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FINAL NON-CONFIDENTIAL REPORT

ON

**TECHNO ECONOMIC ASSESSMENT OF THE FINANCIAL VIABILITY
OF THE COLLECTION AND SAFE DISPOSAL OF REFRIGERANT
GASES AND RELATED MATERIALS IN AFRICA**
(Project No. US/RAF/90/173)

FOR

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
VIENNA, AUSTRIA
(UNIDO CONTRACT No.91/212)**

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TABLE OF CONTENTS

<u>CHAPTER NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
1.	INTRODUCTION	1 - 2
-	BACKGROUND	1
-	STUDY OBJECTIVES	1
-	APPROACH TO THE STUDY	1
-	STRUCTURE OF THE REPORT	2
2.	EXECUTIVE SUMMARY	3 - 27
-	CFC AUDIT	3
-	DEMAND FORECAST	5
-	EQUIPMENT FOR RECOVERY & RECYCLING OF CFCs	6
-	TECHNICAL OPTIONS FOR COLLECTION/ RECOVERY AND RECYCLING OF CFCs	7
-	ECONOMIC VIABILITY	9
-	COMPLIANCE WITH MONTREAL PROTOCOL	13
-	FRAMEWORK FOR IMPLEMENTATION	17
-	COMPARISON OF COUNTRY CASE STUDIES	19
-	REGIONAL GUIDELINES FOR AFRICA AS A WHOLE	22
-	REGIONAL DATA BANK	24

LIST OF APPENDICES

- 2.1 TECHNICAL DETAILS OF REPRESENTATIVE EQUIPMENT FOR RECOVERY OF CFCs
- 2.2 TECHNICAL DETAILS OF REPRESENTATIVE EQUIPMENT FOR RECYCLING OF CFCs
- 2.3 COMPARATIVE FEATURES OF REPRESENTATIVE EQUIPMENT FOR COLLECTION & RECYCLING OF REFRIGERANT GASES
- 2.4 ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING SUBSTANCES) NO. 1U.1B., VICTORIA, AUSTRALIA, 1990 PROVISIONS RELATING TO SALE OF CFCs
- 2.5 ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING SUBSTANCES) NO. 1U.1B., VICTORIA, AUSTRALIA, 1990 PROVISIONS RELATING TO ACCREDITATION OF USERS OF CFCs
- 2.6 ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING SUBSTANCES) NO. 1U.1B., VICTORIA, AUSTRALIA, 1990 PROVISIONS RELATING TO PURCHASE OF CFCs
- 2.7 ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING SUBSTANCES) NO. 1U.1B., VICTORIA, AUSTRALIA, 1990 PROVISIONS RELATING TO ADOPTING PROPER PRACTICES IN USE OF CFCs
- 2.7(a) EXTRACTS OF RULES 1411 AND 1415 PERTAINING TO CFC RECOVERY, RECYCLING AND REDUCTION - SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT, CALIFORNIA, 1991
- 2.8 PROVISIONS IN SWISS ORDINANCE ON ENVIRONMENTALLY HAZARDOUS SUBSTANCES DISPOSAL OF EQUIPMENT CONTAINING CFCs
- 2.9 FORMAT FOR ENTERPRISE LEVEL DATA (LEVEL 1)
- 2.10 FORMAT FOR COUNTRY LEVEL DATA (LEVEL 4)

CHAPTER - 1

INTRODUCTION

1.1 BACKGROUND

There is overwhelming scientific evidence to indicate that damage to the ozone layer is being caused by chlorofluorocarbons (CFCs) which are used in refrigeration and airconditioning equipment, aerosols, plastic foams and cleaning solvents.

In response to worldwide concerns on depletion of the ozone layer, CFC control measures were agreed upon at Montreal in 1987 in an international agreement now commonly referred to as "Montreal Protocol". The Protocol came into force in 1989 and was further strengthened in London in 1990.

As a contribution to the efforts of the developing countries to meet the requirements of Montreal Protocol, UNIDO has embarked upon a project - US/RAF/90/173 with 9 sub-programmes with specific reference to countries in Africa.

The first two sub-programmes have been completed and they have brought out that the maximum reductions in CFC consumption in African countries can be achieved by adoption of efficient recovery and recycling systems of the coolant gases - CFC 11 and CFC 12 used in the refrigeration and airconditioning sector.

1.2 STUDY OBJECTIVES

- 1.2.1 The present project has been assigned to Mantec Consultants Pvt Ltd, India vide UNIDO letter dated 28th October, 1991. This forms the sub-programme 3 of the above project US/RAF/90/173 and is aimed at "Techno-economic Assessment of the Financial Viability of the collection and safe disposal of refrigerant gases and related materials".

This project concentrates on 3 countries - Egypt, Kenya and Nigeria to serve as a basis for development of a generalised set of guidelines for Africa as a whole. These three countries are signatories to the Montreal Protocol, and fall in the category of "Developing Countries" as defined in the Montreal Protocol as their per capita CFC consumption is far less than 300 gms. per annum.

1.3 APPROACH TO THE STUDY

The overall approach adopted for the country studies is

outlined below :

Step I : Comprehensive CFC Audit, to ascertain

- Total supply of CFCs
- CFC consumption pattern (by sub-sector)
- Unit CFC consumption norm (by equipment)
- Estimation of New and Recharging demand (by sub-sector)
- Physical distribution of suppliers/users

Step II : Demand Forecasting for airconditioning and refrigeration sector (upto year 2010)

- By equipment type and by sub-sector
- New and Recharging demand for CFCs
- To carry out an assessment of technically feasible quantities for recovery and recycling
- To estimate practically Recoverable quantities
- To evaluate implications on compliance with Montreal Protocol

Step III : Technical options for Recovery, Recycling and Safe Disposal

- Identifying schemes for recovery & recycling in various sub-sectors
- Equipment selection
- Examining logistics and other aspects of technical feasibility
- Identification of types of ventures & framework for a national system for recovery & recycling

Step IV : Economic Viability Analysis

- At venture as well as national level
- Sensitivity Analysis

Step V : Developing a Framework for Implementation

- Review of present Scenario
- Proposing measures such as Legislative, Financial, Market oriented and Institutional

1.4 STRUCTURE OF THE REPORT

The Final Confidential Report, covering the studies related to Egypt, Kenya and Nigeria, has been prepared and presented separately in four volumes, as under:

- Volume I - Egypt Country Study
- Volume II - Kenya Country Study
- Volume III - Nigeria Country Study
- Volume IV - Regional Guidelines & Data Bank

This Final Non-Confidential Report provides a brief overview of the work done, for wider dissemination and distribution.

