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THE REPUBLIC OF SUDAN

MINISTRY OF ENVIRONMENT & PHYSICAL DEVELOPMENT

HICHER COUNCIL FOR ENVIRONMENT &NATURAL RESOURCES

INFORMATION FOR THE PREPARATION OF THE NATIONAL ODS PHASE-OUT PLAN IN SUDAN

FINAL REPORT

KHARTOUM, AUGUST 2004

CONTENT

1- Background

1.1 General Information

The present report contains information and data required for the preparation of the national ODS phase-out plan (NPP) in Sudan. This NPP aims at phasing-out the remaining consumption of all ODSs in Sudan, particularly Annex A, Group I Substances over the period 2004-2010, to comply with the Montreal Protocol Obligation, The report has been prepared by the Higher Council for Environment & Natural Resources (HCENR) (The council that is supervising ozone issues in Sudan) with the assistance from UNIDO, using US$ 70000 that were approved at the 41th meeting of the Executive Committee of the Multilateral fund of the Implementation of the Montreal Protocol to assist in the preparation of an NPP in Sudan.
Sudan is an African country with a total area of 2.5 million square kilometres and 33.3million inhabitants. The Government of Sudan in promoting peace and building capacities towards fostering transition to sustainable livelihood and development is facing a number of serious challenges.
The status of Sudan in terms of Montreal Protocol ratification is as follows:

Vienna Convention;	accession on 29 January 1993,
Montreal Protocol;	accession on 29 January 1993,
London Amendment;	accession on 2 January 2002,
Copenhagen Amendment;	accession on 2 January 2002,
Montreal Amendment;	accession on 18 May 2004,
Beijing Amendment;	accession on 18 May 2004.

Reflecting the country's commitment to the Montreal Protocol, the ratification of both Montreal and Beijing Amendments has been already done.

Controlled substances consumed in Sudan are given in Table 1. Due to measures taken by the Federal Government of Sudan and the industry, the consumption has been gradually declining since1996. The present NPP covers Annex A, Group I substances, and Annex B Group II substances for terminal phase-out.

Table 1. Consumption of ODSs (ODP tones) in Sudan for 1993 - 2003

ODSs		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Base line	CFC net
Annex A, Group I	CFCs	320	338	635	430	306	295	295	292	266	253	216	456.8	359.2
Annex A, Group II	Halon*	3	4	0	5	2	0	0	0	0	0	0	0	-
Annex B, Group I	Fully halot'd. CFC	0	0	0	0	0	0	0	0	0	0	0	0	-
Annex B, Group II	CTC	2	2	3	2	4	2	2	2	2.2	2.2	2.2	2.2	-
Annex B, Group III	TCA	0	0	0	0	0	0	0	0	0	0	0	0	-
Annex E, Group I	MeBr	12	6	0	3	3	3	3	3	3	3	3	3	-

1.2 Basic Data on the Country Consumption of CFCs

Sudan's baseline average consumption of Annex A, Group I substances for the period from 1995 to 1997 amounted to 456.8 ODS tonnes. The country has always been in compliance with the Montreal Protocol control measures for the CFC consumption since 1999.

In 2003,the Government of Sudan reported a total consumption of 221.2 ODP tonnes of Annex A, Annex B and Annex E controlled substances distributed as shown in table 1 above.

In accordance with Decision 35/57, the Government of Sudan opted for 359.2 ODP tonnes as starting point to determine the remaining CFC consumption eligible for funding. No projects have been approved to phase-out CFC in Sudan since the adoption of the starting point consumption. Therefore, the maximum consumption eligible for funding for Sudan remains as 359.2 ODP tonnes.

Relevant data for Multilateral Fund assistant scheme are given in table 2 below.

Table 2. CFC Consumption data related to MFMP assistance for Sudan, ODP tonnes.

Baseline consumption	456.8
Starting point established by Decision 35/57	359.2
Consumption funded since the starting point	0
Remaining eligible consumption un-funded as of submission of the proposal	359.2

1.3 Assessment of Consumption Reduction Schedule

Sudan has no CFC production. All CFC consumed for manufacturing and servicing purposes are imported mainly from Western Europe. Sudan is classified as a high volume consuming country.

Under the present NPP, the Government targets to reduce the CFC consumption as scheduled in Table 3.The past CFC consumption in the country is shown in Table 1.The country is in compliance with the Montreal Protocol obligation for freeze of the CFC consumption. Table 3 indicates the country target of the CFC consumption reduction in the present NPP.

In 2003, the CFC consumption in the manufacturing sector remained only in aerosol, foam and refrigeration sectors. This relatively small consumption will be phased out through relevant programmes proposed in this NPP. The major CFC consumption still exists in the refrigeration service sector. With a series of activities proposed in NPP, the service usage of CFCs will be gradually reduced. With this arrangement, Sudan will achieve the 50% reduction target in 2005, 85% reduction in 2007 and zero consumption in 2010 in terms of the CFC consumption.

Table 3: CFC Consumption reduction schedule, in ODP tonnes:-

	2003	2004	2005	2006	2007	2008	2009	2010
Montreal Protocol Reduction Schedule	456.8	456.8	228.4	228.4	68.52	68.52	68.52	0
Total consumption, all sectors	216	216	216	130	65	45	25	0
Total reduction by on-going activities, all sectors	0	0	0	0	0	0	0	0
Total reduction by new activities, all sectors	0	0	25	86	65	20	20	25
Aerosol sector	30	30	30	0	0	0	0	0
Foam sector	6	6	6	0	0	0	0	0
Refrigeration manufacturing sector	0	0	0	0	0	0	0	0
reduction by on-going			0	0	0	0	0	0
reduction by new activity			0	0	0	0	0	0
Refrigeration service sector	180	180	180	130	65	45	25	0
reduction by on-going	0	0	0	0	0	0	0	0
reduction by new activity			25	50	65	20	20	25

CTC	2003	2004	2005	2006	2007	2008	2009	2010
Montreal Protocol Reduction Schedule	No control	No control	0.33	0.33	0.33	0.33	0.33	0
Target	1.1	1.1	0.33	0.33	0.33	0.33	0.33	0
Total reduction by on-going activities, all sectors	0	0	0	0	0	0	0	0
Total reduction by new activities, all sectors	0	0	1.87	0	0	0	0	0.33

Methyl bromide	2003	2004	2005	2006	2007	2008	2009	2010
Montreal Protocol Reduction Schedule								
Target	3	3	1.5	1.5	1.5	1.5	1.5	0
Total reduction by on-going activities, All sectors	0	0	0	0	0	0	0	0
Total reduction by new activities, all sectors	0	0	1.5	0	0	0	0	1.5

1.4 Target sectors

The sectors targeted in this report and ultimately in the NPP of Sudan are the following:

1) Manufacturing sector using CFCs for: aerosol, foam and refrigeration
2) Solvent sector using CTC
3) Refrigeration servicing sub-sector using CFCs for maintenance and service for:
    a) Domestic refrigeration
    b) Commercial and industrial refrigeration, and
    c) Mobile air-conditioners (MACs)

2- Data and Information Collection

2.1 Refrigeration Servicing Sub sector–Update Inventory of Service Workshops:

CFCs are used for maintenance and service for domestic refrigeration, commercial refrigeration, industrial refrigeration and mobile air-conditioners.

