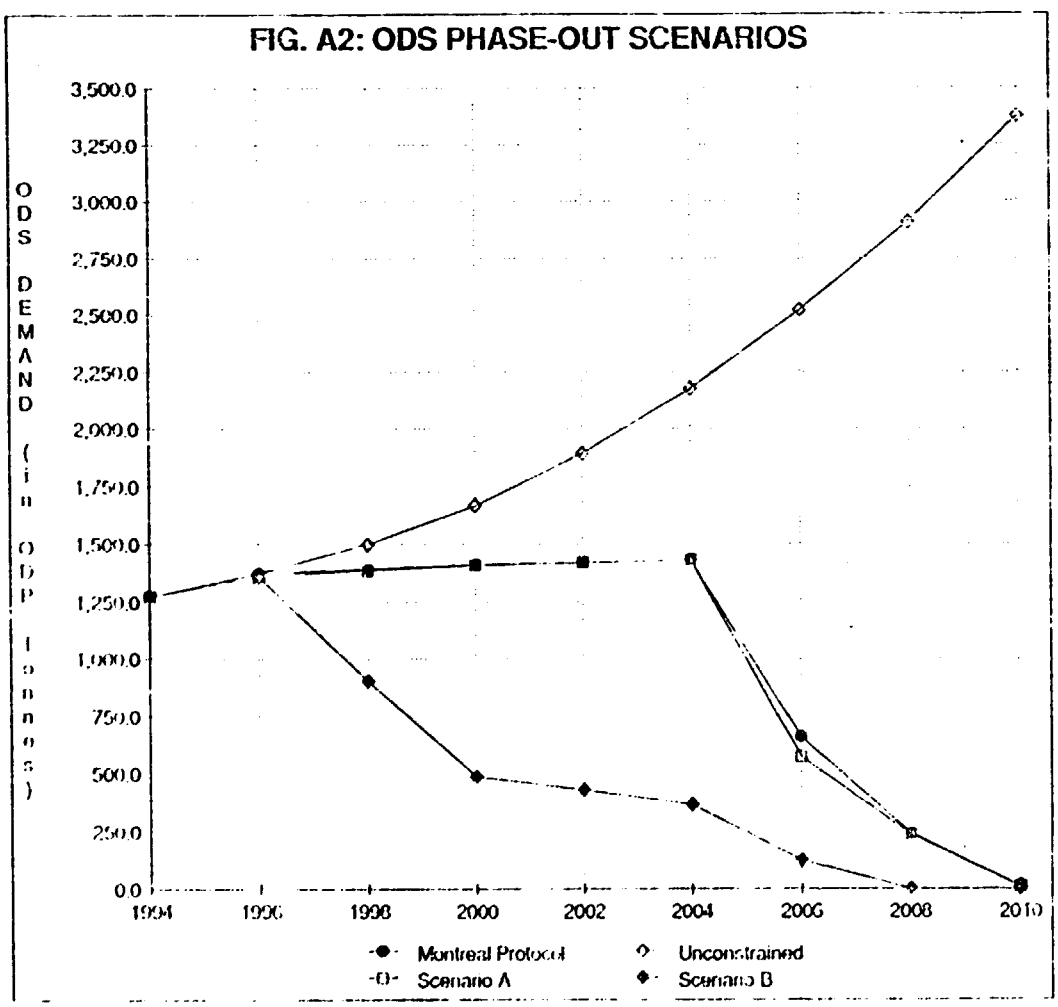
A6.1 The unconstrained demand for ODSs in Nigeria can be defined as the demand into the future, if the Montreal Protocol had not existed. For this case, ODSs are not regulated and unconstrained quantities of the controlled substances are imported into the country at current prices throughout the period 1995-2010. Growth assumptions, covering specific periods were made on parameters like; manufacture/assembly of new equipment; import of new and second hand equipment (Tokunbos); retirement of equipment; etc in order to estimate the unconstrained demand over the period 1994-2010. The already phased-out consumption of ODSs in the foaming, aerosol, and fire-fighting sectors in pre-1994 was factored into the estimation procedure to produce an unconstrained 1994 base year demand.

A6.2 We have estimated that between 1994 and the year 2010 cumulative unconstrained demand for ODS in the airconditioning and refrigeration sector of Nigeria can amount to about 24,700 ODP tonnes.

A7 ODS Consumption Profiles in the Two Scenarios

A7.1 The ODS consumption profiles for the two phase-out Scenarios considered, the Montreal Protocol requirement,

and the unconstrained demand are shown in Fig. A2. The allowable phase-out Scenario follows closely the Montreal Protocol requirement, with a slightly sharper dip during the period 2004 to 2008, and complete phase out by 2010. The accelerated phase-out implies consumption well below the Scenario A and the Montreal Protocol schedules during the whole period. Very sharp dips in consumption is first noticed starting from the year 1996 and continuing at different periodic rates until complete phase-out by the year 2008.



A7.2 A [illegible] US$ 13,410 GDP [illegible], [illegible] of uncontrained demand is [illegible] between 1994-2010 if the Accelerated Scenario is implemented. For the Accelerated Scenario, [illegible] will amount to about 12,400 ODP tonnes, [illegible] 77% of the uncontrained demand.

A8 Comparison of Alternative Phase Out Scenarios

A8.1 The total incremental cost for the Alternative Scenario is about 14% lower than that of the Accelerated Scenario. Total incremental cost for the two Scenarios are US$ [illegible] million and US$130.0 million respectively. Based on per kilogram basis of ODS consumption, [illegible] over the period 1994-2010, the Accelerated Scenario has an [illegible] requirement about US$6.9/kg compared to US$[illegible]/kg for the Alternative Scenario. The reason for this [illegible] is because about 41% more ODS will be phased out if the Accelerated Scenario is implemented. The cost and benefits of these two Scenarios are presented in Table A8.

A8.2 The above studied Scenarios [illegible] the Government's recommended phase out schedule for the following reasons:

(a) The Scenario has the least cost effectiveness ratio, US$/kg, when given the savings from avoiding the additional [illegible].

(b) [illegible] the Scenario that [illegible] in maximum welfare, given the fact that [illegible] the availability of data will be constrained in the near future due to the fact that ODS producers in Europe and the USA will shut down their production facilities in line with the Montreal Protocol schedule.

Table A3: COST AND BENEFITS OF ALTERNATIVE PHASE-OUT SCENARIOS[3]

Scenario	ODS Use Eliminated over the period 1994-2010 (ODP Tonnes) (% of Total Unconstrained Demand[4])	Incremental User Costs Mill. US$ (1994 Present Value)	Incremental Consumer Cost Mill. US$ (1994 Present Value)	Government Costs Mill US$ (1994 Present Value)	Total Incremental Cost Mill US$ (1994 Present Value)	Discounted Cost Per KG ODS eliminated US$/KG
1. Allowable Phase-Out SCENARIO A	13,310 (54%)	42.6	67.1	1.8	114.0	8.6
2. Accelerated Phase-out SCENARIO B	19,040 (77%)	67.2	53.9	3.2	130.0	6.8

[3]The Costs and Benefits apply to Refrigeration and Airconditioning Sector only.

[4]Total Unconstrained ODS demand over the period 1994 - 2010 is estimated at 24,700 ODP tonnes.

(c) Thirdly, this Scenario calls for an early introduction of measures like better servicing and maintenance procedures which are less costly, and are easier to implement.

A9 Recommended Phase-Out Strategy

A9.1 The recommended phase-out schedule starts with the Montreal Protocol level of ODS consumption of about 1,357 ODP tonnes in 1996. A 64% reduction in consumption is expected between the years 1997 to 2000; 25% between the year 2000 to 2004, 66% between 2004 and 2006, and complete phase-out by the year 2008.

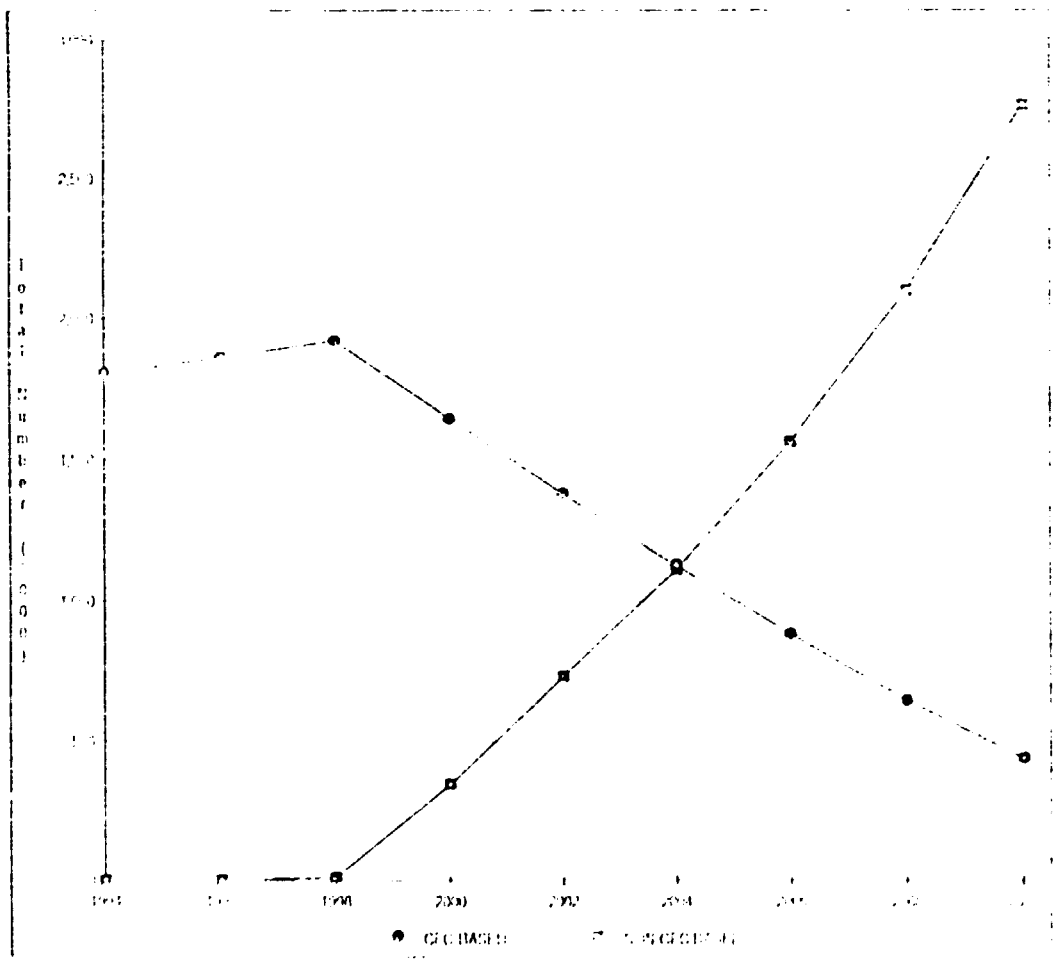
A9.2 The control built into this Scenario that are principally responsible for this accelerated phase-out schedule include: introduction of manufacturing of non-ODS equipment as from the year 1998; retrofit of ODS based equipment as from the year 1998, increasing in intensity between that year and the year 2008; introduction of better servicing and maintenance procedure as from the year 1998, leading to a 50% reduction in use of CFCs for leak testing and system purging by 1998, and complete elimination of CFC use for these service requirement by the year 2000; recovery and recycling of CFCs, with 40% recycling between 1998 and 2005, and increasing to 70% till phase out; retrofit of CFC based equipment during the phase-out period.

A9.3 The total unit incremental cost of the recommended phase-out schedule has been estimated at US$ 6.8/Kg of ODS phased out. The benefit is a reduction in total unconstrained ODS consumption of approximately 77% over the period 1994-20008.

A9.4 The estimated cost of the recommended phase out schedule for Nigeria has been based on a simulation of the phase-out strategy, using assumptions on the cost of such phase-out

on the air-conditioning and refrigeration sector. A better phase-out schedule may be put together, if the various options and the control options are analysed, using an optimisation procedure, where control options during each year and each period are optimally used. This optimal analysis should be carried out before a final country programme is put together. The quantitative results presented here should only serve as the basis of the likely effect of the phase-out programme. Fig. A3 shows the development of domestic refrigerator and deep freezer population in the recommended phase-out Scenario.

FIG. A3: REFRIGERATOR STOCK DEVELOPMENT IN SCENARIO B



A10 Action Plan

A10.1 The objective of the Action Plan is to phase-out the consumption of ODSs in Nigeria in compliance with the Montreal Protocol as ratified by the Nigerian Government and in accordance with the recommended ODS phase-out strategy.

A10.2 The Action Plan covers an initial period of 3 years covering the first quarter of 1996 to the end of the year 1998. The plan comprises the introduction of Government initiatives to effectively regulate and monitor the use of ODSs, and a series of proposed projects in the ODS user sectors, which are vital to the successful implementation of the recommended phase-out schedule.

A10.3 Government Actions

A10.3.1 Institutional strengthening will involve the immediate putting in place of a National Committee for Ozone Depleting substances (NCODS). This committee will be coordinated from the Ozone Office currently existing in FEPA. According to a source in FEPA, this committee has once been put in place, but there are no indications that it has since been functioning. Its effective functioning should be a priority Government Action. Recommended membership of the committee will include: FEPA as the Coordinating Agency; Federal Ministries of Finance, and Industry; National Planning Commission; Customs and Excise Department; National Agency for Food and Drug Administration, (NAFDAC); and representation of ODS user groups.

A10.3.2 The already existing Ozone office in FEPA must be strengthened, through the provision of necessary infrastructure and recruitment of additional personnel

to strengthen existing capabilities. The office will serve as the secretariat for NCODS. The office will also be responsible for all control actions, and monitoring functions of activities relating to the Ozone phase-out programme.

A10.3.3 The currently existing monitoring system for ODS that is being carried out by NAFDAC need to be revamped. The recommended system will require that permit for import of ODS must be filed at the Ozone office which will after evaluation give approval or decide otherwise. In addition, the Customs and Excise Department will be responsible for documenting all import declaration concerning ODS imports into Nigeria. Such documentation will be routinely made available to the ODS office.

A10.3.4 Other Proposed Government Actions include:

(a) Introduction of Regulatory Measures

The proposed regulatory measures will include: a schedule of bans on the use of ODSs for specific purposes at specific dates in accordance with the recommended phase-out strategy. Table A4 gives the recommended schedule of the bans in line with the recommended strategy; introduction of a special ODS tax on imports of all controlled substances to encourage initial substitution of ODSs in easily substitutable applications; introduction of tax exemptions for companies importing ODS conserving equipment.

(b) Training Programmes

Two training programmes will be instituted by Government to promote effective control monitoring and

TABLE A4: DRAFT SCHEDULE OF BANS ON ODS USE IN NIGERIA

The use of ODSs is allowed in the production and servicing of the below listed application areas until the given date.		
All CFCs:		
1.	Production of domestic refrigerators and deep freezers	1st January, 1998
2.	Installation of commercial and industrial refrigeration equipment.	1st January, 1998
3.	Installation of commercial airconditioning equipment	1st January, 1998
4.	Installation of mobile airconditioning	1st January, 1998
5.	Servicing of domestic refrigerators and deep freezers; commercial and industrial refrigeration, equipment; and mobile airconditioning	1st January, 2008
6.	Manufacture of foam in the foam industry	1st January, 2008
7.	In imported new refrigeration equipment/appliances	1st January, 1998
8.	In imported second hand refrigeration equipment/appliances	1st January, 1998
All Halons:		
9.	Import/Installation of new portable/transportable fire-fighting equipment	1st January, 1998
10.	Servicing of halon fire-fighting equipment	1st January, 2008
Carbon Tetrachloride:		
11.	All uses	1st January, 2008
Methyl Chloroform:		
12.	All uses	1st January, 2008
Other uses[1]		
13.	All other uses not mentioned above	1st January, 1998

[1] Use of ODSs for research, laboratory purposes are to be not regulated either.

use of ODSs as part of the Action plan. The first programmes will be targeted at officials of the Ozone office, Customs and Excise Department, and NAFDAC. The second will be targeted at improving the technical expertise of technicians involve in servicing and maintenance of refrigeration equipment.

(c) Public Enlightenment Campaigns

The Government must introduce these campaigns to promote proper understanding of ODS issues by consumers, small user enterprises and other large ODS users. This campaign should be immediately launched as part of the Government Action Plan.

A10.4 Recommended Project Proposals

A10.4.1 Three projects are proposed for funding from the Multilateral Fund. In addition to this a scheme of public enlightenment campaign which is expected to be launched immediately is also proposed for funding.

Project 1: Elimination of the Use of Ozone Depleting Substances in Refrigerator and Deep Freezer Manufacturing

The purpose of this project is to provide financial and technical assistance to the three leading manufacturers of domestic refrigerator and deep freezers, to enable them to retrofit their facilities to produce non-ODS based equipment. This will lead to a phase-out of CFC-11 and CFC-12 used in the manufacturing of these equipment. The recommended companies and their expected annual non-ODS equipment manufacturing capacity after the retrofit are: Thermocool Engineering Co. Plc, (50,000 units); Kolinton Technical Industries Ltd. (40,000 units) and

Debo Industries Ltd (30,000 units).

Project 2: Institutional Strengthening for Programme Implementation

The purpose of this project is to strengthen the capability of the Federal Environmental Protection Agency (FEPA) to coordinate the implementation of the Nigerian Country Programme to phase-out the use of ODSs.

Project 3: Training Programmes

The purpose of this training programmes is to provide a forum for proper and adequate education of Nigerians, who will be involved in the implementation of the phase-out programme, either at institutional level, or at the manufacturing level. It is also proposed that the programme should have as an objective, strengthening of the capabilities of some selected training institution on non-ODS based technology. Two training programmes have been proposed. The first will have as a target, public officers from: FEPA; Customs and Excise Department, NAFDAC, etc. The focus of this programme will be the policy and implementation Protocol of the ODS phase-out programme. The second which will have as a target, technicians from refrigeration and aircondition manufacturing companies, will focus on: improved and better techniques for servicing and maintaining refrigerators and airconditioners; use of non-ODS for leak testing and system flushing; techniques for recovery/recycling of ODSs; as well as policy and implementation Protocol of the country ODS phase-out programme.

A10.5 Budget and Financing Activities 1996 - 1998

Table A5 gives a breakdown of cost of the Action Plan by components and by year of implementation. It is proposed that all cost are incremental project costs to be funded by the Multilateral Fund. Government actions which include projects 2 and 3, as well as the public enlightenment programme will be covered by the fund as part of the overall institutional support project.

TABLE A5: SUMMARY OF COSTS OF PHASE-OUT PROGRAMME ACTIVITIES 1996 - 1998 (IN MILLION US $)

PROGRAMME COMPONENT	1996	1997	1998	TOTAL
A. Institutional Strengthening				
(i) NCODS and Ozone office	0.1	0.1	0.1	0.3
(ii) Training	0.1	0.1	0.1	0.3
(iii) Public Enlightenment	0.05	0.05	0.05	0.15
B. Retrofit of Refrigeration Manufacturing Facilities	5.5	0.5	-	6.0
Total	5.75	0.75	0.25	6.75

INTRODUCTION

1.1 BACKGROUND

In 1974, some researchers at the University of California in the USA claimed that man-made chemicals known as chlorofluorocarbons (CFC's.) were damaging the stratospheric Ozone layer. CFC's are chemical compounds which are derived by replacing the hydrogen atoms from simple hydrocarbons (Methane, Ethane etc.) by halogen atoms. Although these compounds have been known and characterized since the 1890's, they only became important commercial chemicals around the late 1920's when Thomas Midglay discovered their use as working fluids (refrigerants) for refrigeration equipment. By 1950s, their use as aerosol propellants, blowing agents for foams and as solvents in addition to their use as refrigerants led to a rapid increase in their production. The utilization of CFC's worldwide grew by leaps and bounds between the 1950s and the early 1970s. It is perhaps correct to say that this phenomenal growth is as a result of the CFCs being perfect in most of the end-uses of its application. CFC's as refrigerants are non-flammable, has very low toxicity, is stable, and has very favorable thermo-physical properties. These combination of properties made halocarbons the dominant refrigerant during the decades of the '0s to the early 70s. While the stability of CFCs was considered as a beneficial property in refrigeration, this same attribute turned out to be the major source of environmental concern. Instead of CFCs breaking down in the lower atmosphere where environmental damage would be limited, they break down in the upper atmosphere where their chlorine and bromine component attacks the Ozone Layer.

The discovery by the two scientists in 1974 of the Ozone depleting properties of CFC's especially in the troposphere led to attention being focused on the need to phase out the use of these products, to protect the Ozone Layer and hence reduce

negative impacts on earth. This culminated in an international agreement in 1985 called the Vienna Convention for the Protection of the Ozone Layer.

The agreement which was endorsed in March 1985 by 21 States and the European Economic Community was based on the principle that Countries will agree internationally to take steps to protect the Ozone layer. The March 1985 agreement which is commonly referred to as the Vienna Convention pledges parties to protect human health and the environment from the effects of Ozone depletion. Two annexes to the convention, provide for participating States to cooperate in research, observation and information exchange. Further evidence between 1985 and 1987 on the ozone depletion capabilities of CFCs led to the birth of the Montreal Protocol in 1987.

1.2 THE MONTREAL PROTOCOL

The Montreal Protocol was developed as an international reaction to the fact that man-made products generally referred to as chloroflucarbons (CFCs) are depleting the Ozone Layer of the troposphere. The protocol was developed under the management of the United Nations Environment Programme in 1987, and came into force on January 1st 1989. It is pertinent to point out that the protocol emerged as a follow up to the Vienna convention for the protection of Ozone Layer that was earlier adopted on March 22nd 1985. The protocol as of the time it came into force, defined the measures that parties must take to limit production and consumption of five CFC's and three halons.

Later on, new scientific information indicated that the protocol as it then existed will be incapable of protecting the Ozone layer adequately. As a result, a revision was made to the protocol by June 1990 at a meeting in London, where controls on ten more CFCs, carbon tetrachloride and methyl chloroforms were added to the protocol. Deadlines for the elimination of these controlled substances were then set. The revision also covered

for the specific nature of the parties from developing countries by providing for technical and financial assistance to these countries that are signatories to the protocol.

In order to quantitatively interpret the regulatory aspects of the protocol, each of the controlled chemicals is assigned an Ozone depleting potential (ODP) in relation to trichlorofluorocarbon (CFC-11) that is assigned an ODP of 1. Consumption of the controlled substances for each country is defined as total production plus imports less exports and excludes recycled substances. To obtain the relative Ozone depletion effect of CFC in a given party state, the annual consumption figure, for each CFC is multiplied by its ODP value. The totals for all the CFCs consumed in the country is then taken as the indicator of potential Ozone damage. Parties are required to reduce this total by 50% by 1995, by 85% by 1997 and by 100% by the year 2000 (all relative to 1986 consumption levels). The protocol however gave a grace period of 10 additional years to developing countries with per capital consumption of less than 0.3kg to meet these requirements. Apart from these issues, the protocol clearly spelt out the interrelationships as regards: control of trades on ODS with non-parties; assessment and review of control measures; reporting of data; non-compliance; R&D, public awareness and exchange of information among parties; among others.

The parties to the Montreal Protocol also established in 1990 an interim multilateral fund to assist qualified signatory developing countries meet their incremental costs to enable them to comply with the phaseout provisions of the protocol. This fund received US$240 million in donor contribution during the period 1991-1993. It has been estimated that about US$500 million replenishment is expected to be requested for the fund, for the period 1994-1996. Nigeria participated actively in all the negotiations for both the Vienna Convention and the Montreal Protocol. The nation finally signed and ratified the convention and the protocol on the 31st October 1988. Nigeria being a

developing country whose per capita ODS consumption as of 1994 has been estimated to be around 0.012 kg, qualifies for technical and financial assistance under the multilateral fund. A requisite activity for obtaining financial assistance from the fund is however the preparation of the country programme. This current study is one of the vital inputs in the process of preparing the Nigerian Country programme.

1.3 NATIONAL EFFORTS FOR THE PROTECTION OF THE OZONE LAYER

As mentioned in the earlier section, Nigeria participated actively in the negotiations for both the Vienna convention and the Montreal Protocol. It has been reported that the nation co-sponsored the resolution of Article 5 of the Protocol on the special needs of developing countries. The nation acceded to the convention and the Protocol on the 31st of October 1988. Since becoming a party to the Protocol, the following activities summarizes some of the pertinent national efforts towards the protection of the Ozone layer in line with the spirit of the Protocol.

- Article 18 of the FEPA Decree No.58 enacted in 1988 specifically provided the national regulatory regime for the protection of the Ozone layer.

- In 1989, FEPA nominated two Nigerian institutions to cooperate with institutions in developed nations towards enhancing capabilities of Nigerian Ozone Science Research.

- Experts nominated from Nigeria have actively participated in four review Panels mandated by Article 6 of the Protocol as from 1990.

- Knowledge and expertise of the staff of FEPA has been broadened and improved through training assistance from international organizations on ODS.

- FEPA has put in place an ODS office in the Abuja Headquarters.

- FEPA has also been working with a number of multilateral agencies for the implementation of the Montreal Protocol. In 1992, the Agency assisted UNIDO nominated Consultants to undertake a study titled "Techno-Economic Assessment of the Financial Viability for the Collection, Recycling and/ or Safe Disposal of Refrigerant Gases and Related materials in Africa". The project was undertaken concurrently in Egypt, Kenya and Nigeria.

- UNIDO as a follow up initiated a second project in collaboration with the Agency titled "Methodological Development of UNIDO Programme to evaluate the substitution of CFC-Based Technology in Refrigeration and Air Conditioning sector".

- The present study is a component of the above project and was initiated with the basic objective of putting quantitative feelings to: current per capita ODS consumption in Nigeria; and a time-phased national plan for phasing out ODS consumption in line with the Montreal Protocol.

- FEPA has also initiated in 1991 in collaboration with the World Bank a country study on ODS in Nigeria. Two missions from the World Bank have visited Nigeria between 1991 and 1992. The first mission's effort in collaboration with FEPA was concentrated on providing a broad based survey of ODS imports and user - industries with a view to evolving terms of reference for the country study. The second mission also collaborated with FEPA in August 1992 to complete the plans for the country programme. However, information available to us indicate that the efforts has not fully taken off. As a matter of fact another mission is being planned for sometimes later in the year to firm up

the effort towards the preparation of the country report.

- The current study, which is expected to contribute to the national effort towards the country report is being funded by UNIDO with full collaboration of FEPA.

1.4 THE STRUCTURE OF THE REPORT

This is the final report of the project "Preparation of CFC phase-out strategy for Refrigeration and Air conditioning Industries and services in Nigeria". The report is structured as follows: An executive summary is provided at the beginning of the report. This is followed by the introductory chapter. Chapter 2 of the report deals with the objectives and methodology of the study. In chapter 3, the Structure of ODS use in Nigeria in historical and current years together with an unconstrained forecast of future ODS use in the country are presented. In the earlier part of this chapter the ODS supply and end-use sector structure are elucidated.

Chapter 4 deals with institutional and policy framework (either currently existing or recommended) to address the ODS phase out strategy in Nigeria. In chapter 5, the possible ODS Phase-out scenarios considered in this study are described and the result of a comparative assessment of the scenarios are presented. Finally in this chapter, the recommended phase-out strategy is presented with the phase out schedule. The report is concluded in chapter 6 with an elucidation of an action plan. These covers the recommended governmental actions to promote the recommended phase-out strategy together with a list of projects identified for funding to enhance the success of the phase-out strategy.

2.0 OBJECTIVES AND METHODOLOGY OF THE STUDY

2.1 AIMS AND OBJECTIVES

The basic aim of the study is the preparation of a strategy paper, in collaboration with the Federal Environmental Protection Agency (FEPA) on the phase-out of CFC in the refrigeration and air-conditioning industries and services in Nigeria. This activity is in compliance with the Montreal Protocol (MP) and the commitment of the Federal Government of Nigeria to phase out Ozone depleting substances in Nigeria. The objectives of the strategy paper are the following:

(i) Review of current ODS imports, application and classification of ODS users and consumers up to the most recent years.

(ii) Supply/demand forecast of ODS in Nigeria during the period 1995-2010.

(iii) Elucidation of the challenges, that will be faced by Nigerian Industries as they implement activities to respond to the Montreal Protocol ODS phase-out programmes.

(iv) Assessment of the current and recommendation of future policy framework, regulatory and economic incentives that is in place and/or that must be put in place to cost-effectively respond to the requirements of the Montreal Protocol in Nigeria.

(v) Preparation of a cost-effective action plan to phase-out ODS in Nigeria, and recommendation of strategies that should be followed by the Nigerian Government to implement the action plan.

(vi) Identification of urgent actions that must be taken by the Federal Government of Nigeria to implement the ODS phase-out plan. This will involve the specification of a timetable for the various stages of the action-plan.

(vii) Development of monitoring arrangements to control the actual and forecast ODS consumption and to monitor the effectiveness of the action - plan.

In 1992, UNIDO conducted a study on the "Techno-Economic Assessment of the Financial Viability of the collection and Safe Disposal of Refrigerant Gases and Related Materials in Africa". The study covered Egypt, Kenya and Nigeria. During the implementation of this project, the data collection was based on a comprehensive field survey of Industrial enterprises involved with importation and use of ODS's in each of the country surveyed. The Nigeria component of the report include a rich database on: Imports of refrigerators by type for 1985, 1990 and 1991; 1991 prices of refrigerants; trend of production and imports of refrigerators and deep freezers; types and number of installations for refrigerated trucks/vans (including A/C units for buses); types and number of centrifugal chillers; mobil air conditioning units for cars; and utilization of CFCs by sub-sectors in 1991.

The present study builds on the database described above, by carrying out focused survey of the various organizations listed in the earlier report. The specific aim during the field surveying aspect of this study is to update the information contained in the earlier report. By so doing we would be in a position to document changes that has taken place in the ODS imports and user-Industries in Nigeria between 1991 and 1994. The exercise has enabled us to update information on ODS use in Nigeria. This is a necessary first step in the process of setting up any phase-out plan for ODS in the country.

2.2. STUDY METHODOLOGY

The first step in the execution of this study was to carry out a literature search of all the past work/studies done in respect of ozone depleting substances (ODS) in Nigeria. Two of such works were found and they are the "Techno Economic Assessment of the Financial Viability of the Collection and Safe Disposal of Refrigerant Gases and Related Materials in Africa" and "Field Data Survey on Ozone Depleting Substances in Nigeria". The first study was commissioned by United Nations Industrial Development Organization (UNIDO) and was carried out concurrently in Nigeria, Egypt and Kenya. The second study was carried out by FEPA in 1990. These past studies provided a good background for the study that we carried out.

The study was divided into 3 phases, namely:

Phase 1: Field Survey and Data Analysis.
Phase 2: Assessment of Response by User Industry to ODS Phase Out Plan and Existing Framework on ODS Phase-Out.
Phase 3: Formulation/Development of a National ODS Phase-Out Action Plan and Time-Table.

The methodology adopted for each of these phases is discussed below:

2.2.1 Phase 1: Field Survey and Data Analysis

This phase addressed item (a) of the terms of reference which is the review of current ODS imports, applications, and classifications of ODS by users and consumers and formed a vital input later in the ODS supply/demand forecast process. Of the two past studies referred to earlier, the first one which is on "Techno-Economic Assessment of the Financial Viability of the Collection and Safe Disposal of Refrigerant Gases and Related Materials in Africa" was found to contain a comprehensive audit of CFC import and utilization in Nigeria up to 1991.

In that report, the CFC user industry was classified into different sub-sectors and the particular characteristics of each sub-sector with respect to CFC consumption was discussed.

Given the rather short duration for this present study, the methodology adopted for this phase was to build on the work done in this past study commissioned by UNIDO. This was found to be the most time-effective strategy. A fresh comprehensive field survey covering a sizeable proportion of the respondents of an earlier similar survey was conducted during this phase of the project. The strategy used was to obtain response from the Lagos area. The Lagos area covers over 80% of the ODS supply and utilization in the country. Lagos is the main entry port for ODS import into the country. Apart from this fact, over 70% of the utilization of ODS occurs in the Lagos area. At the end of the intensive coverage of the Lagos area, sample survey covering selected sources in the Northern and Eastern part of the country was carried out. This enabled us to have pertinent information to characterize ODS supply and consumption patterns in the other parts of the country.

A list of both the primary and secondary sources of field data was compiled from the previous study and all these places were visited to obtain updated data through the use of prepared questionnaires. The primary sources of field data include importers and users of ODS. The user industry was classified into the following categories:

- Airconditioning and Refrigeration Sector;
- Aerosols;
- Plastic Foams;
- Solvents;
- Fire Fighting Sector.

The Airconditioning and Refrigeration sector which is the main focus of this study was further classified into:

* Domestic Refrigerators and Deep Freezer
* Commercial and Industrial Refrigeration
* Domestic and Commercial Airconditioning
* Mobile Airconditioning.

The secondary sources of data includes: government regulatory bodies such as National Agency for Food and Drug Administration and Control (NAFDAC); Federal Environmental Protection Agency (FEPA); and associations such as Manufacturers Association of Nigeria (MAN). Specific questionnaires and discussion papers were prepared for each of these data/information sources.

Data and information on specific figures of ODS imported by type and ODS consumed by user categories were obtained through the field survey. In the course of the field survey, information on actions already adopted or planned by both the major and minor end-users in response to ODS phase-out was obtained. The respondents were also asked to give input in terms of suggestions to the formulation of a National ODS phase-out strategy for Nigeria.

The methodology for the analysis of field data involve the collation and classification of ODS consumption by type and by user industries and sub-sectors. The collation of the ODS consumption data for the base year 1994 was carried out using data from the import regulation agency NAFDAC, buffered by import statistics from importers and utilization statistics obtained from end-users. Based on information on the trends of activities and ODS consumption in each sub-sector, future demand projections were estimated. Trends in data for the past few years were studied and specific information from each user sub-sector on ODS consumption were used in the determination of driving factors for future demand. Analysis of data was carried out on a computer-based electronic spreadsheet.

2.2.2 **Phase 2:** Assessment of Response by User Industry to ODS Phase Out Plan and Existing Framework on ODS Phase-Out

Essentially, the work of this phase served to address the issues in items (b), (c) and (d) of the terms of reference which are:

- Addressing the Nigerian industry challenges and general activities in response to the Montreal Protocol ODS phase-out programmes;

- Assessment of the Nigerian actual and recommended policy framework, regulatory and economic incentives;

- Assessing the strategies of the Nigerian Government to phase-out ODS with regard to the Action Plan chosen by the Government.

The strategy for this phase of the study was firstly to feel out what actions are being carried out by specific sub-sectors of the ODS user industry. This was done through the administration of the questionnaires and observations during the field survey. Secondly, the field survey of secondary sources of information particularly, associations such as Manufacturers Association of Nigeria (MAN) was geared towards obtaining information on jointly co-ordinated actions in response to the ODS phase-out plan. In both of these cases, the respondents were asked to contribute their suggestions concerning a workable and mutually benefitting framework for ODS phase-out.

Lastly, we held discussion with a top official of the Federal Environmental Protection Agency (FEPA) to obtain pertinent information on governmental framework for the ODS phase-out programme. This official who is responsible for the Ozone office in FEPA contributed a lot of information on Government feelings on the strategy for ODS phase-out in Nigeria. We also had discussion with some selected respondents of the survey to collate industry

views on the ODS phase-out strategy in Nigeria. The assessment exercise served to elucidate the shortcomings of existing framework and the workability of recommended ones. It is worthy of note that in 1992, FEPA jointly organized an international Seminar with United Nations Development Programme (UNDP) and United Nations Environmental Programme (UNEP) on "Industry and Protection of the Ozone Layer in Nigeria". The proceedings of this seminar which drew participants from the industry, academia and government parastatals, was a valuable source of input to this phase of the study.