EXECUTIVE SUMMARY

2.1 CFC AUDIT

- 2.1.1 A comprehensive survey was carried out in the three project countries, covering in detail the airconditioning and refrigeration sector, for assessment of the present levels of consumption of CFCs in various sub-sectors.

The survey involved contacting manufacturers, importers of CFCs, service agencies, commercial installations as well as professional bodies, associations and government agencies such as Egyptian Environment Affairs Agency (EEAA) in Egypt, National Environment Secretariat (NES) in Kenya & Federal Environment Protection Agency (FEPA) in Nigeria.

As none of the project countries manufacture CFCs and there are no significant exports of CFCs or CFC based products, the consumption in each of the countries is approximately equal to the imports. The utilisation in each country has been estimated by building up the demand for each of the sub-sectors, through a comprehensive field survey of the industrial enterprises.

- 2.1.2 The total consumption of CFC-11 & CFC-12 in 1991 in Egypt, Kenya & Nigeria is shown below in Table - I.

TABLE - I

CFC UTILISATION BY SUB-SECTOR IN 1991

(MT)

	EGYPT		KENYA		NIGERIA	
	CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12
1. Refrigeration & Airconditioning						
- Domestic refrigerators & deep freezers	264	321	10.5	20.7	60.5	77.8
- Commercial & industrial refrigeration	50	25	6	51.7	6.5	3.5
- Domestic & commercial airconditioning	31	-	-	-	4.7	7.3

Table - I (Contd..)

	EGYPT		KENYA		NIGERIA	
	CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12
- Mobile airconditioning	-	89	-	6.5	-	382.7
Sub-Total	345	435	16.5	78.9	71.7	471.3
2. Aerosols	90	360	5	4	-	150
3. Plastic Foams	640	50	-	-	280	-
Total	1075	845	21.5	82.9	351.7	621.3
	1920		104.4		973	

The utilisation in the case of Egypt and Kenya is slightly higher than import figures, as part of the CFCs are indirectly imported, through refrigerators and foamed cabinets. However, in Nigeria the consumption of CFC 12 is lower than import quantity as about 10-15% of the imported CFC 12 is re-exported to neighbouring countries such as Ghana & Cameroon.

- 2.1.3 The current retail prices of refrigerants in the three project countries are given at Table - II below :

	EGYPT	KENYA	NIGERIA
CFC 11	2.2	2.85	1.8 - 2.3
CFC 12	3.5 - 3.9	4.6 - 7.8	3.0 - 4.0

- 2.1.4 CFC National audits have shown that the total consumption of CFC 11 and CFC-12 in the project countries has decreased during the last few years primarily due to substitution by other substances in the foam and aerosol sectors. In Egypt the import of CFC 11 & CFC 12 has gone down from 2400 MT in 1989, to 1900 MT in 1991. Similarly in Kenya there is a decrease from 230 MT (1989) to less than 100 MT in 1991; and in Nigeria the reduction has been less significant, i.e. from 1300 MT in 1985 to 1050 MT in 1991. Trends indicate that these figures will further go down.
- 2.1.5 There is no significant consumption of CFCs in the solvent sector as CFC-113 has been substituted by Carbon Tetrachloride and Methyl Chloroform which are also controlled substances as per the amended Montreal Protocol.

2.1.6 The major proportion of CFC consumption in all countries has been in the air conditioning & refrigeration sector (41%, 91% and 56% in Egypt, Kenya & Nigeria respectively).

2.2 DEMAND FORECAST

2.2.1 In the airconditioning and refrigeration sector, due to the complete dependence on imports for compressors as well as CFCs, the trend is that of phasing out the CFC based equipment in line with the developments in advanced countries. Gradual phaseout of CFC based equipment is expected to start from 1992/1993 itself, with complete phaseout expected by 1997. The earliest phaseout will be for commercial refrigeration equipment which can be easily designed for operation with HCFC 22.

In other sectors viz aerosols, plastic foams and solvents, complete phase out is expected by 1995, 1993 and 1994 in Egypt, Kenya and Nigeria respectively.

2.2.2 Taking the above into account, the demand for CFCs upto the year 2010 has been arrived at for each of the three countries by aggregation of the demand for the various sub-sectors of airconditioning and refrigeration in the respective countries, as summarised in Table - III below.

TABLE - III

PRESENT & PROJECTED DEMAND FOR CFCs IN THE PROJECT COUNTRIES

COUNTRY		1991		1996		2005		2007		2010	
		CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12
EGYPT	- New	1055	497.0	179	43.1	0.0	0.0	0.0	0.0	0.0	0.0
	- Recharging	20	348.0	25.0	411.6	19.0	276.7	17.9	229.8	16.3	156.0
	- Total	1075	845	204.0	454.7	19.0	276.7	17.9	229.8	16.3	156.0
KENYA	- New	21.5	39.5	6.7	4.8	0.0	0.0	0.0	0.0	0.0	0.0
	- Recharging	0	43.4	0.0	49.9	0.0	37.0	0.0	29.7	0.0	18.3
	- Total	21.5	82.9	6.7	54.7	0.0	37.0	0.0	29.7	0.0	18.3
NIGERIA	- New	347	216	43.2	42.5	0.0	0.0	0.0	0.0	0.0	0.0
	- Recharging	4.7	405.3	4.2	318.2	0.0	104.2	0.0	50.3	0.0	11.7
	- Total	351.7	621.3	47.4	360.7	0.0	104.2	0.0	50.3	0.0	11.7

2.2.3 In each of the three countries, the import and consumption of CFCs is concentrated in and around the national capitals. In Egypt, most of the importers of CFCs and the major users are located in and around Cairo. Similarly in Kenya & Nigeria the concentration of importers and users of CFCs is in Nairobi and Lagos respectively. However in Nigeria, the distribution network of the importers is

quite spread out across the country, whereas in the other two countries it is limited to only a few of the important cities/towns, where the manufacturers and/or servicing agencies for CFC based equipment are operative.

- 2.2.4 After 1997, a substantial part of the demand for CFCs is on account of recharging, i.e. for servicing of the existing population of CFC based equipment, which emphasises the need of recovery and recycling systems as an important means to further reduce the consumption for an eventual phase out.

As all the three countries are signatories to the Montreal Protocol, the above demand projections, when viewed in the context of compliance with the Protocol requirements, shows that these countries have no alternative but to plan, organise and implement programmes which will bring down the recharging requirements for CFC based products. This can only be achieved by putting in place, an effective national system for collection/recovery and recycling, as well as substitution of CFCs.