The refrigeration-servicing sub-sector remains the most significant CFC-consuming sub-sector. This sector is widely dispersed throughput the largest country in Africa. The numbers of service workshops are increasing rapidly mainly in Greater Khartoum Area and other major towns in Sudan like Wad Madani, Port Sudan Al Ubayyid and Nyala. For obtaining reliable and valid statistics of refrigeration service sub-sector in Sudan, the HCENR based its survey on the baseline data available from the previous RMP survey. Moreover a comprehensive survey was carried out for service workshops spread in the country with special emphasis on western and southern regions and information was collected from about 2600 shops in over 50 cities. Major cities covered by this survey are presented as

Annex I. The survey covered service shops for mobile air–conditioners as well as industrial equipment, particularly chillers used in industry and big installations . Distribution of service workshops and their CFC-12 consumption by regions and cities are presented in Annex II. As per the terms of reference, this survey included the following activities:

- Analysis of existing refrigeration sector
- Analysis of network for distributing refrigerants
- Study of the trends, and future demands for refrigeration technology and CFC consumption
- Estimations of the potential recycling CFCs

To have an overview of the refrigeration sector in the country, the following data were collected:

- Numbers of refrigeration units.
- Geographical distribution of these units.
- Approximate age of the equipment.
- CFC consumption.
- Inventory of service workshops, including their numbers, size specialization, number of employees and their skills levels, and companies maintaining their own refrigeration equipment.
- Inventory of importers and wholesalers of refrigerants and equipment.
- Inventory of R & R equipment already available in the country.

Based on the HCENR survey, the total number of service workshops was estimated at 2660 classified as follows:

- Domestic refrigeration 2501
- Commercial refrigeration 29
- Mobile air- conditioners (MACs) 120
- Industrial refrigeration 10

The estimated total numbers of service workshops in each region are listed in the table bellow:

Table 4: Number of Service Workshops in each region:

Main Service	Khartoum State	Central States	Western States	Eastern States	Southern States	Northern States	Total
Domestic	927	369	332	402	202	269	2501
Commercial	12	5	3	3	3	3	29
MACs	40	25	20	20	2	5	120
Industrial	4	3	-	2	10	1	10
Total	983	402	355	427	215	278	2660

All updated information on locations/addresses, name of managers, number of employees and CFC consumption pertaining to these service workshops have been stored in the database in CD-ROM .

Numbers of skilled and semiskilled service technicians are presented in the following table (Table 5).

Table 5: Number of Skilled and Semiskilled Technicians: -

Region	Number of Service Workshops	Number of Skilled Technicians	Number of Semi Skilled Technicians	Total number of workers
Khartoum state	815	896	897	1793
Central States	210	253	398	651
Western states	137	150	165	315
Eastern states	195	205	243	448
Southern states	48	20	32	52
Northern states	95	124	161	285
Total	1500	1648	1896	3544

A typical service workshop is small with staff that usually of 1 to 3 technicians, at least one of them with some sort of academic background. It generally has minimum of service equipment. The owners manage most of the service workshops.

It is estimated that domestic refrigerators repair involving re-charging of refrigerant represents about 2700 man-year. As some of the personnel do other jobs as well, it is estimated that about 3500 persons are engaged in this activity. Thus, at least 2000 technicians will require appropriate training in good practices in refrigeration.

Service workshop's experience indicates that:

- About 150 tons of CFC-12 is used in serving domestic and commercial refrigeration system.
- The majority of this is due to motor burnouts (domestic compressors last on average one year) and thus the charge is generally recoverable.
- On the average one kg CFC is used on each servicing to replace the original refrigerant charge and the balance for flushing, purging and leak testing.
- Non- ODS (mainly HFC 134a) is used domestic and small commercial equipment is entering the market, and start affect marginally on the CFC volumes needed for servicing.
- Servicing HFC-134a based units requires a higher level of skill and most technicians are not adequately prepared for handing the alternative lubricant, which is much more humidity sensitive than mineral oil.
- It is common for technicians to release the remaining charge of CFC-12 to atmosphere while servicing household and commercial refrigerators.
- The number of air-conditioning devices is increasing considerably.
- The retail price of virgin CFC-12 varies widely, repair shops paid US$ 54.4 for a 13.6 kg cylinder in Khartoum, remarkably higher than 1994.
- The price of HFC-134a is not established, but it is 2-3 times higher than CFC12 price.

- Significant price differential between CFC-12 and HFC-134a proved to be the major reason for technicians to charge the repaired units with CFC-12 without any consideration to weather the units were originally designed for that refrigerant or another.

Generally, the current maintenance practices of domestic and commercial refrigeration equipment is poor. When refilling the equipment actual refrigerant volume used is 2-3 times more than the final charge volume. More repair shops have no leak detectors. The cleaning and flushing of the system is made by the refrigerant itself. There is limited recovery and recycling activity. These often lead to the release of significant quantities of CFCs directly into the atmosphere.

Workshops in informal sector are difficult to identify since they are usually small and not registered to any organization. Local authorities were able to provide information about potential number of this informal sector.

Total number of household refrigeration units is estimated as 2 millions. 1-3 persons per workshop usually run the service operations. The operators have little technical training, but have learned their skills with practical experience. The workshops are poorly equipped. There is limited number testing devices or recovery equipment. Some industrial companies are running large workshops with staff of 10-20 persons and they service various types of refrigeration equipment. Some checks made during the conducted survey indicated that refrigerant consumption is almost one kilogram per serviced unit. This means that some two third (2/3) of refrigerant is lost in servicing operation representing about one third (1/3) of the total annual CFC-12 consumption.

The conducted survey revealed the following:

1. Knowledge, Skills& Training:

There are reasonable skills in the country in refrigeration sector. Skilled technicians about 50% of the total workers, having technical education in specialized industries and high technical schools in the field of cooling engineering and refrigeration technology. The other operators gained training in vocational training and youth training centres. They have the basic technical knowledge beside practical and operational skills in practicing the job.

2. The Major Activities:

The workshop provide maintenance services for:

- Domestic refrigerators.
- Deep freezers.
- Commercial and display cabinets.
- Industrial refrigeration.
- Mobile A.Cs.