2.2.3 **Phase 3:** Formulation/Development of a National ODS Phase-Out Action Plan and Time-Table

This phase covers item (e) and (f) of the term of reference which are:

- Identifying urgent actions of the Government to implement ODS phase-out, consistent with the mentioned strategies. A time table should be developed for the various steps of the Action Plan;

- Development of monitoring arrangements to control the actual and forecasted ODS consumptions and to monitor the effectiveness of the Government actions to phase-out ODS.

The methodology for this phase of the project involve the development of several future ODS consumption scenarios based on current trends and possible future trends in the user industry. Each of these scenarios were then evaluated based on: conformance to Montreal Protocol's stipulated limits; supply and cost of ODS; and ODS substitutes in the future and in the light of the various issues which emanated from the assessment of Phase 2. This evaluation aided the selection of the most workable phase-out scenario. All actions needed for the attainment of the limits defined by the selected scenario were then identified and the necessary urgent actions were highlighted.

This will basically be a component of the a National Action Plan for ODS phase -out. A time-table was also developed from the Action Plan coupled with the time limits of the selected future consumption scenario. From international experience of the common lapses of existing framework on ODS phase-out and implementation of similar environmental policies, a sound monitoring arrangement is developed which will aid in the regular check on the conformance of actual to forecasted ODS consumption and serve as an indicative tool to measure the adequacy or otherwise of the suggested Action Plan.

3.0 STRUCTURE OF ODS USE IN NIGERIA

3.1 ODS SUPPLY STRUCTURE

All the ODS consumed in Nigeria in 1994, like all other previous years were imported. The importation of these substances is carried out by a limited number of local companies with contacts in producing countries. These companies then distribute most of the substances directly to ODS - using companies while a small percentage goes to dealers outside Lagos. In some cases, we discovered that some user - companies directly imported ODS from overseas countries. The National Agency for Food and Drug Administration and Control (NAFDAC) is the governmental agency with mandates to control and register the imports of chemicals including ODS. An observation from the result of the survey is that not all the imports of ODS into Nigeria is properly documented by NAFDAC. Data obtained from NAFDAC and the major importers of ODS indicated cases where imports were not recorded. This lack of reporting has been described by sources in NAFDAC to be either deliberate, or arising from importation of ODS with other materials. It has been estimated by NAFDAC that about 30% of total ODS coming into Nigeria may not have been documented by the Agency.

The following summarises the lessons learnt from the survey carried out by us as regards current ODS Supply structure in Nigeria:

(i) All ODS are imported into Nigeria, mainly from Europe. Although it has been reported elsewhere that legal and illegal export of ODS from Nigeria to neighbouring countries exist, our data generation process showed that this is negligible, when compared to the quantity utilized within the domestic economy.

(ii) About seven companies were active in the importation of ODS in bulk into Nigeria in 1994. Two of them, namely

Ashimina Ltd, and Nulec Ltd accounts for over 60% of the market.

(iii) Most of the end-users purchase their ODS needs from these importers. Some medium to big end-use companies import their ODS use directly from the manufacturers overseas, while some of the smaller end-users purchase these substances from small to medium scale dealers who obtain their supplies mostly from the major importers.

(iv) Medium scale dealers are the major sources of ODS in towns and cities far removed from the major port entry city of lagos. It has been estimated that ODS use in the greater Lagos area constitute over 70% of total country consumption.

(v) The National Food and Drug Administration and Control (NAFDAC), an agency of the Federal Government of Nigeria, has been mandated to control the entry of ODS into Nigeria. NAFDAC mandate stipulate that anybody bringing ODS into the country like all other controlled chemicals, must register such imports with the Agency.

(vi) Not all the ODS that entered Nigeria in recent years were documented by NAFDAC. This lack of documentation in many cases can be described as deliberate, while in some cases they arise from the inability of the Agency to rightly classify such imports as ODS.

(vii) Major sources of import of ODS into Nigeria in 1994 include: France; UK; and Italy. Together, they account for over 80% of all imports of ODS.

(viii) ODS importation from the USA, seemed to have ceased as from 1992 as show in Table 3.1. A reduction in imports of these substances from Spain over the period 1991-1994 can also be observed. We note the emergence of India as a source of ODS starting from 1993.

(viii) ODS importation from the USA, seemed to have ceased as from 1992 as show in Table 3.1. A reduction in imports of these substances from Spain over the period 1991-1994 can also be observed. We note the emergence of India as a source of ODS starting from 1993.

(ix) Most of the importers surveyed indicate awareness of the ODS issue and the emergence of substitute such as HFC-134A. All of them are yet to introduce this substance into the Nigerian market.

(x) There seems to be a general lethargy on the part of importers over the feasibility of a phase out in Nigeria before the year 2,010.

TABLE 3.1: SOURCES OF ODS IMPORTS INTO NIGERIA (1991 - 1994)

COUNTRY	1991[1]	1992[2]	1993[2]	1994[2]
	%	%	%	%
1. FRANCE	10.0	6.90	4.20	20.60
2. U.K	55.0	30.63	19.11	33.90
3. SPAIN	24.0	22.90	8.00	4.20
4. ITALY	5.0	25.37	58.54	27.40
5. INDIA	-	3.3	5.70	3.60
6. HOLLAND	-	3.2	-	8.13
7. GREECE	-	-	2.52	-
8. GERMANY	-	-	1.94	-
9. BELGIUM	3.0	-	-	2.18
10. U.S.A	3.0	7.7	-	-

SOURCE:
1. 1991 Report
2. NAFDAC

3.2 STRUCTURE OF END-USE SECTOR

The major end-users of ODS in Nigeria include: refrigeration and airconditioning sectors; manufacture of flexible foams; aerosol manufacturing; fire fighting equipment; and industrial solvents. Airconditioning and refrigeration sectors account for approximately about 75% of the total ODP tonnes utilized in Nigeria in 1994. This sector include applications like; installation, assembling and manufacturing of domestic appliances; car air-conditioning systems; miscellaneous commercial and industrial refrigeration equipments;large factory chillers, and servicing of these equipments. During the survey, we establised the fact that limited recovery and recycling of ODS, especially by medium to large scale industries took place in 1994. Brief description of the ODS use in each of the sectors is described in the following sections:

3.2.1 Domestic Refrigerators and Deep Freezers

The total installed capacity of the manufacturing/assembly of refrigerators and freezers in Nigeria as of 1991 stood at about 600,000 units per annum. A few of these companies have either shut down or were producing at greatly reduced capacity by the year 1994. Based on our survey of about 95% of the producing companies, we have estimated that in 1994 only about 86,000 units were produced. The largest producers being Thermocool Engineering Co. Plc. (47%), Kolinton Technical Industries Nig. Ltd. (29%) Debo Industries Ltd (20%) all located in Lagos. We discovered however that by the first quarter of 1995 production figures in two of these companies had gone up by as much as 50% of their 1994 levels. It has been postulated that domestic manufacturing of these equipment had been hampered in the past few years due to the declining economic conditions in the country, coupled with the availability of cheap imports of second hand refrigerators/deep freezers popularly called "Tokunbos" in the market.

Domestic refrigerators/deep freezers are produced in different sizes ranging from 140 to 440 litres capacity. The charging refrigerant most commonly used in the production of these equipment is CFC-12. All the refrigerators and deep freezers use polyurethane foam for insulation. The insulation which is produced in-factory during the manufacturing/assembling process uses CFC 11 as the predominant blowing agent. The trend in the production of domestic refrigerators and freezers between 1991 and 1994 in some of the companies surveyed is shown in Table 3.2. This represent over 95% of domestic production. From the production figure obtained, we noticed that there is no significant change in the total number of units of refrigerators and deep freezers in Nigeria in the last 5 years.

TABLE 3.2: PRODUCTION TREND IN DOMESTIC REFRIGERATOR AND DEEP FREEZERS (IN UNITS)

NAME	1991	1992	1993	1994
DEBO IND	24,859	24,004	14,280	16,920
KOLINTON TECHNICAL NIGERIA LTD	26,400	28,000	30,200	25,000
THERMOCOOL	28,900	31,800	37,800	40,000
ASSO.ELEC	2,600	4,500	2,500	2,600
NIG. SEW. MACHINE	100	500	50	0
GACOL NIG. LTD	2,000	1,250	1,100	1,100
TOTAL	84,859	90,054	85,930	85,620.0

As mentioned earlier, importation of "Tokunbo" refrigerators and deep freezers became an important source of these equipments in the Nigerian market over the last few years. Although no accurate statistics of these imports are kept (as none could be found during our investigation). Informed guesses using information obtained from the customs department put the number at between 20,000-25,000 units per annum. Majority of these imports usually need servicing before being put into use. Such servicing usually involve leakage mending, recharging with refrigerants, repairs or complete replacement of compressors. Our field survey showed that compressor failure and leakage-in-system are the most

frequent problems that service technicians in Nigeria are faced with. We also found out that about 80% of these service jobs are performed by Road-side Technicians.

3.2.2 Commercial and Industrial Refrigeration

Activities included under this sub-heading include; cold room/stores; refrigerated trucks/vans; and industrial refrigeration. There are two categories of companies involved in this sub-sector activities. These are the fairly large installers such as Alumaco Nig Ltd, Debo Industries Ltd etc and the smaller installers such as UAC foods Ltd who is involved in cold stores and other refrigeration and airconditioning equipment of their group etc. Alumaco Nig Ltd is the largest actor in the first category and is very active in the installation of cold rooms, air-conditioning systems in Vans/Buses/Trailers. Some refrigeration system components such as compressors, electrical motors, etc, are usually imported while others, such as the panels, etc. are fabricated locally.

Most of the installed cold rooms to date are in the range of 6-36 TR (tonnage refrigeration). Most of the first category companies are affiliated with overseas companies and have been informed about the need for a change to non-ODS refrigerants or new equipment has already been sent for the replacement refrigerants. As of the time of carrying out our survey, almost all existing cold rooms are based on CFC-12 as the refrigerant. In quite a few, use of CFC-502 (ie. a mixture of CFC-12 and HCFC-22) as refrigerant was noted. It has been estimated that about 1000 cold rooms existed in Nigeria with an average of about 12 installation per year from 1991-1994. Our survey also indicated the following characteristics of the activities of companies in this sector: the big companies still use ODS for system flushing e.g. CFC-11 (Alumaco), HCFC-22 (Debo Industries, Palmer Ltd), and CFC-12 (Debo Industries); electronics leak detector and soap solutions are the common leak testing methods; none of the sampled companies uses ODS for leak testing; flushing which is

the largest area of wastage differs in terms of quantity of ODS used in each company, due possibly, to wide variation in the sizes of units produced. For example 5kg of ODS is used on average per unit in Alumaco, while figures for other companies varies from 0.16kg per unit at Debo Industries, to 13.-40kg per unit at Palmer Ltd; there has been a downward trend in equipment manufactured in this sector over the years. For example Alumaco, a major actor, installed a total of 38 units in 1990, falling off to 6 in 1994.

Concerning refrigerated Trucks/Van/Buses, Alumaco is also the largest actor, accounting for nearly 80% of total installations in 1991, while the balance is imported. It has been estimated that there are about 500 operational units in 1994. About 11 units were installed on the average annually between 1991-1994. CFC-12 is the refrigerant commonly used with quantity per unit depending on size or capacity of the compressor.

Industrial refrigeration systems are generally of larger sizes, most commonly in the range of 200 TR to 2000 TR using reciprocating compressors. HCFC-22 was found to be the most preferred refrigerant although there is a significant use of CFC-502. It has been estimated that the total number of installed, and functioning industrial refrigeration systems in the country by 1994 did not grow beyond the level of 50 since not many were installed between 1991-1994.

3.2.3 Domestic and Commercial Air Conditioning

The domestic airconditioning systems common in the country include room airconditioners and split units, while the commercial units consist of mostly centrifugal and reciprocating chillers. Of all these systems, only the industrial centrifugal chillers uses control substances CFC-11 and CFC-12. The rest utilizes the transition substance HCFC-22. Most of the centrifugal chillers were installed between 1960s and the late 1970s with Mandillas Nig. Ltd accounting for about 80%. By the

beginning of 1980 about 30 of such installations existed in the country. No installations of centrifugal chillers have been made after 1980. Mandillas is currently equipped with mobile facilities to service the functioning system whose number in 1994 has been put at about 24.

From 1980 to date, most installations have been utilizing reciprocating chillers in place of one large centrifugal chillers since reciprocating compressors are easier to maintain and failure of one compressor does not affect the whole system. The only source of CFC loading to the environment therefore can only come from the servicing of the existing centrifugal chillers.

Such services which take place, usually bi-yearly, involve pumping down of the refrigerant and flushing of the system with either nitrogen or freon-11 (CFC-11). During each service, topping up of the refrigerant to the tune of about 20% of initial charge is usually required. Leak testing is done using nitrogen gas and/or soap solution.

According to Mandillas Enterprises Ltd, over the last two years, owners of commercial air-conditioning systems have been informed on the need to maintain storage vessels for CFC or the conversion of old equipment. Mandillas also informed us that the company introduced a CFC recovery/recycling programme in early 1994 for domestic air-conditioners. Since then, about 3 tonnes of HCFC-22 has been recycled.

3.2.4 Mobile Airconditioning (Cars)

As of the beginning of 1995, one of the existing car assembly plant in Nigeria, the Volkswagen Plant had folded up, leaving only the Peugeot Automobile Nigeria, and General Motors Plant in operation. The production and imports of cars in Nigeria in 1991 has been put at about 40,000 cars, with about 45% assembled locally mostly in the plants of Volkswagen and Peugeot. Between 1992 and 1994, production of cars at the Volkswagen plant

declined fastly and by 1994 an average of about 1,000 cars was said to have been assembled at the plant. Production eventually stopped by the first month of 1995.

While Volkswagen was folding up its operations, another assembly plant/company entered the market fully in 1993. This is the General Motor Assembly Plant which introduced its brand of cars and vans into the market. The net effect was that domestic car assembly fell by an average of about 5.5% per annum. On the other hand, importation of car and small-to-medium trucks, a high percentage of which are imported used cars (Tokunbos), rose by an average of about 17% per annum. The net effect was that by the end of the year 1994, we estimated that about 650,000 air-conditioned cars existed in the country.

Recharging of airconditioning in these vehicles occur as a result of topping up needs; leakages; and compressor failures. Our survey showed that leakages account for a large proportion of service demand. It has been estimated that 70% of ODS consumed in this sector is for leakage servicing. The probability estimate used for proportion of cars in leakage vis-a-vis the total population is about 15%. This estimate was developed, based on the assumption that more than 50% of cars have a leakage problem once in their lifetime. A higher quantity of gas than the one needed for the initial charge is usually used for refilling due to the needs of cleaning, flushing and testing of the system. An average of 2 kgs per car has been used for estimating total refilling demands.

Respondents to our survey also confirmed that most car owners in Nigeria do not top-up their refrigerant until the reduced cooling effect become very noticeable. They also confirmed the fact that vibrations due to bad road is a major cause of leakage in car airconditioning system, with the cars loosing on average about 10% of their initial charge per annum. We therefore assumed that all airconditioned cars in 1994 had to be topped-up to the tune of 10% of their initial charge. Furthermore, the respondents

confirmed that compressor failure cases are few, but increasing with the higher importation of "Tokunbo" cars. 1% of total population of airconditioned cars was adjudged to be a good estimate of such failures.

Using these figures of merits, we have estimated that about 366.0 metric tonnes of CFC-12 was consumed in 1994 for the initial charge up and servicing of airconditioning cars in Nigeria. This represent about 47.6% total CFC-12 consumed in the refrigeration and airconditioning sectors in the country in that year. Some of the other pertinent results of our survey for this sector include:

(i) CFC-12 is the major refrigerant currently in use.

(ii) HCFC-134A has been introduced in new vehicles that were recently imported.

(iii) Some of the big-time companies operating in this sub-sector, have already acquired ODS recovery/recycling equipment. For example, R.T.Briscoe Nig. Ltd acquired their equipment in 1993 and have since recovered 25 kg of ODS per year.

3.2.5 Foam Blowing

The Nigerian foam industry produces mainly flexible polyurethane in slabstock form for mattresses, pillows and cushions. Some amount of rigid polyurethane is also produced for use as insulation in refrigerators. Many of the 84 slabstock polyurethane foam manufacturers that were registered with the foam Producers Association as of 1991 have already closed down by 1994. The adverse economic condition that have been prevalent in the country for most of 1990s have forced most of the small to medium foam producers to halt operation. Our survey showed that less than 30 slabstock polyurethane foam manufacturers exist as of 1994. Out of this, only about 12 own the major units while

the rest are small to medium.

In terms of quantity, CFC-11 has remained the main blowing agent used in foam manufacture in Nigeria. The quantity of CFC-11 has however been declining due the combination of decreasing economic activity in this sector, coupled with the fact that many old foam manufacturers are switching to non - ODS alternatives like Methyl chloride. For example, Vitafoam Nigeria Plc, which has 35% of flexible foam market in Nigeria, has converted two of its existing five plants to methylene chloride, with plans to convert one in 1995 and the remaining two in 1996. There are however indications that the 1995 and 1996 plans may be stalled or outrightly suspended due to increasing realization of the carcinogenic nature of this substitute. The net effect is that a decreased use of ODS may not be registered as expected in future years.

Vitafoam also informed us that they were aware of the development of a new polyol in the USA that does not need any blowing agent. They are considering this option for the future given the information that foam produced from such polyols is as good as the one they are using now.

3.2.6 Aerosols

Aerosols based pesticides, insecticides, and air freshener are produced in Nigeria by a handful of companies. All the pesticide and insecticide production in Nigeria were based on the use of stenched LPG which is available locally. In 1994, there were about 4 large cosmetic companies and many small to medium scale ones producing air fresheners and body deodorants . The dominant share is however held by the large companies. Our survey covered four companies in the Lagos area accounting for about 70% of the total national market. The result of the survey showed that three of the four companies had already changed from the use of CFCs to unstenched LPG between 1992 and 1994. Only one company in the survey population, is yet to make the shift. Our

discussion with management of this company indicated that they are yet to be convinced of the need to change. They fear such change will require high capital investment which they are currently not ready to make. They however seem to be receptive to the idea of receiving support for such effort. They are responsible for about 30% of the market.

The reaction of the other companies that have shifted away from ODS is perhaps mixed. While D.N. Meyer Plc have remained at ease with such a change in that consumers had remained receptive to their products, the case was different for Cybele Cosmetics Ltd. This company actually shut down its production facilities due to a drop in market share since 1992 when they changed to unstenched LPG as aerosols. They are of the opinion that the decline in market was as a result of consumer's rejection of their reformulated product and believe they will be in the market when the Nigerian public is better enlightened to appreciate their environmentally friendly product. While it is not our intention to debate this view, the only common problem highlighted by our survey of ODS use in this sector, is not market reception but the constraint of inadequate and uncertain supply of unstenched LPG in Nigeria.

3.2.7 Halon Fire Extinguishing Agent

In order to obtain indicative demand figure for halons in Nigeria, we held discussion with officials of fire protection companies such as, Omot Fire Protection Engineering Ltd. In its line of business, the company account for about 60% of the national market. The discussion enabled us to come to the following conclusion about this sector:

(i) By and large the use of halon 1211 in transportable fire fighting equipment has been replaced with Carbon-dioxide and other non-ODS medium. As such consumption of halon - 1211 presently is very negligible.

(ii) Halon - 1301 which is more used in stationary equipment is currently been utilized. Its use is very common in Oil Installations; computer industries; communication installations; and some little use can be found in manufacturing industries.

(iii) It is becoming more and more difficult to source halon - 1211 and halon-1301 in the international market due to the fact that production of these substances has almost been phased out in Europe and the USA.

(iv) The search for alternative to these halon, especially halon-1301 has been on since the montreal Protocol of 1987. One of such alternative, FM-200 seem to be under consideration for adoption by the major fire protection companies in Nigeria.

(v) The major companies that we surveyed however informed us that they will definitely have to stop the importation of halon-1301 by 1996 when they believe they will not have access to these substances again.

(vi) The shift to FM-200 will be smooth since, on a cost per kg basis, it is not much expensive than the currently used halon-1301. Furthermore, because of its low vapour pressure, it is compatible with existing halon-1301 containers.

3.2.8 Solvents

Investigation shows that current use of solvents in Nigeria is limited to two chemicals, namely; Methyl Chloroform (MCF) and Carbon tetrachloride (CTC). The use of the solvents in Nigeria has been attributed majorly to the needs of degreasing in industries and as well as for paint removals. We were also reliably informed that the paint industry which is a major user of ODS solvents has virtually discontinued the use of CTCs. It

has also been concluded that for the major application types, cheaper alternatives such as use of kerosene and/or petrol is currently being practiced. Methyl Chloroform[1] use account for about 60% of total controlled solvent use in Nigeria. It has been estimated that the total use of Ozone depleting solvent in Nigeria in 1994 is about 1 kiloliter per day. The structure of ODS use in Nigeria in 1994 showing the common substances and the applications are shown in Table 3.3.

TABLE 3.3: STRUCTURE OF ODS CONSUMPTION IN NIGERIA BY TYPE AND APPLICATION

USER SECTOR	SUBSTANCE	APPLICATION
(A) REFRIGERATION		
(i) DOMESTIC REFRIGERATORS & DEEP FREEZERS	CFC-12	- REFRIGERANT & SERVICING & MAINTENANCE
	CFC-11	- FOAMING
(ii) COMMERCIAL & INDUSTRIAL	CFC-12 CFC-502	- REFRIGERANT AND SYSTEM FLUSHING
	CFC-11	- SYSTEM FLUSHING
	HCFC-22	- REFRIGERANT & SYSTEM FLUSHING
(B) AIR-CONDITIONING		
(i) DOMESTIC AND COMMERCIAL	CFC-11	- REFRIGERANT AND SYSTEM FLUSHING
	CFC-12	- REFRIGERANT
(ii) MOBILE AIR-CONDITIONING (CARS)	CFC-12	- REFRIGERANT - MAINTENANCE AND SERVICING.
(C) FOAM BLOWING	CFC-11	- BLOWING AGENT FOR FOAM.
(D) AEROSOLS	CFC-12	- PROPELLANTS
(E) FIRE-FIGHTING	HALON-1301	- FIRE EXTINGUISHER.

3.3 CURRENT CONSUMPTION OF ODS IN NIGERIA

In 1994, consumption of controlled ODS in Nigeria was made up of: about 206.7 tonnes of CFC-11, 772.3 tonnes of CFC-12, 7.2 tonnes of CFC-114 in the composite substance CFC-12/114 used in aerosol production, 4.9 tonnes of CFC-115 in the composite refrigerant

[1] Also known as 1,1,1 Trichloroethane.

R-502 (51.2% CFC-115, 48.8% HCFC-22), 35 tonnes of halon-1301, 105.6 tonnes of Carbon tetrachloride, and 25.4 tonnes of 1,1,1-trichloroethane, all in ODP tonnes. During the same year, about 24.3 ODP tonnes of HCFC-22 was consumed. ODS consumption by sector and by substance are presented in Tables 3.4 and 3.5 respectively. Figure 3.1 shows the ODS consumption by sector and by types, while Figure 3.2 indicates percentage use by sector.

TABLE 3.4: ODS CONSUMPTION IN NIGERIA BY SECTOR IN 1994

SECTOR	APPLICATION	ODS	ODP FACTOR	CONSUMPTION IN ODP TONNES
1. Refrigeration & Airconditioning	Insulation Foam Blowing and System Flushing	CFC-11	1.0	105.4
	Refrigerants	CFC-12	1.0	758.9
	Mobile System Refrigerant	CFC-115	0.6	4.9
Sub-Total				869.1
2. Foam Industry	Blowing of Flexible Foam	CFC-11	1.0	99.0
Sub-Total				99.0
3. Aerosols	Propellant	CFC-11	1.0	2.3
		CFC-114 (IN CFC 12/114)	1.0	7.2
		CFC-12	1.0	13.5
Sub-Total				23.0
4. Fire Fighting	Fire Extinguisher	Halon-1311	3.0	-
		Halon-1301	10.0	35.0
Sub-Total				35.0
5. Solvents	Degreasing Industrial Cleaning etc	Carbon tetrachloride	1.1	105.6
		Methylene Chloroform	0.1	25.4
Sub-Total				131.0
TOTAL				1,157.1

These ODSs were utilized in the following sectors according to the stated applications:

(i) Domestic Refrigeration

About 386 ODP tonnes of CFC-12, representing about 33.4% of total national ODS consumption in 1994 was utilized as refrigerants and for servicing and maintenance of refrigerators in the country. During the same year, about 94 ODP tonnes of CFC-11 was consumed for the purpose of foam blowing in the manufacture of foam insulators for new refrigerators and deep freezers. Consumption of CFC-11 for this purpose, represented about 8.1% of national ODS consumption.

TABLE 3.5: CONSUMPTION OF ODS IN NIGERIA IN 1994 BY SUBSTANCE

SUBSTANCES CONTROLLED BY THE MONTREAL PROTOCOL	CONSUMPTION IN METRIC TONNES	ODP FACTOR	CONSUMPTION IN ODP TONNES
GROUP I ANNEX A			
CFC - 11	206.7	1.0	206.7
CFC - 12	772.3	1.0	772.3
CFC - 114	7.2	1.0	7.2
CFC - 115	8.2	0.6	4.9
Sub-Total	**994.4**		**991.1**
GROUP II ANNEXE A			
Halon 1211	-	3.0	-
Halon 1301	3.5	10.0	35.0
Sub-Total	**3.5**		**35.0**
GROUP I ANNEX B	-	1.0	-
Sub-Total	-		-
GROUP II ANNEX B			
Carbon tetrachloride	96.0	1.1	105.6
Sub-Total	**96.0**		**105.6**
GROUP III ANNEX B			
1,1,1 -trichloromethane	254.0	0.1	25.4
Sub-Total	**254.0**		**25.4**
TOTAL	**1,347.9**		**1,157.1**

FIG. 3.1: 1994 ODS CONSUMPTION BY SECTOR AND BY TYPES (IN ODP TONNES)

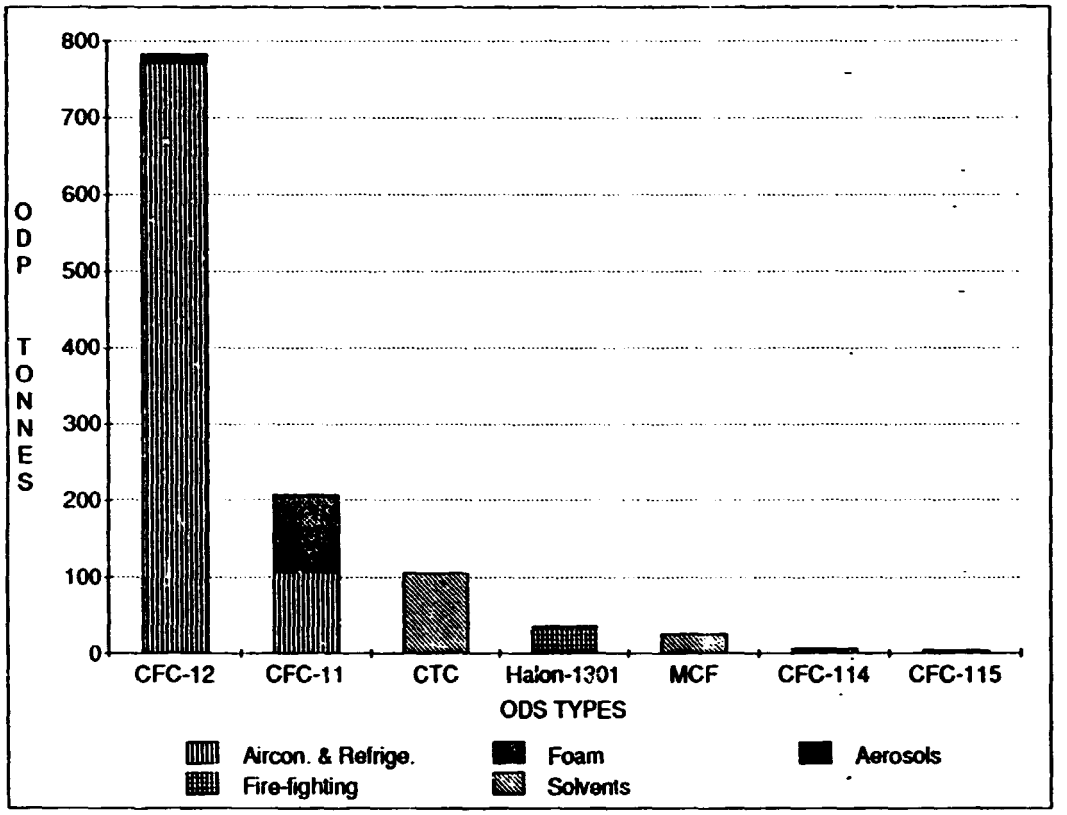
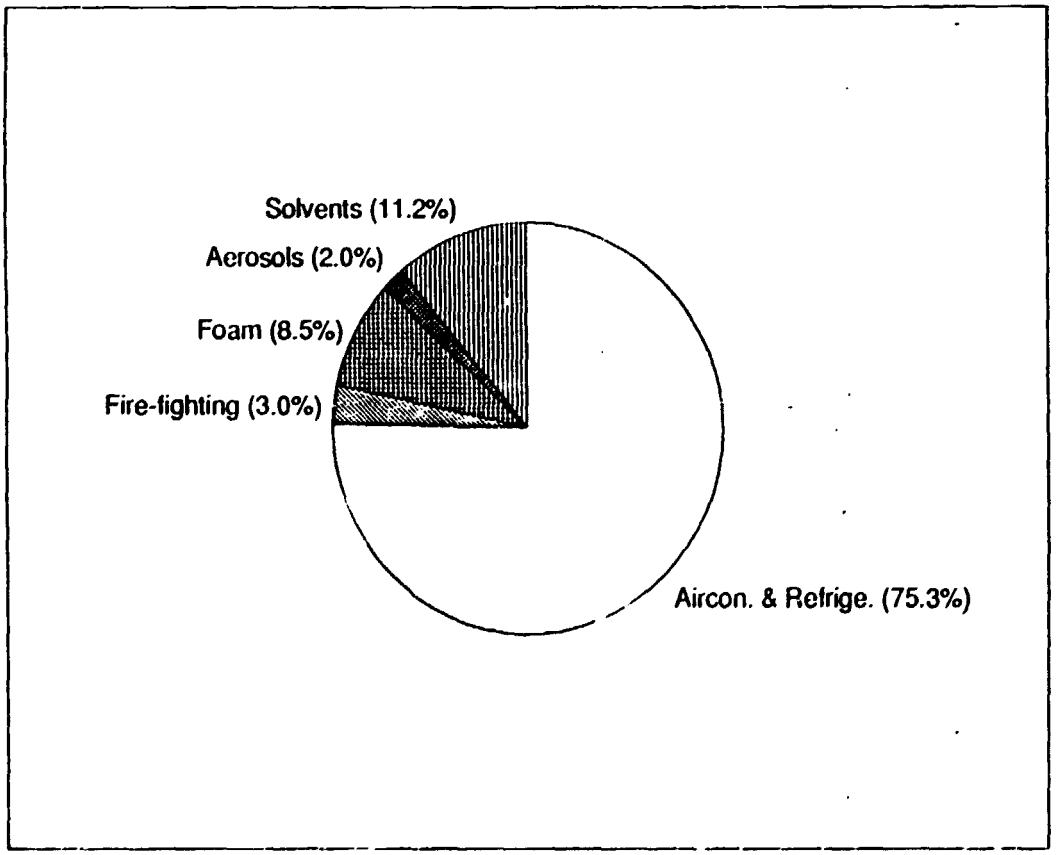


FIG. 3.2: PERCENTAGE USE OF ODS BY SECTOR IN NIGERIA (1994)



(ii) Commercial and Industrial Refrigeration

In this sector, CFCs are utilized as refrigerant and for system flushing. In 1994, about 3.8 ODP tonnes of CFC-12 was utilized as refrigerant and for system flushing. R-502 (a composite refrigerant composed of 51.2% CFC-115 and 48.8% HCFC-22) was also used in the sector as a refrigerant. In 1994, about 4.9 ODP tonnes of CFC-115 was utilized for this purpose. CFC-11 amounting to about 6.70 ODP tonnes was used in the sector for system flushing. Some amount of HCFC-22 was also utilized for this purpose. Controlled ODS consumption in this sector as a percentage of national total in 1994 was about 1.3%.

(iii) Air-Conditioning

For the domestic and commercial air-conditioning sub-sectors, about 13.2 ODP tonnes of CFC-12 and 5.2 ODP tonnes of CFC-11 was utilized as refrigerant and part of the quoted quantity of CFC-12 was used for system flushing in 1994. Total controlled ODS used in this sub-sector as a percentage of national total in 1994 amounted to about 1.6%. CFC-12 is the most popular CFC consumed in the mobile air-conditioning sub-sector in 1994. During this year total CFC-12 consumed in this sub-sector as refrigerant and for servicing and maintenance of mobile air-conditioners amounted to about 355.5 ODP tonnes. This represented about 30.7% of national controlled ODS consumption.

(iv) Foam Blowing

About 99 ODP tonnes of CFC-11 was utilized for blowing of flexible foam in the manufacture of pillows, mattresses etc. in 1994. This represented about 8.6% of controlled ODS consumption in the country during that year.

(v) Aerosols

CFC-11 and CFC-12 in the composite mixture of CFC-11/12, CFC-12 and CFC-114 in CFC-12/114, are the major controlled ODS used as aerosols in this sector. In 1994 about 23 ODP tonnes, corresponding to about 2.0% of national consumption of controlled ODS was recorded by this sector.

(vi) Fire Fighting

About 35 ODP tonnes of Halon-1301 was utilized in this sector in 1994. This represent about 3.0% of national consumption of controlled ODS in the country that year.

(vii) Solvents

Carbon tetrachloride amounting to about 105.6 ODP tonnes and methyl chloroform of about 25.4 ODP tonnes was used as solvents for degreasing and other industrial cleaning purposes in 1994. This represented about 11.2% of total controlled ODS consumption in the counting in 1994.