2.3 EQUIPMENT FOR RECOVERY AND RECYCLING OF CFCs

- 2.3.1 Several manufacturers/users of these equipment were contacted and met by the project team experts, to understand the features and operations of the same. The technical details of representative equipment for recovery and recycling are attached at Appendices 2.1 and 2.2 respectively.

Based on this, a comparative evaluation of the technical features of various representative models of recovery and recycling equipment was carried out and is presented at Appendix 2.3 to this report.

- 2.3.2 In view of the fact that the volumes of CFCs handled by typical individual enterprises in the project countries are very small as compared to those in developed countries, the low capacity portable models of the recovery and recycling equipment would be most appropriate for adoption in Egypt, Kenya and Nigeria. These equipment are versatile and can be used for recovery and recycling of HCFC-22 also. Their utility will thus continue even after the CFCs are phased out completely.
- 2.3.3 Features incorporated in the recovery and recycling equipment are such that these can be easily operated and maintained by local technicians, after an initial training input. The important operating parameters for these equipment are as follows :

	Recovery equipment	Recycling equipment
- Capacity	0.5 lb/min.	25 kg/hr
- Indicative Price (US \$)	1000	1400

- Spares & consumables (US \$/Kg)	0.31	0.41
- Energy consumption	0.05 KWH/kg	0.05 KWH/kg

2.4 TECHNICAL OPTIONS FOR COLLECTION/RECOVERY AND RECYCLING OF CFCs

2.4.1 The various technical options for collection/recovery and recycling of CFCs from the refrigeration and airconditioning equipment were evolved taking into consideration the present practices for repair and maintenance of equipment in the four sub-sectors, viz domestic refrigerators and deep freezers, commercial and industrial refrigeration, domestic and commercial airconditioning, and mobile airconditioning.

2.4.2 The recovery and recycling of CFC-11, which is a liquid at room temperature and is used for large commercial installations, has been an established practice. Hence the focus in this study was on recovery and recycling of CFC 12. Though HCFC-22 is not covered under the project, it is of interest as similar equipment could be used, as for CFC 12, for recovery and recycling.

2.4.3 The three project countries - Egypt, Kenya and Nigeria have per capita CFC-consumption levels as given in Table - IV below :

TABLE - IV

PER CAPITA CFC CONSUMPTION

	TOTAL CFC CONSUMPTION IN 1991 (MT)	ESTIMATED POPULATION IN 1991	PER CAPITA CFC CONSUMPTION
EGYPT	1920.0	57 Mn	33.70 gms
KENYA	104.4	25 Mn	4.15 gms
NIGERIA	973.0	115 Mn	8.50 gms

These are far lower than the specified limit of 300 gms per capita, and put them in the category of "Developing Countries".

Presently, CFC imports in these countries are mainly from France, UK and Germany. Even if these countries stop or curtail the production of CFCs in the next few years, the project countries viz. Egypt, Kenya & Nigeria, will not have any problem, as these will still be available from other sources such as China, India, etc., although prices of CFCs are likely to rise world-wide due to the accelerated phasing out of CFCs in developed countries.

2.4.5 The project team, however, saw a considerable amount of enthusiasm in these countries to counter the ozone depletion problem and to reduce the consumption/import of CFCs. Initiative taken by these countries to sign the

Montreal Protocol alongside developed countries is indicative of the positive attitude of their governments to this issue.

2.4.6 Based on the findings of the field survey and evaluation of the equipment available for collection/recovery and recycling of CFCs, the technical options found relevant in the specific context of the three countries are as follows :

1. Widespread use of plastic bags for collection of CFC-12 during servicing of domestic refrigerators and deep freezers
2. Recovery equipment to be installed at the workshops of manufacturers/assemblers as well as large servicing agencies
3. Recycling of the collected/recovered CFCs would be ideally done by dealers/distributors/importers of CFCs, who already have a network for supply to the end users

2.4.7 The priorities for recovery and recycling of CFCs in the three countries are as follows based on the CFC consumption pattern and assessment of recoverable quantities for each sub-sector.

<u>Country</u>	<u>Sub-Sector</u>
Egypt	- Domestic refrigeration & deep freezers - Mobile airconditioning
Kenya	- Domestic refrigerators & deep freezers - Commercial & Industrial refrigeration
Nigeria	- Mobile airconditioning - Domestic refrigerators & deep freezers

2.4.8 Considerations for Adoption of Recovery & Recycling Equipment

Local manufacture/assembly of the recovery and recycling equipment in the project countries is technically feasible but not commercially viable due to low volumes. To make local manufacture/assembly in an African country viable, it would be necessary to club local requirements with the neighbouring countries' requirements. Therefore 3 or 4 such projects can be considered for Africa as a whole.

However, the necessary technical skills and competence exist in each of the project countries to operate and maintain the equipment, with necessary training inputs being provided initially.

2.4.9 Attainable Reduction in CFC Consumption

Recovery and recycling programmes in each country will help to reduce the CFC consumption substantially. The

maximum reductions attainable, based on 1991 field survey data, are given in Table V below :

TABLE - V

MAXIMUM ATTAINABLE REDUCTION IN CFC CONSUMPTION
BY RECOVERY & RECYCLING (1991 DATA)

	as % of recharging demand	as % of total demand for airconditioning & refrigeration sector
Egypt	58	28
Kenya	56	26
Nigeria	36	27

The maximum attainable reduction in Nigeria is the lowest, as a percentage of recharging demand, because in the mobile airconditioning sub-sector, which accounts for the largest share of recharging demand in Nigeria, most of the requirement is for leakage cases where the average recoverable quantity is low, as a percentage of total initial charge.

2.4.10 Recovery of CFCs from related materials (Insulation Foam)

The recovery of CFCs from insulation foam is logistically and economically not found feasible in the project countries. Reported initial estimates from developed countries suggest that the overall cost of CFCs recovered from domestic refrigerators would be nearly twenty five times the cost of virgin CFCs.

2.4.11 Safe Disposal of CFCs

Disposal of CFCs is not found to be a practical proposition for any of the project countries as the facilities for thermal incineration require very high capital investment (over US\$ 40 million) and hence can be justified only if the quantity of CFCs to be destroyed is of the order of 15,000 MT per annum. Even then the cost of destruction is about US\$ 3000-3500 per MT of CFC making it economically unviable.