3.The Services Include:

- Refrigerant recharging.
- Recovery spare parts.
- Body repair.

- General Maintenance.

4. Equipment:

The majority of the workshops use very limited equipment and hand tools such as:

- Clamp meter.
- Volt & Ohm meters (AVO meter).
- Gauges
- Vacuum pump.
- Welding equipment.

5. Service Capacity:

The service capacities of the workshops increase during the summer time to about 45%. The average activities: 75% Refrigerators (different), 20% Air-conditions, 5% Vehicles & Other. The average of the serviced units a the workshop per month is about 15 units.

6. New NON-CFC Refrigerants:

Most of the technicians and operators are quite well aware of the forthcoming restrictions and the new still not adequate CFC free refrigerant, but the technical information about correct servicing is yet not available. By now a great number of commercial refrigerators and new vehicles using the new refrigeration are due for servicing. The new refrigerant "R134a" is available in market but with very high prices compared to CFC-12.

7. Small-scale Industry Organization:

All small-scale industries and craftsmen are members in the chamber of small-scale industries and craftsmen's. There is special branch for refrigeration sector. The members are expecting assistance to develop their skills and knowledge in the new refrigeration technology to comply with forthcoming restrictions.

8. Potential for Practices:

A significant amount of CFC emissions could be avoided through the application of good practices during design, installation, operation, serving and decommissioning of refrigeration and air-conditioning equipment. Good practices include activities such as preventive maintenance and inspection; record keeping, appropriate training, recovery & recycling as well as the safe handling of refrigerants. Good practices are easy to follow methods to achieve an early reduction of the CFC consumption in the refrigeration sector.

2.2 Technical Institutions and/or Training Centres:

Technical institutions and training centre relevant to refrigeration techniques are distributed all over the country. Data were collected in all educational and training institutions in Sudan in order to assess their current curriculum and identify those with the capability to provide technical training to refrigeration technicians or in order to cooperate with their facilities in the training of trainers and custom officers. The survey was conducted in Technical Colleges, Vocational s

Secondary Schools and Training Centres, both public and private looking for those that include courses in refrigeration and air conditioning in their syllabus. As shown 1n the table below, a total of 58 institutes with capability to participate in the training activities were identified on the bases of the courses of refrigeration which they offers, laboratory facilities, teaching staff and geographical location. All these 58 institutes are currently teaching either refrigeration or air conditioning or both courses, and all of them are interested in participating in the National Training Programme for the NPP. However, at present there is a lack of sufficient equipment at those institutes limiting their capability to provide proper basic practical training. Only ten (10) institutes out of the listed in Table 58 have been considered during the implementation of RMP by UNIDO. List of these mentioned 10 institutes is given in table 7.

Table 6: Summary of Technical Institutions and Training Centres of Sudan:-

State	Location	Level			Total Number
		Technical Colleges	Vocational Secondary School	Training Centres	
Khartoum	Khartoum	2	2	7	11
	Omdurman	3	3	4	7
	Khartoum-North	-	-	-	3
Central State	Wad Madani	1	1	2	4
	Sennar	-	-	1	1
	Kosti	-	-	1	1
Western State	Kordofan	1	1	3	5
	Darfour	1	1	2	4
Eastern State	Port Sudan	1	2	1	4
	Kassala	-	1	1	2
	Gadarif	1	1	1	3
Southern State	Juba	1	1	-	2
	Wau	1	1	-	2
	Malakal	-	1	-	1
	Maridi	-	1	-	1
	Rumbeik	-		-	
	Toreit	-		-	
Northern State	Atbara	1	1	2	4
	Dongla	-	1		1
	Karima	-			2
	Barber	1	1		
Total		13	19	25	58

Table 7 : Technical Institution and Training Centres that received assistance:-

Name of Institution	Region	City
1.University of Sudan of Science & Technology	Khartoum State	Khartoum
2. Khartoum-2 Vocational Training Centre	Khartoum State	Khartoum
3. E 3.Ekhbari Training Centre	Khartoum State	Burry
4. Khartoum North Vocational Secondary School Centre	Khartoum State	Khartoum North
5.Youth palace Training Centre	Khartoum State	Omderman
6. Port Sudan Secondary School Training Centre	Red Sea State (East)	Port Sudan
7.Gadarif Secondary School Training Centre	Qadarif State (East)	Qadarif
8.WadMadani Secondary School Training Centre	Gazeera State (Centre)	Wad Madani
9. Alobied Secondary School Training Centre	North Kordofan State (West)	Al Ubayyid
10.Atbara Secondary School Training Centre	River Nile State (North)	Atbara

These 10 training centres are actively cooperating with local service and manufacturing enterprises to supply them with trained service technicians. The current curriculum in these training centres contain both theoretical and practical components as follows:

- Background information on the Montreal Protocol
- Explanation of the effects of Ozone Layer Depletion
- The results of Ozone depletion.
- Presentation on appropriate regulations.
- The need for Recovery & Recycling refrigerates.
- Presentation of Recovery & Recycling technologies and methodologies in different refrigeration and A/C systems.

The practical component is almost taught out-side the training centres through hands-on work expense at trade companies. As the service practice and equipment in the field is not always state of art it is considered to be of high priority to make it possible for these centres to conduct the practical training as well.

2.3 Industrial Statistics of existing CFC Equipment:

As shown in table below, in Sudan there are five main manufacturers of refrigeration and air-conditioning equipment.

Table 8: Producers of refrigeration equipment in Sudan:-

Company	Location	Year of Establishment	No. of Employees	Products
Cold air Co. Ltd.	Khartoum North	1948	130	-Domestic refrigerators and freezers -Storerooms for food, commercial refrigerators (water cooler, display cabinets ...) -Chillers for plastic and soap industries.
Metal Sheet Co. Ltd.	Khartoum North	1960	150	- Domestic refrigerators - Water cooler & display cabinets - Chillers
Modern Refrigerators factory	Omdurman	1982	8 0	- Domestic refrigerators -Commercial and industrial refrigerators.
El Raie	Khartoum	1993	20	Domestic refrigerators and freezers.
Nile Star Co. Ltd.	Khartoum North	1998	15	Domestic refrigerators and freezers.

Based on the responses to the questionnaires as well as inputs from site visits, the obtained information indicated that in addition to domestic refrigerators these companies produce different refrigeration equipment, such as transportation refrigeration units, cold storage rooms, display cabinets, commercially used freezers, water coolers and chillers. The annual production of domestic refrigerators is currently around 50000units. The following table shows production of domestic refrigerators in 2003.