3.3.1 Historical Trend in ODS Consumption.

As shown in Table 3.6, controlled ODS consumption declined between 1991 and 1994 at an average annual rate of about 11.5%. In terms of substance mix, CFC-11 utilization recorded the highest average annual decline of about 26.2% during the period 1991-1994, while the decline in use of CFC-12 averaged only about 8.1% per annum. (See Figures 3.3 and 3.4) It has been concluded that the net decrease over this period in controlled substance utilization in the country can be majorly attributed to the shift by foam manufacturers from CFC-11 to other substitutes. Many foam industries, especially those that were commissioned around 1992 built systems that utilized methylchloride as a foam blowing agent. Other existing foam manufacturers, like Vitafoam Plc implemented gradual phase-out

TABLE 3.6: HISTORICAL TREND OF ODS CONSUMPTION IN NIGERIA IN 1991-1994

SUBSTANCE	1991			1992			1993			1994		
	Metric Tonnes	ODP Tonnes	%	Metric Tonnes	ODP Tonnes	%	Metric Tonnes	ODP	%	Metric	ODP	%
CFC - 11	530.4	530.4	30.0 (30.6)	332.2.	332.2	25.0. (25.7)	269.9	269.9	22.9 (23.4)	206.7	206.7	17.5 (17.7)
CFC - 12	1,044.6	1,044.6	59.1 (60.3)	789.2	789.2	59.3 (61.6)	714.2	714.2	60.6 (61.9)	772.3	772.3	65.4 (66.7)
CFC - 114	0.0	0.0	0.0 (0.0)	1.0	1.0	0.1 (0.1)	7.2	7.2	0.6 (0.6)	7.2	7.2	0.6 (0.6)
CFC - 115	15.3	9.2	0.5 (0.5)	9.8	5.9	0.4 (0.5)	8.8	5.3	0.4 (0.5)	8.2	4.9	0.4 (0.4)
HCFC - 22	690.0	34.5	0.2	980.0	49.0	3.7 (-)	508.0	25.4	2.2 (-)	485.9	24.3	2.1 (-)
HALON - 1211	1.3	3.9	0.2 (0.2)	1.2	3.6	0.3 (0.3)	0.0	0.0	0.0 (0.0)	0.0	0.0	0.0 (0.0)
HALON - 1301	3.0	30.0	1.7 (1.7)	3.1	31.0	2.3 (2.4)	3.3	33.0	2.8 (2.9)	3.5	35.0	3 0 (3.0)
Carbon Tetrachloride	84.9	93.4	5.3 (5.4)	86.6	95.3	7.2 (7.4)	91.2	100.3	8.5 (8.7)	96.0	105.6	8.9 (9.1)
1,1,1 Trichlroethane	220.0	22.0	1.2 (1.3)	229.2	22.9	1.7 (1.8)	241.3	24.1	2.0 (2.1)	254.0	25.4	2.1 (2.2)
Total without HCFC-22	1,899.5	1,733.5	100.0	1,452.3	1,281.1	100.0	1,335.9	1,154.0	100.0	1,347.9	1,157.1	100.0
Total with HCFC-22	2,589.5	1,768.0	100%	2,432.3	1,330.1	100.0	1,843.9	1,179.4	100.0	1,833.8	1,181.4	100.0

NOTE: The numbers in brackets are the % of the controlled substances i.e. without R-22.

FIG. 3.3A: HISTORICAL ODS CONSUMPTION BY TYPE (IN ODP TONNES)

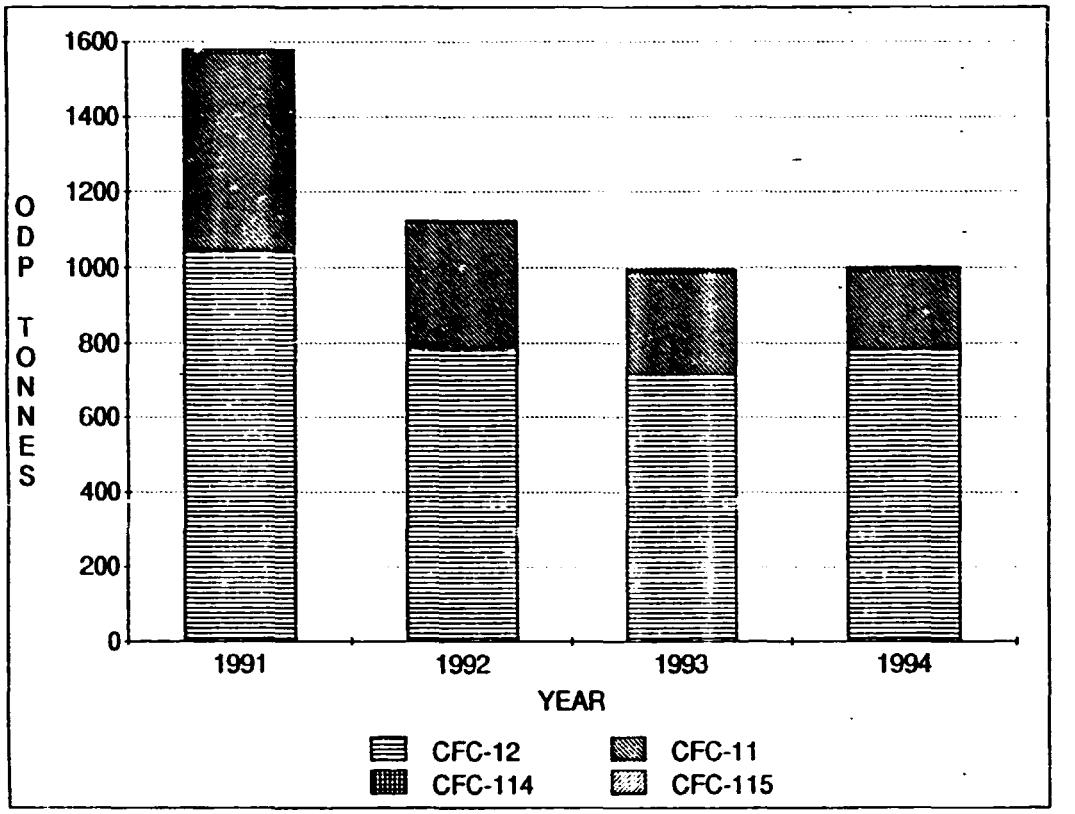


FIG. 3.3B: HISTORICAL ODS CONSUMPTION BY TYPE (IN ODP TONNES)

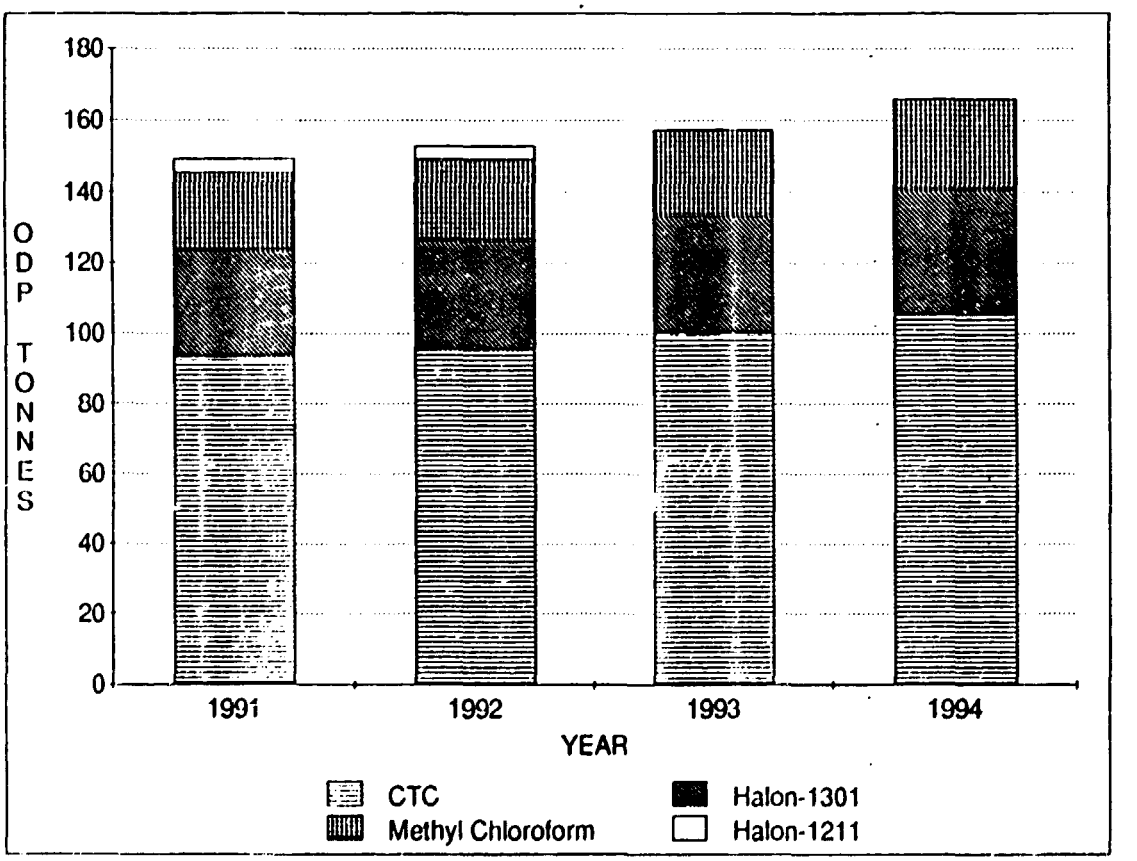
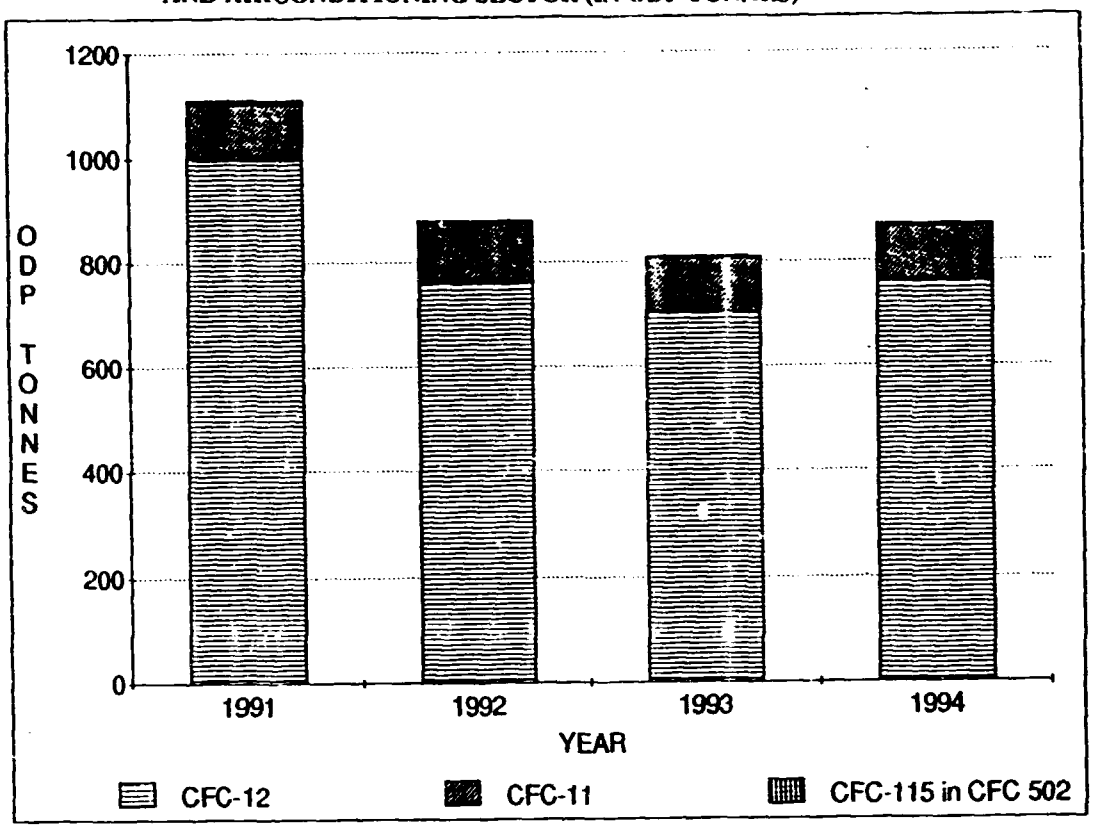


FIG. 3.4: HISTORICAL ODS CONSUMPTION BY TYPE IN THE REFRIGERATION AND AIRCONDITIONING SECTOR (IN ODP TONNES)



programs with completion target dates. It was also documented from our survey that Mouka Ltd, aflexible foam manufacturing company has even gone a step further by shifting first to the use of methylene chloride and more recently to auxilliary blowing agent-free foam.

It has been postulated that the decrease in CFC-12 utilization in 1994 was a result of increasing price of CFC-12 in the international market due to stoppage in production as a reaction to the phase-out requirement of the Montreal Protocol. We however believe that the decline in consumption recorded between 1991-1994 may be due, more to the decline in economic activity recorded in Nigeria during the same period. We also note that the use of HCFC-22, which is a transitional substance grew during the period 1991-1992, probably in response to its lower ozone depletion potential, recorded a significant downturn in use between 1992 - 1993 as a result of worsening economic situation, and stabilized in later years.

3.4 FORECAST OF ODS CONSUMPTION IN NIGERIA 1994 - 2010

3.4.1 Factors Determining Demand for ODS

In order to be able to assess the relative structural change of ODS consumption in Nigeria, especially in reaction to the Montreal Protocol, it is necessary to forecast ODS demand up to the year 2010 as if the Montreal Protocol did not exist. As such, we have assumed in the estimation of this unconstrained demand that; ODSs are not regulated; and unconstrained quantities of the controlled substances are imported into the country at current prices throughout the period.

The demand for ODSs is derived from the demand for products that contain or are made with ODSs, and from the need for servicing and topping up of refrigerators, deep freezers air-conditioning and fire fighting equipment. The demand for these in turn depend on several factors among which the key ones include: population growth rate; income growth rate; expected specific sector growth rates; market saturation of consumer goods e.g. refrigerators, aerosols etc. in the present market; service needs and standards etc. These factors combine with each other to determine the evolution of the structure of the activities of the ODS end-use sectors, which in turn determines the amount of ODSs that could have been consumed during these future years if no constraint on utilization exist.

Apart from these factors which are internal to Nigeria, some factors which are external are also expected to affect the unconstrained demand. The crucial ones among these include; the evolution of prices of ODS in the international market during the period; as well as the availability of alternative technology utilizing non - ODSs and/or non - controlled substances.

3.4.2 Unconstrained Demand by End-Use Sectors, 1994 - 2010

Tables 3.7 to 3.11 gives the basic assumptions made in the development of the unconstrained ODS demand in Nigeria for the period 1995 - 2010. While Tables 3.12 and 3.13 show the results of forecast of unconstrained demand for ODS by sector and by substance respectively. The forecasted unconstrained ODS consumption by sector is illustrated in figured 3.5 while figure 3.6 shows the forecast unconstrained ODS consumption by type in the Airconditioning and Refrigerators. Brief elucidation of the underlying assumptions for each of the ODS use sectors is presented as follow:

(a) Domestic Refrigeration and Deep Freezing

In 1994, about 1.81 million was the estimated population of domestic refrigerators and deep freezers in the country. For the study period, 1995 - 2010, the following process of addition and subtraction is expected to govern the population of these stock of equipment from year to year. Domestic production of these equipment will contribute additional stock to existing ones in each of the years. The installed capacity for the manufacturing/assembly of these equipment stood at about 400,000 units by 1994. Most of these capacities are still in place and can play a very significant role in domestic supply if the economic atmosphere is right. We have therefore assumed that the unutilized capacity for domestic manufacture/assembly of these units will play a larger role in the supply mix in future years. It has been assumed that 1995 - 2005 will represent a post - recession period for this sector during which manufacture of new units will grow at an annual average of about 15%. This growth rate is expected to stabilize to an annual average of about 10% during the period 2006 - 2010.

Importation of these equipment either in brand new or slightly used conditions (Tokunbos) is another historical supply mode in Nigeria. The major actors in the importation of brand new

domestic refrigerators and freezers into Nigeria in recent years were the manufacturers of the equipment in Nigeria. Our survey showed that many of them had stopped this import business by 1994 because it was uncompetitive compare to the "Tokunbos" which was coming in large quantities. Many of the manufacturers we discussed with informed us of their preference to rescucitate their manufacturing capacities rather than rely on imports. They also informed us that as long as the uncontrolled importation of "Tokunbos" continue, they may be constrained in their ability to expand production. The most recent government directives has tightened this uncontrolled imports.

Given these background, we have made the following assumptions: the recent tightening up of imports will lead to an average annual growth of 5% in the import of "Tokunbos" between 1994 - 2000. Deliberate policy will be implemented to control import of these used equipment in subsequent years, leading to an annual average decrease of about 25% and 50% between 2001 - 2005, and 2006 - 2010 respectively. It is expected that as a consequence of the Montreal Protocol, Countries in Europe and America which are the basic sources of the imports of Tokunbos will cease the production of ODS based equipment by 1st of January 1996. Given that equipment lifetime is between 10 - 15 years, then "Tokunbos" that will be available from about 2006 will be ones that have passed their useful lifetime. It has therefore been assumed that appropriate national policy will be put in place to ban or reduce the importation of these equipment.

We have also assumed that given the preference of major equipment manufacturers in Nigeria to upgrade their production capacities, they will not engage in substantial new equipment imports. As a result, we assumed that between 1994 - 1995 there will be a 50% decrease in imports of new equipment, 90% for 1996, and for subsequent years, we have assumed that new equipment imports will be frozen at the zero level. For domestic manufacturing of these equipment, we have assumed that CFC-12 that will be required to charge such equipment will average about 0.3 Kg/unit. It has

further been assumed that refrigerators/deep freezers need to undergo recharging once in 5 years, as such 20% of equipment were assumed to undergo recharging annually. For recharging of such old equipment 1.0 Kg/unit of CFC-12 will be required. Also 1.12 Kg/unit of CFC-11 will be required for foam blowing during the manufacture of foam insulators for new equipment.

(b) Commercial and Industrial Refrigeration

(i) Cold Stores (6 - 36 TR)

We have estimated that the population of the stock of this range of Cold Stores in Nigeria by 1994 was about 830 units. It has been assumed in the development of the unconstrained demand for ODS that between 1994 - 2000, the average annual growth of this stock of equipment will follow the real GDP growth of 4.5%, while for the period 2001 - 2010 the growth is expected to average annually about 5.0%. For this range of equipment, it has further been assumed that every year, about 1% of the total population will be scrapped. Furthermore, about 7.2 Kg of CFC-12 and 540 Kg of CFC-11 will be required for the manufacture of each new units. It has also been assumed that: 9% of all equipment in a year will have compressor failure, the repair of which will require 7.5 Kg/unit of CFC-12; 5% of total population of equipment will suffer refrigerant leakages each year requiring that about 11.2 Kg of CFC-12 to recharge each unit of this equipment; and all the equipment in this category will require topping up once in a year with each unit requiring about 7.9 Kg of CFC-12 for this purpose.

(ii) Cold Stores (50 - 100 TR)

There were 206 units of this range of Cold Stores in Nigeria in 1994. For the purpose of estimating the unconstrained demand for ODS, we have made the following

assumptions: the population of these equipment will grow at a rate equal to the general GDP growth rate i.e 4.5% per annum between 1995 - 2000 and 5.0% between 2001 - 2010; 1% of total population of equipment will be scrapped each year; 21.6 Kg of CFC-12 will be needed to charge each unit of newly manufactured equipment; 9% of all such equipment will experience compressor failure each year, requiring about 22.5 Kg/unit of CFC-12 for recharging; about 5% of total equipment population will experience refrigerant leakage each year, requiring about 33.7 Kg/unit of CFC-12 for recharging; while all existing and functioning equipment each year will require about 23.8 Kg of CFC-12 to top-up each unit; about 540 Kg of CFC-11 will also be required during the manufacturing of each new units.

(iii) Refrigerated Trucks

We have estimated the total population of refrigerated trucks in Nigeria in 1994 to be about 533 units. It has been assumed that during the period 1994 - 2010, this population will grow at a rate equal to the general GDP growth rate of 4.5% p.a between 1994 - 2000, and 5.0% p.a between 2001 - 2010. It has further been assumed that: 1% of total population of these equipment will be scrapped each year; about 5.3 Kg of CFC-12 will be required for charging each new equipment; 9% of all such equipment in a year will have compressor failure and will require about 5.5 Kg of CFC-12 to recharge each unit; 5% of all such equipment will suffer refrigerant leakage in a year, requiring about 8.3 Kg/unit of CFC-12 for recharging; while all the equipment will require about 5.8 Kg of CFC-12 for topping up each unit.

(c) Domestic and Commercial Airconditioning

As pointed out in an earlier section, equipment types in this sector include: room airconditioners, split units,

centrifugal chillers, and reciprocating chillers. Of all these only the industrial centrifugal chillers uses the controlled substances CFC-11 and CFC-12. The rest utilizes the transitional substance HCFC-22. The current trend in the country now is for installation of reciprocating chillers, which are easier to maintain and more flexible to operate than the centrifugal type. Therefore in order to estimate future ODS demand for the unconstrained scenario, we have assumed that no new centrifugal chillers will be brought into service in Nigeria during the period 1995-2010. All new installations will be reciprocating chillers and other emerging ODS free technologies. Furthermore, starting from 1996, an average of 3 of the existing centrifugal chillers will be scrapped each year. We have further assumed that; 40% of the centrifugal chillers in place use CFC-12 as the refrigerant and their servicing requirement is about 549.1 Kg of CFC-12 per unit; the balance 60% use CFC-11 as refrigerant, with a service requirement of about 216.3 Kg of CFC-11 per unit; all existing centrifugal chillers will undergo a minimum of one service each year.

(d) Mobile Airconditioning

We have estimated that the population of airconditioned vehicles in Nigeria as of 1994 to be about 650,000 units. The growth rate of this stock will be affected by; domestic production of airconditioned vehicles; imports of airconditioned vehicles, new and fairly used (Tokunbos); retrofitting of existing non- AC cars with airconditioning systems; and scrapping of aged vehicles. In order to generate the unconstrained demand for ODS use during the period 1995-2010, we have made the following assumptions; domestic production of vehicles will be frozen at the 1994 levels of 14,000 units (minus VON) till 1997; about 85% of domestically assembled vehicles are airconditioned; and average annual growth of 10% in domestic production of cars

in Nigeria between 1998-2010; import of new and "Tokunbo" Cars is assumed to grow at an average annual rate of 10% between 1994-2010; 50% of all imported vehicles come in with airconditioners; 8% of airconditioned cars are scrapped annually; CFC-12 refrigerant charge requirement for new cars is about 2kg/unit; 1% of existing stock of cars which are retrofitted with airconditioners require a charge of 1.62 Kg of CFC-12 per unit; each year, 15% of total population of airconditioned cars suffer refrigerant leakages requiring a recharge of 2 Kg of CFC-12 per units; 1% has compressor failure problems with a subsequent recharge requirement of about 2 kg/unit; and all cars with airconditioner require an annual top-up of CFC-12 to the tune of 0.16 kg/unit.

(e) Foam Sector

It has been noted in an earlier section that flexible foam producers in Nigeria have consciously been substituting methylene chloride as a blowing agent in place of CFC-11. This is a reaction to the Montreal Protocol awareness. In order to generate the unconstrained demand for ODS in Nigeria during the period 1994-2010, we have made the following assumptions for this sector; use of CFC-11 in the production of flexible foam in Nigeria will witness an average annual growth of about 4.5% and 5.0% during the periods 1994 - 2000 and 2001 - 2010 respectively; No substitution of CFC-11 to Methylene chloride will take place during these periods; the 1994 base year consumption of CFC-11 as a foam blowing agent has been fixed at the 1991 level, in order to reduce the effect of the shift that had already taken place between 1991 - 1994.

(f) Solvents, Aerosols, and Fire Extinguishing Agents

It has been assumed that the use of ODS for each of these applications in Nigeria will grow at the rate equal to the

general GDP growth rate. This has been put at 4.5% p.a for the period 1995 -2000, and 5.0% p.a for the period 2001 - 2010. For Aerosols, 1991 has been used as the base year of the forecast in order to reduce the effect of some of the shift to unstenched LPG that has already taken place. Similarly, it has been assumed that the halons will still be used as fire extinguishing agents throughout the period 1994 - 2010.

TABLE 3.7: ASSUMPTIONS FOR UNCONSTRAINED ODS DEMAND FORECAST FOR DOMESTIC REFRIGERATION AND DEEP FREEZING

ODS APPLICATIONS	GROWTH AND OTHER ASSUMPTION	PERIOD
° New Equipment Refrigerant Charge	1. New Equipment Manufacture	
	15% average annual growth	1994 - 2005
	10% average annual growth	2006 - 2010
° Servicing	2. Imports of "Tokumbos"	
	5% average annual growth	1994 - 2000
	25% average annual decrease	2001 - 2005
° Manufacture of Insulation Foams	50% average annual decrease	2006 - 2010
	3. New Equipment Imports	
	50% average annual decrease	1994 - 1995
	90% average annual decrease	1996
	No Imports	1997 - 2010
	4. Equipment Retirements	
	5% average annually	1994 - 2010

Other Assumptions:

(i)	CFC-12 Requirement for Charging New Equipment:	300g/unit
(ii)	CFC-12 Requirement for Recharging Old stock:	1 Kg/unit
(iii)	Percentage of Total Equipment Undergoing Recharging annually:	20%
(iv)	CFC-11 Requirement for Foam Blowing in New Equipment:	1.12 Kg/unit

EEE

QUESTIONNAIRE ON THE STUDY ON PHASE-OUT OF OZONE DEPLETING SUBSTANCES (ODS) - CHLOROFLUOROCARBONS (CFCs) AND OTHERS

QS-3

1) DOES YOUR COMPANY SERVICE REFRIGERATION AND AIRCONDITIONING EQUIPMENT? ..... IF YES, WHAT TYPES OF SERVICES DO YOU RENDER?

[] IN-HOUSE SERVICE OF COMPANY'S EQUIPMENT
[] SERVICE OF EQUIPMENT OTHER THAN COMPANY'S OWN
[] MOBILE SERVICE UNITS
[] OTHERS (Specify) .....

2) WHAT CATEGORY OF EQUIPMENT DO YOU SERVICE? Please tick the appropriate box(es).

[] DOMESTIC REFRIGERATORS AND DEEP FREEZERS
[] COMMERCIAL AND INDUSTRIAL REFRIGERATORS (e.g. COLD STORES, REFRIGERATED TRUCKS)
[] DOMESTIC AND COMMERCIAL AIRCONDITIONERS
[] MOBILE (OR CAR) AIRCONDITIONERS

3) HOW MANY TECHNICIANS (TRAINED & UNTRAINED) DO YOU EMPLOY FOR THE SERVICING OF EQUIPMENTS?

.....
.....

4) PLEASE GIVE THE PERCENTAGES OF THE DIFFERENT TYPES OF SERVICE/REPAIRS CARRIED OUT BY YOUR FIRM; RATE OF RECHARGING WITH REFRIGERANTS AND THE FREQUENCY OF EACH TYPE OF FAILURE FOR THE DIFFERENT EQUIPMENT.

(a) DOMESTIC REFRIGERATORS AND DEEP FREEZERS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

(b) COMMERCIAL AND INDUSTRIAL REFRIGERATORS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

(c) DOMESTIC AND COMMERCIAL AIRCONDITIONERS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

(d) MOBILE (OR CAR) AIRCONDITIONERS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

5) WHAT IS THE PERCENT WASTAGE IN THE RECHARGING THE DIFFERENT TYPES OF EQUIPMENT WITH REFRIGERANTS SINCE 1990?

(a) DOMESTIC REFRIGERATORS AND DEEP FREEZERS

.....
.....
.....

(b) COMMERCIAL AND INDUSTRIAL REFRIGERATORS

.....
.....
.....

.....
.....

(c) DOMESTIC AND COMMERCIAL AIRCONDITIONERS

.....
.....
.....

(d) MOBILE (OR CAR) AIRCONDITIONERS

.....
.....
.....

6) WHAT TYPE OF REFRIGERANTS DO YOU USED FOR SERVICING?

(a) DOMESTIC REFRIGERATORS AND DEEP FREEZERS

.....

(b) COMMERCIAL AND INDUSTRIAL REFRIGERATORS

.....

(c) DOMESTIC AND COMMERCIAL AIRCONDITIONERS

.....

(d) MOBILE (OR CAR) AIRCONDITIONERS

.....

7a) WHICH CHEMICALS DO YOU USE FOR LEAK TESTING? .....
.....

7b) WHICH CHEMICALS DO YOU USE FOR FLUSHING? .....
.....

7c) WHAT QUANTITY OF THESE CHEMICALS DO YOU USE:

(i) FLUSHING .....
.....

(ii) LEAK TESTING .....
.....

8) WHAT ARE YOUR SOURCES OF REFRIGERANTS PURCHASE (LOCAL/IMPORTED)? Give Names of Company & Country.
.....
.....

9) ARE YOU AWARE OF THE EFFECTS OF REFRIGERANTS (CFCs AND RELATED CHEMICALS) ON OZONE LAYER AND THE MONTREAL PROTOCOL PLAN TO PHASE THEM OUT? IF YES, SINCE WHEN?
.....

10) WHAT ARE YOUR COMPANY'S PLANS IN RESPONSE TO THE PHASE-OUT PROGRAMME? .....
.....
.....
.....

11) DOES YOUR ORCANISATION CARRY OUT ANY RECOVERY/RECYCLING OF REFRIGERANTS? GIVE DETAILS OF THE TIME IT STARTED, EQUIPMENT, AND QUANTITY RECOVERED PER YEAR.
.....
.....
.....
.....
.....

EEE

QUESTIONNAIRE ON THE STUDY ON PHASE-OUT OF OZONE DEPLETING SUBSTANCES (ODS) - CHLOROFLUOROCARBONS (CFCs) AND OTHERS

QS-4

Please kindly provide answer to the following questions:

1) NAME AND ADDRESS OF COMPANY: .....
.....
.....
.....
.....

2) NAME OF CONTACT PERSON AND POSITION: .....
.....
.....

3) TICK THE MANUFACTURING PROCESS CARRIED OUT IN YOUR COMPANY

[ ] PLASTIC FOAMS (POLYURETHANE, RIGID POLYURETHANE OR POLYSTYRENE)
[ ] AEROSOLS FILLING (PESTICIDES, HOUSEHOLD PRODUCTS COSMETICS/BODY DEODORANTS)
[ ] MANUFACTURING PROCESS REQUIRING THE USE OF SOLVENTS
[ ] FIRE EXTINGUISHERS

4) PLEASE TICK THE APPLICABLE ODS (e.g. CFCs, ETC) IN USE IN YOUR PROCESS OPERATIONS

[ ] CFC 12/11 MIXTURE
[ ] CFC 12/114 MIXTURE
[ ] CCI4
[ ] METHY/CHLROFORM (CH_3CCI_3)
[ ] HALON 1301
[ ] HALON 1211
[ ] CFC 113
[ ] O T H E R S , L I S T .....

5) WHAT IS YOUR INSTALLED CAPACITY?
.....

6) WHAT HAS BEEN YOUR PRODUCTION FIGURES FROM 1990 - 1994?

YEAR	QUANTITY (IN KG)
1990	
1991	
1992	
1993	
1994	

7) GIVE THE QUANTITY BY TYPE OF ODS USED FROM 1990 - 1994.

TYPE OF ODS/GOODS	1990	1991	1992	1993	1994
1.					
gms/unit					
2.					
gms/unit.					
3.					
gms/unit					
4.					
gms/unit					

8) WHAT ARE THE SOURCES OF YOUR SUPPLY FOR ODS? Give Company and Country.

.....

.....

9) WHAT IS YOUR COMPANY'S MARKET CAPTURE IN YOUR LINE OF BUSINESS?

.....

10) WHO ARE YOUR COMPETITORS WHO MAKE USE OF THE SAME PROCESS (UTILIZING ODS) - GIVE NAME & ADDRESS

.....

.....

.....

11) DO YOUR HAVE AFFILATION WITH ANY FOREIGN COMPANY? IF YES, GIVE NAME OF COMPANY AND COUNTRY.

.....

.....

.....

12) IS YOUR COMPANY AWARE OF THE OZONE DEPLETING PROPERTIES (OR THE NEGATIVE ENVIRONMENTAL EFFECTS) OF CFCs AND RELATED CHEMICALS? IF YES, HOW LONG AGO?

.....

.....

13) WHAT ARE YOUR COMPANY'S PLANS IN RESPONSE TO THE PHASE-OUT PROGRAMME? .....

.....

.....

.....

14) WHAT ARE THE PLANS OF YOUR AFFILIATE IN RESPONSE TO THE PHASE-OUT PROGRAMME, IF DIFFERENT FROM THAT ABOVE?

.....

.....

15) IS THERE ANY PHASE-OUT PLAN BY YOUR UMBELLA ASSOCIATION/BODY?

....

.....

.....

16) WHAT ARE THE COST IMPLICATIONS OF YOUR PLAN ON THE PRODUCTS?

.....

.....

17) ARE YOU OF THE OPINION THAT CFCS SHOULD BE PHASED-OUT GRADUALLY BEFORE THE YEAR 2010 OR WAIT UNTIL THE YEAR 2010? PLEASE EXPANTIATE YOUR VIEW. .....

.....

.....

.....

.....

APPENDIX D

COST FOR RETROFITTING OF: THERMOCOOL ENGINEERING COMPANY LTD. AND KOLINTON INDUSTRIES LTD.

TECHNICAL INDUSTRIES LIMITED

Head Office: 25, ABIMBOLA STREET, ISOLO INDUSTRIAL ESTATE, ISOLO LAGOS NIGERIA.

Telex No - 27375 TOLTEC NG
Cable Address: KOLINTECH LAGOS
Telephone: 5-2729, 523482, 523494, 860105.
Fax: 523494, 860105

Bankers:
SAVANNAH BANK OF NIGERIA PLC.
P. O. Box 2317 Lagos.
UNITED BANK FOR AFRICA PLC.
53, Idumagbo Avenue, Lagos.

Postal Address:
P.M.B. 1060,
Ebute - Metta,
Lagos - Nigeria

Our Ref. Your Ref Date

7th June, 1995.

TO WHOM IT MAY CONCERN

Dear Sir,

RE:OZONE DEPLETING SUBSTANCES PHASE-OUT STUDY

These are the analysis of our machines that need to be retrofited, with unite price and total amount.

DESCRIPTION	QTY	UNIT PRICE	TOTAL COST
1. Low pressure Cannon Foaming Machine	2		extimated total cost $800,000.00
2. Charging Board "EDWARD'S MACHINE"	4		
3. Edward Vacuum Pump	20		
4. Halide Leak Detector	2		

N.B TECHNICAL DETAILS OF THE SHORT COMINGS OF OUR MACHINES WHICH NECESSITATED THEM TO BE RETOFITTED ARE AS FOLLOWS.

THE LOW PRESSURE CANNON FOAMING MACHINE

THE CHEMICALS USED: Polyol MDI, with R11 gas, the gasket/Kits of the pump will be affected due to density change from 32 to 36 kg/M^3.

New Tanks which must be pressurised will be needed and the mixing should be done in the line by a EASYFROTH UNIT.

EDWARD VACUUM PUMP: The materials with oils at ester base is neede for vacuum operation.

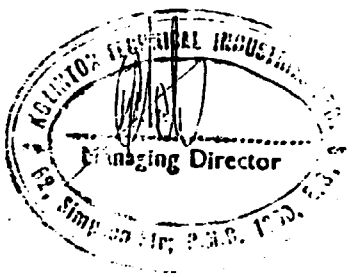
..../2

CHARGING BOARD The charging Machines use R12 and R22. The charge of gas will necessitate new type of drier.

HILIDE LEAK DETECTOR Should be able to defect leakag of the new gas.

We would appricate any further assistance.

Yours faithfully,



THERMOCOOL

CFC PHASE-OUT
CAPITAL INVESTMENT ESTIMATE

1. FOAMING PLANT

(a) Refrigerators Cabinet

(i) Modify Carousel No 1 to be able to do both TEC and NRD models (**US $ 250,000).**
(ii) There is preference in foaming TEC models in the " bath " position like the NRD's.
(iii) Purchase of 9 aluminium adjustable plugs (inclusive of one spare) that will be used to foam all TEC models **(US $ 360, 000).**
(iv) Reconstruct the cabinet pre-foaming assy line to lead to Unit 1 Carousel **(US $ 70,000).**

(b) Freezer Cabinets.