2.5 ECONOMIC VIABILITY

2.5.1 The economic viability of the identified technical options for recovery and recycling was done at

- a) Venture (individual enterprise) level
- b) National level

2.5.2 Viability Analysis at Venture level

The three types of practical ventures for recovery and/or recycling of refrigerant gases in the

Airconditioning and refrigeration sector for each country, are :

- a) Collection using plastic bags - for domestic refrigerators and deep freezers sub-sector
- b) Recovery using portable equipment - all sub-sectors
- c) Recycling using portable equipment (with additional recovery equipment) - all sub-sectors

These ventures will be operated as an extension of the existing activities of industrial enterprises in the field, and hence must provide sufficient economic motivation to the promoters.

The venture for collection using plastic bags does not involve any capital investment, while the ventures of type (b) & (c) would require initial capital investment for suitable equipment, which are priced at about US \$ 1000 and US \$ 2400 respectively.

The viability analysis for each type of venture is done taking the following aspects into account :

- a) Estimation of cost of the project, in local currency, and means of financing on the basis of current norms in each country.
- b) Computation of operating revenues for each type of venture based on quantity of CFC processed and the price to be realised for the same.
- c) Assessment of operating costs including cost of raw materials, consumables & spares, power, labour, transportation, depreciation, interest and other overheads.
- d) Projection of the level of activity/scale of operation for each type of venture in each country, upto the year 2010 (terminal year for CFC phaseout).
- e) Estimation of the total number of ventures in each country, on the basis of :
 - concentration and dispersion of sectors/sub-sectors to be addressed by each type of venture.
 - level of activity of a typical venture.
 - realistic proportion of the target population to be addressed.
 - manpower availability.
 - recognition of the fact that the recoverable quantity would progressively reduce due to phasing out of CFC based equipment.

The first step in venture level viability analysis was to establish the dimensions of the venture in terms of equipment required, based on which the project investment and means of financing were determined taking the current prevailing norms in each country. The number of ventures of each type for the three project countries were arrived at as follows :

TABLE - VI

MAXIMUM NUMBER OF RECOVERY & RECYCLING VENTURES IN THE PROJECT COUNTRIES

	EGYPT		KENYA		NIGERIA	
	Recovery only	Recy- cling	Recovery only	Recy- cling	Recovery only	Recy- cling
Technically feasible qty. (average for 1993-2010)	57 MT	211 [*] MT	16 MT	24 [*] MT	60 MT	81 [*] MT
Min economic qty per venture @	261 Kg	1799 Kg	180 Kg	1266 Kg	256 Kg	1633 Kg
Max. number of ventures possible	218	117	90	19	234	50

Note : * Includes additional quantity collected through plastic bags which is processed with the help of portable recovery equipment installed at all the recycling ventures.

@ Taken as 25% higher than the break-even quantity

Based on the above and taking into account the findings of the industrial field surveys carried out, the practical number of ventures for each country were determined. The practically feasible quantities for recovery and recycling, as compared to technically feasible quantities were also estimated.

The important findings regarding the viability of ventures are summarised at Table VII below :

TABLE - VII

SUMMARY OF VENTURE VIABILITY ANALYSIS

VENTURE TYPE	EGYPT	KENYA	NIGERIA
- No. of ventures	100	40	150

Table - VII (Contd.)

VENTURE TYPE	EGYPT	KENYA	NIGERIA	
Recovery only	- Practically feasible Qty (average for 1993 - 2010)	26.5 MT	10.6 MT	36 MT
	- Cost per kg of CFC recovered (US \$)	0.92	1.04	0.92
	- Break-even quantity	209 Kg	145 Kg	205 Kg
	- Actual qty. per venture	265 Kg	265 Kg	240 Kg
	IRR			
	- on equity	67.8%	93.9%	215.1%
	- on total capital	23.5%	27.9%	47.2%
	Payback Period			
	- on equity	1 Year & Six months	1 Year	6 Months
	- on total capital	4 Years	4 Years	2 Years
Recycling	- Practically feasible Qty (average for 1993 - 2010)	98 MT	14 MT	45.3 MT
	- No. of ventures	12	5	10
	- Cost per kg of CFC recycled (US \$)	4.10	5.80	4.47
	- Break-even quantity	1439 Kg	1013 Kg	1306 Kg
	- Actual qty. per venture	8167 Kg	2811 Kg	4539 Kg
	IRR			
	- on equity	197.2%	179.9%	325.1%
	- on total capital	78.9%	75.6%	97.7%
	Payback period			
	- on equity	1 Year & 2 Months	8 Months	6 Months
- on total capital	2 Years	2 Years	1 Year & 6 Months	

The break-even quantity for recovery and recycling ventures in Kenya are the lowest as compared to Egypt and Nigeria, as the existing selling prices of CFCs in Kenya are the highest.

2.5.3 Net National Economic Benefit

The Net National Economic Benefit for each country has been worked out using the principles of social cost benefit analysis, and aggregating the venture level analysis at the national level. The following costs and benefits (at 1992 prices) have been assessed for the period 1993 to 2010.

Benefits:

- savings in imports of refrigerants
- increase in employment
- increase in consumption and investment
- increase in government revenues

Costs:

- cost of equipment and consumables
- training and publicity costs
- increase in costs of overheads and maintenance of ventures
- duties and taxes foregone by the government

The present value of the net benefits to the country was obtained by discounting at the rate of 2% for arriving at the net national economic benefit for each country, as summarised in Table - VIII below.

TABLE - VIII

NET NATIONAL ECONOMIC BENEFIT

	EGYPT	KENYA	NIGERIA
In local currency	(-) LE 19.69 Mn	(-) KSH 13.52 Mn	(-) N 17.44 Mn
In US \$	(-) US\$ 5.95 Mn	(-) US\$ 0.48 Mn	(-) US \$ 0.97 Mn

The net value for Egypt is particularly high owing to the subsidy on plastic bags which is the major medium for collection of CFCs from the largest sub-sector i.e. domestic refrigerators.