Table 9: Sudan Production of Domestic Refrigerators in 2003:-

Company	Production Unit
Cold air	25839
Modern Refrigerators	15773
El Raie	8625
Nile Star	735
Total	50972

Also there are imports of very fluctuating quantities and various sources. Import of domestic refrigerators in 2003 was estimated as 34000 units.

The estimation regarding existing CFC-based equipment in operation in 2003 throughout the country are:

2000000	domestic refrigerators and freezers
200000	commercial refrigeration units
50000	industrial refrigeration units
3000	Transport refrigeration units, and
50000	Chillers

It is noted that Sudan has banned the import of ODS refrigeration system in November 2001, this means that current refrigeration equipment coming into local market only charged with R-134a refrigerant. But all equipments in use imported before November 2001 came with CFCs. With an average time span of 20 years for domestic refrigerators and 10 year commercial and transport ones. It is expected that all CFC-based domestic refrigerators will be out of use by 2023 while commercial and transport ones by 2013. Therefore, after 2010 there will be a considerable number of CFC based refrigeration equipment that will require servicing.

Consumption of CFC12 in Domestic Refrigeration:

Based on the total number of domestic refrigerators and freezers of 2000000units, and assuming that 20 percent of these units require service annually the number which goes for service is then 400000 units. If each unit consumes about 300 grams of CFC-12 in the process of recharging, then the total CFC-12 consumption in domestic refrigeration servicing sub sector become 120 tonnes ODP.

Consumption of CFC-12 in Commercial and transport refrigeration:

This sub sector includes the use of CFCs as refrigerant in display cabinets, food storage equipment, refrigerates transports (containers) and commercial cold storage facilities. Commercial refrigeration is crucial to Sudan since it is primarily used for food storage and transport.

Based on the total number of 200000 food stores, chest freezers, display cabinets, cold rooms and other commercial refrigeration units, and assuming that 30 percent of the total to be serviced annually, then 60000 units will require service each requiring 500 grams of CFC-12 in the process of recharging, the total amount of CFC-12 consumed annually in the commercial sub sector is 30 tonnes CFCs.

Consumption of CFC in chillers and Industrial Refrigeration sub-sector:

Chillers are large centralized cooling services that are usually used for cooling in industrial process and can also be used for air conditioning in larger buildings. The carried out survey carried out estimated that about 50000 chillers with CFCs are still in use in Sudan, with overall annual consumption of about 5 ODP tonnes.

They are mainly used in different industries, hospitals, hotels, commerce and others. These units are between 15 and 20 years old and most of them are expected to still be working beyond 2010. Due to poor maintenance these chillers could be a source of leaks and may need special attention in this NPP. There are also about 1000 industrial refrigeration equipment 200 out of them require service with 2 ODP tonnes CFC-11. The total CFC-12 consumption in this sub sector 7 tonnes ODP.

Consumption of CFC-12 in Mobile Air-Conditioning (MAC) sub-sector:

Based on data provided by the transportation authorities in Sudan, there were 593000 vehicles in 2003. The breakdown is 200000 passenger cars, 290000 trucks and 43000 buses. It is estimated that 50000 passenger cars, 5000 trucks and 5000 buses are equipped with air conditioning. Assuming that the frequency of services is 0.80 for passenger cars, and 0.30 for trucks as well as for buses and knowing that each passenger car requires 750 grams, each truck requires 1000 grams and each bus consumes 3000 grams of CFC-12 in the process of recharging. Therefore, the total consumption for passenger cars will be 52 ODP tonnes, for trucks will be 3 ODP tonnes and the grand total of this sub-sector will be 60 ODP tonnes.

CFC Consumption in Service Sector:

The overall consumption of ODS by refrigeration servicing sub sectors in Sudan for the year 2003 is shown in the table below. The grand total of CFC-12 consumption is currently estimated to be 217ODP tonnes as detailed in table 10. Service shops statistics are shown in Annex IV.

Table 10: Summary of ODS consumption by Refrigeration Servicing Sub-sectors in Sudan in 2003

Servicing Sub-Sector	CFC consumption ODP tonnes
Domestic	120
Commercial	30
Chillers and Industrial	7
Mobile A. C.	60
Total	217

2.4 Information of CFC using manufacturing sector:

(1) Foam Sector:

The consumption of CFCs in the foam sector has decreased from 16 tonnes of CFC-11 in1993 to 6 tonnes consumption in 2003. In Sudan CFCs are still used as blowing agent to manufacture a range of foam product. The following types of foams are produced: rigid polyurethane (PU) foam for refrigeration, rigid foam for sandwich panels, flexible slab stocks for furniture and bedding flexible moulded PU foam for automotive industry, extruded polyurethane sheets (EPS) for packing. Work associated with phasing-out 16 tonnes CFC-11in the production of polyurethane flexible block foam at Patra Foam Company in Khartoum was completed in November 1988. TheCFC-11 was replaced by methyl chloride in this project.

Recently there are several companies producing flexible and rigid polyurethane foams and extruded polyurethane. Major foam manufacturers are listed in table below:

Table 11 : Foam Manufacturers in Sudan:

Companies	Location	Product
MAMAS	Khartoum North	Rigid foam
Polystyrene Dishes	Khartoum North	Flexible foam
Universal Company	Khartoum North	Flexible foam

One remaining company of the foam sector is manufacturing flexible foam. Information of this factory is presented below:

Name of the company: Industrial Foam Factory
Owner: International Company for Investment &Agriculture
Location: Khartoum North
Year of establishment: 1993
Number of employees: 30
Production facility : continuous line for slab stock
Production in 2003: 35 cubic meter
CFC-11 consumption in 2003: 97 MT

(2) Aerosol Sector:-

In Sudan CFC consumption decreased in 2003 by 326.6 ODP tonnes compared to the 1993 consumption. This reduction resulted from implementation of two investment projects and ODS legislation, which are currently in place.

The first aerosol project was approved by the Executive committee in November 1995 to phase-out 281.5 ODP tonnes at the Sudanese Cosmetics & House hold Products company and was completed in May 1997. The second aerosol sector project was approved in July 1999 to phase-out 45.1ODP tonnes at Taj Cosmetics company. This project was completed in July 2001. Summery of the investment components for this two project is as follows:

Table 12 Summery of the investment components:

Company	CFC Consumption (ODP tonnes)	Cost US$	Cost Effectiveness US$ / Kg
Sudanese Cosmetics & Company	281.5	497.613	1.76
Taj Cosmetics Company	45.1	131.718	2.92

A recent survey was carried out in July – August 2004 to identify remaining manufacturers in the aerosol sector, as a result only one producer of deodorants, insecticides and hairspray was identified with CFC propellants. Company background and products are given below:

Name of the company : COSOMTICS INDUSTIES LABORATORY.
No. Of employees : 11
Year of establishment : 1968
Type of machines : DALLENBACH Nr 8 3 TA 385A.
Date of installation : 1976.
PRODUCTS:
1. **Deodorants** : A- 8X4 150 ML.
B- LIMAR 100ML

2. **Hairspray** : WELLAFLEX 400 ML
3. **Insecticides** : A- SHELLTOX. 275 ML
B- MOBID

PRODUCTION (CFCs CONSUMPTION) (CFC12/114, CFC -11)

	CANS	QTY/TONS
1. 2000	340.000	41
2. 2001	290.000	37
3. 2002	230.000	30
4. 2003	255.000	35

AEROSOLS PRODUCTION FACILITIES:-

A-SEMI-AUTOMATIC AEROSOLS PRODUCTION UNIT: 2 UNITS.
B-WATER BATH : 1 UNIT.
C- COMPRESSOR 200/ LBS/SQ IN (TYPE KT 6A5) : 2 UNITS.