(i) Modify Carousel No 2 to be able to foam freezer cabinets **(US $ 150,000).**
(ii) For the foaming position to be changed from the " bell " to the " bath " position additional cost will be necessary to convert the assembly procedure , as well as some possible tooling costs . Tentative estimate at this stage **(US $ 200, 000).**
(iii) Purchase five aluminium adjustable plugs (including one spare) which will be able to foam the current F 251 , F 381 as well as the new F 151 models **(US $ 200, 000).**
(iv) Re-construct the cabinet pre-foaming assembly line around the Unit 2 Carousel **(US $ 50, 000).**

(c) Doors and Lids

(i) No significant change is necessary on the refrigerator door Carousel No 5 , apart from the installation of safety equipment.

(ii) To produce the freezer lids on Carousel No 4 will require the purchase of twelve aluminium nests, four for each model (including one spare per model) **(US $ 240, 000).**

(d) Foaming Machines

(i) Two H 40 machines with one additional head will have to be purchased to produce the doors and lids **(US $ 360, 000) .**

(ii) Three H 100 machines will be needed one on Carousel No 1 , one on Carousel No 2 and one spare **(US $ 570, 000).**

(e) Cyclo -Pentane Storage and Mixing

(i) Underground pentane storage tank complete with ventilating facilities **(US $ 60,000).**

(ii) Three mixing stations (Carousel No. 1 , No. 2 , Nos. 4 & 5)**(US $ 210 , 000).**

(g) Miscellaneous

(i) Gas detection , Ventilation and Exhaust System , Anti - Static Floor and Pipe installation .
Four sets of the above for Carousels No 1 , 2 , 4 , and 5 **(US $ 600 , 000).**

(ii) Water heater system and fire protection system **(US $ 70 , 000).**

(h) Generators

Two 320 KVA auto - start generators **(US $ 150 , 000).**

FOAMING PLANT SUB - TOTAL : (US $ 3.54 million).

2. FINAL ASSEMBLY PRODUCTION

a) Vacuum Pumps

Refrigerator Assy (65 off) }
Freezer Assy (65 off) } TOTAL : (130 off)

i)	Replacement of aged vacuum pumps	(65 off)	**$ 260 , 000**
ii)	Refurbishment and conversion of the rest	(65 off)	**$ 65 , 000**

b) Charging Boards

(i) Refrigerators Assy Line	(2 off)	**$ 70 , 000**
(ii) Freezers Assy Line	(2 off)	**$ 70 , 000**

c) HFC R134a Leak Detectors

i)	Refrigerator Assembly Line	(3 off)
ii)	Freezer Assembly Line	(3 off)
iii)	Q. C. Laboratory	(1 off)
	TOTAL	7 off

$ 70 , 000

d) Q. C. Laboratory Testing Equipment

To be able to test our range of products . **$ 40 , 000**

e) R12 Collection Stations

i)	Refrigerator Assy Line	(2 off)
ii)	Freezer Assy Line	(2 off)
iii)	Q.C. Laboratory	(1 off)
	TOTAL	5 off

$ 30 , 000

f) Helium Leak Detectors

i)	Refrigerator Assy Line	(1 off)
ii)	Freezer Assy Line	(1 off)
	TOTAL	2 off

$ 140 , 000

f) R134a Recycling and Reclaim Unit **$ 65 , 000**

g) FINAL ASSEMBLY PRODUCTION SUB -TOTAL : (US $ 0.81 million)

3. AFTER - SALES SERVICE EQUIPMENT

a) Portable Evacuation and Charging Boards

Fifteen units (To cover thirteen depots and have two spare) **$ 45 , 000**

b) R12 Portable Recovery Units

Thirty units (two per depot and 4 spare) **$ 90 , 000**

c) R134a Portable leak Detectors

Thirty units (two per depot and 4 spare) **$ 15 , 000**

d) AFTER - SALES SERVICE SUB - TOTAL : US $ 0.15 million

4. *CAPITAL INVESTMENT GRAND TOTAL :* *US $ 4.5 million*

APPENDIX E

LIST OF REFERENCES

1. UNEP (1989) - Technical Progress On Protecting the Ozone Layer (Refrigeration, Air Conditioning and Heat Pumps Technical Options Report).

2. UNEP (1989) - Economic Panel Report (Montreal Protocol on Substances that Deplete the Ozone Layer).

3. UNEPIE/PAC(1992) - Protecting the Ozone Layer (Vol.1:Refrigerants).

4. UNEPIE/PAC (1992) - Protecting the Ozone Layer (Vol. 2: Solvents, Coatings and Adhesives.)

5. Government of Ghana and UNEPIE/PAC (1992) - Ghana Country Programme for Phase-Out of Ozone, Depleting Substances.

6. Ministry of Environment Protection, National Resources and Forestry (1992) - National Strategy for the Protection of the lithosphere.

7. UNEP (1993) - Cameroon Country Programme for the Implementation of Montreal Protocol.

8. UNIDO (1992) -Technoeconomic Assessment of the financial viability of the collection and Safe disposal of Refrigerant Gases and Related materials in Africa.

9. FEPA MONOGRAPH 4 (1993) - Industry and Ozone Layer Protection in Nigeria.

10. Egyptian Environment Affairs Agency/United States Environmental Protection Agency (1990) - Cost to Egypt of Protecting the Stratospheric Ozone Layer

11. World Bank (1992) - Montreal Protocol Sourcebook of Benchmark Unit Abatement Costs Policy Document

APPENDIX F

METHODOLOGY FRAMEWORK FOR INCREMENTAL COST CALCULATIONS

(a) Incremental Capital Costs

For Domestic Refrigerators and Deep Freezers Manufacturing substituting CFC-12 by HFC-134a and CFC-11 by cyclopentane:

Manufacturing (motor/compressor, refrigerating system, thermostat), foaming plant plus technical assistance, retraining and technology transfer/assimilation costs. ------ $ 13,200,000

Size of plant (for the whole country, hence cumulative for 3 plants of varying sizes) This represents about 70% of the existing capacity which is for production of CFC-based units ----- 300,000 units

Life time of equipment (This was given in Montreal Protocol's document "Source book of Benchmark Unit Abatement Costs") ------- 15 years

Annualized incremental Costs[a] ------- $ 1,030,000

Salvage value of capital[b] ---------- $ 2,950,000 for Scenario A
$ 172,000 for Scenario B

For Foaming Plant used in Commercial and Industrial Refrigeration Substituting HFC-11 by Cyclopentane:

Foaming Plant plus Technical Assistance, Retraining, Technology Transfer/Assimilation Costs ---------- $ 5,310,000

[a] This was obtained by multiplying the capital cost by capital recovery factor $r/[1/(1+r)^L]$, where r is the real social discount rate (2%, as used in the Egypt Report and Montreal Protocol's Economic Assessment Panel Report) and L is the capital's lifetime capital Recovery factor was estimated as 0.0773

[b] Salvage value was estimated since the annualized costs did not last the 15 years lifetime before the year 2010 for both Scenarios and the salvage value was added to the annualized cost for the year 2010 on both scenarios. The salvage value is $= S \times C/(1+r)^L$ where S is the percentage of capital cost estimated to be recoverable on salvage (based on remaining lifetime) and C is the original capital cost

Size of Plant	----------	Same as size of foaming plant for domestic refrigerators with capacity of 225,000 units per annum
Annualized Increment Capital Cost	----	$ 413,118
Salvage Value of Capital	----	$1,960,000 for Scenario A $258,750 for Scenario B

Incremental Capital Costs Applies only to the Domestic Refrigerator and Deep Freezers and the Commercial and Industrial Refrigeration Sub Sectors only and not to Mobile Air-conditioning Sub-sector.

(b) Incremental Operational Production Cost:

Methodology and costs were obtained from Montreal Protocol's "Sourcebook of Benchmark Unit Abatement Costs".

For manufacturing Non-ODS Domestic Refrigerators and Deep Freezers:

ODS savings	----------	3.1 Kg ODP/refrig.

This is based on the following:

Charge size of CFC - 12	----	0.3 Kg
Amount vented at each service	----	0.3 Kg
Number of services in lifetime	----	4
ODP of CFC - 12	----	1.0

Incremental Operational Costs:

Price of HFC - 134a	----	$ 3.30/Kg
Charge Size	----	0.3 Kg/refrigerator
Cost of Compressor and Oil	----	$ 1.00/refrigerator
Cost of Desiccant	----	$ 0.81/refrigerator
Number of refrigerators	----	500,000/year
Annual Operational Costs	----	$ 2,130,000/annum

Offsetting Benefits:

Cost of CFC - 12	----	$ 3.30/kg
Amount of CFC - 12 saved	----	3.1 Kg/refrigerator
Lifetime of Refrigerator	----	20 years
Number of refrigerators manufactured	----	500,000/year
Annualized Savings of CFC - 12	----	77,500 $/plant
Annual Savings	----	$ 255,750/plant

Incremental Operational Production Cost is:

Incremental Operational Production cost less Annual Savings on CFC - 11 ------- $ 2,364,200 p.a.

This was estimated by assuming that it will be one-third that of substituting CFC - 12 by HFC - 134a since there will be no need for things like compressor, oil and desiccant.

Incremental cost per refrigerator is:

(427,000 x 7,092,5000 - 148,569 x 1,706,000 + 2,364,200)/500,000

= $ 22.8/refrigerator.

Adding 30% for freight, taxes, etc. and for return on investment for both producer and importer, the cost will become about $ 30/refrigerator.

For Mobile Air-conditioners:

This cost is taken as 75% of the cost of retrofitting an existing CFC - 12 based compressor to HFC-134a and this cost is computed in the next section at $ 53.03/per unit. Hence, incremental cost of procuring non-ODS compressor = $ 39.76/unit.

(c) Incremental Cost of Retrofitting Equipment to Use Non-ODS Refrigerant

For Domestic Refrigerators and Deep Freezers:

As mentioned earlier, under sub-section (b), this incremental cost is taken to be same as the incremental operational production cost which is $14.35/refrigerator.

For Commercial and Industrial Refrigeration Equipment:

Retrofitting was not considered in this sub-sector because the potential of ODP savings from this control measure is small.

For Mobile Air-conditioners:

The costs were obtained from Montreal Protocol's "Source book on Benchmark Unit Abatement Costs" and they are for the replacement of CFC - 12 by HFC 134a. They are summarized as follows:

Average Annualized incremental Capital Cost	$ 38.0
Average Incremental Operational Cost	$ 16.2
Net Offsetting Benefit	($ 1.2*)
	$ 53.01

6. Government Cost for Campaign and Institutional Strengthening

An annual cost of $ 250,000 has been estimated for the purpose of organizing awareness campaign to discourage use of ODS for flushing and leak testing in refrigeration and air-conditioning equipment; mobilizing technicians to engage in the practice of recovery and recycling and for monitoring and control of ODS activities; and organizing various training programmes and enlightenment campaigns. This cost expenditure is assumed to start 2 years before the start of the implementation of ODS phase-out activities (1995 in Scenario-1 and 1997 in Scenario-2) and continue until 2010.

All the costs considered for the computation of incremental [illegible] 1995 costs and they are discounted by using a discount rate of 10.0%.

APPENDIX G

SPREADSHEET TABLES FOR UNCONSTRAINED, SCENARIOS A AND B AND INCREMENTAL COST

DOMESTIC REFRIGERATORS & DEEP FREEZERS (UNCONSTRAINED PROJECTION)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TOTAL NUMBER OF EQUIPMENT ('000)	1,806	1,830	1,865	1,914	1,978	2,060	2,161	2,285	2,421	2,577	2,758	2,970	3,219	3,490	3,788	4,117	4,481
NUMBER OF NEW EQUIPMENT (DOMESTIC PRODUCTI	84	96	110	127	146	168	193	222	255	294	338	389	427	470	517	569	626
NUMBER OF NEW EQUIPMENT IMPORTED ('000)	2	1	0 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF SECOND-HAND IMPORTED ('000)	29	30	31	33	35	36	38	29	21	16	12	9	5	2	1	1	0
Usage of Equip. Scrapped	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
NUMBER OF EQUIPMENT WITHDRAWN SCRAP ('000) -	90	91	93	96	99	103	108	114	121	129	138	149	161	175	189	206	224
CFC-12 (reqd. for new equip) (Tonnes)	25	29	33	38	44	50	58	67	77	88	101	117	128	141	155	171	188
CFC-12 (reqd. for existing equip.) (Tonnes)	361	366	373	383	395	412	432	457	484	515	552	594	644	69[illegible]	758	823	896
TOTAL CFC-12	386	395	406	421	439	462	490	524	561	604	653	711	772	839	913	994	1,084
CFC-11 (reqd. for new equip.)	94	108	124	142	164	188	216	249	286	329	378	435	479	527	579	637	701
TOTAL CFC	480	502	530	563	603	651	707	772	847	933	1,031	1,146	1,251	1,366	1,492	1,631	1,785

COMMERCIAL AND INDUSTRIAL REFRIGERATION (UNCONSTRAINED PROJECTIONS)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Demand Growth Rate		4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
A COLD STORES (6 - 36 TR)																	
Number of New Installations	10	10	11	11	12	12	13	14	14	15	16	17	17	18	19	20	21
Number of Equipment Scrapped (1% of Total)	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9
Total Population of Equipment	830	832	835	839	843	847	851	856	861	867	874	882	890	900	910	921	933
CFC-12 (reqd. for new equip) (Tonnes) - 7.2kg/unit	0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.15
CFC-12 (reqd. for existing equip.) (Tonnes) - see note a & b	1.65	1.65	1.66	1.67	1.67	1.68	1.69	1.70	1.71	1.72	1.74	1.75	1.77	1.79	1.81	1.83	1.85
CFC-11 (reqd. for new equip.) (Tonnes) - 540kg/unit	5 40	5 64	5 90	6.16	6.44	6.73	7.03	7.38	7.75	8.14	8.55	8.98	9.42	9.90	10.39	10.91	11.45
B. COLD STORES (50 - 100 TR)																	
Number of New Installations	2	3	3	3	3	3	3	3	3	4	4	4	4	4	5	5	5
Number of Equipment Scrapped (1% of Total)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Population of Equipment	206	207	207	208	209	210	211	212	214	215	217	219	221	224	226	229	232
CFC-12 (reqd. for new equip) (Tonnes) - 21.6kg unit	0.05	0 05	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0 08	0.08	0.09	0.09	0.09	0.10	0.10	0.11
CFC-12 (reqd. for existing equip.) (Tonnes) - see note a & b	1 23	1.23	1.23	1.24	1.24	1.25	1.26	1.26	1.27	1.28	1.29	1.31	1 32	1.33	1.35	1.37	1 38
CFC-11 (reqd. for new equip.) (Tonnes) - 540kg/unit	1 30	1.35	1 42	1 48	1.55	1.62	1.69	1.77	1.86	1.95	2 05	2.15	2.26	2.37	2 49	2.62	2 75

C. REFRIGERATED TRUCKS																	
Number of New Installations	11	11	12	13	13	14	14	15	16	17	17	18	19	20	21	22	23
Number of Equipment Scrapped (1% of Total)	5	5	5	6	6	6	6	6	6	6	6	6	6	7	7	7	7
Total Population of Equipment	533	539	547	553	560	568	576	585	595	606	617	629	643	656	670	685	701
CFC-12 (reqd. for new equip) (Tonnes) - 5.35kg/unit	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.12
CFC-12 (reqd. for existing equip.) (Tonnes)	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.88	0.89	0.91	0.93	0.95	0.97	0.99	1.01	1.04
TOTAL CFC-12 (reqd. for new equip) (Tonnes)	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.28	0.29	0.30	0.32	0.33	0.35	0.37	0.39
TOTAL CFC-12 (reqd. for existing equip.) (Tonnes)	3.66	3.68	3.70	3.72	3.75	3.77	3.80	3.83	3.86	3.90	3.94	3.99	4.04	4.09	4.15	4.21	4.27
TOTAL CFC-12	**3.85**	**3.87**	**3.90**	**3.93**	**3.96**	**4.00**	**4.04**	**4.08**	**4.13**	**4.18**	**4.23**	**4.29**	**4.35**	**4.42**	**4.50**	**4.58**	**4.66**
TOTAL CFC-11 (reqd. for new equip.)	**6.70**	**7.00**	**7.31**	**7.64**	**7.99**	**8.34**	**8.72**	**9.16**	**9.61**	**10.09**	**10.60**	**11.13**	**11.69**	**12.27**	**12.88**	**13.53**	**14.20**
TOTAL CFC	***10.54***	***10.87***	***11.21***	***11.57***	***11.95***	***12.34***	***12.76***	***13.24***	***13.74***	***14.27***	***14.83***	***15.42***	***16.04***	***16.69***	***17.38***	***18.10***	***18.86***

Note a: 9% of equip. have compressor failure (cf); 5% have leakage (lk); and 100% needs topping-up (tu)

Note b: use 4.2% higher than qty. for new equip for cf; 55% higher than qty. for new equipment for lk; and 10% of cf for tu.

DOMESTIC AND COMMERCIAL AIRCONDITIONING CFC CONSUMPTION PROJECTIONS

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of New Installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of Equipment Scrapped			3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Total Population of Equipment	24	24	21	18	15	12	9	6	3	0	-	-	-	-	-	-	-
CFC-12 (reqd. for existing equip.) (Tonnes) - see note c	13.18	13.18	11.53	9.88	8.24	6.59	4.94	3.29	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-11 (reqd. for new equip.) (Tonnes) - see note d	5.19	5.19	4.54	3.89	3.24	2.60	1.95	1.30	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL CFC	18.37	18.37	16.07	13.78	11.48	9.19	6.89	4.59	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note c: 40% of Centrifugal chillers in place use cfc-12 and the weighted average for servicing is 549.12kg/unit

Note d: 60% of Centrifugal chillers in place use cfc-11 and the weighted average for servicing is 216.32kg/unit

MOBILE AIRCONDITIONING CFC CONSUMPTION PROJECTIONS

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Vehicle Production by PAN & others in future ('000)	10	10	10	10	11	12	13	15	16	18	19	21	24	26	29	31	35
Vehicle Production by VON ('000)	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vehicle Production by GM ('000)	4	4	4	4	4	5	5	6	6	7	8	9	9	10	11	13	14
Imported Vehicles (New and Fairly-used) ('000)	35	39	42	47	51	56	62	68	75	83	91	100	110	121	133	146	161
Total Number of New AC Vehicles	27	34	36	38	42	45	49	53	59	64	69	76	83	91	100	109	120
Number of AC in Vehicles Scrapped (5% of Total Population)	33	34	34	35	35	35	36	37	38	39	41	43	45	47	50	52	56
Total Population of AC Vehicles ('000)	650	650	652	656	662	672	685	702	722	746	775	808	847	891	941	997	1,061
CFC-12 (reqd. for new AC Vehicles) (Tonnes) - 1.62kg/unit -	43.50	55.49	58.60	62.06	67.28	73.06	79.44	86.50	94.31	102.93	112.45	122.95	134.53	147.30	161.37	176.88	193.96
CFC-12 (reqd. for existing AC Vehicles) (Tonnes) - see note	312.00	312.02	312.91	314.74	317.94	322.60	328.83	336.74	346.45	358.10	371.85	387.87	406.34	427.49	451.54	478.75	509.41
TOTAL CFC	355.497	367.50	371.52	376.80	385.21	395.65	408.27	423.25	440.76	461.04	484.30	510.82	540.88	574.79	612.91	655.63	703.37

Note e: Added to the new AC vehicles is 1% of total AC vehicles in stock as vehicles retroffited with new AC unit

Note f: 1% of total AC vehicles have compressor failure (cf); 15% have leakage (lk); and 100% needs topping-up (tu)

Note g: use 2.0kg/unit for cf; 2.0kg/unit for lk; and 0.16kg/unit for tu.

SUMMARY OF REFRIGERATION AND AIRCONDITIONING (UNCONSTRAINED PROJECTION)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. REFRIGERATION AND AIRCONDITIONING																	
A. DOMESTIC REFRIGERATION AND DEEP FREEZER																	
CFC-12	386	395	406	421	439	462	490	524	561	604	653	711	772	839	913	994	1,084
CFC-11	94	103	124	142	164	188	216	249	286	329	378	435	479	527	579	637	701
B. COMMERCIAL AND INDUSTRIAL REFRIGERATION																	
CFC-12	3.85	3.87	3.90	3.93	3.96	4.00	4.04	4.08	4.13	4.18	4.23	4.29	4.35	4.42	4.50	4.58	4.66
CFC-11	6.70	7.00	7.31	7.64	7.99	8.34	8.72	9.16	9.61	10.09	10.60	11.13	11.69	12.27	12.88	13.53	14.20
C. DOMESTIC AND NON-MERCIAL AIRCONDITIONING																	
CFC-12	13.18	13.18	11.53	9.88	8.24	6.59	4.94	3.29	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-11	5.19	5.19	4.54	3.89	3.24	2.60	1.95	1.30	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. MOBILE AIRCONDITIONING																	
CFC-12	355.5	367.5	371.5	376.8	385.2	395.7	408.3	423.2	440.8	461.0	484.3	510.8	540.9	574.8	612.4	655.6	703.4
TOTAL CFC-11	*105.4*	*119.8*	*135.6*	*153.8*	*174.8*	*199.1*	*227.0*	*259.3*	*296.4*	*339.1*	*389.0*	*446.3*	*490.4*	*538.8*	*592.1*	*650.6*	*715.0*
TOTAL CFC-12	*759.8*	*779.3*	*793.1*	*811.5*	*836.9*	*868.6*	*907.5*	*954.2*	*1,007.4*	*1,068.8*	*1,141.5*	*1,225.7*	*1,317.3*	*1,418.3*	*1,530.2*	*1,654.3*	*1,791.9*
SUB-TOTAL (1) ALL-CFC	864.2	899.1	928.7	965.3	1,011.7	1,067.7	1,134.5	1,213.4	1,303.8	1,407.9	1,530.5	1,672.0	1,807.7	1,957.1	2,122.3	2,304.9	2,506.9
2. FOAM INDUSTRY																	
CFC-11	165.0	172.4	180.2	188.3	196.8	205.6	214.9	225.6	236.9	248.7	261.2	274.2	288.0	302.3	317.5	333.3	350.0
3. AEROSOLS																	
CFC-11	7.7	8.0	8.4	8.8	9.2	9.6	10.0	10.5	11.1	11.6	12.2	12.8	13.4	14.1	14.8	15.6	16.3
CFC-12	24.0	25.1	26.2	27.4	28.6	29.9	31.3	32.8	34.5	36.2	38.0	39.9	41.9	44.0	46.2	48.5	50.9
CFC-114	45.0	47.0	49.1	51.4	53.7	56.1	58.6	61.5	64.6	67.8	71.2	74.8	78.5	82.5	86.6	90.9	95.5
SUB-TOTAL (3) ALL-CFC	76.7	80.2	83.8	87.5	91.5	95.6	99.9	104.9	110.1	115.6	121.4	127.5	133.9	140.5	147.6	155.0	162.7
4. FIRE-FIGHTING																	
HALON 1301	35.0	36.6	38.2	39.9	41.7	43.6	45.6	47.9	50.3	52.8	55.4	58.2	61.1	64.1	67.3	70.7	74.2
5. SOLVENTS																	
CARBON TETRACHLORIDE	105.6	110.4	115.3	120.5	125.9	131.6	137.5	144.4	151.6	159.2	167.2	175.5	184.3	193.5	203.2	213.3	224.0
METHYL CHLOROFORM	*25.4*	26.5	27.7	29.0	30.3	31.7	33.1	34.7	36.5	38.3	40.2	42.2	44.3	46.5	48.9	51.3	53.9
SUB-TOTAL (5)	*131.0*	*135.9*	*143.1*	*149.5*	*156.2*	*163.2*	*170.6*	*179.1*	*188.1*	*197.5*	*207.4*	*217.7*	*228.6*	*240.0*	*252.0*	*264.7*	*277.9*
TOTAL ODS	*1,272*	*1,325*	*1,374*	*1,431*	*1,498*	*1,576*	*1,665*	*1,771*	*1,889*	*2,023*	*2,176*	*2,350*	*2,519*	*2,704*	*2,907*	*3,129*	*3,372*

MONTREAL PROTOCOL LIMITS

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. REFRIGERATION & AIRCONDITIONING																	
CFC-11	105.4	119.8	135.6	135.6	135.6	135.6	135.6	135.6	135.6	135.6	135.6	67.8	67.8	20.3	20.3	20.3	0.0
CFC-12	758.8	779.3	793.1	793.1	793.1	793.1	793.1	793.1	793.1	793.1	793.1	396.6	396.6	119.0	119.0	119.0	0.0
SUB-TOTAL (1 ALL-CFC)	864.2	899.1	928.7	928.7	928.7	928.7	928.7	928.7	928.7	928.7	928.7	464.3	464.3	139.3	139.3	139.3	0.0
2. FOAM INDUSTRY																	
CFC-11	165.0	172.4	180.2	180.2	180.2	180.2	180.2	180.2	180.2	180.2	180.2	90.1	90.1	27.0	27.0	27.0	0.0
3. AEROSOLS																	
CFC-11	7.7	8.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	4.2	4.2	1.3	1.3	1.3	0.0
CFC-12	24.0	25.1	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	13.1	13.1	3.9	3.9	3.9	0.0
CFC-114	45.0	47.0	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	24.6	24.6	7.4	7.4	7.4	0.0
SUB-TOTAL (3 ALL-CFC)	76.7	80.2	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	41.9	41.9	12.6	12.6	12.6	0.0
4. FIRE-FIGHTING																	
HALON 1301	35.0	36.6	38.2	39.9	41.7	43.6	45.6	47.9	38.2	38.2	38.2	19.1	19.1	19.1	19.1	19.1	0.0
5. SOLVENTS																	
CARBON TETRACHLORIDE	105.6	110.4	115.3	120.5	125.9	131.6	137.5	144.4	151.6	159.2	167.2	19.7	19.7	19.7	19.7	19.7	0.0
METHYL CHLOROFORM	25.4	26.5	27.7	29.0	30.3	31.7	33.1	34.7	36.5	31.7	31.7	22.2	22.2	22.2	22.2	22.2	9.5
SUB-TOTAL (5)	131.0	136.9	143.1	149.5	156.2	163.2	170.6	179.1	188.1	190.8	198.8	41.9	41.9	41.9	41.9	41.9	9.5
TOTAL ODS	1,272	1,325	1,374	1,382	1,391	1,399	1,409	1,420	1,419	1,422	1,430	657	657	240	240	240	9.5

DOMESTIC REFRIGERATORS & DEEP FREEZERS (SCENARIO A)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GROSS TOTAL NUMBER OF EQUIPMENT ('000) -	1,806	1,830	1,861	1,901	1,940	2,066	2,117	2,258	2,327	2,409	2,508	2,625	2,695	2,758	2,821	2,858	2,932
CFC-based Equipment	1,806	1,830	1,861	1,901	1,930	1,952	1,969	1,982	1,989	1,993	1,995	1,997	1,829	1,638	1,412	1,133	858
Non-CFC-based Equipment	0	0	0	0	10	114	147	277	338	416	512	628	866	1,120	1,408	1,725	2,074
TOTAL DEMAND FOR NEW EQUIPMENT	86	93	101	111	122	134	148	163	179	197	217	238	262	288	317	349	384
NUMBER OF NEW EQUIPMENT (DOMESTIC PRODUCTION) ('000)																	
CFC-based Equipment	84	92	101	101	101	101	101	101	101	101	101	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	0	0	0	0	0	0	0	0	83	91	100	110	121	133
NUMBER OF NEW EQUIPMENT IMPORTED ('000)																	
CFC-based Equipment	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	10	21	33	47	62	78	96	116	156	171	188	207	228	251
NUMBER OF SECOND-HAND IMPORTED ('000) CFC-BASED	29	30	31	24	18	13	10	5	2	1	1	0	0	0	0	0	0
%age of Equip. Scrapped	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
NUMBER OF EQUIPMENT WITHDRAWN/SCRAP ('000)																	
CFC-based Equipment	90	91	93	95	97	98	98	99	99	100	100	100	91	82	71	57	43
Non-CFC-based Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF CFC- BASED EQUIPMENT RETROFITTED ('000)	0	0	0	0	0	0	0	0	0	0	0	68	99	144	209	219	229
PERCENTAGE OF CFC-BASED STOCK RETROFITTED	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	5.1%	8.8%	14.8%	19.3%	26.7%
CFC-12 (reqd. for new equip) (Tonnes)	25	28	30	30	30	30	30	30	30	30	30	0	0	0	0	0	0
CFC-12 (reqd. for existing equip.) (Tonnes)	361	366	372	380	386	390	394	396	398	399	399	215	173	119	22	2	0
QUANTITY OF CFC-12 RECOVERED & RECYCLED (Tonnes)	0	0	0	0	0	0	0	0	0	0	0	34	31	28	33	27	29
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	50%	70%	70%	70%
Total Recoverable (Tonnes)	61.1	62.0	63.0	64.4	65.4	66.1	66.7	67.1	67.3	67.5	67.6	67.6	61.9	55.5	47.8	38.4	41.2
NET CFC-12 DEMAND	386.2	393.6	402.6	410.4	416.4	420.8	424.1	426.7	428.0	428.9	429.4	181.3	142.3	91.6	(11.4)	(24.5)	(28.9)
CFC-11 (reqd. for new equip.)	93.5	102.9	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL CFC	479.8	496.4	515.7	523.6	529.5	534.0	537.3	539.8	541.2	542.0	542.6	181.3	142.3	91.6	(11.4)	(24.5)	(28.9)

COMMERCIAL AND INDUSTRIAL REFRIGERATION (SCENARIO A)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Demand Growth Rate		4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
A. COLD STORES (6 - 36 TR)																	
Number of New Installations (Total)	10	10	11	11	11	11	11	11	11	11	11	12	13	13	14	15	15
CFC-based Equipment	10	10	11	11	11	11	11	11	11	11	11	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	0	0	0	0	1	1	1	1	12	13	13	14	15	15
Number of Equipment Scrapped - CFC Based (1% of Total)	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9
Number of CFC-based Equipment Retrofitted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Population of Equipment	830	832	835	839	842	846	849	851	854	856	859	862	866	870	875	880	887
CFC-based Equipment	830	832	835	838	841	844	847	849	851	853	855	846	837	828	819	810	801
Non-CFC-based Equipment	0	0	0	0	1	1	2	3	3	4	4	16	29	42	56	71	86
CFC-12 (regd. for new equip) (Tonnes) - 7.2kg/unit	0.07	0.08	0.09	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (regd. for existing equip.) (Tonnes) - see note a & b.	1.65	1.65	1.66	1.67	1.67	1.68	1.68	1.69	1.69	1.69	1.70	1.58	1.57	1.55	1.44	1.42	1.41
Quantity of CFC-12 Recovered & Recycled (Tonnes)	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.23	0.23	0.32	0.31	0.31
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	50%	70%	70%	70%
Total Recoverable (Tonnes)	0.46	0.46	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.46	0.46	0.45	0.45	0.44
NET CFC-12 DEMAND	1.72	1.73	1.74	1.74	1.75	1.76	1.76	1.77	1.77	1.77	1.78	1.35	1.34	1.32	1.12	1.11	1.10
CFC-11 (regd. for new equip.) (Tonnes) - 540kg/unit	5.40	5.64	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	5.90	0.00	0.00	0.00	0.00	0.00	0.00
B. COLD STORES (50 - 100 TR)																	
Number of New Installations (Total)	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
CFC-based Equipment	2	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	4
Number of Equipment Scrapped (1% of Total)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of CFC-based Equipment Retrofitted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Population of Equipment	206	207	207	208	209	209	210	211	212	212	213	214	215	216	217	218	220
CFC-based Equipment	206	207	207	208	208	209	210	210	211	211	212	210	208	206	204	202	200
Non-CFC-based Equipment	0	0	0	0	0	0	0	1	1	1	1	4	7	10	13	16	20
CFC-12 (regd. for new equip) (Tonnes) - 21.6kg/unit	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (regd. for existing equip.) (Tonnes) - see note a & b.	1.23	1.23	1.23	1.24	1.24	1.25	1.25	1.25	1.26	1.26	1.26	1.18	1.17	1.16	1.08	1.07	1.06
Quantity of CFC-12 Recovered & Recycled (Tonnes)	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.17	0.17	0.24	0.23	0.23
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	50%	70%	70%	70%
Total Recoverable (Tonnes)	0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.33	0.33
NET CFC-12 DEMAND	1.28	1.29	1.29	1.30	1.30	1.30	1.31	1.31	1.31	1.32	1.32	1.01	1.00	0.99	0.84	0.83	0.82
CFC-11 (regd. for new equip.) (Tonnes) - 540kg/unit	1.30	1.35	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	0.00	0.00	0.00	0.00	0.00	0.00

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
C. REFRIGERATED TRUCKS																	
Number of New Installations	11	11	12	13	13	13	13	13	13	13	13	13	13	14	15	15	16
CFC-based Equipment	11	11	12	12	12	12	12	12	12	12	12	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	1	1	1	1	1	1	1	1	13	13	14	15	15	16
Number of Equipment Scrapped (1% of Total)	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Number of CFC-based Equipment Retrofitted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Population of Equipment	533	539	547	553	560	566	573	579	586	593	599	606	613	621	630	639	649
CFC-based Equipment	533	539	547	553	559	565	571	577	583	589	595	589	583	577	571	565	559
Non-CFC-based Equipment	0	0	0	1	1	2	2	3	3	4	5	17	30	44	59	74	90
CFC-12 (reqd. for new equip) (Tonnes) - 5.35kg/unit	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (reqd. for existing equip.) (Tonnes)	0.79	0.80	0.81	0.82	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.82	0.81	0.80	0.75	0.74	0.73
Quantity of CFC-12 Recovered & Recycled (Tonnes)	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.12	0.16	0.16	0.16
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	50%	70%	70%	70%
Total Recoverable (Tonnes)	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23
NET CFC-12 DEMAND	0.85	0.86	0.87	0.88	0.85	0.90	0.91	0.92	0.92	0.93	0.94	0.70	0.69	0.68	0.58	0.58	0.57
TOTAL CFC-12 (reqd. for new equip) (Tonnes)	0.18	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL CFC-12 (reqd. for existing equip.) (Tonnes)	3.66	3.68	3.70	3.72	3.74	3.76	3.78	3.79	3.81	3.82	3.84	3.58	3.55	3.51	3.26	3.23	3.19
TOTAL CFC-12 RECOVERED & RECYCLED (Tonnes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.52	0.52	0.72	0.71	0.70
NET TOTAL CFC-12	**3.85**	**3.87**	**3.90**	**3.92**	**3.94**	**3.96**	**3.97**	**3.99**	**4.01**	**4.02**	**4.04**	**3.06**	**3.02**	**2.99**	**2.55**	**2.52**	**2.49**
TOTAL CFC-11 (reqd. for new equip.)	**6.70**	**7.00**	**7.31**	**7.31**	**7.31**	**7.31**	**7.31**	**7.31**	**7.31**	**7.31**	**7.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