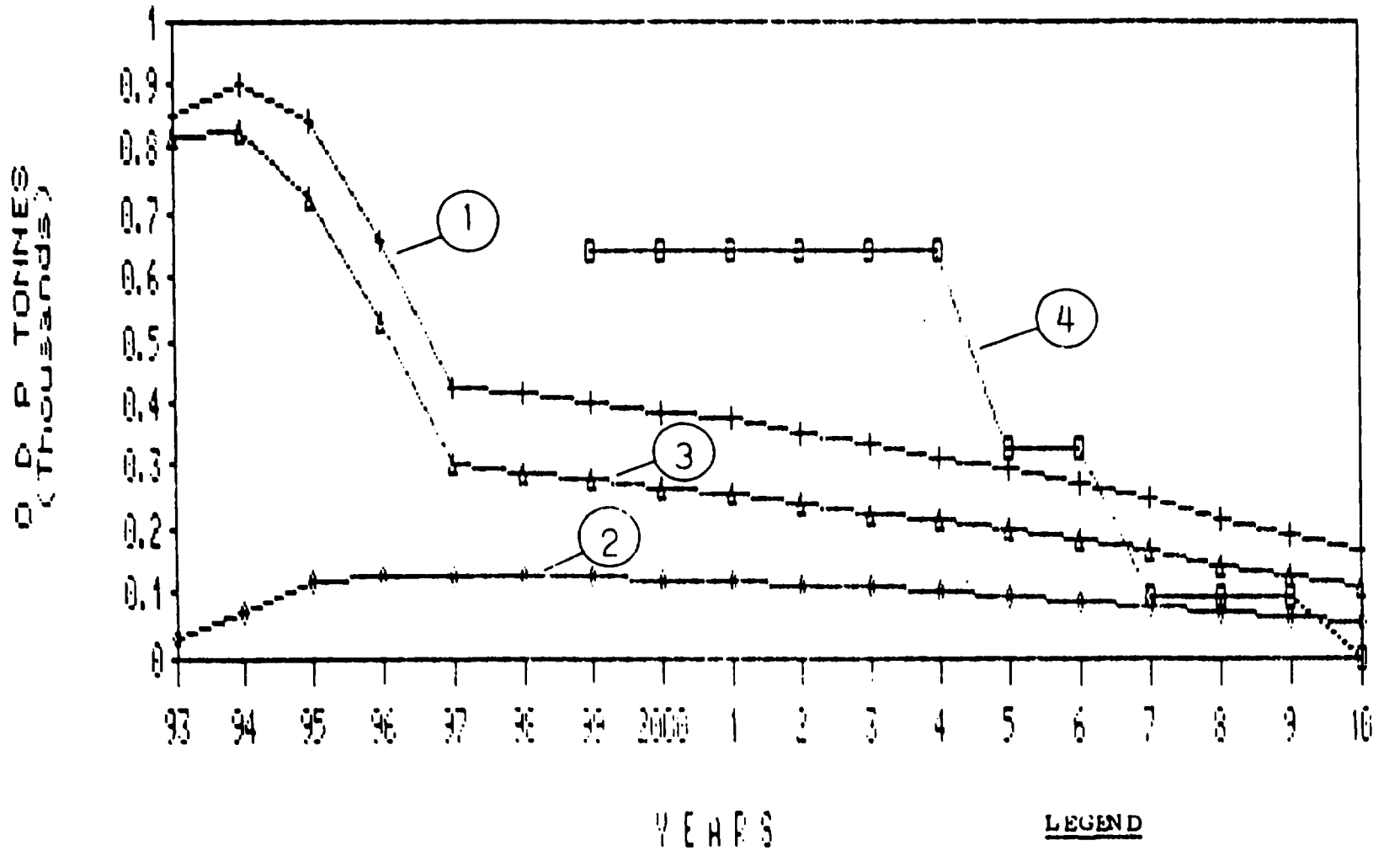
This further confirms the fact that recovery and recycling programmes in these countries have to be viewed as a requirement needing financial support from international agencies.

2.5.4 Compliance with Montreal Protocol

In the context of compliance with the requirements of the Montreal Protocol, it is seen that in Egypt and Nigeria the total demand exceeds the limit in the year 2007. However, in the case of Kenya, this takes place earlier, i.e. in the year 2005. The overall scenario for Egypt, Kenya and Nigeria is shown in figures 2.1, 2.2 and 2.3 respectively.

FIGURE - 2.1

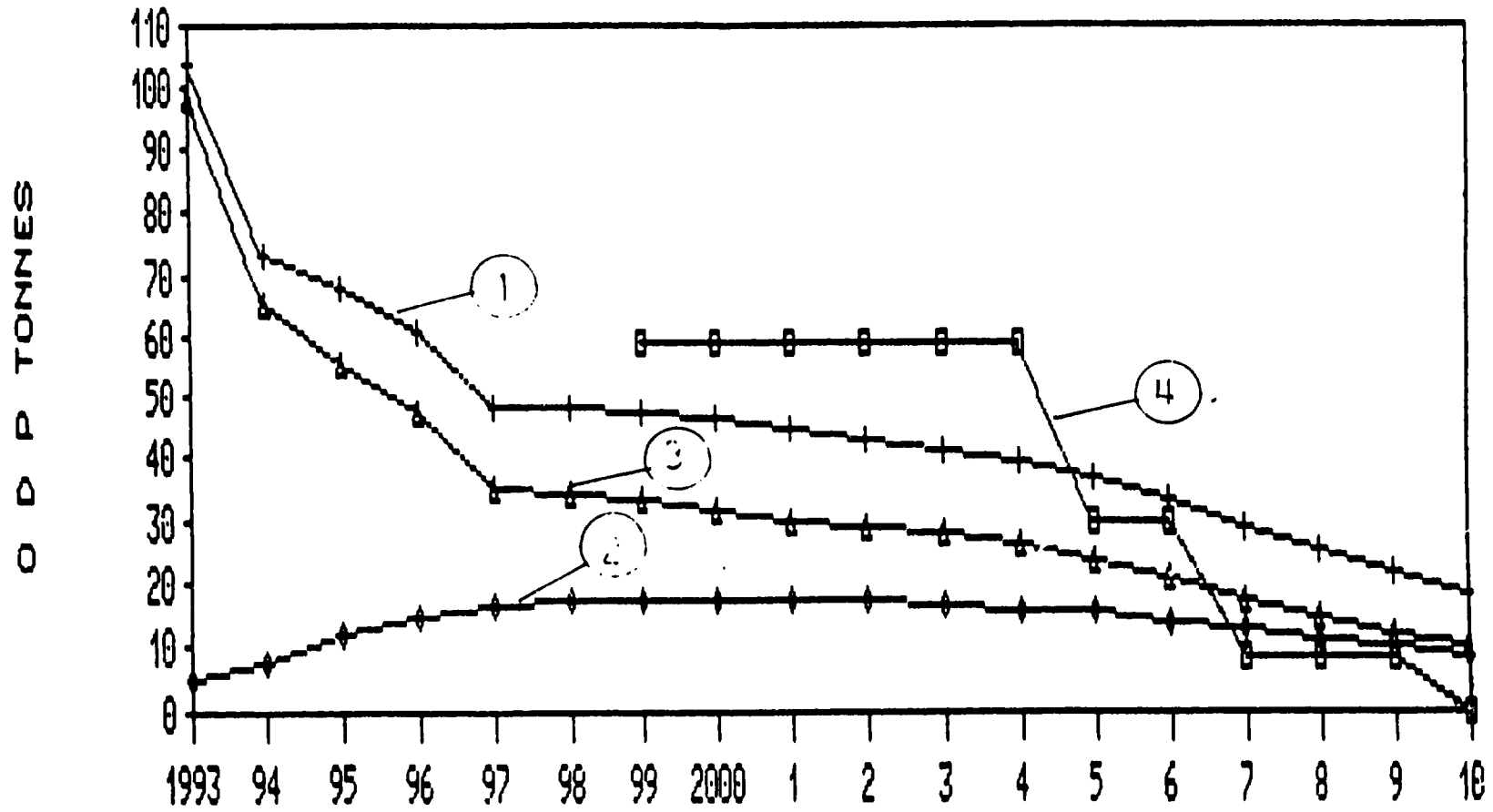
IMPACT OF RECOVERY & RECYCLING IN EGYPT
(VIS A VIS MONTREAL PROTOCOL)