(3) Refrigeration manufacturing sector:-

There are estimated about 2 million household refrigerators and freezers in the country. About 60% of the demand is satisfied by the domestic production and the rest by imports. Three manufacturers of domestic appliances, namely Coldair, Modern Refrigeration Factory and Sheet Metal, have already been assisted by the Multilateral Fund for their conversion to non-CFC refrigerant in domestic refrigeration, though the project at one enterprise, Sheet Metal Industries (project impact, 0.12 ODP tones) was cancelled. However, the commercial units in two enterprises, Coldair and Modern Refrigeration were not assisted.

There are several manufacturers of refrigeration equipment, such as transportation refrigeration units, cold storage rooms, and commercially used freezers. Some of them have already converted to non-CFC refrigeration technology at their own expenses.

Baseline Data of eligible manufactures in the refrigeration sector is presented in the following table.

Table 13: Enterprise baseline data:-

Company name	Established year	Number of Employee	Remarks
Coldair	1948	130	Domestic refrigeration part project was assisted by MFMP
Modern refrigeration Factory	1982	80	Domestic refrigeration part project was assisted by MFMP
El Rae	1993	20	Not assisted

Coldair: Coldair is the largest manufacturer of refrigeration equipment in Sudan. The enterprise uses glass fibbers for insulation and there is no consumption of CFC11. Through the previous MFMP domestic refrigeration project, the domestic

appliances manufacturing line was converted to HFC-134a technology by having a hand-held leak detector, vacuum pump systems and a charging unit. In addition to eight models of domestic refrigerators, the enterprise also manufactures display cabinets and water coolers in a separate factory. Furthermore, the company assembles cold storages for vegetables and fruits and chillers for the plastic and soap industry, on a contractual basis. The enterprise has already made investments for the conversion of the production of commercial units, and they have been phasing out the use of CFC-12 in their manufacturing since 1999. The company requests reimbursement of their expenditures.

Modern Refrigeration Factory: The company was assisted by the MP project to convert their production technology to HFC-134a for domestic appliances 10 of models at 3,000 units per year. Through this project the refrigeration equipment, including a charging unit, a vacuum pump system and an HFC-134a leak detector were provided. However, the production of commercial equipment was not included in the previous domestic refrigeration project. The foam operation is still done with CFC-11 on a low-pressure foaming machine. In 2002, the enterprise purchased a high-pressure machine to be used with R-141b foam blowing for producing domestic units. The enterprise is keen on phasing out CFC-11 and CFC-12 in their production lines and seeks the assistance of the Fund.

El Rae: The company manufactures domestic refrigerators, some of which are made from old units by changing the refrigeration cycle with keeping the use of cabinet. There is no consumption of CFC-11 for foaming. The company also assembles cold storage and chillers. They are keen on converting to HFC-134a refrigeration technology.

Table 14: Annual production of appliances at three enterprises (units):-

Enterprise	Cold air (Only commercial units)			Modern Refrigeration (only commercial units)	El Rae	
Year	Water cooler	Display Cabinet	Cold Room	Freezer	Domestic Refrigerator	Chillers and Cold room
1999	474	315	9	1,000	2,650	-
2000	522	354	18	4,500	2,100	-
2001	609	73	10	5,000	5,141	20
2002	182	420	12	7,000	6825	2
2003	712	465	14	16,000	8625	4

Table15 shows product models manufactured by three enterprises.

Table15. Break down of production at three enterprises in 2001:-

Coldair, only commercial refrigeration products

Model	Type	Comp. Size, kw	Production	R-134a Charge, Kg/unit	Foam, Kg/unit	CFC-11 Kg/unit	R-134a Total use, Kg/model	CFC-11 Total use, Kg/model
15 Gallon	Water Cooler	1.19	35	2.94	0	0	93	0
20 Gallon		1.38	57	2.56	0	0	131	0
25 Gallon		1.65	147	2.39	0	0	243	0
12FA	Display Cabinet	0.432	73	0.86	0	0	57	0
							Total, 523 Equivalent to CFC-12, 582	
Model depend On user's Request with Capacity of 15 - 40 kW	Cold Room	15 - 40 KW (Open Type)	10	50 -100	0	0	675 Equivalent to CFC-12, 750	0
Total							1,332	0

Modern Refrigeration Factory, only commercial units						
Model	Type	Production	CFC-12 Charge, g/unit	Foam, Kg/unit	CFC-12 Total use, Kg/model	CFC-11 Total use, Kg/model
GT 28	Freezer	500	195	7.27	98	545
GT 34		3,000	165	8.3	495	3,735
GT 44		1,500	140	10.0	210	2,255
Total						6,535

El Rae							
Model	Type	Production	CFC-12 Charge, g/unit	Foam, Kg/unit	CFC-11 g/unit	CFC-12 Total use, Kg/model	CFC-11 Total use, Kg/model
6 - 14 CF	Refrigerator	2,037	170 - 340	-	-	524 Not eligible	-
6- 14 CF	Chest freezer	604	200 - 400	-	-	154 Not eligible	-
Reassudanbly	Refrigerator	2,500	200 - 400	-	-	750 Not eligible	-
On customer Requirement	Chillers and Cold room	20	5 - 10 kg	-	-	175	-
Total						175	0

CFC- Usage

All enterprises in this project proposal use a certain amount of CFC-12 for servicing and maintaining refrigeration equipment. The service consumption is not eligible and not taken into consideration in the present project. Only the design consumption of CFCs given in Table 5 above is considered.

Product Supply

The three enterprises supply their products to the domestic market.

Baseline Production Equipment

Factories in the three enterprises were locally designed. Compressors are imported. Low-pressure foaming machines are used in the Modern Refrigeration Factory. The relevant equipment available at three enterprises is listed in Table 16 below.