DOMESTIC AND COMMERCIAL AIRCONDITIONING (SCENARIO A)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of New Installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of Equipment Scrapped			3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Total Population of Equipment	24	24	21	18	15	12	9	6	3	0	-	-	-	-	-	-	-
CFC-12 (reqd. for existing equip.) (Tonnes) - see note c	13.18	13.18	11.53	9.88	8.24	6.59	4.94	3.29	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-11 (reqd. for existing equip.) (Tonnes) - see note d	5.19	5.19	4.54	3.89	3.24	2.60	1.95	1.30	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL CFC	18.37	18.37	16.07	13.78	11.48	9.19	6.89	4.59	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MOBILE AIRCONDITIONING (SCENARIO A)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Vehicle Production by FAN & others in future ('000)	10	10	10	10	11	12	13	15	16	18	19	21	24	26	29	31	35
Vehicle Production by VON ('000)	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vehicle Production by GM ('000)	4	4	4	4	4	5	5	6	6	7	8	9	9	10	11	13	14
Imported Vehicles (New and Fairly-used) ('000)	35	39	42	47	51	56	62	68	75	83	91	100	110	121	133	146	161
Total Number of New AC Vehicles ('000)																	
CFC-based ACs	27	28	36	36	36	36	36	36	36	36	36	0	0	0	0	0	0
Non-CFC-based ACs	0	0	0	2	5	9	13	17	22	27	32	68	75	82	91	100	110
Number of AC in Vehicles Scrapped ('000)																	
CFC-based ACs	33	34	34	34	34	34	34	34	35	35	35	33	31	29	27	24	21
Non-CFC-based ACs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	28	34
Number of Cars (from old stock) retrofitted to Non-CFC ACs ('000)	0	0	0	0	0	0	0	0	0	0	0	3	7	13	26	45	77
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	1.1%	2.3%	4.9%	9.2%	18.3%
Total Population of AC Vehicles ('000)	650	644	646	650	657	668	682	701	724	753	786	821	854	916	954	997	1,043
CFC-based ACs	650	644	646	648	650	652	653	655	657	658	660	623	585	543	489	420	322
Non-CFC-based ACs	0	0	0	2	7	16	29	46	68	94	127	198	279	373	464	577	721
CFC-12 (reqd. for new AC Vehicles) (Tonnes) - 1.62kg unit	43.50	44.96	58.50	58.50	58.50	58.50	58.50	58.50	58.50	58.50	58.50	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (reqd. for existing AC Vehicles) (Tonnes)	312.0	309.1	310.1	311.0	311.9	312.8	313.6	314.4	315.2	315.9	316.6	275.5	252.9	222.7	166.7	113.5	51.6
QUANTITY OF CFC-12 RECOVERED & RECYCLED (Tonnes)	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.97	19.82	18.62	24.17	21.79	25.13
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	50%	70%	70%	70%
Total Recoverable (Tonnes)	41.34	43.10	43.25	43.39	43.51	43.63	43.75	43.86	43.95	44.05	44.15	41.94	39.64	37.24	34.54	31.13	35.91
NET TOTAL CFC	355.5	354.0	368.6	369.5	370.5	371.3	372.2	372.9	373.7	374.4	375.1	254.6	233.1	204.1	142.5	91.7	26.4

SUMMARY OF ODS DEMAND IN PHASE-OUT SCENARIO A (ODP Tonnes)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. REFRIGERATION AND AIRCONDITIONING																	
A. DOMESTIC REFRIGERATORS & DEEP FREEZERS																	
CFC-11	93.5	102.9	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	113.2	0.0	0.0	0.0	0.0	0.0	0.0
NET CFC-12	386.2	393.6	402.6	410.4	416.4	420.8	424.1	426.7	428.0	428.9	429.4	181.3	142.3	91.6	(11.4)	(24.5)	(28.9)
B. COMMERCIAL AND INDUSTRIAL REFRIGERATION																	
CFC-11	6.7	7.0	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	0.0	0.0	0.0	0.0	0.0	0.0
NET CFC-12	3.8	3.9	3.9	3.9	3.9	4.0	4.0	4.0	4.0	4.0	4.0	3.1	3.0	3.0	2.5	2.5	2.5
C. DOMESTIC AND COMMERCIAL AIRCONDITIONING																	
CFC-11	5.2	5.2	4.5	3.9	3.2	2.6	1.9	1.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CFC-12	13.2	13.2	11.5	9.9	8.2	6.6	4.9	3.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D. MOBILE AIRCONDITIONING																	
NET CFC-12	355.5	354.0	368.6	369.5	370.5	371.3	372.2	372.9	373.7	374.4	375.1	254.6	233.1	204.1	142.5	91.7	26.4
TOTAL CFC-11	*125.4*	*115.1*	*125.0*	*124.4*	*123.7*	*123.1*	*122.4*	*121.8*	*121.1*	*120.5*	*120.5*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
TOTAL CFC-12	*759.8*	*764.6*	*786.6*	*793.8*	*799.0*	*802.7*	*805.2*	*806.9*	*807.4*	*807.3*	*809.5*	*438.9*	*378.4*	*298.2*	*133.7*	*69.7*	*0.0*
SUB-TOTAL (1) ALL-CFC	864.2	879.7	911.6	918.2	922.7	925.8	927.6	928.7	928.5	927.8	929.0	438.9	378.4	298.8	133.7	69.7	0.0
2. FOAM INDUSTRY																	
CFC-11	165.0	172.4	180.2	180.2	180.2	180.2	180.2	180.2	180.2	180.2	180.2	90.1	90.1	27.0	27.0	27.0	0.0
3. AEROSOLS																	
CFC-11	7.7	8.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	4.2	4.2	1.3	1.3	1.3	0.0
CFC-12	24.0	25.1	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	13.1	13.1	3.9	3.9	3.9	0.0
CFC-114	45.0	47.0	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	24.6	24.6	7.4	7.4	7.4	0.0
SUB-TOTAL (3) ALL-CFC	76.7	80.2	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	41.9	41.9	12.6	12.6	12.6	0.0
4. FIRE-FIGHTING																	
HALON 1301	35.0	36.6	38.3	39.9	41.7	43.6	45.6	47.9	38.2	38.2	38.2	19.1	19.1	19.1	19.1	19.1	0.0
5. SOLVENTS																	
CARBON TETRA-CHLORIDE	105.6	110.4	115.3	120.5	125.9	131.6	137.5	144.4	151.6	159.2	167.2	19.7	19.7	19.7	19.7	19.7	0.0
METHYL CHLOROFORM	25.4	26.5	27.7	29.0	30.3	31.7	33.1	34.7	36.5	31.7	31.7	22.2	22.2	22.2	22.2	22.2	9.5
SUB-TOTAL (5)	*131.0*	*136.9*	*143.1*	*149.5*	*156.2*	*163.2*	*170.6*	*179.1*	*188.1*	*190.8*	*198.8*	*41.9*	*41.9*	*41.9*	*41.9*	*41.9*	*9.5*
TOTAL ODS	*1,272*	*1,306*	*1,357*	*1,372*	*1,385*	*1,397*	*1,408*	*1,420*	*1,419*	*1,421*	*1,430*	*632*	*571*	*399*	*234*	*170*	*10*

DOMESTIC REFRIGERATORS & DEEP FREEZERS (SCENARIO B)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GROSS TOTAL NUMBER OF EQUIPMENT ('000) -	1,806	1,830	1,861	1,901	1,933	1,993	1,991	2,084	2,117	2,168	2,239	2,332	2,447	2,573	2,745	2,950	3,205
CFC-based Equipment	1,806	1,830	1,861	1,901	1,922	1,782	1,646	1,513	1,383	1,255	1,129	1,005	882	762	646	533	440
Non-CFC-based Equipment	0	0	0	0	10	211	345	571	734	913	1,110	1,327	1,565	1,811	2,099	2,416	2,765
TOTAL DEMAND FOR NEW EQUIPMENT	86	93	101	111	122	134	148	163	179	197	217	238	252	288	317	349	384
NUMBER OF NEW EQUIPMENT (DOMESTIC PRODUCTION) ('000)																	
CFC-based Equipment	84	92	101	101	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	0	83	91	100	110	121	133	146	161	177	195	214	235	259
NUMBER OF NEW EQUIPMENT IMPORTED ('000)																	
CFC-based Equipment	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	10	40	44	65	53	58	64	70	78	85	94	103	113	125
NUMBER OF SECOND-HAND IMPORTED ('000) CFC-BASED	29	30	31	16	0	0	0	0	0	0	0	0	0	0	0	0	0
%age of Equip. Scrapped	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
NUMBER OF EQUIPMENT WITHDRAWN/SCRAP ('000)																	
CFC-based Equipment	90	91	93	95	96	89	82	76	69	63	56	50	44	38	32	27	22
Non-CFC-based Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF CFC- BASED EQUIPMENT RETROFITTED ('000)	0	0	0	0	44	47	51	55	59	63	68	73	75	78	81	66	55
PERCENTAGE OF CFC-BASED STOCK RETROFITTED	0.0%	0.0%	0.0%	0.0%	2.3%	2.7%	3.1%	3.6%	4.2%	5.0%	6.0%	7.3%	8.5%	10.2%	12.5%	12.5%	12.5%
CFC-12 (reqd. for new equip) (Tonnes)	25	28	30	30	0	0	0	0	0	0	0	0	0	0	0	0	0
CFC-12 (reqd. for existing equip.) (Tonnes)	351	366	372	380	221	201	84	74	65	56	47	38	30	22	15	12	10
QUANTITY OF CFC-12 RECOVERED & RECYCLED (Tonnes)	0	0	0	0	26	24	22	20	19	17	15	14	21	18	15	13	10
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	40%	40%	40%	40%	40%	40%	40%	40%	70%	70%	70%	70%	70%
Total Recoverable (Tonnes)	61.1	62.0	63.0	64.4	65.1	60.3	55.7	51.2	46.8	42.5	38.2	34.0	29.8	25.8	21.9	18.1	14.9
NET CFC-12 DEMAND	386.2	393.6	402.6	410.4	195.3	176.9	61.2	53.9	46.6	39.4	32.1	24.8	9.4	4.3	(0.7)	(0.6)	(0.5)
CFC-11 (reqd. for new equip.)	93.5	102.9	113.2	113.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL CFC	479.8	496.4	515.7	523.6	195.3	176.9	61.2	53.9	46.6	39.4	32.1	24.8	9.4	4.3	(0.7)	(0.6)	(0.5)

COMMERCIAL AND INDUSTRIAL REFRIGERATION (SCENARIO B)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Demand Growth Rate		4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
A. COLD STORES (6 - 36 TR)																	
Number of New Installations (Total)	10	10	11	11	12	12	13	14	14	15	16	17	17	18	19	20	21
CFC-based Equipment	10	10	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	0	12	12	13	14	14	15	16	17	17	18	19	20	21
Number of Equipment Scrapped - CFC Based (1% of Total)	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9
Number of CFC-based Equipment Retrofitted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Population of Equipment	830	832	835	839	843	847	851	856	861	867	874	882	890	900	910	921	933
CFC-based Equipment	830	832	835	838	830	822	813	804	795	786	777	768	753	750	741	732	723
Non-CFC-based Equipment	0	0	0	0	12	25	38	52	66	81	97	113	131	149	168	189	210
CFC-12 (reqd. for new equip) (Tonnes) - 7.2kg/unit	0.07	0.08	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (reqd. for existing equip.) (Tonnes) - see note a & b.	1.65	1.65	1.66	1.67	1.55	1.54	1.43	1.41	1.40	1.38	1.37	1.35	1.34	1.32	1.30	1.29	1.27
Quantity of CFC-12 Recovered & Recycled (Tonnes)	0	0.00	0.00	0.00	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.29	0.29	0.29	0.28	0.28
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	40%	40%	40%	40%	40%	40%	40%	40%	70%	70%	70%	70%	70%
Total Recoverable (Tonnes)	0.46	0.46	0.46	0.46	0.46	0.45	0.45	0.44	0.44	0.43	0.43	0.42	0.42	0.41	0.41	0.40	0.40
NET CFC-12 DEMAND	1.72	1.73	1.74	1.74	1.37	1.36	1.25	1.24	1.22	1.21	1.20	1.18	1.04	1.03	1.02	1.00	0.99
CFC-11 (reqd. for new equip.) (Tonnes) - 540kg/unit	5.40	5.64	5.90	5.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. COLD STORES (50 - 100 TR)																	
Number of New Installations (Total)	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4	5	5
CFC-based Equipment	2	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	0	3	3	3	3	3	3	4	4	4	4	4	5	5
Number of Equipment Scrapped (1% of Total)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of CFC-based Equipment Retrofitted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Population of Equipment	206	207	207	208	209	209	210	212	213	214	216	218	220	222	224	227	230
CFC-based Equipment	206	207	207	208	206	204	202	200	198	196	194	192	190	188	186	184	182
Non-CFC-based Equipment	0	0	0	0	3	5	9	12	15	19	22	26	30	34	39	43	48
CFC-12 (reqd. for new equip) (Tonnes) - 21.6kg/unit	0.05	0.05	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (reqd. for existing equip.) (Tonnes) - see note a & b.	1.23	1.23	1.23	1.24	1.16	1.14	1.06	1.05	1.04	1.03	1.02	1.01	1.00	0.99	0.98	0.97	0.96
Quantity of CFC-12 Recovered & Recycled (Tonnes)	0	0.00	0.00	0.00	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.22	0.22	0.22	0.21	0.21
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	40%	40%	40%	40%	40%	40%	40%	40%	70%	70%	70%	70%	70%
Total Recoverable (Tonnes)	0.34	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.31	0.31	0.31	0.30	0.30
NET CFC-12 DEMAND	1.28	1.29	1.29	1.30	1.02	1.01	0.93	0.92	0.91	0.90	0.89	0.88	0.78	0.77	0.76	0.76	0.75
CFC-11 (reqd. for new equip.) (Tonnes) - 540kg/unit	1.30	1.35	1.42	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
C. REFRIGERATED TRUCKS																	
Number of New Installations	11	11	12	13	13	13	14	14	15	16	17	17	18	19	20	21	22
CFC-based Equipment	11	11	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based Equipment	0	0	0	1	13	13	14	14	15	16	17	17	18	19	20	21	22
Number of Equipment Scrapped (1% of Total)	5	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5
Number of CFC-based Equipment Retrofitted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Population of Equipment	533	539	547	553	561	569	577	587	597	608	619	632	645	660	675	691	708
CFC-based Equipment	533	539	547	553	548	543	538	533	528	523	518	513	508	503	498	493	488
Non-CFC-based Equipment	0	0	0	1	13	26	40	54	69	85	102	119	138	157	177	199	221
CFC-12 (reqd. for new equip) (Tonnes) - 5.35kg/unit	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (reqd. for existing equip.) (Tonnes)	0.79	0.80	0.81	0.82	0.76	0.75	0.70	0.70	0.69	0.68	0.68	0.67	0.66	0.66	0.65	0.64	0.64
Quantity of CFC-12 Recovered & Recycled (Tonnes)	0	0.00	0.00	0.00	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.15	0.14	0.14	0.14	0.14
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	40%	40%	40%	40%	40%	40%	40%	40%	70%	70%	70%	70%	70%
Total Recoverable (Tonnes)	0.22	0.22	0.22	0.23	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20
NET CFC-12 DEMAND	0.85	0.86	0.87	0.88	0.67	0.67	0.61	0.61	0.60	0.60	0.59	0.59	0.52	0.51	0.51	0.50	0.50
TOTAL CFC-12 (reqd. for new equip) (Tonnes)	0.18	0.19	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL CFC-12 (reqd. for existing equip.) (Tonnes)	3.66	3.68	3.70	3.72	3.47	3.44	3.20	3.16	3.13	3.10	3.06	3.03	3.00	2.97	2.93	2.90	2.87
TOTAL CFC-12 RECOVERED & RECYCLED (Tonnes)	0.00	0.00	0.00	0.00	0.41	0.41	0.40	0.40	0.39	0.39	0.38	0.38	0.66	0.65	0.64	0.64	0.63
NET TOTAL CFC-12	**3.85**	**3.87**	**3.90**	**3.92**	**3.06**	**3.03**	**2.80**	**2.77**	**2.74**	**2.71**	**2.68**	**2.65**	**2.34**	**2.31**	**2.29**	**2.26**	**2.24**
TOTAL CFC-11 (reqd. for new equip.)	**6.70**	**7.00**	**7.31**	**7.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
TOTAL CFC	***10.54***	***10.87***	***11.21***	***11.23***	***3.06***	***3.03***	***2.80***	***2.77***	***2.74***	***2.71***	***2.68***	***2.65***	***2.34***	***2.31***	***2.29***	***2.26***	***2.24***

OMESTIC AND COMMERCIAL AIRCONDITIONING (SCENARIO B)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Number of New Installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of Equipment Scrapped			3	3	3	3	3	3	3	3	-	-	-	-	-	-	-
Total Population of Equipment	24	24	21	18	15	12	9	6	3	0	-	-	-	-	-	-	-
CFC-12 (regd. for existing equip.) (Tonnes) - see note c	13.18	13.18	11.53	9.88	8.24	6.59	4.94	3.29	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-11 (regd. for existing equip.) (Tonnes) - see note d	5.19	5.19	4.54	3.89	3.24	2.60	1.95	1.30	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL CFC	18.37	18.37	16.07	13.78	11.48	9.19	6.89	4.59	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

OBILE AIRCONDITIONING (SCENARIO B)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ehicle Production by PAN & others in future ('000)	10	10	10	10	11	12	13	15	16	18	19	21	24	26	29	31	35
ehicle Production by VON ('000)	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ehicle Production by GM ('000)	4	4	4	4	4	5	5	6	6	7	8	9	9	10	11	13	14
mported Vehicle. (New and Fairly-used) ('000)	35	39	42	47	51	56	62	68	75	83	91	100	110	121	133	146	161
otal Number of New AC Vehicles ('000)																	
CFC-based ACs	27	28	36	36	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-CFC-based ACs	0	0	0	2	41	45	48	52	56	61	66	72	78	85	93	101	111
Number of AC in Vehicles Scrapped ('000)																	
CFC-based ACs	33	34	34	34	32	30	29	27	25	23	20	18	16	13	10	7	5
Non-CFC-based ACs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	50	54
Number of Cars (from old stock) retrofitted to Non-CFC ACs ('000)	0	0	0	0	6	8	10	13	16	20	25	31	37	45	55	38	26
ercentage of CFC-based Stock Retrofitted	0.0%	0.0%	0.0%	0.0%	1.0%	1.3%	1.8%	2.4%	3.2%	4.4%	6.0%	8.5%	11.8%	17.2%	26.8%	27.3%	28.0%
otal Population of AC Vehicles ('000)	650	644	645	650	659	672	690	714	744	780	824	874	933	1,000	1,033	1,073	1,122
CFC-based ACs	650	644	645	648	609	571	532	493	452	410	365	315	262	204	139	94	63
Non-CFC-based ACs	0	0	0	2	49	101	159	222	292	371	459	559	670	796	893	979	1,059
CFC-12 (regd. for new AC Vehicles) (Tonnes) - 1.62kg unit	43.50	44.96	58.50	58.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CFC-12 (regd. for existing AC Vehicles) (Tonnes)	312.0	309.1	310.1	311.0	263.7	243.6	207.7	187.5	166.0	142.8	117.2	88.9	59.6	32.7	22.3	15.1	10.1
UANTITY OF CFC-12 RECOVERED & RECYCLED (Tonnes)	0	0	0	0	16.48	15.50	14.51	13.53	12.53	11.50	10.43	9.28	14.04	13.82	23.84	16.73	11.83
Percentage Recovered of the Total Recoverable	0%	0%	0%	0%	40%	40%	40%	40%	40%	40%	40%	40%	70%	70%	70%	70%	70%
Total Recoverable (Tonnes)	41.34	43.10	43.25	43.38	41.21	38.74	36.29	33.83	31.33	28.76	26.06	23.19	20.06	19.75	34.05	23.90	16.90
NET TOTAL CFC	355.5	354.0	368.6	369.5	247.3	228.1	193.2	174.0	153.5	131.3	106.8	79.7	45.6	18.8	(1.6)	(1.6)	(1.7)

SUMMARY OF ODS DEMAND IN PHASE-OUT SCENARIO B (ODP Tonnes)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. REFRIGERATION AND AIRCONDITIONING																	
A. DOMESTIC REFRIGERATORS & DEEP FREEZERS																	
CFC-11	93.5	102.9	113.2	113.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET CFC-12	386.2	393.6	402.6	410.4	195.3	176.9	61.2	53.9	46.6	39.4	32.1	24.8	9.4	4.3	(0.7)	(0.6)	(0.5)
B. COMMERCIAL AND INDUSTRIAL REFRIGERATION																	
CFC-11	6.7	7.0	7.3	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET CFC-12	3.8	3.9	3.9	3.9	3.1	3.0	2.8	2.8	2.7	2.7	2.7	2.7	2.3	2.3	2.3	2.3	2.2
C. DOMESTIC AND COMMERCIAL AIRCONDITIONING																	
CFC-11	5.2	5.2	4.5	3.9	3.2	2.6	1.9	1.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CFC-12	13.2	13.2	11.5	9.9	8.2	6.6	4.9	3.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
D. MOBILE AIRCONDITIONING																	
NET CFC-12	355.5	354.0	368.6	369.5	247.3	228.1	193.2	174.0	153.5	131.3	106.8	79.7	45.6	18.8	(1.6)	(1.6)	(1.7)
TOTAL CFC-11	*105.4*	*115.1*	*125.0*	*124.4*	*3.2*	*2.6*	*1.9*	*1.3*	*0.6*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
TOTAL CFC-12	*758.8*	*764.6*	*786.6*	*793.8*	*453.9*	*414.6*	*262.1*	*234.0*	*204.5*	*173.3*	*141.6*	*107.1*	*57.3*	*25.4*	*0.0*	*0.0*	*0.0*
SUB-TOTAL (1) ALL-CFC	**864.2**	**879.7**	**911.6**	**918.2**	**457.1**	**417.2**	**264.1**	**235.3**	**205.2**	**173.3**	**141.6**	**107.1**	**57.3**	**25.4**	**0.0**	**0.0**	**0.0**
2. FOAM INDUSTRY																	
CFC-11	165.0	172.4	180.2	180.2	180.2	180.2	90.1	90.1	90.1	90.1	90.1	27.0	27.0	27.0	0.0	0.0	0.0
3. AEROSOLS																	
CFC-11	7.7	8.0	8.4	8.4	8.4	8.4	4.2	4.2	4.2	4.2	4.2	1.3	1.3	1.3	0.0	0.0	0.0
CFC-12	24.0	25.1	26.2	26.2	26.2	26.2	13.1	13.1	13.1	13.1	13.1	3.9	3.9	3.9	0.0	0.0	0.0
CFC-114	45.0	47.0	49.1	49.1	49.1	49.1	24.6	24.6	24.6	24.6	24.6	7.4	7.4	7.4	0.0	0.0	0.0
SUB-TOTAL (3) ALL-CFC	**76.7**	**80.2**	**83.8**	**83.8**	**83.8**	**83.8**	**41.9**	**41.9**	**41.9**	**41.9**	**41.9**	**12.6**	**12.6**	**12.6**	**0.0**	**0.0**	**0.0**
4. FIRE-FIGHTING																	
HALON 1301	35.0	36.6	38.2	38.2	38.2	38.2	19.1	19.1	19.1	19.1	19.1	5.7	5.7	5.7	0.0	0.0	0.0
5. SOLVENTS																	
CARBON TETRA-CHLORIDE	105.6	110.4	115.3	115.3	115.3	115.3	57.7	57.7	57.7	57.7	57.7	17.3	17.3	17.3	0.0	0.0	0.0
METHYL CHLOROFORM	*25.4*	26.5	27.7	27.7	27.7	27.7	13.9	13.9	13.9	13.9	13.9	4.2	4.2	4.2	0.0	0.0	0.0
SUB-TOTAL (5)	*131.0*	*136.9*	*143.1*	*143.1*	*143.1*	*143.1*	*71.5*	*71.5*	*71.5*	*71.5*	*71.5*	*21.5*	*21.5*	*21.5*	*0.0*	*0.0*	*0.0*
TOTAL ODS	*1,272*	*1,306*	*1,357*	*1,363*	*902*	*862*	*487*	*458*	*428*	*396*	*364*	*174*	*124*	*92*	*0*	*0*	*0*

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DOMESTIC REFRIGERATORS & DEEP FREEZERS (SCENARIO A)																	
NUMBER OF NON-CFC EQUIPMENT PRODUCED LOCALLY ('00	0	0	0	0	0	0	0	0	0	0	0	83	91	100	110	121	133
Capital Recovery Cost ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	193.8	193.8	193.8	193.8	193.8	193.8	1,160.5
Incremental operating cost of production ('000,000 Naira)	0	0	0	0	0	0	0	0	0	0	0	267.0	323.1	390.9	473.0	572.4	692.6
QUANTITY OF ODS RECOVERED/RECYCLED (Tonnes)	0	0	0	0	0	0	0	0	0	0	0	34	31	28	33	27	29
Cost of recycling/recovery ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6	41.9	41.3	54.8	48.4	57.2
NUMBER OF NEW IMPORTED NON-CFC BASED EQUIP. ('000)				10	21	33	47	62	78	96	116	156	171	188	207	228	251
Incremental cost of substitution ('000,000 Naira)	0	0	0	32	75	129	199	289	401	543	719	1,067	1,291	1,562	1,890	2,286	2,767
TOTAL NUMBER OF CFC-BASED EQUIPMENT IN USE ('000)	1,805	1,830	1,861	1,901	1,930	1,952	1,969	1,982	1,989	1,993	1,995	1,997	1,829	1,633	1,412	1,133	858
NUMBER OF CFC-BASED EQUIPMENT RETROFITTED ('000)	0	0	0	0	0	0	0	0	0	0	0	68	99	144	209	219	229
with compressor failure (11.43%)	0	0	0	0	0	0	0	0	0	0	0	68	99	144	161	129	98
without compressor failure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	89	131
Incremental cost of substitution ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	224.3	357.7	570.6	910.1	1,049.2	1,209.5
TOTAL INCREMENTAL COST	0.0	0.0	0.0	32.3	74.6	129.3	199.4	288.5	401.1	542.5	913.1	1,793.3	2,207.2	2,758.3	3,521.4	4,150.2	5,906.4
COMMERCIAL AND INDUSTRIAL REFRIGERATION (SCENARIO A)																	
NUMBER OF NON-CFC EQUIPMENT INSTALLED	0	0	0	1	1	1	1	1	1	1	1	27	29	30	32	33	35
Capital Recovery Cost ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.0	78.0	78.0	78.0	78.0	78.0	474.9
Incremental operating cost of production ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2
QUANTITY OF ODS RECOVERED/RECYCLED (Tonnes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.52	0.52	0.72	0.71	0.70
Cost of recycling/recovery ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7	0.8	1.2	1.3	1.4
TOTAL INCREMENTAL COST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.0	78.7	78.8	78.9	79.3	79.4	476.5
MOBILE AIRCONDITIONING (SCENARIO A)																	
NUMBER OF NON-CFC EQUIPMENT INSTALLED	0	0	0	2	5	9	13	17	22	27	32	68	75	82	91	100	110
Incremental cost of installation ('000,000 Naira)	0.0	0.0	0.0	9.9	27.2	49.7	78.5	115.3	161.7	220.1	293.2	677.8	820.2	992.4	1,200.8	1,453.0	1,758.1
TOTAL NUMBER OF CFC-BASED EQUIPMENT IN USE ('000)	650	678	650	682	684	686	688	690	691	693	694	660	623	585	543	489	420
NUMBER OF CFC-BASED EQUIPMENT RETROFITTED ('000)	0	0	0	0	0	0	0	0	0	0	0	3	7	13	26	45	77
with compressor failure (1%)	0	0	0	0	0	0	0	0	0	0	0	3	6	6	5	5	4
without compressor failure	0	0	0	0	0	0	0	0	0	0	0	0	0	7	21	40	73
Incremental cost of substitution ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.7	96.2	211.6	465.6	873.8	1,639.8
QUANTITY OF ODS RECOVERED/RECYCLED (Tonnes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.97	19.82	18.62	24.17	21.79	25.13
Cost of recycling/recovery ('000,000 Naira)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8	26.8	27.7	39.6	39.3	49.8
TOTAL INCREMENTAL COST	0.0	0.0	0.0	9.9	27.2	49.7	78.5	115.3	161.7	220.1	293.2	747.3	943.2	1,231.8	1,705.0	2,366.0	3,447.7
Government Costs for Campaign and Institutional Strengthening	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47	52	57	63	69	76	84	92
GRAND TOTAL INCREMENTAL COST	0.0	0.0	0.0	42.2	101.8	179.0	277.9	403.8	562.8	809.8	1,336.1	2.7E+03	3,291.9	4,138.0	5,382.6	6,679.1	9,922.4

PRESENT VALUE @ 10%	9.14 Billion Naira	68[illegible].82 Naira/Kg	
	114 Million US$	8.59 US$/Kg	

Total Cummulative ODS Consumption- Unconstrained	24.70 '000 Tonnes		
Total Cummulative ODS Consumption- Scenario A	11.38 '000 Tonnes		
Total Cummulative ODS Phased out in Scenario A	13.31 '000 Tonnes	53.9%	

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
USERS COSTS	0.0	0.0	0.0	9.9	27.2	49.7	78.6	115.3	161.7	220.1	486.9	1,206.8	1,406.6	1,647.0	1,963.4	2,308.2	3,739.8
PRESENT VALUE @ 10%	3.41 Billion Naira																
	42.598 Million US$																
CONSUMER COST	0.0	0.0	0.0	32.3	74.6	129.3	199.4	288.5	401.1	542.5	719.4	1,334.7	1,744.6	2,343.9	3,265.4	4,209.4	5,615.9
PRESENT VALUE @ 10%	5.37 Billion Naira																
	67.08 Million US$																
GOVERNMENT COST	0.15 Billion Naira																
	1.8182 Million US$																

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DOMESTIC REFRIGERATORS & DEEP FREEZERS (SCENARIO B)																	
NUMBER OF NON-CFC EQUIPMENT PRODUCED LOCALLY ('000)	0	0	0	0	83	91	100	110	121	133	146	161	177	195	214	235	259
Capital Recovery Cost ('000 000 Naira)	0.0	0.0	0.0	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	90.4	147.9
Incremental operating cost of production ('000,000 Naira)	0	0	0	0	135.3	163.7	198.1	239.7	290.0	350.9	424.6	513.7	621.6	752.2	910.1	1,101.2	1,332.5
QUANTITY OF ODS RECOVERED/RECYCLED (Tonnes)	0	0	0	0	26	24	22	20	19	17	15	14	21	18	15	13	10
Cost of recycling/recovery ('000,000 Naira)	0.0	0.0	0.0	0.0	16.4	16.8	17.0	17.2	17.3	17.3	17.1	16.7	28.3	24.9	25.1	22.8	20.7
NUMBER OF NEW IMPORTED NON-CFC BASED EQUIP. ('000)	0	0	0	10	40	44	65	53	58	64	70	78	85	94	103	113	125
Incremental cost of substitution ('000,000 Naira)	0	0	0	32	140	169	278	248	300	362	439	531	642	777	940	1,138	1,376
TOTAL NUMBER OF CFC-BASED EQUIPMENT IN USE ('000)	1,806	1,830	1,861	1,901	1,922	1,782	1,646	1,513	1,383	1,255	1,129	1,005	882	762	646	533	440
NUMBER OF CFC-BASED EQUIPMENT RETROFITTED ('000)	0	0	0	0	44	47	51	55	59	63	68	73	75	78	81	66	55
with compressor failure (11.43%)	0	0	0	0	44	47	51	55	59	63	68	73	75	78	74	61	50
without compressor failure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	6	5
Incremental cost of substitution ('000 000 Naira)	0.0	0.0	0.0	0.0	73.9	87.3	103.3	122.1	144.4	170.8	201.9	238.8	271.6	308.9	351.3	318.8	289.3
TOTAL INCREMENTAL COST	0.0	0.0	0.3	122.7	455.7	527.3	687.0	717.0	841.7	991.8	1,172.6	1,390.4	1,654.0	1,955.3	2,317.1	2,670.8	3,166.9
COMMERCIAL AND INDUSTRIAL REFRIGERATION (SCENARIO B)																	
NUMBER OF NON-CFC EQUIPMENT INSTALLED	0	0	0	1	27	28	30	31	33	34	36	38	40	42	44	46	48
Capital Recovery Cost ('000 000 Naira)	0.0	0.0	0.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	101.1
Incremental operating cost of production ('000,000 Naira)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3
QUANTITY OF ODS RECOVERED/RECYCLED (Tonnes)	0.00	0.00	0.00	0.00	0.41	0.41	0.40	0.40	0.39	0.39	0.38	0.38	0.66	0.65	0.64	0.64	0.63
Cost of recycling/recovery ('000,000 Naira)	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.9	1.0	1.1	1.1	1.2
TOTAL INCREMENTAL COST	0.0	0.0	0.0	78.0	78.3	78.3	78.3	78.4	78.4	78.5	78.5	78.6	79.0	79.1	79.2	79.4	102.7
MOBILE AIRCONDITIONING (SCENARIO B)																	
NUMBER OF NON-CFC EQUIPMENT INSTALLED	0	0	0	2	41	45	48	52	56	61	66	72	78	85	93	101	111
Incremental cost of installation ('000,000 Naira)	0.0	0.0	0.0	9.1	193.0	228.3	270.6	321.5	382.7	456.3	544.9	651.5	779.8	934.3	1,120.2	1,344.2	1,617.9
TOTAL NUMBER OF CFC-BASED EQUIPMENT IN USE ('000)	650	678	680	682	648	609	571	532	493	452	410	365	315	262	204	139	94
NUMBER OF CFC-BASED EQUIPMENT RETROFITTED ('000)	0	0	0	0	6	8	10	13	15	20	25	31	37	45	55	38	26
with compressor failure (1%)	0	0	0	0	6	6	6	5	5	5	4	4	3	3	2	1	1
without compressor failure	0	0	0	0	0	2	4	7	11	15	21	27	34	43	53	37	26
Incremental cost of substitution ('000,000 Naira)	0.0	0.0	0.0	0.0	40.2	55.3	76.1	104.6	143.8	197.7	271.9	373.9	497.2	661.2	879.3	672.3	515.4
QUANTITY OF ODS RECOVERED/RECYCLED (Tonnes)	0	0	0	0	16.48	15.50	14.51	13.53	12.53	11.50	10.43	9.28	14.04	13.82	23.84	16.73	11.83
Cost of recycling/recovery ('000 000 Naira)	0.0	0.0	0.0	0.0	10.4	10.8	11.1	11.4	11.6	11.7	11.7	11.4	19.0	20.6	39.0	30.1	23.4
TOTAL INCREMENTAL COST	0.0	0.0	0.0	9.1	243.7	294.3	357.7	437.4	538.1	665.8	828.5	1,036.8	1,296.0	1,616.0	2,038.6	2,046.6	2,156.7
Government Costs for Campaign and Institutional Strengthening	0.0	0.0	0.0	27	29	32	35	39	43	47	52	57	63	69	76	84	92
GRAND TOTAL INCREMENTAL COST	0.0	0.0	0.3	236.3	806.9	932.1	1,158.5	1,271.8	1,501.0	1,783.2	2,131.4	2,562.8	3,091.8	3,719.6	4,510.9	4,880.3	5,518.2

PRESENT VALUE @ 10%	10.37 Billion Naira	544.8 Naira/Kg	
	130 Million US$	6.81 US$/Kg	
Total Cummulative ODS Consumption- Unconstrained	24.70 '000 Tonnes		
Total Cummulative ODS Consumption- SCENARIO B	5.66 '000 Tonnes		
Total Cummulative ODS Phased out in SCENARIO B	19.04 '000 Tonnes	77.093	