1. TOTAL PROJECTED CFC DEMAND
2. PRACTICALLY RECOVERABLE QUANTITY
3. NET CFC DEMAND
4. MONTREAL PROTOCOL

FIGURE - 2.2

IMPACT OF RECOVERY & RECYCLING IN KENYA
(VIS A VIS MONTREAL PROTOCOL)



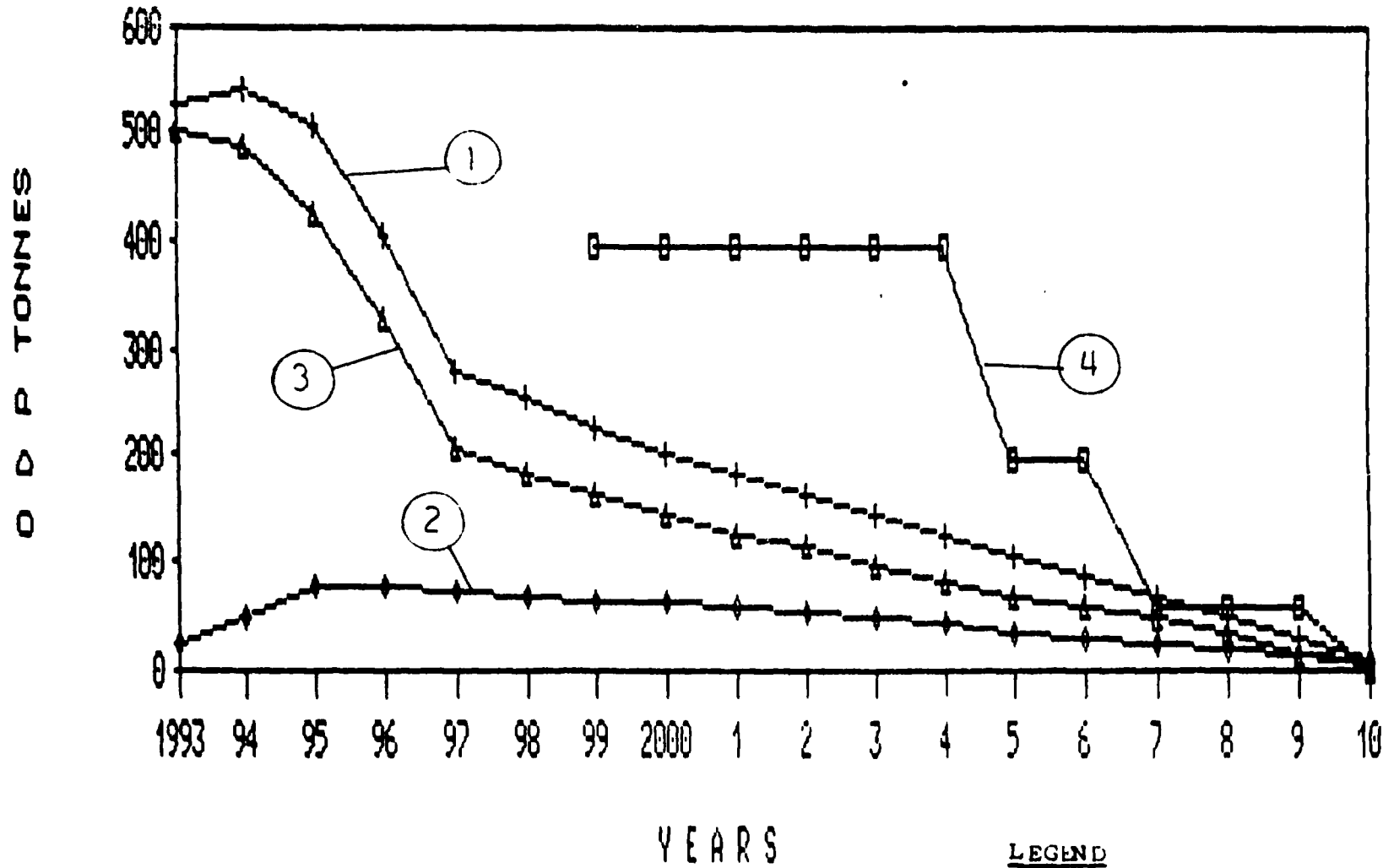
YEARS

LEGEND

- 1. TOTAL PROJECTED CFC DEMAND
- 2. PRACTICALLY RECOVERABLE QUANTITY
- 3. NET CFC DEMAND
- 4. MONTREAL PROTOCOL

FIGURE - 2.3

IMPACT OF RECOVERY & RECYCLING -NIGERIA (VIS A VIS MONTREAL PROTOCOL)



- 1. TOTAL PROJECTED CFC DEMAND
- 2. PRACTICALLY RECOVERABLE QUANTITY
- 3. NET CFC DEMAND
- 4. MONTREAL PROTOCOL

The promotion of recovery and recycling ventures will help each of the countries to comply with the Montreal Protocol as shown in the figures, with the possible reduction in total CFC demand in each country.

With the implementation of recovery and recycling programmes, the compliance with protocol requirements can be achieved as follows :

- | | | | |
|---|---------|---|-----------|
| - | Egypt | - | upto 2007 |
| - | Kenya | - | upto 2007 |
| - | Nigeria | - | upto 2010 |

In Egypt & Kenya, the further reduction in CFC consumption required after 2007 to meet the protocol limits is of such an order that it can be met through CFC banks, or use of drop-in substitutes, which are expected to be available by that time.