Table 16: Baseline production equipment at three enterprises:-

Equipment	Designation/manufacture	Year of installation
Coldair		
Refrigerant charging station	- 2 locally made - Galileo (by the previous MFMP project)	1994 1999
Vacuum pump	10 for CFC-12 5 for HFC-134a; Galileo (x1) and Retrofitted by a previous project	1996 1999
Leak detector	- Halogen leak detector for R-12 - Leybold HLD 4000 (x1) by company - Hand held detector (x3) by the previous project	1996 1999
Modern refrigeration factory		
Foaming machine	- Low pressure injection machine, Cannon 35 - High pressure injection machine, Cannon A System 40 - Pre-mixing tank, storage tank	1981 2002
Foaming molds	Locally-made molds and plugs (X20)	-
Refrigerant charging station	- Refco (x2) for CFC-12 - Galileo charging unit for R-134a (x1)	1990 1999
Vacuum pump	A"Gramkow (x2) Refco (x3) Vac sound (x1) – by a previous project	1996 1990 1996
Leak detector	Halogen leak detector (x3)	-
El Rae		
Refrigerant charging station	- Manual units, locally made (x6)	
Vacuum pump	- Robinair (x1), Refco (x2)	
Leak detector	- Halogen leak detector (x4)	1992

2.5 Solvent Sector:-

Regulated ozone depleting solvents application in Sudan are not significant. CTC is used in Sudan mainly for the following purposes:

- Laboratory purposes by numerous small consumers.
- Textile cleaning and
- As industrial solvent.

The use of methyl chloroform as a solvent was also identified by the industrial & consultancy centre, but in negligible quantity. The table below summarize the CTC main consumers in Sudan.

Table 17: CTC Consumption in 2003:-

Institution	CTC Consumption (MT)
Universities	0.3
Khartoum Chemical Laboratory & Research Centres	0.3
Tev Industry	0.4

2.6 Other factors relevant to sustainable recovery and recycling scheme: -

2.6.1 CFCs availability and price information:

As there is no production of CFCs in Sudan, the entire demand is satisfied by imports.

The prices of virgin refrigerants vary widely from region to region within the country. Current indicative prices for CFCs and other refrigerants are shown in the table below:

Table 18: Price information of refrigerants in Khartoum, Central States and Eastern:

Refrigerant	Price Cylinder 13.6 (kg)	Unit price US$/kg
CFC-11	48.90	5.17
CFC-12	54.40	5.75
HCFC-22	50.57	4.80
R-502	220.30	21.07
HFC-134a	111.11	13.41
R-404A	268.20	46.74
R-407C	268.20	46.74
R-410A	-	-
R-507	-	-

Price information of refrigerants in Western States:-

Refrigerant	Price (kg) Cylinder 13.6 kg	Unit price US$/kg
CFC-12	128.80	8
HCFC-22	145.20	9.5
HFC-134a	264	15

Price information of refrigerants in Southern States:

Refrigerant	Price Cylinder 13.6 (kg)	Unit price US$/kg
CFC-12	63.36	9.6
HCFC-22	171.11	11.5
HFC-134a	411.26	25

2.6.2 Sources and delivery routes of ODS and non-ODS refrigerants:-

The imports of ODS and non-ODS refrigerants are very scattered in Sudan. There are more than 20 major importers and local distributors who are supplying the market in Sudan with ODSs and other refrigerants.

The major refrigeration, aerosol and foam manufacturers directly import the ODSs that they need in their production. Several other servicing agencies in the refrigeration and air conditioning sector import directly for their own needs and for those of minor operators. The imports vary from small amount to tens of kilos up to tens of tons . List of major importers and wholesalers of refrigerants and refrigeration equipment is shown in Annex V .

There is an import duty for CFCs, which adds approximately 60% to the importing price. This duty is of pure fiscal nature.

2.6.3 Certificates and licensing systems for service workshops and technicians:-

Eighteen core experts attended the training course for good practices in refrigeration given by the UNIDO expert; additionally a national training programme on good practices in refrigeration was organized.

In total 406 service technicians participated in this programme. All participants had professional background in the refrigeration service and were selected from the greater Khartoum Area (228 participants), Portsudan (50 participants), Wadi Madani (34 participants), Kassala (25 participant), Al Qadarif (18 participants), Atbara (23 participants) and Al Ubayyid (28 participants).

The training programme consisted of 21 training courses lasting 2 days each. 12 courses were organized in Greater Khartoum Area, 2 in Port- Sudan, 2 in Wadi Madani and 2 in Al Ubayyid, one course in Al Qadarif, one in Atbara and one in Kassala.

The average number of participants in each course was 20. In these courses participants were trained on good practices in refrigeration and received introductory training on specific features of the recovery & recycling equipment. At the beginning of each training session all participants passed a pre-training test. As a matter of fact the principles of good servicing practices, which have been taught through these training courses will be applicable to all refrigeration and air-conditioning systems and applications. The lead instructor for the training programme was from Sudan University of Science & Technology.

Training sessions were arranged using suitable venues i.e. University of Sudan of Science and technology, vocational training centres and trade schools already delivering programmes leading to refrigeration and air-conditioning qualifications and have adequate equipment tools and necessary training components to provide safe practical work areas.

UNEP training manuals (translated into Arabic by national experts) on good practices in refrigeration was used as resource document. Other training materials were also used. The training programme consisted of theoretical and hands-on-sessions. During the hands-on-sessions, the participants practiced the recovery and recycling of refrigeration and did a retro-filling exercise.

Training activities were initiated in the year 2000. The train-the–trainer programme for good practices in refrigeration was successfully implemented in November 2000. Additional special refreshment courses were organized to retrain centre operators all over the country prior to the distribution of the R & R equipment. Representatives from Cold air, Modern refrigeration and A Raee Manufacturing Companies also attended these courses.

These refreshment courses were held in Khartoum during 2-10 April 2003. The aim of the courses was to introduce and explain the recovery programme and the recycling infrastructure. In general the courses included the following items:

- Background information on the Montreal Protocol.
- Explanation of the effects of Ozone Layer Depletion.
- The results of Ozone depletion.
- Presentation on appropriate regulations.
- The need for Recovery and Recycling refrigerant.
- Presentation of Recovery and Recycling technologies and methodologies in different refrigeration and A/C systems.

A total of 60 trainers and managers participated in these courses.

After the successful completion of the training programme all participants passed a post-assessment test and received certificate. The government is prepared to introduce a licensing system for refrigeration and air-conditioning servicing operators in order to enforce better working practices. Improvements of certification and licensing systems are to be taken into account in this NPP.

2.6.4 **Financial/Commercial incanting for recovery and recycling:**

The development and application of business criteria of refrigerant & recycling centres is considered in this NPP, so that the national recovery & recycling scheme would be commercially viable.