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
USERS COSTS	0.0	0.0	0.0	99.5	445.9	510.2	587.5	680.5	792.4	927.1	1,089.2	1,284.4	1,540.2	1,825.5	2,186.2	2,590.1	3,144.0
PRESENT VALUE @ 10%	5.37 Billion Naira																
	67.152 Million US$																
CONSUMER COST	0.0	0.0	0.3	32.3	253.8	311.8	457.6	474.3	587.8	731.0	912.4	1,143.3	1,410.9	1,747.1	2,170.9	2,128.7	2,181.3
PRESENT VALUE @ 10%	4.31 Billion Naira																
	53.88 Million US$																
GOVERNMENT COST	0.25 Billion Naira																
	3.1818 Million US$																

TABLE 3.8: ASSUMPTIONS FOR UNCONSTRAINED ODS DEMAND FORECAST FOR COMMERCIAL AND INDUSTRIAL REFRIGERATION

ODS APPLICATIONS	GROWTH ASSUMPTIONS	PERIOD
○ Installations and servicing	(i) Increase in Demand at GDP growth rate 4.5% per annum	1995 - 2000
	(ii) Increase in Demand at GDP growth rate 5% per annum	2001 - 2010

TABLE 3.9: ASSUMPTIONS FOR UNCONSTRAINED ODS DEMAND FOR DOMESTIC AND COMMERCIAL AIRCONDITIONING

ODS APPLICATION	GROWTH ASSUMPTIONS	PERIOD
○ Installation and Servicing	Phase out of use of Centrifugal Chillers at a rate of 3 units per year	1995 - 2002

TABLE 3.10: ASSUMPTIONS FOR UNCONSTRAINED ODS DEMAND FORECAST FOR MOBILE AIRCONDITIONING

ODS APPLICATIONS	GROWTH ASSUMPTIONS	PERIOD
° Charging of Refrigerants for new Vehicles	1. Domestic Production	
° Recharging of Leaked Systems·	° Freeze Local Production at 1994 levels	1995-1997
° Recharging of System after Compressor Failure	° Growth of Production at average annual rate of 10%	1998-2010
° Topping Up	2. Imported Vehicles	
	° Growth rate of 10% per annum on the average	1994-2010
	3. Retirement of Vehicles	
	° Average annual rate of 8%	1994-2010

Other Assumptions

(i)	CFC-12 use per new Car produced locally:	2 Kg/unit
(ii)	1% of existing stock of cars retrofitted annually with new ACs	
(iii)	CFC-12 requirement for retrofit:	1.62 Kg/unit
(iv)	15% of total number of AC cars with leakage problems	
(v)	CFC-12 need for recharge of leaked systems:	2 Kg/unit
(vi)	Topping up requirement for all cars annually:	0.16 Kg/unit

TABLE 3.11: ASSUMPTIONS FOR UNCONSTRAINED ODS DEMAND FOR FOAM PRODUCTION, SOLVENT, FIRE FIGHTING, AND AEROSOLS SECTORS

ODS APPLICATIONS	GROWTH AND OTHER ASSUMPTIONS	PERIOD
° Manufacture of Flexible Foams	4.5% average annual growth 15.0% average annual growth (1991 used as base year for forecast)	1995 - 2000 2001 - 2010
° Solvents for degreasing, paint removal and other industrial uses	4.5% average annual growth 5.0% average annual growth	1995 - 2000 2001 - 2010
° Fire Extinguisher	4.5% average annual growth 5.0% average annual growth	1995 - 2000 2001 - 2010
° Aerosols	4.5% average annual growth 5.0% average annual growth	1995 - 2000 2001 - 2010

TABLE 3.12: FORECAST OF UNCONSTRAINED DEMAND FOR ODS BY SECTOR 1994 - 2010 IN ODP TONNES[2]

SECTOR AND SUBSTANCES	1994	1996	1998	2000	2002	2004	2006	2008	2010
1. Airconditioning & Refrigeration									
CFC-11	105.4	135.6	174.8	227.0	296.4	389.0	490.4	592.1	715.0
CFC-12	758.8	793.1	836.9	907.5	1,007.4	1,141.5	1,317.3	1,530.2	1,791.9
Sub-Total	864.2	928.7	1,011.7	1,134.5	1303.8	1,530.5	1,807.7	2,122.3	2,506.9
2. Foam Industry									
CFC-11	165.0	180.2	196.8	214.9	236.9	261.2	288.0	317.5	350.0
Sub-Total	165.0	180.2	196.8	214.9	236.9	261.2	286.0	317.5	350.0
3 Aerosols									
CFC-11	7.7	8.4	9.2	10.0	11.1	12.2	13.4	14.8	16.3
CFC-12	24.0	26.2	28.6	31.3	34.5	38.0	41.9	46.2	50.9
CFC-114	45.0	49.1	53.7	58.6	64.6	71.2	78.5	86.6	95.5
Sub-Total	76.7	83.7	91.5	99.9	110.1	121.4	133.9	147.6	162.7
4. Fire Fighting									
Halon-1301	35.0	38.2	41.7	45.6	50.3	55.4	61.1	67.3	74.2
Sub-Total	35.0	38.2	41.7	45.6	50.3	55.4	61.1	67.3	74.2
5. Solvent									
Carbon Tetrachloride	105.6	115.3	125.9	137.5	151.6	167.2	184.3	203.2	224.0
Methyl Chloroform	25.4	27.7	30.3	33.1	36.5	40.2	44.3	48.9	53.9
Sub Total	131.0	143.1	156.2	170.6	188.1	207.4	228.6	248.5	277.9
Total	1,271.9	1,373.9	1,497.9	1,665.5	1,888.9	2,175.9	2,519.2	2,906.7	3,371.7

[2]For foam and aerosol sectors, projections started from 1991.

TABLE 3.13: FORECAST OF UNCONSTRAINED DEMAND FOR ODS BY SUBSTANCE IN ODP TONNES

EEE

SUBSTANCES CONTROLLED BY MONTREAL PROTOCOL	1994	1996	1998	2000	2002	2004	2006	2008	2010
GROUP I, ANNEX A									
CFC-11	278.1	324.2	380.8	451.9	544.4	662.4	791.8	924.4	1,081.3
CFC-12	782.8	819.3	865.5	938.8	1038.9	1179.5	1359.2	1576.4	184.8
CFC-114	45.0	49.1	53.7	58.6	64.6	71.2	78.5	86.6	95.5
Sub-Total	1,105.9	1,192.6	1,300.0	1,449.3	1,647.7	1,913.1	2,229.5	2,587.4	3,019.6
GROUP II, ANNEX A									
Halon-1301	35.0	38.2	41.7	45.6	50.3	55.4	61.1	67.3	74.2
Sub-Total	35.0	38.2	41.7	45.6	50.3	55.4	61.1	67.3	74.2
GROUP II ANNEX B									
CTC	105.6	115.1	125.9	137.5	151.6	167.2	184.3	203.2	224.0
Sub-Total	105.6	115.1	125.9	137.5	151.6	167.2	184.3	203.2	224.0
GROUP III, ANNEX B									
1,1,1 Trichloroethane	25.4	27.7	30.3	33.1	36.5	40.2	44.3	48.9	53.9
Sub-Total	25.4	27.7	30.3	33.1	36.5	40.2	44.3	48.9	53.9
Total	1,271.9	1,373.9	1,497.9	1,665.5	1,888.9	2,175.9	2,519.2	2,906.7	3,371.7

FIG. 3.5: FORECASTED UNCONSTRAINED ODS CONSUMPTION BY SECTOR (IN ODP TONNES)

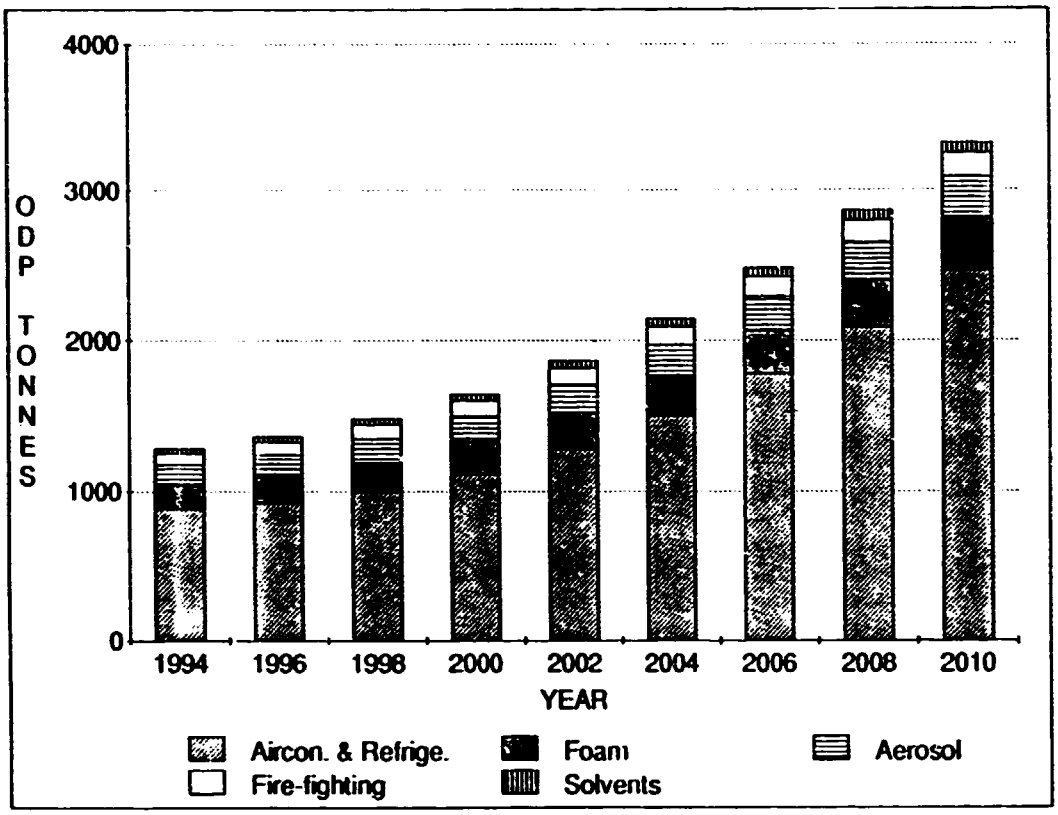
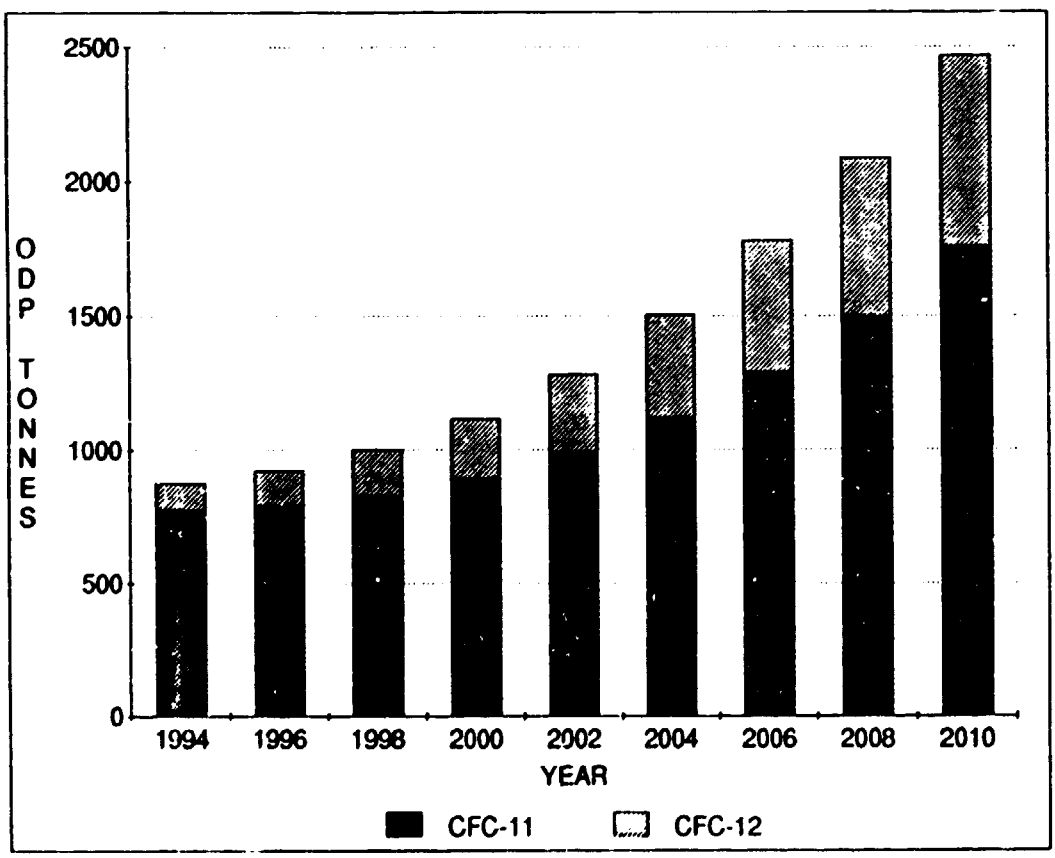


FIG. 3.6: FORECASTED UNCONSTRAINED ODS CONSUMPTION BY TYPE IN THE AIRCONDITIONING AND REFRIGERATION SECTOR (IN ODP TONNES)



CHAPTER FOUR

INSTITUTIONAL AND POLICY FRAMEWORK

4.1 EXISTING INSTITUTIONAL FRAMEWORK AND ODS PHASE-OUT STRATEGY IN NIGERIA

(a) The Current Roles of FEPA

The aim in this section is to briefly review existing framework and actions in the general protection of the environment that has bearing to the goal of phasing out the use of Ozone depleting substances in Nigeria. Before discussing institstutional framework, it is perhaps necessary to set in proper perspectives, actions taken by Nigeria over the past decades, toward the international agreement on ODS phase-out. Nigeria's interest in the subject of Ozone has been reported to date back to 1978 when the United States Government informed the Nigerian Government that some industries in Nigeria were importing CFCs and other chemicals that had been banned in the US. At the 9th and 10th meeting of the Govering Council of UNEP, in Nairobi in 1981 and 1982 respectively, Nigeria and Sweden sponsored a Resolution on the Protection of the Ozone Layer. In 1988, a Federal Environmental Protection Agency Decree 58 was enacted. Section 18 of the decree mandated the Agency to pay particular attention to studying, and understanding, activities that may affect especially Ozone in the stratosphere. Sub-section 2 of Section 18 of the decree further directed the Agency to make recommendations and programme for the control of any substance that may be affecting the Ozone component of the stratosphere. It can therefore be concluded that Government is aware of the need to control the emission of Ozone damaging substances in Nigeria. Nigeria acceded to the Montreal Protocol on October 31st 1988 and it became effective by January 29 1989.

The following also demonstrate the continuing awareness at the Governmental level of the need to join the international community in phasing out the ODSs:

(a) In 1989, FEPA nominated two Nigerian institutions to cooperate with institutions in developed nations towards enhancing capabilities of Nigerian Ozone Science Research.

(b) Experts nominated from Nigeria have actively participated in four review Panels mandated by Article 6 of the Protocol as from 1990.

(c) Knowledge and expertise of the staff of FEPA has been broadened and improved through training assistance from international organizations on ODS.

(d) FEPA has also been working with a number of multilateral agencies for the implementation of the Montreal Protocol. In 1992, the Agency assisted UNIDO nominated Consultants to undertake a study titled "Techno-Economic Assessment of the Financial Viability for the Collection, Recycling and/ or Safe Disposal of Refrigerant Gases and Related materials in Africa". The project was undertaken concurrently in Egypt, Kenya and Nigeria.

(e) UNIDO as a follow up initiated a second project in collaboration with the Agency titled "Methodological Development of UNIDO Programme to evaluate the substitution of CFC-Based Technology in Refrigeration and Air Conditioning sector".

(f) The present study is a component of the above project and was initiated with the basic objective of putting quantitative feelings to: current per capita ODS consumption in Nigeria; and a time phased national plan for phasing out ODS consumption in line with the Montreal Protocol.

(g) FEPA has also initiated in 1991 in collaboration with the World Bank a country study on ODS in Nigeria. Two missions from the World Bank has visited Nigeria between 1991 and

1992. The first mission's effort in collaboration with FEPA was concentrated on providing a broad based survey of ODS imports and user - industries with a view to evolving terms of reference for the country study. The second mission also collaborated with FEPA in August 1992 to complete the plans for the country programme.

(h) Information available to us indicate that the efforts has not fully taken off. As a matter of fact another mission is being planned for between the second and third quarter of 1995 to firm up the effort towards the preparation of the country report.

(b) Relevant Activities of NAFDAC

CFCs, halons, and ODS solvents are all materials whose importation into the country are expected to be licensed and documented by an Agency of the Federal Government called NAFDAC. Currently, all importers are expected to obtain documentary permit from NAFDAC before such materials can be imported. In addition importers are expected to furnish NAFDAC with information on name of chemical (or Trade Name); price; and other relevant data on the import.

The NAFDAC mandate did not emanate from the requirements of the Montreal Protocol. Rather, it is part of the National effort to control and monitor the importation of toxic and harzadous chemicals into the country. Our evaluation of the database on ODS obtained from NAFDAC showed the following:

(i) The coverage may not encompass all the controlled ODS listed in the Montreal Protocol. We note that NAFDAC provided information on CFCs and precluded other controlled substances like: halons, methyl chloroform, carbon tetrachloride, etc.

(ii) Even for those ODS covered by the NAFDAC database, our direct survey of importers and ODS users indicated that not all imports are reported. It has been estimated that a minimum of about 30% of ODS imports is usually not reported to NAFDAC.

Definitely, the existing arrangement is inadequate to achieve a proper control and monitoring of ODS use in Nigeria. A more co-ordinated approach involving proper understanding of the definition of substances classified in the Montreal Protocol will be required. This will require that an adequate institutional structure be put in place for this purpose. Such a set - up must clearly resolve the issue of the Governmental Agency that should be responsible for the necessary control activities on ODS imports into the country. It is also important that relevant trade groups in the ODS user sector should be sensitized to champion the cause of a systematic and cost-effective phase-out of the substances under a collaborative joint venture with the regulatory body. Finally we are of the opinion that, regulatory, control and monitoring of ODS use in the country should be carried out under a single umbrella set - up, if the achievement of the phase-out strategy to be proposed is not to be jeopardized.

4.2 RECOMMENDED INSTITUTIONAL FRAMEWORK

Given the shortcoming of the existing institutional framework, we are recommending the following:

(i) Role of FEPA

FEPA should be the fulcrum Agency responsible for the ODS phase-out strategy and its implementation in Nigeria. This we believe is in line with the mandate given to the Agency through the National Policy on the Environment. Section 3.7 of this National Policy State; inter alia:

"As part of the Environmental policy, necessary administrative rules and legislation will be operated to govern the monitoring, introduction, manufacture, import, sales, transportation, use and disposal of toxic, hazardous and radioactive substances in Nigeria. Furthermore, the appropriate governmental agencies shall therefore:

(a) maintain an up-to date register of toxic, hazardous and radioactive substances.
(b) control the generation of toxic, hazardous and radioactive waste and ensure that those banned shall be stringently controlled.
(c) monitor the effects and control all phases of the life cycle of all substances likely to have an adverse impact on human health and environment.
(d) determine and use environmentally safe and technologically sound techniques for disposal of toxic, hazardous and radioactive waste".

The FEPA Decree 58 of 1988 under the Air Quality And Atmospheric Protection Sub-heading of Section 18 put the mandate for achieving the goals and objectives of the National Policy on the Environment in Sub-section (1) for ODS as follows:

"The Agency (i.e FEPA) shall undertake to study data and recognize developments in international force and other countries regarding the cumulative effect of all substances, practices, processes and activities which may effect the stratosphere especially Ozone in the stratosphere".

Sub-section (2) of section 18 of the same decree states as follows:

"The Agency (i.e FEPA) may make recommendations and programmes for the control of any substance, practice, process or activity which may reasonably be anticipated to affect the stratosphere especially Ozone in the stratosphere when such effect may

reasonably be anticipated to endanger public health or welfare".

It is therefore concluded that FEPA should and does have the responsibility of setting the National Policy governing the Montreal Protocol. The implementation of the Montreal Protocol under the leadership of FEPA should however be carried out in collaboration with other relevant Agencies and Governmental Ministries.

(ii) National Committee on Ozone Depleting Substances (NCODS)

In order to implement the ODS phase-out programme in a coordinated way, it is important that a National Committee on Ozone Depleting Substances be formed. This committee will serve as an advisory body to FEPA on ODS related matters. The committee which will be responsible for giving advice on ; policy requirements; legislations; programmes of action; research and public enlightenment; should be made up of representatives of public and private organizations. The organizations that we have identified as necessary members of this committee include:

(a) Federal Environmental Protection Agency-Coordinator

This Agency will provide the coordination and leadership base for the committee. The Ozone office that has already been created in FEPA will become the secretariat for the NCODS. The Ozone office will also undertake monitoring functions of ODS phase-out activities. The Ozone office should be responsible for the granting of permit to import ODS. This is a control function that we believe should be centralized within the secretariat of NCODS if it is to be effective. It will however be necessary to strengthen the current manpower base of the office. This will require that well trained and experienced professionals be recruited to join the Ozone office. Specialized quick and cost-effective training programs may need to be organized for the new staff.

(b) Federal Ministry of Industries

This is the Ministry responsible for all relations between Government and industry. It is responsible for granting permit for the establishment and operations of all new companies in Nigeria. In this capacity, it will strengthen the ability of the committee to ensure that new outfits are planned, implemented and operated within the stipulations of the Montreal Protocol. Since the Ministry is also involved in the control and regulation of existing industries, the committee will have a basis for ensuring that the activities of existing ODS related industries are effectively regulated.

(c) Federal Ministry of Finance

This ministry has the legislative power as regards policy formulation and implementation on taxes and tariffs. Since the phase-out strategies that is likely to be employed will involve, policies including, taxes, surcharges, etc the involvement of this ministry will give the necessary legislative power to the committee's activities.

(d) National Planning Commission

The commission is responsible for preparation and coordination of national development plans. It is important that it is a member of the committee so that technology changes and assimilation that will form a component of the ODS phase-out plan will be incorporated into the relevant sections of the National Development Plans.

(e) Customs and Excise Department

This is a department under the Federal ministry of Internal Affairs. It is responsible for enforcing duties and taxes on imported goods. It also ensures that illegal goods are prevented form entering the country. The membership of this department in

the committee will aid in ensuring that taxes on imported ODS's are promptly collected. They will also ensure that banned ODS's and ODS containing equipment are not allowed entry into the country. The department will also serve to provide all copies of import declarations concerning ODSs to the Ozone office. There will however be a need for training of selected officers in the Customs and Excise Department, especially on issues relating to ODS and the Montreal Protocol.

(f) National Agency for Food and Drug Administration and Control (NAFDAC)

This is an Agency of the Federal Government of Nigeria charged with the responsibility of ensuring that appropriate quality of food, drugs and chemicals enter into the Nigerian market. The Agency maintain inventory of various ranges of substances coming into Nigeria. It is equipped with functional laboratory facilities to test the quality of products and substances before being approved for introduction into the market. According to all the importers we surveyed, current ODS import regime stipulates that all importers of ODS must obtain import permit from NAFDAC. In order to obtain such a permit, the importer must provide information on; quantities and types of ODS to be imported; the source country and company name; value of the imports; etc. We observed however that the coverage of substances defined as ODS by NAFDAC was inadequate. This strengthens our feeling for the need for training on ODS, its use technologies, and the Montreal Protocol for NAFDAC personnel. We believe that NAFDAC as a member of the National Ozone committee should continue to maintain the database on ODS imports. Such database should be filed through NAFDAC for the process of obtaining import license for ODS from the Ozone Office in FEPA. This arrangement calls for collaborative and mutually supportive efforts on the parts of NAFDAC and FEPA.

(g) Representative of ODS User Groups

The Manufacturers Association of Nigeria (MAN) is the main representative of manufacturing companies in Nigeria.
The voluntary association is organized into trade groups. The relevant identified groups include; Foam manufacturers; Insecticides and Aerosol Manufacturers; Refrigeration and Airconditioning. A representative from each of these groups should be a member of the National Committee. Other non-governmental organizations, especially those in environmentally related areas can also be coopted into the committee in order to broaden its base.

4.3 POLICY FRAMEWORK

In this subsection, the policy framework within which the ODS phase-out strategy can be implemented in order to achieve the goals and objectives of the Montreal Protocol for Nigeria is described. In order to phase-out ODS use from the Nigerian economy, two types of policy strategies will have to be implemented. These are:

(a) Market Oriented Policies

These are strategies formulated into concrete policies targeted at the ODS market place. Such policies when properly formulated and implemented will act to penalize and discourage the importation and use of ODS while encouraging the shift to the use of non-ODS alternatives. Such policies include; import surcharges; import tax on ODS; sales tax; excise tax; lowering of import duties on ODS alternatives; financing alternative technologies with subsidized funds; and restriction on quantities of ODSs that can be imported.

(b) Regulatory Control and Enforcement Policies

Many of the market oriented strategies discussed in (a) will be ineffective if not backed up by proper documented regulations, coupled with adequate monitoring and enforcement policies. Under this framework, regulations guiding the importation and use of ODS in the country will have to be put in place, monitoring and control programmes on ODS will have to be implemented. Such control programme may involve; actual ban on importation and use of ODSs with properly defined time schedule; licensing of ODS imports; effective enforcement and monitoring systems; and training and certification of personnel handling ODS substances during the phase-out period.

Government through FEPA has a big role in the formulation and implementation of these policy strategies. The eventual mix of the policy strategy chosen must however be cost-effective as far as the phase-out is concerned and must not create any irreversible dislocation in people's welfare.

4.4 GOVERNMENT AND INDUSTRY RESPONSES TO THE MONTREAL PROTOCOL

4.4.1 Current Status of the Montreal Protocol in Nigeria

The Federal Government of Nigeria acceded to the Vienna convention and the Montreal Protocol on the 31st of October 1988. Both entered into force on the 29th of January 1989. Nigeria has been participating since then in all meetings related to both the convention and the Protocol. Nigeria is eligible for assistance from the Interim Multilateral fund as it is classified as a developing country, with a per capital ODS consumption of about 0.012 kg/capita which is well below the 0.3 kg/capita limit allowed for article 5 countries. Various efforts are in place to prepare a country programme for ODS phase-out in Nigeria as a precursor for requesting for funds from the Interim multilateral fund.

4.4.2 Government Response to the Protocol

The various responses of the Federal Government of Nigeria since the Protocol was ratified has been elucidated in Section 1.3 of this report. The most significant apart from the ratification is the setting up of the Ozone office in FEPA, and current efforts aimed at preparing the country programme which will spell out the action plans. This office however is understaffed. With the renewed zeal of FEPA to take concrete actions on the Ozone depleting Substances phase-out, it is expected that the office will be strengthened with adequate manpower and funds. In the next few months, it is expected that the institutional infrastructure set up will be strengthened to ensure adequate response to the ODS phase out programme.

4.4.3 Industry Response to the Protocol

It can be concluded that industrial users of ODS in Nigeria are well aware of the issues surrounding the Montreal Protocol. Responses obtained from these users indicated that the level of awareness is very high. However, the levels of adoption of the ODS issues in recent and planned actions varies from sector to sector.

In the refrigeration and airconditioning sector, all the companies can be described as being very aware of the ODS issues. Their awareness of the issues has been mostly as a result of the fact that many of them maintain technical relationship with companies overseas especially in Europe, where the ODS phase-out actions has reached advanced stages. Many of these companies are aware of the structural changes going on as far as new ODS technology and ODS issues are concerned. They are also aware of the fact that many of the current technologies may become obsolete, especially by the time the conventional substances have been phased-out in these countries. The leading industries in this sector are currently finalizing plans on technical requirement for their ODS phase-out programmes. Many of them are

now aware of the financial commitments required to undertake technical retrofit of their systems to align with the national ODS phase-out strategy when it comes. They are all aware of the fact that they will need financial support if they are to successfully carry out the required ODS phase-out programmes. Examples of such companies in this sector include: Thermocool Engineering Co Plc; Kolinton Technical Nigeria Ltd.; Debo Industries Ltd; Mandilas Enterprises Ltd.

As an example, Thermocool has recently carried out an inventory of technical requirements for CFC phase-out in its manufacturing facilities. The inventory is shown in Appendix 1. According to the company, the capital investment estimate for the technical activities highlighted is about US$4.5 million. This company like others in the sector are currently trying to obtain technical know-how to facilitate the change to the use of non-ODS refrigerants.

As for the flexible foam manufacturers, it will be accurate to characterize their level of awareness of ODS issues as high. A lot of progress has been made over the last few years in this sector in the replacement of foam blowing with CFC-11 to the use of Methylene Chloride. Over the last few year, many old foam manufacturers have been switching to non-ODS alternatives like Methylene Chloride. For example, Vitafoam Nig Plc which has about 35% of the Nigerian market for flexible foams, has converted two of its existing five plants to this alternative non-ODS foam blowing agent. The increasing awareness of the carcinogenic nature of this alternative is expected to slow down the shift to Methylene Chloride in the near future. As a matter of fact, another active company in this sector Mouka Limited made available to us information on its already implemented shift which included an initial shift from F-11 to Methylene Chloride and much latter to the use of auxiliary blowing agent free foam.

The Nigerian aerosol producers are also well aware of the Montreal Protocol. Many of them have recently shifted from the

use of CFCs to unstenched liquified Petroleum Gases (LPG) as a propellant. Nearly all the companies, with the exception of a few have completely eliminated the use of ODS. Some of these companies, that have shifted have however had to shut down due to what they described as loss of market occasioned by poor product resulting from the use of the non-ODS propellant. Since there were many more that have successfully changed without market loss, we are of the opinion that mere shift to LPG may not be the reason for market share loss. The issues of availability of LPG and consumer safety are however what we believe should be of more concern to Government.

Companies offering fire fighting services in Nigeria as well as users of ODS based solvents are also equally aware of the Montreal Protocol issues. While there are concrete plans to phase out use of halons in fire fighting in Nigeria, a wait and see attitude is perhaps more prevalent as regards ODS solvent use in the country.

IMPLEMENTATION OF THE ODS PHASE-OUT STRATEGY IN NIGERIA

5.1 ALTERNATIVE ODS PHASE-OUT TECHNOLOGIES CONSIDERED

The alternative substitutes considered in the present study for phasing out ODS use in the various sectors are presented in Table 5.1. These substitutes represent the most plausible alternatives that are either currently available or that will be available in proven forms during the period under consideration. These plausible alternatives, most of which have been factored into the scenarios developed in a later section are discussed below:

5.1.1 Local Manufacture of Domestic Refrigerators and Deep Freezers

Current practice in this sector is to use CFC-12 as refrigerants and CFC-11 as foam blowing agents in the manufacture of these equipment in Nigeria. The most preferred alternative refrigerant in the manufacture of domestic refrigerators and deep freezers is HFC-134a. Although this refrigerant has a zero ODP value, it is not a drop-in substitute for CFC-12. In order to manufacture such ODS free refrigerators there will be a need to carry out important technical retrofit of existing manufacturing outfits in the country. Examples of such necessary retrofits for two of the main manufacturers of these equipment, namely Thermocool Nigerian Technical Co. and Kolinton Industries Ltd. are shown in Appendix D. Apart from changing the refrigerant system the retrofit will also involve changing the set up for the foaming plant from the use of CFC-11 to non-ODS options. Options that have been considered for the foaming sector include; CO_2/water; cyclopentane; and HCFC-141b.

TABLE 5.1: POTENTIAL SUBSTITUTES FOR CFCS IN NIGERIA

USER SECTOR		CURRENT USE		POTENTIAL SUBSTITUTES		EARLIEST START DATE
1	Manufacture of Domestic Refrigerator Freezers	i	CFC 12 (Refrigerant)	i	HCF 134 a (Refrigerant)	1998 (Import ban from 1997)
		ii.	CFC-11 (Insulation Foam Blowing)	ii.	CO_2/water (Foaming Agent)	1998
				iii.	Recovery/Recycling of CFCs	1998
2.	Servicing of Domestic Refrigerator and Freezers	i.	CFC-12	i.	Better Servicing Procedure	1998
				ii.	Recycling	1998
				iii.	Retrofitting of Existing CFC-Based Equipment	1998
3.	Servicing of Commercial and Industrial Refrigerators	i.	CFC-12	i.	Better Servicing	1998
		ii.	CFC-115 in R-502	ii.	Recycling	1998
				iii.	Retrofit	1998
4.	Mobile Airconditioning	i.	CFC-12	i.	Better Maintenance and Servicing Procedure	1998
				ii.	Recycling	1998
				iii.	HFC-134a	1998
5.	Fire Extinguishers	i.	Halon 1211	i.	Shift to FM 200A	1997
		ii.	Halon 1301			
6.	Flexible Foam	i.	CFC-11	i.	Methylene Chloride	1997
				ii.	Use of Auxiliary Blowing Agent free Foam	1997
				iii.	CO_2/Water	1997
7.	Solvents	i.	CCL_4	i.	Alcohol Solvents	1997
		ii.	$CHCCL_3$	ii.	Saponifers	1997
				iii.	Water Solvents	1997

5.1.2 Servicing of Domestic Refrigerators and Deep Freezers

Servicing of these equipment usually involve leakage mending, recharging with refrigerants, repairs or complete replacement of compressors. Compressor failure and leakage in system are the two most frequent problems that service technicians are faced with in Nigeria. CFC-12 consumption in the servicing of the equipment is in the range of about 1.0 kg per unit compared to an average charge of about 0.3 kg per unit. It is therefore feasible that if better servicing procedures can be introduced through proper and quantitative re-training of the service technicians, a substantial portion of the current level of CFC-12 consumption can be trimmed. The technical options that has been considered include:

* Improvement of service procedures and increased use of nitrogen and HCFC-22 for leak testing and system purging.

* Recovery and recycling of CFC-12 during equipment servicing. We noticed from the result of our survey that some level of recovery and recycling activities has been registered in the country. It is unlikely that the many small scale technicians can afford the recovery equipment. In order to have a well organized recovery set up it has also been assumed that a well planned recovery programme will be promoted through some selected major service centers.

* Program of retrofitting existing equipment to non-ODS based one. At the beginning of the phase-out programme, retrofit will start with a percentage of equipment with compressor failure being retrofitted with non-CFC based compressors. At a certain point, equipment without compressor failure will be mandatorily retrofitted in addition to those with compressor failure. In order to ensure the success of

this programme CFC based compressor imports may have to be banned at a certain point.

5.1.3 Installation and Servicing of Commercial and Industrial Refrigerators

This includes cold room/stores/display cabinets; refrigerated trucks/vans; and industrial refrigerators. Almost all existing cold rooms are based on CFC-12 as the refrigerant. In quite a few, use of CFC-502 as refrigerant was noted. Since the refrigerant and technology used in the commercial refrigeration equipment are the same as that for the domestic appliances, the technical options for ODS reduction discussed in section 5.1.2 will also apply. A variance however is that it has been assumed that there will be no retrofit of existing commercial and industrial refrigeration systems. For industrial refrigeration systems the technical option considered include better maintenance and service procedures. Such improvement will come in form of: proper and timely repair of leaky systems prior to recharging; routine maintenance and system check-ups; and use of nitrogen/HCFC-22 for purging and leak testing.