2.6 FRAMEWORK FOR IMPLEMENTATION

At present none of these project countries have an appropriate legislative and institutional framework, with respect to usage, recovery and recycling of CFCs. In the context of the findings of the study, it is felt desirable and necessary to introduce regulatory legislative measures regarding various aspects of CFC consumption, viz sale, purchase and conservation through recovery & recycling. Appendices 2.4 to 2.8 show the illustrative examples of legislations in other countries in this context. These are provided as guidelines for enacting similar legislations in the countries of the African Region.

These legislative and regulatory measures would be aimed at achieving the following:

- a) identification of users of CFCs
- b) imposing an obligation on sellers and users to report consumption or utilisation of CFCs
- c) establishing codes of practice for repair/servicing agencies
- d) accreditation of service mechanics and agencies
- e) ensuring proper disposal of equipment containing CFCs
- f) ensuring adoption of recovery and/or recycling equipment

The economies of these countries are characterised by low rate of growth, adverse balance of payments situation and dependence on imports in the manufacturing sector.

The public awareness and consumer pull is limited and at the present level cannot be counted on to drive a recovery and recycling programme. Further, the existing institutions are not geared up in terms of organisation or training for coordinating the total programme.

We recommend the following framework for implementing the recovery and recycling programme :

1. Command and Control Measures

These measures are in terms of enactment of legislation on practices in the following areas which would be applicable in all the countries.

- Sale of CFCs and maintaining records of the same
- Accreditation/certification of users of CFC
- Obligation on the part of large installations especially chillers and equipment manufacturers to install recovery equipment
- Obligation of service agencies to recover CFCs
- Obligation on sellers of CFCs to buy back recovered CFCs
- Obligation on service agencies to return a certain proportion of recovered CFCs to be able to purchase virgin CFCs

2. Financial Support Measures

These are -

- Making imported equipment and spares for the recovery and recycling ventures duty exempt
- Providing grants/subsidies to entrepreneurs for setting up ventures. The minimum subsidy to make the ventures viable is 20%. However higher subsidy of upto 50% can be considered by each country depending on the priority to be accorded for implementation.
- Increasing the price of virgin CFC by imposing higher duties so as to raise the price of 'recovered' CFC
- Free supply of plastic bags to accredited service agencies
- Meeting expenses for training and promotion
- Meeting the costs of setting up a CFC bank when required

It is recommended that these costs should be met out of a special fund created with the help of foreign aid.

3. Institutional Strengthening

We have recommended that in each of the project countries the existing agency dealing with environmental issues like EEAA in Egypt, NES in Kenya and FEPA in Nigeria, create a separate department to deal exclusively with the following in conjunction with manufacturers associations and other bodies.

- Evolving codes of practice
- Providing technical inputs through training
- Certification/accreditation of service agencies

- Assisting in start-up of ventures
- Collection and compilation of data on CFC supply and use
- Running demonstration centres for recovery and recycling equipment
- Setting up of CFC banks (e.g. Kenya & Egypt)
- Organising public awareness programs
- Intervention in pricing of 'recovered' CFC
- Overall coordination & monitoring with industry and multilateral agencies

While the measures suggested by and large are common for these countries, the differences in the environment and industrial situation in each of the countries, calls for some variations in approach.

While in Egypt legislation would be effective in many areas, in Nigeria it would be financial incentives that would evoke the stronger response.

The actual mix of measures and their timing in each of the countries would finally depend on the level of response and the speed at which the respective governments wish to implement the programme.

2.7 COMPARISON OF COUNTRY CASE STUDIES

The comparison of recovery and recycling programmes in the three project countries is summarised in Table-IX below.

TABLE - IX

CFC RECOVERY AND RECYCLING - A COMPARATIVE ANALYSIS

<u>PARAMETERS</u>	<u>EGYPT</u>	<u>KENYA</u>	<u>NIGERIA</u>
CFC consumption by sub-sector cumulative for 1993-2010 (MT)			
- Domestic Fridges	5876.2	278.2	923
- Commercial & Industrial Refrigeration	309	490.8	79
- Commercial Air Conditioning	412	-	90
- Mobile Air-Conditioners	1102	60.7	2826.2
Total cumulative Consumption (MT)	7699.2	829.7	3918.2

Table - IX (Contd..)

PARAMETERS	EGYPT	KENYA	NIGERIA
Curulative total recharging requirement from 1993 to 2010 (MT)	6131	727.4	3339
- as a % of total consumption	79.6%	87.7%	85.2%
Max. CFC Recoverable by sub-sector from 1993 to 2010 (MT)			
- Domestic Fridges	3084	145	422.1
- Commercial & Industrial Refrigeration	133	233.5	23.4
- Commercial Air Conditioning	46	-	17.1
- Mobile Air-Conditioners	566	26	1005.7
Total	3829	404.5	1468.3
Practically recoverable quantity (1993-2010)			
- through recovery equipment	477	191	649
- through plastic bags	1287	62	168
Total (MT)	1764	253	817
- as a % of total consumption	22.9%	30.4%	20.8%
- as a % of recharging requirement	28.8%	34.7%	24.4%
Type of service set up in each sub-sector			
- Domestic Fridges	Small repair agencies	Manufacturers' service deptt. plus small agencies	Manufacturers' service deptt. plus small agencies

Table - IX (Contd..)

PARAMETERS	EGYPT	KENYA	NIGERIA
- Commercial & Industrial refrigerators	Manufacturers service network	Manufacturers' service deptt.	Manufacturers' service deptt.
- Mobile Air-conditioners	Garages of various sizes	Big Garages/agencies	Garages of various sizes
Total Project Investment(inUS\$)	173,888	70,860	235,030
Average annual value of CFC saved (in US\$)	215,606	35,159	100,889

Further, the evaluation of the country case studies brings out the following :

- a) The present industrial infrastructure is poor and manufacture of CFC based equipment is dependent on import of components as well as CFCs. Hence the substitution with non-CFC based equipment in manufacture of new equipment would take place in line with the developed countries.
- b) However, economic pressures would motivate extended use of existing CFC based equipment, resulting in continued requirement of CFCs for recharging.
- c) In all cases, technical options identified are similar. These are
 - Use of plastic bags for collection of CFCs from domestic refrigerators
 - Recovery equipment for recovering CFCs from car airconditioners and commercial refrigeration systems
- d) In all cases, recycling would be ideally undertaken by the CFC suppliers as they have the necessary infrastructure for collection, storage and distribution.
- e) All countries would have to import the recovery and recycling equipment, hence the project cost for ventures is similar.
- f) We have found that recovery and recycling ventures can be made viable by giving adequate financial support and instituting an appropriate pricing mechanism for collected/recovered and recycled CFCs.