The developments of such business criteria with certainly encourage service workshops and technicians to recover refrigerants. It may contain the guideline of the recycling centre business elements, including the guideline of receiving refrigerants recovered in the morleet, and price sitting of recycled refrigerants.

3. Existing Policies and Regulations:

3.1 Policy Framework:

The policies of the government of Sudan traditionally rely on broad consultation with different interest groups of the society. Command and control policies in areas relevant to the implementation of the Protocol are not generally preferred. However in the current constitutional and administrative situations the government has issued rules and regulations. Taxation especially in the form excise and import duties is mainly used for revenue collection and has not at all been used as a prevention and control measure.

All key players regarding ODS consumption are in the private ownership in Sudan and no change is expected in this respect.

For the Sudanese society and economy food processing and preservation and the textile industry are extremely important. Thus the possible and related measures regarding terminal of ODS are assessed against this background.

The government of Sudan ratified the Montreal Protocol on January 29,1993 and started to operate as a party since April 29,1993.

The Higher Council for Environment and National Resources has established a special broad based National Committee for the implementation of the Montreal Protocol, including NGOs and the private sector beside relevant representatives of the public sector. It is clearly understood that the phase-out of ODS is a necessity and obligation and Sudan has to follow the international development. The government of Sudan believe that the quick phase-out will best serve the interests of the society economy, industries and business thus preventing the country suffering from outdated equipment and operations in the future.

3.2 Existing Legislations:

Sudan will rely on the existing legal framework (with the necessary amendment and modification in the by-laws). Moreover it is prepared to take all necessary administrative steps to enhance the phase-out measures in a timely manner according to the provisions of the Montreal Protocol and its amendments.

3.2.1 The Management and Organization of Ozone Sphere Penetrating Substances Regulation 2001 (by-law issued under Environmental Protection Act 2001).

The highlights of the by-law are:

I – Requirement of permission from the committee, formed under the by-law, for any imports-or exports containing chemical materials mentioned in the schedules of the by-law (ozone depleting substances including CFCs, Halons, Methyl bromide, HCFCS, Equipment containing ODS etc).

II – Ban on of import of Refrigerators and air conditioners containing or using the materials mentioned in the first schedule (CFCs).

III – As from Jan. 2001 there was a ban on vehicles to contain refrigerators and air conditioning units containing ODS mentioned in the first schedules (CFCs).
IV – Ban on import of aerosols containing (ODS) expected in medical sprayers used for athma.
V - Label requirement.
VI – Requirement of permission from the committee for any new establishment or activity in which the substances under control are used.
VII- Provision of information is mandatory.
VIII- Avoidance of leak of ODS in the air during maintenance and reuse is staled.
IX – Requirement of permission from the committee for any business and repairs operations.
X - Requirement of the availability of leak-detection equipment for ODS in all companies and industries carrying out business of repair.
XI – Ban on using halons material when substitutes like Co_2, water and dry powder are available.
XII – Ban on use of halons for training purposes.
XIII – Ban on fire combating systems using halons as from Jan. 2007.
XIV – Ban on use of control materials (ODS) for the manufacture of foaming materials.
XV – Punishment is indicated in form of a fine and confiscations.
♦**Required amendments:** Revision of the existing by-law on the Management and Organization of Ozone Sphere Penetrating Substances 2001 is required. The aim of the revision is to support terminal ODS phase-out plan. The revision may include but not limited to:
-Licensing
-Introduction of system of quotas.
- Fixing of dates of terminal phase-out of certain ODS.
-Regulation of recycled CFCs.
-Regulation of importation of recycled CFCs.
-Introduction of a system for reclamation.

3.2.2 Ministerial Decree 2001 for the measures for management and control of ozone depleting substances:

This decree further indicates the mechanisms for the enforcement of the by-law for the Management and Organization of Ozone Penetrating Substances 2001.

3.2.3 Other by-laws which are indirectly relevant for the control of ODS are:

I – Environment Protection Act 2001
II – Pesticides and Pest Control Product Act 1994 (methyl bromide)
III – Pharmacy and Poisons Act (medical aerosols)

IV – Customs Act (control of importation)
V – National Strategy on Environmental Protection (framework)
VI – Meteorology and Standards Act (control).

Annex (1)

Major cities covered by Survey:

I. Khartoum state (3):

1. Khartoum
2. Omdurman
3. Khartoum North

II. Central states (13):

1. Elbagair
2. Hasahisa
3. Wed Madani
4. Managel
5. Rowfaa
6. Sennar
7. Senga
8. Dmazeen
9. Doeum
10. Robac
11. Kosti
12. Tendalty
13. Maranjan

III.Western States (8):

1. Elobied
2. Elfasheer
3. Bara
4. Kadogli
5. Zalingi
6. Nyala
7. Genina
8. Nuhood

IV. Eastern States (8):

1. Al Qadarif
2.New Halfa
3.Kassala
4.Tooker
5.Swakin
6.Portsudan 7. Senkat 8. Aroma

V. Southern States (13):

1.Juba
2.Wao
3.Malakal
4.Bantio
5.Toreat
6. Toagli
7. Warab
8.Kaboita
9.Aweel
10.Yai
11. Mangala
12.Rank 13 Bor

VI.Northern States (9):

1.Shandi
2.Damer
3.Atdbora
4.Borber
5.Abuhamed
6.Murawi
7. Karima
8. Dongola 9.Wadi Halfa

Annex II

Distribution of service workshops and CFC-12 consumption by Regions and Cities:

1 – Khartoum State:

City	Domestic		Commercial		Industrial		MACs		Total	
	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption
Khartoum	324	15.58	6	5.0	1	0.71	14	13.44	345	34.73
Omdurman	418	20.02	4	3.7	-	-	18	17.28	440	41.00
Khartoum North	185	8.90	2	1.3	3	2.16	8	7.68	198	20.04
Total	927	44.50	12	10	4	2.87	40	38.40	983	95.77

2 – Central States:

City	Domestic		Commercial		Industrial		MACs		Total	
	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption
El bagair	10	0.48	-	-	2	1.43	-	-	12	1.91
Hasahisa	28	1.37	1	0.83	-	-	2	0.50	31	2.67
Wed Medani	79	3.79	2	164	1	0.72	15	3.72	97	9.87
Managel	32	1.35	-	-	-	-	-	-	32	1.53
Rowfaa	10	0.48	-	-	-	-	-	-	10	0.48
Maranjan	15	0.72	-	-	-	-	-	-	15	0.72
Sennar	22	1.02	1	0.8	-	-	3	0.74	26	2.56
Senja	18	0.86	-	-	-	-	-	-	18	0.86
Damazeen	30	1.43	-	-	-	-	-	-	30	1.43
Doeum	28	1.34	-	-	-	-	-	-	28	1.34
Raback	32	1.53	-	-	-	-	2	0.50	34	2.03
Kosti	40	1.91	1	0.8	-	-	3	0.74	44	3.45
Tendalty	25	1.20	-	-	-	-	-	-	25	1.20
Total	369	17.70	5	4	3	2.15	25	6.2	402	30.05