5.1.4 Manufacture/Assembly and New Airconditioned Vehicles

The most currently used refrigerant in new vehicles assembled in Nigeria is CFC-12. Although HFC-134a is the internationally accepted replacement refrigerant with an ODP of Zero, our survey showed that none of the manufacturers have started producing airconditioned cars with such non-ODS refrigerant. In our phase-out strategy analyses, we have considered the fact that all such new vehicles that will be assembled in Nigeria as from a cut-off date will be fitted with airconditioning systems having HFC-134a as refrigerant. The choice of the cut-off date has been dictated by our understanding of when the non-ODS technology will be readily available at such assembly plants.

5.1.5 Servicing of Mobile Airconditioning Systems

A large wastage of refrigerant occurs during the servicing of mobile airconditioning systems. This is because the techniques usually used for cleaning, flushing and testing of the systems usually consume a higher quantity of the refrigerant gas compared to the one needed for the initial charge. Therefore, a substantial level of savings in CFC-12 can be recorded during the phase-out period if the following technical options are introduced:

- Improve maintenance and service practices in addition to using non-CFC gases for leakage testing, cleaning, testing and flushing of systems.

- Introduce recovery and recycling of CFC-12 during system services.

- Introduce the retrofit of existing CFC-12 based system with HFC-134a, especially in cases of compressor failure.

5.1.6 Manufacture, Installation, Servicing and Maintenance of Domestic and Commercial Airconditioners

Domestic airconditioning units which include room airconditioner and split units. Centrifugal and reciprocating chillers represent examples of commercial units. Domestic airconditioners and reciprocating units uses HCFC-22 as refrigerant while CFC-11 and CFC-12 are used in the centrifugal chillers. For the phase-out programme therefore, the centrifugal chillers was our focus of attention. It has been assumed that no new centrifugal chillers will be installed in Nigeria in post 1994. For the ones already installed, a gradual programme of phase-out has been built into the programme. Better maintenance and servicing of these systems will also be practiced. Recovery and recycling of the ODS will also be practiced as long as the systems remain in

services. This will involve the installation of facilities for emptying and storing of the refrigerant during servicing. Such system often contain large quantities of CFCs.

5.1.7 Installation and Recharging of Fire Extinguisher Systems

As of 1994, information gathered from the sector indicate that portable/transportable halon-1211 fire extinguisher had nearly been completely substituted by systems using available alternatives such as water, CO_2 and foam/powder solution. A substantial portion of the CFC used in this sector is as halon-1301 used almost exclusively in stationary equipment in medium to large facilities. Since it is becoming more and more difficult to source these halons in the international market, future technology in this sector will be geared more towards non ODS alternatives. An example of such alternative which will soon be introduced into the Nigerian market to replace halon-1301 is FM-200.

5.1.8 Manufacture of Flexible Foam for Mattresses and Cushions

The quantity of CFC-11 used in this sector as a blowing agent has been declining in the recent past. The decline has been due to a combination of poor economic atmosphere and deliberate switch by the manufacturers to non - ODS blowing agent like methylene chloride. For the ODS phase-out programme, technologies using methylene chloride as foam blowing agent will continue to be introduced as well as the introduction of Auxiliary Blowing Agent (ABA) Free Foam. We envisage that new facilities will be a mixture of these options while retrofit of existing facilities still based on CFC-11 as blowing agent to use non-ODS blowing agents, and ABA free foam.

5.1.9 Aerosols

Nearly all the companies manufacturing pesticides, insecticides, air fresheners, and deodorants have shifted to the use of unstenched LPG as aerosols instead of CFC gases. For the phase-out programme the few companies still using CFCs will convert their system to unstenched LPG. Therefore a rapid phase-out of CFC use in this sector is expected.

5.1.10 Solverts

Alternative solvents that will replace the ODS solvents like CTC and Methyl Chloroform include: alcohol solvents, saponifiers and water soluble solvents.

5.2 PHASE-OUT SCENARIOS

5.2.1 Description of Phase-Out Scenarios Considered

Two alternative phase-out scenarios have been considered in this study. In choosing the time schedules of these scenarios, we have considered the fact that the Montreal Protocol as ratified for Article 5 countries requires that Nigeria should freeze its ODS consumption at the 1996 levels up till 2005 when consumption is expected to be halved.

This consumption level is then expected to be kept till the year 2008 when it will again be reduced by 50% and frozen at this level till the year 2009. Complete phase-out is expected by the year 2010. This Montreal Protocol schedule formed the extreme limit that must be met. In considering the implementable Phase-Out scenarios, the following ODS consumption reduction factors were considered:

(i) Reduction of ODS-based equipment stock through scrapping and retrofitting.

(ii) Recovery and recycling of ODS's.

(iii) Reduction of quantity of ODS used for servicing and maintenance operations like flushing, testing and leak detection.

Two alternative Phase-Out scenarios that have been analysed include:

(i) An allowable Phase-Out scenario that postpones the phase-out schedule until the latest possible date allowed by the Montreal Protocol. For this scenario, ODS use in Nigeria will be phase out by the year 2010. This is referred to as scenario A.

(ii) An accelerated Phase-Out scenario, for which the speed of the phase-out is accelerated to ensure compliance by as early as the year 2008. This is referred to as Scenario B.

The general assumptions relating to the two scenarios are described below:

(i) Local manufacture/assembly of ODS using equipment will be stopped by the year 2005 for scenario A and by the year 1998 for Scenario B.

(ii) Retrofit of ODS using equipment in the current stock in the country will start by the year 2005 for scenario A and by 1998 for scenario B.

(iii) In Scenario A, use of ODS for leak detection and system flushing will be disallowed by the year 2008, while the corresponding year for Scenario B is 2000.

(iv) Recovery and recycling of ODS will start by the

year 2005 in Scenario A and by the year 1998 in scenario B. In scenario A it has been assumed that 50% of recoverable ODS will be recovered in each year of the period 2005-2007, and 70% between 2008-2010. For scenario B the corresponding recovery period during which these rates are assumed valid are 1998-2005, and 2006-2010 respectively.

The sector specific assumptions are described below and Tables 5.2 and 5.3 shows the demand forecast of the two phase-out scenarios:

a. Domestic Refrigerators and Deep Freezers

Total demand for new equipment is expected to grow by a yearly average of about 10% between 1994 and 2010. Domestic production of new CFC-based equipment is expected to grow at this rate between 1994-1996 in both scenario A and B. For scenario A, production of these new CFC-based equipment will be frozen at the 1996 level till the year 2004, while for scenario B the terminal year will be 1997. Production of new CFC-based equipment is expected to be completely stopped by the year 2005 for scenario A and by the year 1998 for scenario B.

Domestic production of non-CFC based equipment is expected to start by the year 2005 in scenario A and by the year 1998 in scenario B. Production in these start-up years for both scenarios has been estimated to be about 82,500 units. Thereafter production is expected to grow at an average annual rate of about 10%. Importation of new CFC-based equipment is expected to be prohibited in each scenario by the end of the year 1996. In order to bridge the shortfall in domestic demand occasioned by this prohibition, non-CFC based equipment will be imported into the country starting from 1997.

TABLE 5.2: DEMAND FORECAST BY SECTOR IN ODS PHASE-OUT SCENARIO A IN ODP TONNES

SECTOR & SUBSTANCES	1994	1996	1998	2000	2002	2004	2006	2008	2010
1. AIRCONDITIONING & REFRIGERATION									
CFC-11	105.4	125.0	123.7	122.4	121.1	120.5	0.0	0.0	0.0
CFC-12	758.8	786.6	799.0	805.2	807.4	808.5	378.4	133.7	0.0
Sub-Total	864.2	911.6	922.7	927.6	928.5	929.0	378.4	133.7	0.0
2. FOAM INDUSTRY									
CFC-11	165.0	180.2	180.2	180.2	180.2	180.2	90.1	27.0	0.0
Sub-Total	165.0	180.2	180.2	180.2	180.2	180.2	90.1	27.0	0.0
3. AEROSOLS									
CFC-11	7.7	8.4	8.4	8.4	8.4	8.4	4.2	1.3	0.0
CFC-12	24.0	26.2	26.2	26.2	26.2	26.2	13.1	3.9	0.0
CFC-114	45.0	49.1	49.1	49.1	49.1	49.1	24.6	7.4	0.0
Sub-Total	76.7	83.8	83.8	83.8	83.8	83.8	41.9	12.6	0.0
4. FIRE-FIGHTING									
Halon 1301	35.0	38.2	41.7	45.6	38.2	38.2	19.1	19.1	0.0
Sub-Total	35.0	38.2	38.2	38.2	38.2	38.2	19.1	5.7	0.0
5. SOLVENTS									
Carbon Tetrachloride	105.6	115.3	125.9	137.5	151.6	167.2	19.7	19.7	0.0
Methyl-Chloroform	25.4	27.7	30.3	33.1	36.5	31.7	22.2	22.2	9.5
Sub-Total	131.0	143.1	156.2	170.6	188.1	198.8	41.9	41.9	9.5
TOTAL	1,271.9	1,356.8	1,384.6	1,407.8	1,418.8	1430.0	571.3	234.3	9.5

TABLE 5.3: DEMAND FORECAST BY SECTOR IN ODS PHASE-OUT SCENARIO B (IN ODP TONNES)

SECTOR & SUBSTANCES	1994	1996	1998	2000	2002	2004	2006	2008	2010
1. AIRCONDITIONING & REFRIGERATION									
CFC-11	105.4	125.0	3.2	1.9	0.6	0.0	0.0	0.0	0.0
CFC-12	758.8	786.6	453.9	262.1	204.5	141.6	57.3	0.0	0.0
Sub-Total	864.2	911.6	457.1	264.1	205.2	141.6	57.3	0.0	0.0
2. FOAM INDUSTRY									
CFC-11	165.0	180.2	180.2	90.1	90.1	90.1	27.0	0.0	0.0
Sub-Total	165.0	180.2	180.2	90.1	90.1	90.1	27.0	0.0	0.0
3. AEROSOLS									
CFC-11	7.7	8.4	8.4	4.2	4.2	4.2	1.3	0.0	0.0
CFC-12	24.0	26.2	26.2	13.1	13.1	13.1	3.9	0.0	0.0
CFC-114	45.0	49.1	49.1	49.1	24.6	24.6	7.4	0.0	0.0
Sub-Total	76.7	83.8	83.8	41.9	41.9	41.9	12.6	0.0	0.0
4. FIRE-FIGHTING									
Halon 1301	35.0	38.2	38.2	19.1	19.1	19.1	5.7	0.0	0.0
Sub-Total	35.0	38.2	38.2	19.1	19.1	19.1	5.7	0.0	0.0
5. SOLVENTS									
Carbon Tetrachloride	105.6	115.3	115.3	57.7	57.7	57.73	17.3	0.0	0.0
Methyl Chloroform	25.4	27.7	27.7	13.9	13.9	13.9	4.2	0.0	0.0
Sub-Total	131.0	143.1	143.1	71.5	71.5	71.5	21.5	0.0	0.0
TOTAL	1,271.9	1,356.8	902.3	486.7	427.8	364.2	124.1	0.0	0.0

As pointed out in an earlier section of this report, it has been estimated that the importation of second hand ODS based equipment will grow by an average of about 5% annually between 1994 and 996. This lower growth compared to recent historic average we believe, will be achieved through the strict implementation of tariff controls recently introduced.

In Scenario A, it has been assumed that the importation of these "Tokunbo" CFC-based equipment will decrease by 25% annually between 1997-2000, and 50% annually between 2001 and 2004, and as from 2005 such importation will be prohibited. In Scenario B, imports will fall at an annual rate of 50% by 1997 and by 1998 such importation will be prohibited. For the non-CFC based equipment, the assumed lifetime is 15 years as such it has been assumed that scrapping will not occur until after the year 2010. Another strategy that has been built into the Scenario analyses to aid in the reduction of ODS consumption in the country is the retrofitting of existing CFC - based equipment. In Scenario A, it has been assumed that 30% of all equipment compressor failure problems will be retrofitted with non-CFC compressors and its necessary peripherals by the year 2005. Between the years 2006 - 2008 the number of such retrofitted equipment is expected to grow at an annual average rate of about 45% and from 2009 - 2010 the growth rate will fall to about 4.8% per annum. In Scenario B, the retrofit will start in 1998 with about 20% of all equipment with compressor failure being retrofitted with non-CFC compressors. This will grow by about 7.5% per annum between 1999 and the year 2005. Between 2006 and 2008, achievable growth rate is expected to average about 3.4% per annum and between 2009 and 2010 an annual decrease of about 27.5% is expected to be recorded. Improved servicing and maintenance practices is expected to lead to a reduction of how much CFC will be used for equipment servicing during the periods 2005 - 2007 (0.65kg CFC-12 per unit) and 2008 - 2010 (0.3kg) for Scenario A.

(b) Commercial and Industrial Refrigerators

In this sector, all the assumptions made in the unconstrained case especially as regards installation of new equipment and scrapping of obsolete ones remain valid in this phase-out case. It is further assumed that installation of new CFC-based equipment will cease as from the end of the year 2004 in Scenario A and for Scenario B, by the end of the year 1997. Retrofit of existing equipment with non - CFC based parts was not considered in this study. As for CFC use in servicing, just like in the domestic equipment case, improved practices is expected to lead to a reduction in CFC required. For Scenario A during the period 1994 - 2004 quantity of CFC-12 used in repair of compressor failure has been assumed to be about 4.2% higher than the requirement for charging new units. For leakage mending the corresponding percentage above new charge rate is 50%. For the period 2005 - 2007 the percentage above initial charge requirement is halved for both compressor failure and leakage problems. As from 2008 and above no CFC will be used in these servicing activities. The corresponding percentages for Scenario B include: between 1994 and 1997 about 4.2% and 56% above new charge requirement of CFC will be required for servicing equipment with compressor failures and leakage problems respectively. Between 1998 and 1999 it is expected that this will drop to 2.1% and 28% respectively. By the year 2000 no CFC will be used in servicing of these equipment as alternative non-ODS materials will be utilized for these purposes. It has further been assumed that 80% of total actual initial charge of CFCs in the equipment (6kg for Cold stores 6-36TR; 18 kg for cold store 50 100TR; and 4.45 kg for Refrigerated Trucks) is recoverable for units with compressor failure. For equipment with leakage problems, only 40% of initial charge has been assumed recoverable.

(c) Domestic and Commercial Airconditioning

The only equipment in this sector with ODS consumption is the centrifugal chiller commercial airconditioners. All others utilize non-ODS or transitional substances. It has been assumed that a deliberate policy of phasing out centrifugal chillers as in the unconstrained projection will be followed. This will lead to ODS consumption in this sector, going to zero by the year 2003.

(d) Mobile Airconditioning

All the assumptions made in the generation of unconstrained demand for ODS in this sector, especially as they relate to new airconditioned vehicles and scrapping of obsolete vehicles holds true in this phase-out Scenario cases. Additional assumptions made to formulate these Scenarios include: in Scenario A assembling and manufacture of new cars with CFC refrigerant will cease by the year 2004, while the corresponding year for Scenario B has been fixed at 1997; it has further been assumed that by the year 2005 for Scenario A, 50% of all airconditioned car with CFC refrigerant and with compressor failure will be retrofitted to use non-CFC refrigerants. This retrofit activities will grow between 2006 and 2008 by about 100% annually. Between 2009 and 2010 this growth in the number of vehicles retrofitted is expected to drop by about 29% annually.

For Scenario B, by 1998 all the CFC-based airconditioned cars with compressor failure are expected to be retrofitted. Between 1999 and 2005, the number retrofitted is expected to grow by an annual average of about 25%, by 20.9% annually between 2006 and 2008, and decline of about 30.5% and 30.3% for the year 2009 and 2010 respectively.

As regards CFC required for servicing airconditioning equipment in this sector, we have assumed that for Scenario A between 1994 to 2004, 2kg of CFC-12 per unit will be needed. This service

requirement is expected to take care of CFC-12 needed for flushing and leak detection. As improved servicing and maintenance culture is introduced, it is expected that this quantity requirement should decrease to about 1.87 kg per unit between 2005 and 2007. By 2008 it is expected that no CFC will be used for leak detection or system flushing again. The corresponding assumption for Scenario B are as follows: between 1994 to 1997 2 Kg of CFC-12 per unit will be required for servicing; this is expected to decrease to 1.82 Kg per unit during the period 1998 and 1999. By the year 2000 it is expected that the practice of using CFC-12 for leak detection and system flushing would have been discontinued. It has also been assumed that 80% of total initial charge of CFC-12 in units with compressor failure and 30% for units with leakage problems are recoverable.

(e) Foam, Aerosol, Solvents and Fire fighting

There has been a significant substitution of methylene chloride for CFC-11 as foam blowing agent in Nigeria over the last few years. As a matter of fact there is documented evidence of one company Mouka Ltd. that has even gone a step further by substituting the use of auxiliary blowing agent free foam for one requiring use of a blowing agent. The trend for the future will therefore call for a phase-out of ODS as foam blowing agent. Similar conclusions can be reached for use of ODS as propellants in Aerosol production. The trend over the last few years has been towards gradual shift to the use of unstenched LPG. This trend is expected to continue. While halons remain the most common firefighting medium, some substitution to non-ODS medium have started to occur. As a matter of fact, one of the major companies in the country, Omot Fire Services Ltd. informed us that they are likely to change completely to ODS free FM-200 by 1996. Although no strong database exist to draw conclusion from the pattern of changes in the use of ODS solvents in the country, we believe that increased awareness of the requirement of the Montreal Protocol, coupled with scarcity and high prices of the

ODS alternative, especially in the International Markets, will lead to a phase-out of these substances.

Given the discussion above, the two Scenarios considered in these sub-sectors were as follows: for each of these sectors in Scenario A, demand was allowed to follow the Montreal Protocol Schedule with the demand for ODS use in any of these sectors phased out by the year 2010. In Scenario B, demand is frozen at 1996 levels up till 1999. Between 2000 and 2004 it is frozen at 50% of 1996 levels, 2005 to 2007 at 15% of 1996 levels, and by 2008 it should be completely phased out.

5.2.2 Estimation of Incremental Cost

Incremental cost of ODS Phase-out programme include the following components:

(a) Users Cost

These are costs that will be incurred by the users of the ODS in the different sectors of the economy. Such users include: Companies involve with the manufacturing/assembly of airconditioners, refrigerators, freezers etc; foam manufacturers; aerosol producer; industries using ODS as solvents etc. The user cost include: capital cost incurred in the acquisition of equipment required to convert production capacity to non-ODS alternatives; non-recurring costs such as product reformulation and training of personnel; other annual operational costs; cost of providing CFC recovery/recycling facilities. These costs are incremental relative to continuing the manufacture of CFC and halon using equipment.

(b) Consumer costs

These are cost expected to be borne by the final consumers of the end products as a result of the phase-out of ODS

using equipment. The costs considered under this category include: incremental cost resulting from; forced purchase of new non-CFC equipment due to the non-availability of CFC alternatives, incremental cost arising from the mandatory need to retrofit equipment with non-CFC based compressor, after the existing CFC compressor has failed; and incremental cost arising from the need to retrofit an equipment with a non-CFC compressor, despite the fact that the CFC based compressor is still in service. These cost will arise as a result of the different strategies considered in the phase-out Scenario for eliminating the use of ODS in Nigeria.

(c) Government Costs

Government is expected to bear some economic cost associated with complying with the Montreal Protocol and such cost will include: cost required to strengthen exising institutional infrastructure to enable proper implementation of necessary laws and regulations; cost associated with necessary campaigns to improve public awareness on the ozone issues; monitoring of ODS supply and use in the country; cost of information dissemination etc. The methodological framework for the quantitative assessment of these costs is presented in Appendix F, a summary of the input used in estimating these incremental costs is presented in Table 5.2.

5.2.3 Comparison of Alternative Phase-Out Scenarios

The two Scenarios described in an earlier section is compared in this section using the following criteria:

(a) Total incremental cost
(b) Total incremental cost per Kg of ODS phased-out
(c) ODS consumption profile over the period
(d) Development of stocks of domestic refrigerators and freezers.

TABLE 5.4: UNIT VALUES FOR ESTIMATING INCREMENTAL COSTS

COST CATEGORIES		DOMESTIC REFRIGERATORS AND FREEZERS		COMMECIAL AND INDUSTRIAL REFRIGERATOR		MOBILE AIRCONDITION	
		Unit	Value	Unit	Value	Unit	Value
A.	**User Costs**						
(i)	Annualized Capital Cost for Retrofit	Million US$	1.03	'000 US$	413.12		
(ii)	Operational Production Cost	US$/Unit	14.35	US$/Unit	17.22		
(iii)	Recovery/Recycling Equipment	US$/Kg	5.39	US$/Kg	5.39	US$/Kg	5.39
B.	**Consumers Costs**						
(i)	Purchase of Imported Non-CFC Equipment	US$/Unit	30.00			US$/Unit	39.8
(ii)	Retrofit of existing System to use Non-ODS Refrigerant	US$/Unit	14.35			US$/Unit	53.01
C.	**Government Cost**	Annual Estimate of US$ 250,000.00 Starting from a fixed year till 2010.					

NOTE: A real discount rate of 10.0% was used to discount future cash flows to comparable present values in the estimation of incremental costs.

(a) Total Incremental Cost

As shown in Table 5.5, the total incremental cost for Scenario A is about US$114 million, compared to US$130 million for Scenario B. The incremental cost of Scenario B is therefore about 35% higher than that for Scenario A. However, implementation of Scenario A will lead to an ODS consumption phase-out on a cumulative basis between 1995 and 2010 of about 13,300 Tonnes compared to about 19,000 Tonnes in Scenario B. In terms of ODS quantity Phased-Out about 43% more ODSs will be phased-out if Scenario B is implemented compared to Scenario A.

Table 5.5 COST AND BENEFITS OF ALTERNATIVE PHASE-OUT SCENARIOS[3]

Scenario	ODS Use Eliminated over the period 1994-2010 (ODP Tonnes) (% of Total Unconstrained Demand[4])	Incremental User Costs Mill. US$ (1994 Present Value)	Incremental Consumer Cost Mill. US$ (1994 Present Value)	Government Costs Mill US$ (1994 Present Value)	Total Incremental Cost Mill US$ (1994 Present Value)	Discounted Cost Per KG ODS eliminated US$/KG
1. Allowable Phase-Out SCENARIO A	13,310 (54%)	42.6	67.1	1.8	114.0	8.6
2. Accelerated Phase-out SCENARIO B	19,040 (77%)	67.2	53.9	3.2	130.0	6.8

[3]The Costs and Benefits apply to Refrigeration and Airconditioning Sector only.

[4]Total Unconstrained ODS demand over the period 1994 - 2010 is estimated at 24,700 ODP tonnes.

(b) Per-Kg Incremental Cost

This is defined as the present value of the cost of the phase-out programme per kilogram of the total cumulative ODSs phased out during the period 1995 to the terminal date of a scenario. This cost-effectiveness attribute for scenario A is US$ 8.59/Kg while that for Scenario B is US$ 6.81/Kg. From the cost-effectiveness point of view, Scenario B should be prefered despite the fact that it entail a higher incremental cost compared to scenario A.

(c) ODS Consumption Profile Over the Period

Fig. 5.1 gives the ODS consumption profile over the period 1994-2010 for the two scenario cases. Also included in this figure are the profiles for Montreal Protocol requirement and the unconstrained consumption. As shown, it is seen that the Scenario A more or less follow the Montreal Protocol requirement, with a sharp dip in consumption of ODSs between the period 2004 - 2008 and complete phase-out by the year 2010. The accelerated case in Scenario B involves consumption patterns following the profile of the Montreal Protocol up till the year 1996, thereafter, the accelerated phase out procedure is introduced leading to complete phase-out by the year 2008. This accelrated phase out implies consumption well below the Montreal Protocol during the period 1998-2010. The reduced consumption levels is due to the earlier introduction of improved servicing and maintenance procedures in Scenario B. This relatively cheap measures are expected to be introduced by the year 1997 in Scenario B.

(d) Development of Stocks of Domestic Refrigerators and Freezers.

The development of the stock of domestic refrigerators and deep freezers for Scenarios A and B are shown in Figs. 5.2 and 5.3 respectively. In Scenario A, there is a slight growth in the development of CFC-based refrigerators during the period 1995

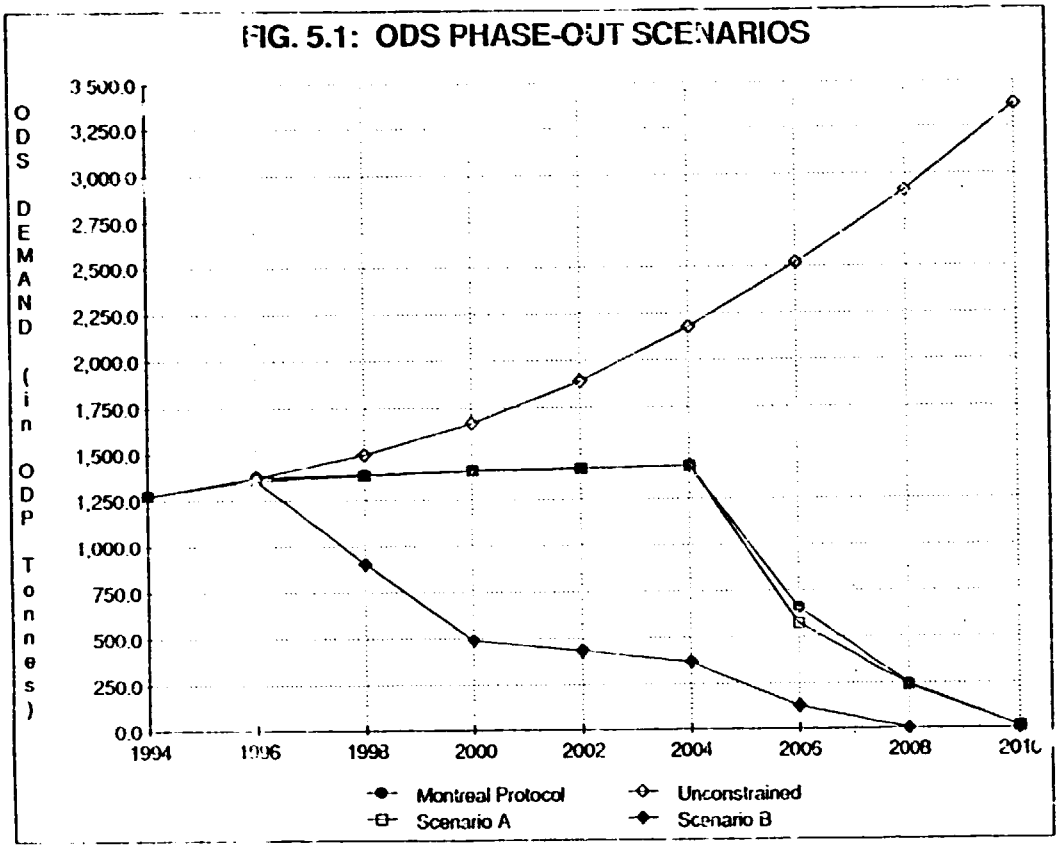


FIG. 5.1: ODS PHASE-OUT SCENARIOS
ODS DEMAND (in ODP Tonnes)
3,500.0
3,250.0
3,000.0
2,750.0
2,500.0
2,250.0
2,000.0
1,750.0
1,500.0
1,250.0
1,000.0
750.0
500.0
250.0
0.0
1994
1996
1998
2000
2002
2004
2006
2008
2010
Montreal Protocol
Scenario A
Unconstrained
Scenario B

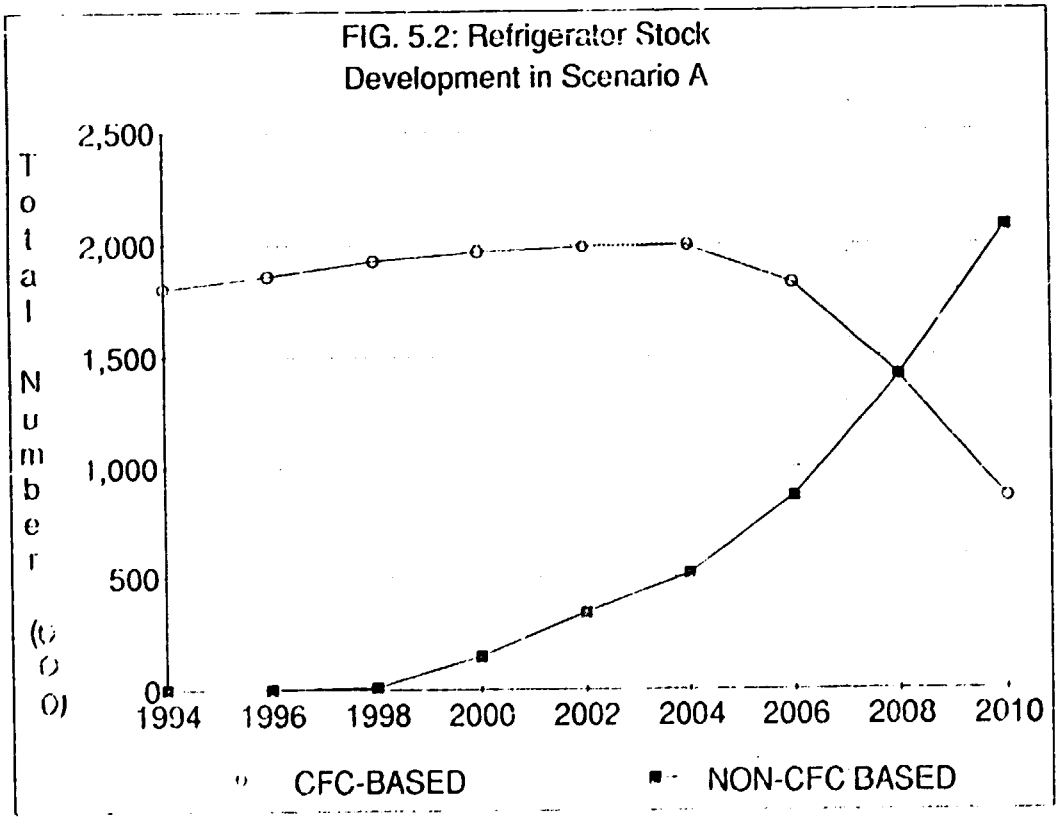
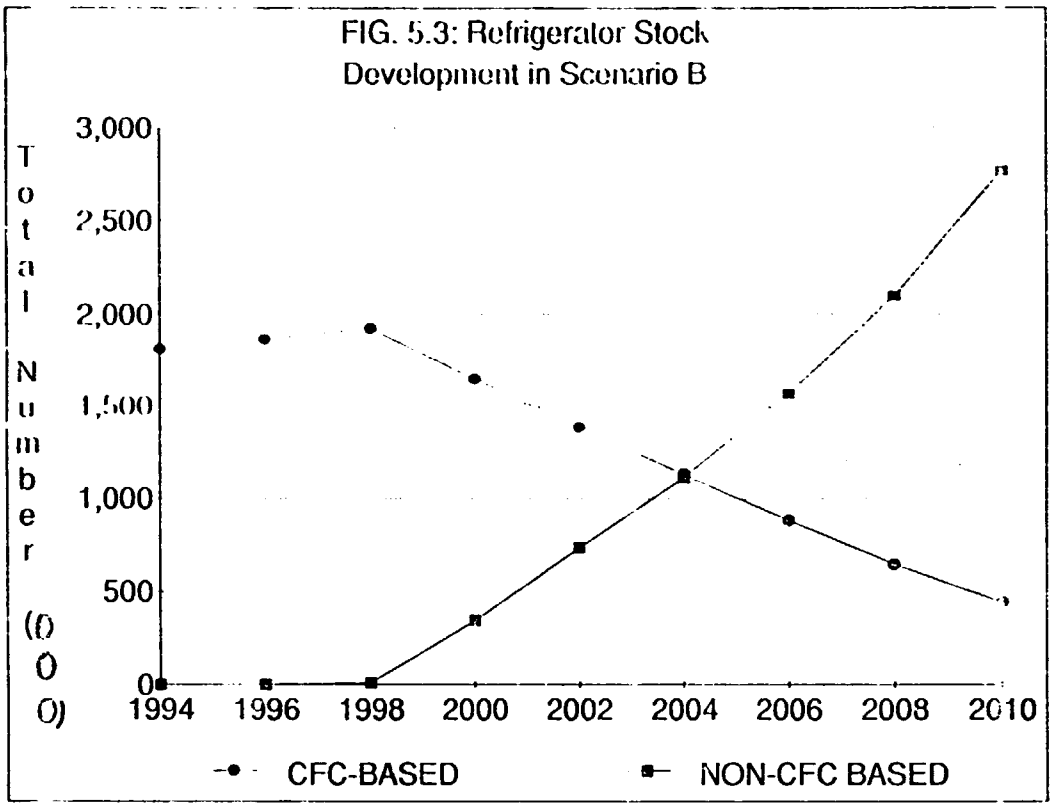


FIG. 5.2: Refrigerator Stock Development in Scenario A
Total Number (000)
2,500
2,000
1,500
1,000
500
0
1994
1996
1998
2000
2002
2004
2006
2008
2010
CFC-BASED
NON-CFC BASED



- 2003. This growth is due to the fact that import of second hand CFC-base equipment is allowed until this terminal date when it is banned. In the case of Scenario B, import of this type of equipment is banned as from the end of 1998. In both Scenarios, starting from about 1998, domestic production and import of HFC-134a type of equipment are expected to enter into the stock development.

(c) The Recommended Phase-Out Scenario

Scenario B, representing an accelerated ODS phase-out programme is recommended. The Scenario has a lower unit incremental cost compared to both the alternative A and the Montreal protocol schedule. The recommended schedule will reequire about US$ 6.81 to phase-out a kilogram of ODS compared to US$ 8.59 per Kg in alternative A. The fact that this schedule is accelerated compared to the Montreal Protocol has the advantage that the penalizing effect of scarcity of ODS due to the earlier phase-out in producing countries will be minimized. It is likely that

price of ODS will go up in the international market, however, the chosen Scenario has incorporated into it, a significantly higher recovery/recycling of ODS as a supply option. Finally, the accelerated schedule should be preferred, given the fact that it is expected that the European Community is likely to call for a global tightening of the Protocol at coming meetings of the parties to the Protocol.

(f) Recommended Phase-Out Schedule

The planned consumption of ODS's until complete phase out is shown in Table 5.6 by substance.

Table 5.6: RECOMMENDED PHASE-OUT SCHEDULE BY SUBSTANCE

SUBSTANCES	1994 CONSUMPTION IN ODP TONNES	PLANNED TOTAL CONSUMPTION UNTIL PHASE OUT IN ODP TONNES	COMPLETE PHASE OUT YEAR (END OF:)
CFC-11	206.7	2,143.5	2007
CFC-12	772.3	5,403.9	2007
CFC-114	7.2	433.6	2007
CFC-115	4.9	NA	2007
HALON 1301	35.0	337.2	2007
CCl_4	105.6	1,017.4	2007
METHYL CHLOROFORM	25.4	244.7	2007

6.1 GOVERNMENT ACTIONS

The five key elements of the various actions expected of the Federal Government of Nigeria in order to ensure an effective phase out of ODS use in the country are discussed below

6.1.1 Institutional Strengthening for the Implementation of the Action Plan

The two components of this element has been elucidated in an earlier section of this report. First and foremost a National Committee on Ozone Depleting Substances must be immediately put in place. We have recommended that the coordination of the activities of this committee should be the responsibility of FEPA. The membership of the committee apart from FEPA as recommended in an earlier section should include: Federal Ministry of Finance; Federal Ministry of Industry; National Planning Commission; Customs and Excise Department; NAFDAC; and Representatives of ODS user groups.