3 – Western States:

City	Domestic		Commercial		Industrial		MACs		Total	
	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption
El obied	53	2.54	1	1.33	-	-	5	1.75	59	5.62
Elfasher	43	2.06	-	-	-	-	5	1.75	48	3.81
Bara	40	1.92	-	-	-	-	-	-	40	1.92
Kadogli	34	1.66	-	-	-	-	-	-	34	1.66
Zalingi	36	1.72	-	-	-	-	-	-	36	1.72
Nyala	48	2.30	2	2.67	-	-	8	2.80	56	7.77
Genina	40	1.92	-		-	-	1	0.35	41	2.27
Nuhood	38	1.82	-		-	-	1	0.35	39	2.17
Total	332	15.94	3	4	-	-	20	7.00	355	26.94

4 – Eastern States

City	Domestic		Commercial		Industrial		MACs		Total	
	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption
Gadarif	55	2.64	-	-	-	-	2	0.48	57	3.12
New Halfa	53	2.54	-	-	-	-	-	-	53	2.54
Kassala	62	2.98	1	1.33	-	-	3	0.72	66	5.03
Toaker	35	1.68	-	-	-	-	-	-	35	1.68
Swakin	52	2.50	-	-	-	-	-	-	52	2.50
Senkat	42	2.16	-		-	-	-	-	45	2.16
Aroma	30	1.44	-		-	-	-	-	30	1.44
Port Sudan	70	3.36	2	2.67	2	1.93	15	3.60	89	11.56
Total	402	19.30	3	4.00	2	1.93	20	4.80	427	30.03

5 – Southern States:

City	Domestic		Commercial		Industrial		MACs		Total	
	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption
Juba	78	1.34	2	2.67	-	-	4	0.96	34	4.96
Waw	27	1.28	-	-	-	-	3	0.72	30	2.00
Malakal	24	1.17	1	1.33	-	-	3	3.72	28	3.22
Bontio	18	0.90	-	-	-	-	-	-	18	0.90
Toreat	14	0.65	-	-	-	-	-	-	14	0.65
Jongli	18	0.84	-	-	-	-	-	-	18	0.84
Warab	9	0.43	-	-	-	-	-	-	9	0.43
Kaboita	8	0.36	-	-	-	-	-	-	8	0.36
Aweel	14	0.70	-	-	-	-	-	-	14	0.70
Yai	15	0.72	-	-	-	-	-	-	15	0.72
Mangala	17	0.81	-	-	-	-	-	-	17	0.81
Rank	10	0.48	-	-	-	-	-		10	0.47
Total	202		3	4	-	-	10	2.4	215	16.06

6. Northern States

City	Domestic		Commercial		Industrial		MACs		Total	
	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption	No. of Shop	CFC-12 consumption
Shandi	42	2.01	-	-	-	-	1	0.24	43	2.25
Damer	28	1.34	-	-	-	-	-	-	28	1.34
Atbara	45	2.17	1	1.33	-	-	3	0.72	49	4.22
Barber	38	1.84	-	-	-	-	-	-	38	1.84
Abuhamed	23	1.10	-	-	-	-	-	-	23	1.10
Marawi	26	1.24	-	-	-	-	-	-	26	1.24
Karima	22	1.05	1	1.33	1	0.1	1	0.24	25	2.72
Dongula	27	1.29	-	-	-	-	-	-	27	1.29
Halfa	18	0.86	1	1.34	-	-	-	-	19	2.20
Total	269	12.90	3	4	1	0.1	5	1.20	278	18.20

Annex III Service shops Statistics

Region	Khartoum state	Central States	Western States	Eastern States	Southern States	Northern States	Total
Number of States	1	4	6	3	10	2	26
Number of major cities	3	13	8	8	13	9	54
Population	5161	7160	10190	3896	5328	1565	33300
(%)	15.5	21.5	30.6	11.7	16	4.7	100
Domestic Refrigeration and Freezers:							
- Number of service shops	927	369	332	402	202	269	2501
- CFCconsumption for service (ODP tonnes)	44.5	17.7	15.94	19.3	9.66	12.9	120
Commercial Refrigeration							
- Number of service shops	12	5	3	3	3	3	29
CFC consumption for service (ODP tonnes)	10	4	4	4	4	4	30
Industrial Refrigeration (including chiller and cold stares)							
Number of service shops	4	3	0	2	0	1	10
CFC consumption for service (ODP tonnes)	2.87	2.15	0	1.93	0	0.1	7.05
Mobile A.C.							
Number of service shops	40	25	20	20	10	5	120
CFC consumption for service (ODP tonnes)	38.4	6.2	7	4.8	2.4	1.2	60
Total workshops	983	402	355	427	215	278	2660
Total CFC consumption (ODP tonnes)	95.77	30.05	26.94	30.03	16.06	18.2	217.05
Number of Recycling Centres in place	5	1	1	2	0	1	10
Number of workshops received equipment	124	25	25	43	0	23	240
coverage %	15.1%	10.4%	13.0%	16.2%		19.8%	14.2%

Annex IV

Major CFCs Imports and wholesalers

1. Liquid Air company	Khartoum Industrial Area
2. Atlas company	Khartoum 2 shopping center
3. Fal	Khartoum DownTown
4.Elfangary Engineering	Khartoum Down Town
5. Ezeis	Khartoum Gamhoria Street
6. Amer Engineering company	Khartoum Gamhoria Street
7. Abdelmoniem Engineering Co.	Khartoum Down Town
8. Alfaki Trading Co.	Khartoum Down Town
9. Gala watt Trading &Services	Khartoum Horia Street
10.Almahi Electrical Equipment	Khartoum Industrial Area
11. Gazeera Trading CO.	Khartoum Down Town
12. Rasheed for refrigant	Khartoum Elsagana
13. AlGadi Engineering CO.	Khartoum 3 Industrial Area
14. Alwadi for Refrigerant	Khartoum North Ind. Area
15.Nadir Modern Workshop	Khartoum 2Ind. Area
16. Home Need CO	Khartoum Down Town
17. Khalid Trading CO.	Central Shopping Area Kh.South
18. AlBagdadi Engineering CO.	Alhagyousif Street
19.Refrigrant Services Centre	Amarat Street No. 61
20.Duty free Corporation	BurryKh.fair Street
21.Decor House	Kh. Parlament Street