Secondly, the existing Ozone office in FEPA will need to be strengthened. This will involve recruiting more personnel for the office. Such personnel must have good basic education and in some cases, exposure in similar jobs. It is recommended that the ozone office should explore the possibilities of close collaboration in its ODS control functions, with NAFDAC.

6.1.2 Monitoring of ODS Use in Nigeria

Monitoring of ODS use in Nigeria as part of the action plan must be reinforced. The recommended format will follow the following procedure: A would-be importer of ODS will file an application to import ODS with the Ozone office. Such an application must give details of: the type of ODS; source of import; and quantity.

The Ozone office will scrutinize such an application and if found not to contravene current ODS phase-out plans, the application is granted. At port of entry, import declarations concerning ODSs are collected by the Customs and Excise department, which supplies a copy of such declaration to the ODS office. The Ozone office should also collect, from time to time, detailed information, especially about consumption and stocks from end-users, to facilitate proper monitoring of ODS use and stocks.

6.1.3 Regulatory Actions

The following regulatory actions must be part of Government actions within the framework of the National Action Plan:

(a) Ban on Use of ODS

The recommended ODS phase-out Scenario assumed that certain use of ODS for some specific purposes must be banned at some given dates. The achievement of the phase-out strategy goals rely on adherence to these bans been implemented at the given times. Table 6.1 gives a draft schedule of the expected bans and the time such should become effective. The schedule is based on the phase-out Scenario that we have recommended and should serve as a guideline on what the phase-out strategy is likely to look like.

TABLE 6.1 DRAFT SCHEDULE OF BANS ON ODS USE IN NIGERIA

The use of ODSs is allowed in the production and servicing of the below listed application areas until the given date.		
All CFCs:		
1.	Production of domestic refrigerators and deep freezers	1st January, 1996
2.	Installation of commercial and industrial refrigeration equipment.	1st January, 1998
3.	Installation of commercial airconditioning equipment	1st January, 1998
4.	Installation of mobile airconditioning	1st January, 1998
5.	Servicing of domestic refrigerators and deep freezers; commercial and industrial refrigeration, equipment; and mobile airconditioning	1st January, 2006
6.	Manufacture of foam in the foam industry	1st January, 2008
7.	In imported new refrigeration equipment/appliances	1st January, 1996
8.	In imported second hand refrigeration equipment/appliances	1st January, 1998
All Halons:		
9.	Import/Installation of new portable/transportable fire-fighting equipment	1st January, 1998
10.	Servicing of halon fire-fighting equipment	1st January, 2008
Carbon Tetrachloride:		
11.	All uses	1st January, 2008
Methyl Chloroform		
12.	All uses	1st January, 2008
Other uses[1]		
13.	All other uses not mentioned above	1st January, 1996

[1]Uses of ODSs for research, laboratory purposes are so far not regulated either.

Apart from the ban of the use of CFCs in servicing and maintenance of refrigerators and airconditioners at some specific dates, the schedule also call for ban on the importation of second hand equipment using the controlled substances. This ban should be carefully implemented and should take into consideration, the low income earning capacity of Nigerians in the present period. It is this low capacity that has increased the demand for the second hand equipment given their relatively lower "apparent" cost. It has been shown in another country report that if the energy inefficiency of these second-hand equipment are factored in, their cost to the consumers may not be as low as they seem. Ban on the importation of these equipment will be necessary at a point in time, given the possibility that shortages in CFC may occur sometimes before the year 2010. It has been assumed that second-hand equipment using non-ODS as refrigerant will not be available to Nigerians until the year 2007. Granted that a ban on ODS using second-hand equipment has been fixed for 1st January 1998, it is expected that there will be some loss of welfare on the part of low income earners who cannot afford brand new equipment.

(b) Special ODS Tax

This special tax on ODS imports will encourage initial substitution in easily substitutable applications such as, for foaming, as solvents and fire extinguishing. It will also eventually encourage final consumers to shift to the use of non-ODS equipment.

Revenue generated from such an ODS tax should contribute to part-financing of the cost of the activities of the NCODS and the Ozone office. It should also contribute to financing selected projects, such as recovery/recycling equipment purchase, and public enlightenment programmes, which will contribute towards the success of the ODS phase out.

(c) Tax Exemptions

Companies importing ODS conserving technology for recovery and recycling of the substances should be exempted from the general import duty. This will make investment in such facilities attractive to the private sector.

These regulatory measures should be implemented and monitored by FEPA. FEPA's legislative and enforcement powers should be strengthened if need be, to ensure adequate implementation. ODS taxes and import duty exemptions will be collected and managed by the Customs and Excise Department, however, a straightforward mechanism to ensure that these funds are credited to the ODS account in FEPA should be put in place.

6.1.4 Training

Training of relevant personnel that will be involved in control and monitoring of ODS in Nigeria as well as actual utilization in some end-use activities, is a very important component of the action plan. The following training programmes are recommended.

(a) Ozone Office Personnel Programme

This programme will have as an objective, proper education of officials of the Ozone office, especially on ODS issues. Such training programme must and should cover : a proper understanding of the components of the Montreal Protocol; the pertinent component of the Nigerian Action Plan for the ODS phase-out; ODS phase out technology options; alternatives to ODS for use in different sectors, etc. This should be a compulsory training for all new staffers of the office. In addition existing staff-members should undergo regular refresher courses.

(b) Training of Refrigeration Service Technicians

A very important components of the recommended ODS phase-out programme is the introduction of improved servicing and maintenance of ODS based equipment such as refrigerators, airconditioners and deep freezers. Specifically, such improved procedures must encompass not only the right techniques for servicing and maintenance, but the technicians must be made to understand the need to use non-ODS for equipment leak tests and system flushing. The training programme must seek to establish codes of good practices; and the strengthening of existing training facility especially for demonstration purposes.

(c) Training of Personnel from Customs and Excise Department and NAFDAC

These personnel are expected to contribute immensely to the success of the ODS phase-out programme. It is imperative that they have very basic understanding of the Montreal Protocol, especially as regard the proper definition of controlled substances. They should also be trained on the Nigerian Action Plan for phasing out ODS, with proper emphasis on the role they are expected to play for the success of the plan.

6.1.5 Public Enlightenment Campaign

The campaign will be focused on information dissemination to small enterprises as well as big industrial users of ODSs. The final consumers will also be targeted. The programme will aim at giving information in general on the Ozone depletion issues; the chemicals regarded as ODS, and their popular uses; and substitute chemicals and technologies. The campaign should aim at sensitizing the general public on their responsibility to phase-out ODSs. The campaign should cover such medium as: workshops; exhibitions; seminars; print media; radio; television; specially designed jingles; ozone friendly labels on non-ODS products.

6.2 PROJECTS PROPOSED

The refrigeration and airconditioning sector accounted for about 75% of ODS use in Nigeria in 1994. As such, it has been assumed that future efforts at reducing ODS use in Nigeria must be targeted at this sector if significant results is to be achieved before the year 2010. In this respect, we recommended that the major use of funds from the multilateral fund should be in retrofitting of existing refrigeration manufacturing assembly outfits to use new HFC refrigerants. We note that significant ODS phase-out has been achieved for most of the airconditioning sub-sector. It is likely that given the technology development in this sub-sector as well as in foam, solvents, aerosols and firefighting, this trend will continue into the future.

It has also been assumed that within the refrigeration sub-sector, the producers of domestic refrigerators and freezers are the most logical target if cost-effective output is the goal. We also recognize that apart from these retrofit capital investment, funds must also be made available to promote institutional strengthening activities to enhance the implementation and monitoring of the phase-out strategy. In this respect, we are recommending that the following projects be funded from the Multilateral Fund:

(a) Retrofitting of Existing Facilities Producing Refrigerators and Deep Freezers to non-ODS Based

It is recommended that at the first phase, the following manufacturing entities should be considered for funding.

(i) Thermocool Engineering Co. Plc

Current installed capacity is about 150,000 of domestic deep freezers and refrigerators. The company had the highest production capacity in 1994, accounting for about 46.7% of total national production. Comprehensive inventory of

requirement for refurbishing the existing facilities to use non-ODS based refrigerant and foaming has been carried out. A comprehensive listing of these requirements is shown in Appendix D. Cost estimate made available to us by the company showed that about US$4.5 million will be required for the retrofit. A proper evaluation of the proposed retrofit programme and its cost has recently been carried out by a UNIDO expert Mr. A. Adler, assisted by Dr. W. Siyanbola of Triple "E". We estimate that about US$ 2.2 million will be required to retrofit the facility to obtain an annual capacity of about 50,000 units of non-CFC based equipment.

(ii) Kolinton Technical Industry Ltd.

Current estimated installed capacity is about 125,000 units of domestic refrigerators and deep freezers. However, its historical production has not matched the fact that it has a large installed capacity. For example in 1994, the company produced only 25,000 units representing about 29.2% of domestic production and about 20% of installed capacity. This poor historical performance has been attributed to the economic downturn of the nation and lack of or inadequate supply of imported raw materials. We also reliably learnt that the Company has stopped production since February 1995 and it is expected that they will restart by late June 1995. Also shown in Appendix D is a tentative estimate of technical evaluation of the retrofit requirement of the company's manufacturing capacities, to produce non-ODS based equipment.

Independent evaluation by our expert also shows that about US$ 2.0 million will be required for the retrofit to enable the company to produce annually about 40,000 units of non-CFC based refrigerators and deep freezers.

(iii) Debo Industries Ltd.

This is the third largest producer of domestic refrigerators and deep freezers in Nigeria. It has a current installed capacity of about 85,000 units per year. In 1994, only about 19% of installed capacity was utilized. For the first phase of the national retrofit programme, it is recommended that this company's manufacturing capabilities should be retrofitted to produce non-CFC based refrigerators and deep freezers. An independent assessment of current production facilities was recently undertaken by a UNIDO Consultant, assisted by an Engineer from our Company. It was estimated based on this assessment that the company will require about US$ 1.8 million to retrofit existing facilities to produce about 30,000 units of non-CFC based equipment per annum.

(b) Institutional Strengthening for the Ozone Depleting Substances Phase-Out

As suggested in an earlier section of this report, a National Committee for Ozone Depleting Substances (NCODS) will be inaugurated. The secretariat of NCODS will be the Ozone office in FEPA. NCODS and the Ozone office will provide a dedicated institutional infrastructure for the effective implementation of the ODS phase-out in Nigeria. NCODS will formulate action programmes for the phase-out, review the progress of their implementation and advise the Federal Government through the FEPA.

The Ozone office currently existing in FEPA will be strengthened both in terms of man-power and infrastructural endowment. The office will:

- be the secretariat of NCODS
- coordinate all activities relating to ODS phase-out in Nigeria

- monitor and control activities relating to ODS use in Nigeria in compliance with the Montreal Protocol

- collect, organize and disseminate information on the ozone problem and related issues

- facilitate exchange of information among parties and organs established by the Protocol

- maintain a computerized information system on ODS issues that can be assessed by Nigerians of all shades

- participate in local and international meeting on Ozone issues

- organize and manage a coherent and focused public information system on the ozone issue.

Given the competing demands on the government's limited resources and budgetary constraints, it is recommended that support from the Multilateral Fund be obtained for the effective functioning of this institutional infrastructure.

(c) Training Programmes

It is recommended that part support be obtained from the Multilateral Fund to facilitate the various training programmes required for the smooth implementation of the ODS phase-out in Nigeria. Two of such training is envisaged:

(i) Training of Public Sector Personnel

Personnel that will attend this training will be selected from government agencies and institutions like: the Ozone office in FEPA; Custom and Excise Department; NAFDAC; and other relevant bodies. The training will be geared towards fundamental understanding of: the ODS issues; the Montreal Protocol; the

adopted Country Action Plan; non-ODS chemical alternatives; introduction to alternative technology; national regulatory framework and its impact on the Action Plan; as well as specific Agency personnel responsibilities within the framework of the phase-out programme.

(ii) Training of Refrigeration Service Technicians

This training programme is crucial to the attainment of the ODS phase-out targets. Specifically, selected Technicians from the Refrigeration sub-sector will be trained on improved methods for servicing and maintenance of refrigerators and deep freezers. They will be trained on modern cost-effective techniques for servicing these equipment, and the use of non-ODS for leak testing and system flushing. In order to sensitize them, they will also be introduced to non-technical topics like: issues on ODS; the Montreal Protocol; the Country's Action Plan; alternative non-ODS technologies; etc.

(d) Public Enlightenment Programmes

Support from the Multilateral Fund should also be used to buffer Government contributions through FEPA in the necessary public campaign on the need for ODS phase-out in Nigeria. This programme is expected to sensitize the general public on: ozone depleting issues; the need for phasing out ODS; responsibility of Nigerians within the international community on the ODS issue; the Montreal Protocol; governmental effort; and responsibility of the public, amongst others.

It has been estimated that an annual sum of US$ 250,000 for 3 years starting from 1996 will be an adequate support from the Multilateral Fund to buffer Governmental contributions towards projects b, c, and d. A summary of these recommended project and a suggested time-schedule for the Action Plan are presented in Tables 6.2 and 6.3 respectively.

TABLE 6.2: SUMMARY OF PROPOSED PROJECTS

SECTOR	PROJECT DESCRIPTION	PROJECT ELEMENT	DURATION	PROJECT COST US$
REFRIGERATION	Retrofitting of the Existing facilities for producing Non-ODS based Refrigerators and Deep freezers.	Retrofitting for: - Thermoccol Engineering Co. Plc Kolinton Technical Industries Ltd - Debo Industries Ltd	1996-1997	 2.2 Million 2.0 Million 1.8 Million
CROSS-SECTOR	Institutional Strengthening for the ODS phase-out.	- Establishment of National Committee for ODS (NCODS) - Strengthening of the currently existing Ozone office in FEPA both in terms of man-power and infrastructure endowment	1996-1998	750,000
	Training Programme	- Training of Public Sector Personnel from Ozone office in FEPA, Customs and Excise, NAFDAC and other related bodies for regulation and control - Training of Refrigeration Service Technicians in the use of non-ODS substances for flushing & leak-testing and in the technology of recovery/recycling		
	Public Enlightenment Programs	- Public campaign on the need for ODS phase-out in Nigeria through print media, electronic media etc. and intimating consumers of the role they will be playing.		

TABLE 6.3: TIME TABLE FOR ACTION PLAN

ACTIONS	1995				1996				1997				1998			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. INSTITUTIONAL STRENGTHENING																
a) Formation of National committee on ODS (NCODS)					■											
b) Approval and Release of Funds for NCODS and Ozone Office					■											
c) Strenghtening of the Ozone office (in terms of manpower and infrastructure)					■											
2. INSTITUTIONAL ACTIONS																
a) Public Enlightenment Campaign					■	■	■	■	■	■	■	■	■	■	■	■
b) Training the Trainer (Ozone Office Personnel)						■	■									
c) Training of Monitory and Control Personnel-(NAFDAC, Customs and Exicise, Ministry of Industries, etc)								■	■							
d) Training of Technicians in the Refrigeration and Airconditioning sector								■	■	■						
e) Design, Review and Approval of Monitoring and Control Mechanism									■							
3. PROJECT ACTIONS																
i) Recovery and Recycling																
a) Designation of Recovery and Recycling Centre							■									
b) Approval and Release of Financial Assistance for Procuring Equipment									■							
c) Procurement and Installation of Recovery and Recycling Equipment										■	■	■				
ii) Domestic Refrigerators and Deep Freezers																
a) Technical & Economic Evaluation of Existing Manufacturing Facilities Designated for Retrofit		■	■													
b) Approval and Release of funds for Retrofit					■											
c) Retrofit Activities							■	■	■	■						

APPENDICES

PROJECT CONSULTANTS FROM TRIPLE "E"

Below is the list of the Personnel that contributed to the Preparation of this report:

(1)	Dr. F.B.O. Bajo	-	Project Co-ordinator
(2)	Dr. W.O. Siyanbola	-	Senior Associate
(3)	Mr. Ade Adedoja	-	Senior Associate
(4)	Mr. Victor Bajomo	-	Associate
(5)	Mr. Soga Odusolu	-	Associate
(6)	Mr. Emmanuel Eleo	-	Associate
(7)	Mr. Adeolu Ailoje		Associate
(8)	Mr. Akinwande Longe	-	Associate
(9)	Mr. Peter Ale	-	Associate

LIST OF PLACES SURVEYED

A. IMPORTERS

1. CAPL
   General Chemical Division
   28 Commercial Road,
   Lagos, Nigeria

2. OAC Nigeria Limited,
   56/58 Ishaga Road,
   Surulere Lagos.

3. Associated Limited,
   Great Nigeria House,
   6th Floor,
   27/37, Marina Street,
   Lagos.

4. Hubee Industrial Ltd,
   Bureau Restaurant Building,
   17 Joseph Street, Lagos.

5. Nigeria Norsk Ltd,
   144, Oba Akran Avenue,
   Ikeja Lagos.

6. Olympic Enterprises (Nig) Ltd,
   [illegible] Lagos.

7. [illegible]

3/4, Abeb[illegible] Villa[illegible] Road,
Iganmu[illegible]
Lagos.

8. Ristian Technic[illegible] Co. Ltd,
17 Olakunle St, off Isolo, Road,
Mushin, Lagos.

B. Manufacturers of Domestic Refrigerators & Deep Freezers.

9. Thermocool Engineering Co Plc.
Planning Office, Bay,
Ilupeju Industrial Estate.
Lagos.

10. Debo Industries Limited,
Adebowale Group of Companies,
Plot 6, Block H, Ishedi Industries
Scheme, Oshodi, Lagos.

11. Associated Electronic Products (Nig) Ltd.
Km-16, Ikorodu Road,
Ojota, Lagos.

12. Nigerian Sewing Machine Manufacturing Co. Ltd.
Singer Industrial Road,
Km 4, Lagos-Abeokuta Express Road.
Sango Otta, Ogun State, Nigeria.

13 Gacol (Nig) Ltd.
Km2, Otta Idiroko Road,
Sango Otta, Ogun State, Nigeria.

14. Cheltex Limited,
(A Division of Cheltarams)
Km 40, Lagos- Abeokuta Express Road,
Sango Otta, Ogun State,
Nigeria.

C. ASSEMBLERS OF COMMERCIAL REFRIGERATION EQUIPMENT

15. Aluminium Manufacturing Company of Nigeria Ltd,
(Alumaco),
32, Creek Road, Apapa,
Lagos.

16. Beam (A division of UAC),
Plot 6, Akinyemi Crescent,
Matori, Mushin Lagos.

17. Palmer Commercial Refrigeration Services Company,
Fasakin Food Compound,
Plot 1, Thomas Lumiyan Street,
Anthony Village, Ikomolu, Lagos.

D. ASSEMBLERS OF REFRIGERATED TRUCKS/VANS

18. Alumaco,
Isolo, Lagos.

E. CENTRAL AIR CONDITIONING

Mandilas Enterprises Ltd,
35, Simpson Street,

20. Leventis Motors Plc,
Creek Road Apapa,
Lagos.

21. Mandilas Motors,
Simpson Street,
Lagos.

22. Scoa Motor Plc,
Kirikiri - Lagos.

23. Scoa Equip,
67, Marina, Lagos.

24. RT Briscoe (Nig) Ltd,
Plot 2, Block G, Isolo Express Road,
Isolo-Lagos.

25. Cooland Technical (Nig) Ltd,
304, Muhammed Way,
Yaba, Lagos.

26. E.O. Innoma & Co
90, Kirikiri Road,
Olodi-Apapa, Lagos.

27. Peerless Technology Ltd,
103, Finbars Road,
Akoka, Lagos.

28. Al-Aziz Technical Investment Ltd,
4, Ogunyemi Street,
Pedro, Shomolu-Lagos.

F. CAR AIR CONDITIONERS

29. Sammy Oguns & Co.
71, Itire Road,
Surulere, Lagos.

30. Adesoycle Technical
Surulere, Lagos.

31. Collstones Technical Co. Ltd,
49/53 Queens St.
Yaba, Lagos

32. Shamrock (Nig) Ltd,
84, Bale Str.
Olodi Apapa, Lagos.

33. Kamccool
53/56B Akintan St
Ojuelegba Road
Lagos.

34. Ade-Shoyele Technical Co. Ltd,
Surulere

35. Maxwell Electrical & Electronics Co. Nig Ltd.
18 Ibidun Street,
Surulere, Lagos.

G. COLD ROOM INSULATIONS

36. UAC Foods,
Oregun, Lagos.

H. AEROSOL FILLERS

37. Cybelle Cosmetics Ltd,
98/100, Ladipo Str.
Mushin, Lagos.

38. Hagemeyer (Nig) Ltd,
Plot 8, Oregun, Oregun Village Road, Alausa,
Ikeja, Lagos.

39. A.J. Seward,
Billingsway, Oregun Industrial Estate,
Ikeja, Lagos.

40. S.C Johnson Wax
13/14 Abimbola Street,
Isolo Industrial Estate,
Isolo-Lagos.

41. P.Z. Industries
Town Planning Way,
Ilupeju, Lagos.

42. Eleganza Industries Ltd,
Plot, 33, Secretariat Road,
Oregun, Ikeja, Lagos.

I. FOAM MANUFACTURERS

43. Vitafoam Nigeria Plc
Oba Akran Avenue,
Ikeja, Lagos.

44. Moukarim Metalwood Factory Ltd,
Plot M, Awosika Avenue,
Ikeja, Lagos.

J. ASSOCIATIONS & GOVERNMENT AGENCIES

45. National Agency for Food and Drug Administrations (NAFDAC)
Oshodi-Lagos.

APPENDIX C

SAMPLES OF QUESTIONNAIRES USED

EEE

QUESTIONNAIRE ON THE STUDY ON PHASE-OUT OF OZONE DEPLETING SUBSTANCES (ODS) - CHLOROFLUOROCARBONS (CFCs) AND OTHERS

QS-1

Please kindly provide answer to the following questions:

1) NAME AND ADDRESS OF COMPANY: .....
.....
.....
.....
.....

2) NAME OF CONTACT PERSON AND POSITION: .....
.....
.....

3) WHAT TYPE OF ODS (CFCS AND OTHERS) ARE IMPORTED BY YOUR COMPANY?

[ ] CFC 12	[ ] CFC 12/114 MIXTURE
[ ] CFC 11	[ ] HCFC 22
[ ] CFC 12/11 MIXTURE	[ ] OTHERS (GIVE NAME BELOW)
[ ] CFC 115	.....

4) WHAT ARE THE SOURCES OF YOUR IMPORT (COUNTRY/COMPANY)?
(a) COUNTRY(IES):.....
.....
(b) COMPANY(IES):.....
.....

5a) PLEASE GIVE THE QUANTITIES (IN KG) AND PRICES (IN US DOLLARS AND NAIRA PER KG) OF ODS (CFCs AND OTHERS) IMPORTED FROM 1990 TO 1994.

TYPE OF ODS	1990	1991	1992	1993	1994
1. ..... Quantity					
US$/Kg					
Naira/Kg					
2. ..... Quantity					
US$/Kg					
Naira/Kg					
3. ..... Quantity					
US$/Kg					
Naira/Kg					
4. ..... Quantity					
US$/Kg					
Naira/Kg					
5. ..... Quantity					
US$/Kg					
Naira/Kg					
6. ..... Quantity					
US$/Kg					
Naira/Kg					

5b) WHAT WAS THE CUSTOM DUTY (%) PAID ON ODS - CFCs AND OTHERS - IN THE YEARS 1990 TO 1995?

1990	1991	1992	1993	1994	1995

6) IS YOUR COMPANY AWARE OF THE OZONE DEPLETING PROPERTIES (OR THE NEGATIVE ENVIRONMENTAL EFFECTS) OF CFCs AND RELATED CHEMICALS? IF YES, HOW LONG AGO?

.....

.....

7) WHAT ARE YOUR COMPANY'S PLAN AND THAT OF THE COMPANY YOU IMPORT FROM REGARDING THE PHASE-OUT OF ODS - CFCs AND OTHERS?

.....

.....

.....

.....

.....

8) HAS ANY SUBSTITUTE TO ODS - CFCs AND OTHERS - BEEN INTRODUCED? IF YES WHAT ARE THEY?

.....

.....

.....

9) WHO ARE YOUR CUSTOMERS FOR THIS SUBSTITUTE REFRIGERANTS?

.....

.....

.....

.....

10) PLEASE GIVE THE QUANTITIES (IN KG) AND PRICES (IN US DOLLARS AND NAIRA PER KG) OF THE DIFFERENT SUBTITUTE PRODUCTS IMPORTED FROM 1990 TO 1994.

TYPE OF ODS	1990	1991	1992	1993	1994
1. Quantity					
US$/Kg					
Naira/Kg					
2. Quantity					
US$/Kg					
Naira/Kg					
3. Quantity					
US$/Kg					
Naira/Kg					
4. Quantity					
US$/Kg					
Naira/Kg					
5. Quantity					
US$/Kg					
Naira/Kg					

EEE

QUESTIONNAIRE ON THE STUDY ON PHASE-OUT OF OZONE DEPLETING SUBSTANCES (ODS) - CHLOROFLUOROCARBONS (CFCs) AND OTHERS

QS-2

Please Kindly provide answer to the following questions:

1) NAME AND ADDRESS OF COMPANY: .....
.....
.....
.....
.....

2) NAME OF CONTACT PERSON AND POSITION: .....
.....
.....

3) WHAT ARE YOUR COMPANY'S AREA OF OPERATION CONCERNING REFRIGERATION AND AIR-CONDITIONING EQUIPMENT? (Tick the applicable ones below).

[ ] MANUFACTURE (M) [ ] ASSEMBLING (A)
[ ] IMPORTATION (IM) [ ] INSTALLATION (IN)

4) WHICH REFRIGERATION AND AIR-CONDITIONING EQUIPMENT DO YOU DEAL IN? Please tick the appropriate box(es) and indicate your area of operation with following letters: (M - Manufacturing; A - Assembling; IM - Importation; IN - Installation).

[ ] DOMESTIC REFRIGERATORS AND DEEP FREEZERS
[ ] COMMERCIAL AND INDUSTRIAL REFRIGERATORS (e.g. COLD STORES, REFRIGERATED TRUCKS)
[ ] DOMESTIC AND COMMERCIAL AIRCONDITIONING
[ ] MOBILE AIR CONDITIONING

5) WHAT IS THE CAPACITY OF YOUR COMPANY/PLANT?

....

6) HOW MANY APPLICATIONS (EQUIPMENT) HAVE YOU PRODUCED, INSTALLED, ASSEMBLED OR IMPORTED FROM 1990 TO 1994?

(a) DOMESTIC REFRIGERATORS AND DEEP FREEZERS

YEAR	MANUFACTURED	INSTALLED	ASSEMBLED	IMPORTED
1990				
1991				
1992				
1993				
1994				

(b) COMMERCIAL AND INDUSTRIAL REFRIGERATORS

YEAR	MANUFACTURED	INSTALLED	ASSEMBLED	IMPORTED
1990				
1991				
1992				
1993				
1994				

(c) DOMESTIC AND COMMERCIAL AIRCONDITIONERS

YEAR	MANUFACTURED	INSTALLED	ASSEMBLED	IMPORTED
1990				
1991				
1992				
1993				
1994				

(d) MOBILE (OR CAR) AIRCONDITIONERS

YEAR	MANUFACTURED	INSTALLED	ASSEMBLED	IMPORTED
1990				
1991				
1992				
1993				
1994				

7) DOES YOUR COMPANY EXPORT? IF SO INDICATE TYPE AND QUANTITY.

YEAR	DOMESTIC REFRIGERATORS/ DEEP FREEZERS	COMMERCIAL/ INDUSTRIAL REFRIGERATORS	DOMESTIC/ COMMERCIAL AIRCONDITIONERS	MOBILE (OR CAR) AIRCONDITIONERS
1990				
1991				
1992				
1993				
1994				

8) WHAT ARE THE SIZES OF EQUIPMENTS MANUFACTURED/ASSEMBLED/IMPORTED OR INSTALLED?

(i) DOMESTIC REFRIGERATORS & DEEP FREEZER (LITERS): .....
.....

(ii) COMMERCIAL AND INDUSTRIAL REFRIGERANTS (Tonnage of Refrigeration - TR): .....
.....

(iii) DOMESTIC AND COMMERCIAL AIRCONDITIONERS (TR): ....
.....

(iv) MOBILE AIRCONDITIONERS: .....
.....

9) DOES YOUR COMPANY HAVE ANY FOREIGN AFFILIATION? IF YES, PLEASE GIVE NAME, COUNTRY AND NATURE OF AFFILIATION.

.....
.....
.....
.....

10) NUMBER OF YEARS YOUR COMPANY HAS BEEN IN OPERATION:
.....

11) NUMBER OF TECHNICIANS (TRAINED AND UNTRAINED) DIRECTLY INVOLVED IN THE COMPANY'S OPERATION:
.....

12) WHAT IS YOUR COMPANY'S MARKET SHARE? .....

13) WHO ARE YOUR COMPETITORS? .....
.....
.....

14) WHICH ODS - CFCs AND OTHERS -, DO YOU USE IN YOUR EQUIPMENT?

[ ] CFC 12 FOR _____ [ ] HCFC 22 FOR _____
[ ] CFC 11 FOR _____ [ ] OTHERS (GIVE NAME BELOW)
[ ] CFC 115 FOR _____ .....
.....

Please use the follwing abbreviations to indicate the type(s) of equipment that each ODS is used for (DRF - Domestic Refrigerators & Deep Freezers; CIR - Commercial & Industrial Refrigerators; DCA - Domestic and Commercial Airconditioners; MA - Mobile (or Car) Airconditioners).

15) WHAT IS THE TOTAL QUANTITY OF ODS USED IN THE YEAR FOR CHARGING NEW EQUIPMENT?

	1990	1991	1992	1993	1994
DOMESTIC REFRIGERATOR & DEEP FREEZERS (G/UNIT)					
COMMERCIAL AND INDUSTRIAL REFRIGERATOR (KG/UNIT)					
DOMESTIC AND COMMERCIAL AIR CONDITIONING (KG/UNIT)					
MOBILE AIR CONDITIONING (KG/CAR)					

16) WHAT ARE THE SOURCES OF THE ODS YOU USE (LOCAL/IMPORTED)? MENTION COMPANY(IES) AND COUNTRY.

.....

.....

.....

17) ARE YOU AWARE OF THE EFFECTS OF CFCs AND RELATED CHEMICALS ON OZONE LAYER AND THE MONTREAL PROTOCOL PLAN TO PHASE THEM OUT?

.....

18) WHAT ARE YOUR COMPANY'S PLANS IN RESPONSE TO THE PHASE-OUT PROGRAMME? .....

.....

.....

.....

19) WHAT ARE THE PLANS OF YOUR AFFILIATE IN RESPONSE TO THE PHASE-OUT PROGRAMME, IF DIFFERENT FROM THAT ABOVE?

.....

.....

20) IS THERE ANY PHASE-OUT PLAN BY YOUR UMBELLA ASSOCIATION/BODY?

.....

.....

.....

21) WHAT ARE THE COST IMPLICATIONS OF YOUR PLAN ON THE PRODUCTS?

.....

.....

23) ARE YOU OF THE OPINION THAT CFCS SHOULD BE PHASED-OUT GRADUALLY BEFORE THE YEAR 2010 OR WAIT UNTIL THE YEAR 2010? PLEASE EXPANTIATE YOUR VIEW. .....

.....

.....

.....

24) DO YOU USE POLYURETHANE FOAM FOR INSULATION? IF YES, WHERE DO YOU OBTAIN IT FROM (COMPANY AND ADDRESS)?

.....

.....

.....

25) WHAT QUANTITY OF POLYURETHANE FOAM DO YOU USE PER UNIT OF THE DIFFERENT TYPES OF EQUIPMENT YOU MANUFACTURE/ASSEMBLE/INSTALL OR IMPORT?

.....

.....

.....

.....

26) DO YOU HAVE ANY SALES OR SERVICE CENTERS OUTSIDE LAGOS? IF YES, GIVE DETAILS.

.....

.....

.....

.....

PART - B (QS-3)

1) DOES YOUR COMPANY SERVICE REFRIGERATION AND AIR-CONDITIONING EQUIPMENT? ..... IF YES, WHAT TYPES OF SERVICES DO YOU RENDER?

[ ] IN-HOUSE SERVICE OF COMPANY'S EQUIPMENT
[ ] SERVICE OF EQUIPMENT OTHER THAN COMPANY'S OWN
[ ] MOBILE SERVICE UNITS
[ ] OTHERS (Specify) .....

2) WHAT CATEGORY OF EQUIPMENT DO YOU SERVICE? Please tick the appropriate box(es).

[ ] DOMESTIC REFRIGERATORS AND DEEP FREEZERS
[ ] COMMERCIAL AND INDUSTRIAL REFRIGERATORS (e.g. COLD STORES, REFRIGERATED TRUCKS)
[ ] DOMESTIC AND COMMERCIAL AIRCONDITIONERS
[ ] MOBILE (OR CAR) AIRCONDITIONERS

3) PLEASE GIVE THE PERCENTAGES OF THE DIFFERENT TYPES OF SERVICE/REPAIRS CARRIED OUT BY YOUR FIRM; THE RATE OF RECHARGING WITH REFRIGERANT AND THE FREQUENCY OF EACH TYPE OF FAILURE FOR THE DIFFERENT EQUIPMENT.

(a) DOMESTIC REFRIGERATORS AND DEEP FREEZERS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

(b) COMMERCIAL AND INDUSTRIAL REFRIGERATORS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

(c) DOMESTIC AND COMMERCIAL AIRCONDITIONERS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

(d) MOBILE (OR CAR) AIRCONDITIONERS

TYPE	PERCENTAGE	RECHARGING RATE	FREQUENCY
TOPPING UP			
LEAKAGE			
COMPRESSOR FAILURE			
OTHERS (Specify)			

4) WHAT IS THE PERCENT WASTAGE IN THE RECHARGING THE DIFFERENT TYPES OF EQUIPMENT WITH REFRIGERANTS SINCE 1990?

(a) DOMESTIC REFRIGERATORS AND DEEP FREEZERS

.....
.....
.....

(b) COMMERCIAL AND INDUSTRIAL REFRIGERATORS

.....
.....
.....

(c) DOMESTIC AND COMMERCIAL AIRCONDITIONERS

.....
.....
.....

(d) MOBILE (OR CAR) AIRCONDITIONERS

.....
.....
.....

5a) WHICH CHEMICALS DO YOU USE FOR LEAK TESTING? .....
.....

5b) WHICH CHEMICALS DO YOU USE FOR FLUSHING? .....
.....

5c) WHAT QUANTITY OF THESE CHEMICALS DO YOU USE:

(i) FLUSHING .....
.....

(ii) LEAK TESTING .....
.....

6) WHAT ARE YOUR COMPANY'S PLANS IN RESPONSE TO THE PHASE-OUT PROGRAMME IN RESPECT OF SERVICING OLD EQUIPMENT?
.....
.....
.....
.....

7) DOES YOUR ORGANISATION CARRY OUT ANY RECOVERY/RECYCLING OF REFRIGERANTS? GIVE DETAILS OF THE TIME IT STARTED, EQUIPMENT, AND QUANTITY RECOVERED PER YEAR.
.....
.....
.....
.....
.....