- g) In all countries, the present organisation under respective environmental agencies requires to be strengthened for implementing and monitoring of the CFC recovery and recycling programmes.
- h) Existing legislative framework in each of the countries is inadequate with respect to CFC utilisation. This calls for necessary legislation to be enacted to cover the following :
- Sale & purchase of CFCs
 - Formulation and implementation of codes of practice in manufacturing as well as servicing
 - Collection/recovery of CFCs by service agencies and purchase of the same for recycling and sale by the selling agencies
- i) Need for emphasis on increasing public awareness to make the collection/recovery and recycling programmes successful.

2.8 REGIONAL GUIDELINES FOR AFRICA AS A WHOLE

As African countries do not manufacture CFCs, the only technical option to reduce CFC consumption/emissions is through implementation of viable CFC collection/recovery and recycling programmes.

The number of recovery and recycling ventures and formulation of an overall National System will require a detailed audit of CFC consumption and a study of manufacturing and servicing practices in each country.

The audit data would need to be analysed for prioritisation of sub-sectors for implementing the recovery and recycling programme. This would be based on the assessment of the quantities of CFC handled and geographical dispersion of users as well as servicing agencies.

The proposed regional policy making framework is shown in Figure 2.4.

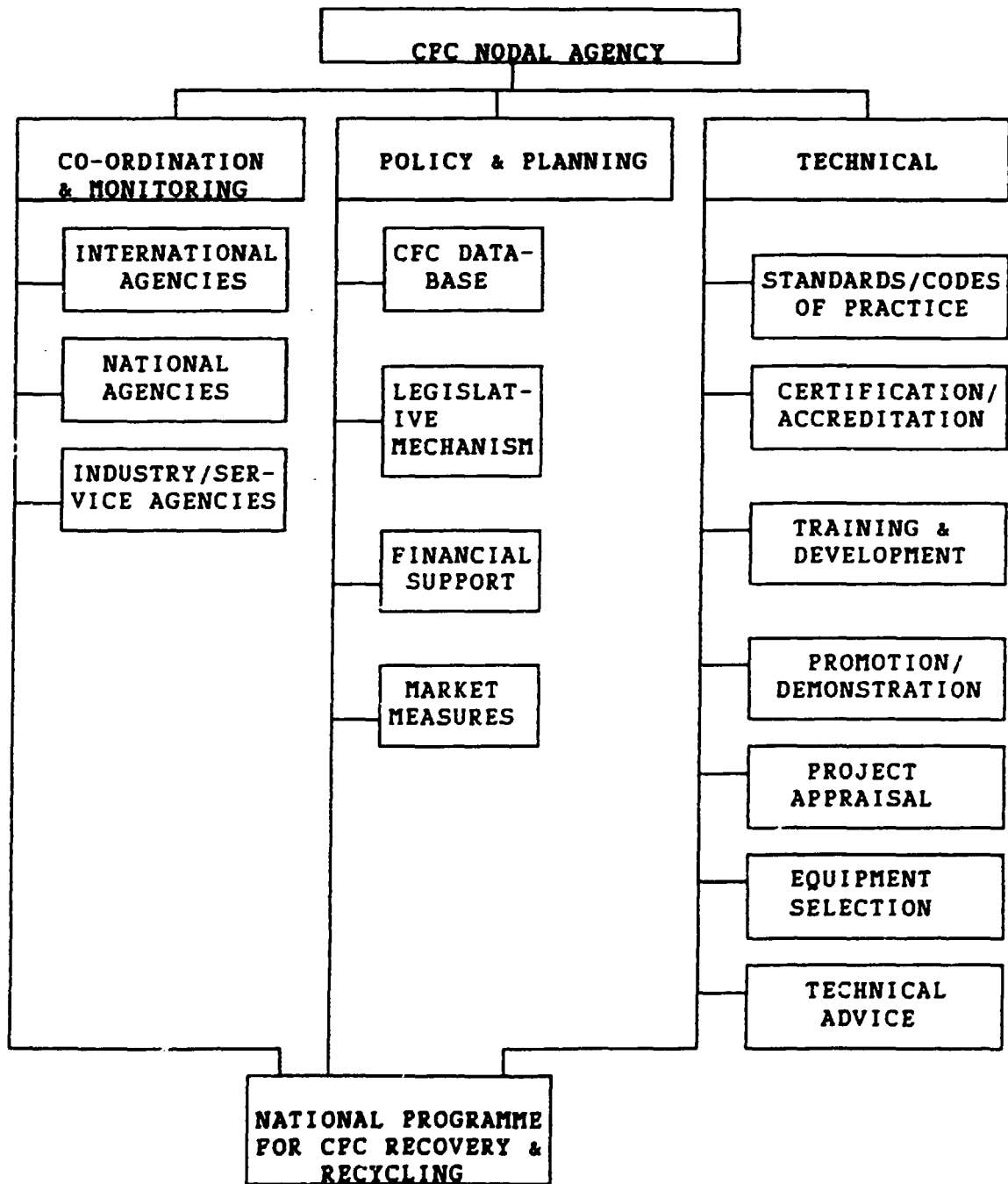
Some of the significant guidelines are :

Institutional

Each country would require to have an organisation identified or created to implement the collection/recovery and recycling programmes. This can be achieved by Institutional strengthening of any existing agency involved in environmental issues.

FIGURE - 2.4

REGIONAL POLICY MAKING FRAMEWORK



Legislative

Enactment of suitable laws in respect of supply and usage of CFCs

Market Measures

Intervention to raise prices of virgin CFCs, curbing of imports through limited quota allocation, setting up central recycling facilities, creation of public awareness etc.

Financial Support

Subsidies on capital investment for recovery and recycling projects, funding of costs on training, waiving of import duty on equipment, subsidising the cost of plastic bags etc.

National Governments would, in turn, need support for funding this programme from external sources, i.e. multilateral fund created by the international community.

2.9

REGIONAL DATA BANK

A national data base would need to be created for each country which would comprise of data on enterprises, sub-sectors and sectors of industry using CFCs. The data base for each country can be integrated into a Regional Data Bank.

The regional data bank would be organised in four levels, as follows:

Level 1 : Enterprise level

Level 2 : Sub-sector level

Level 3 : Sector level

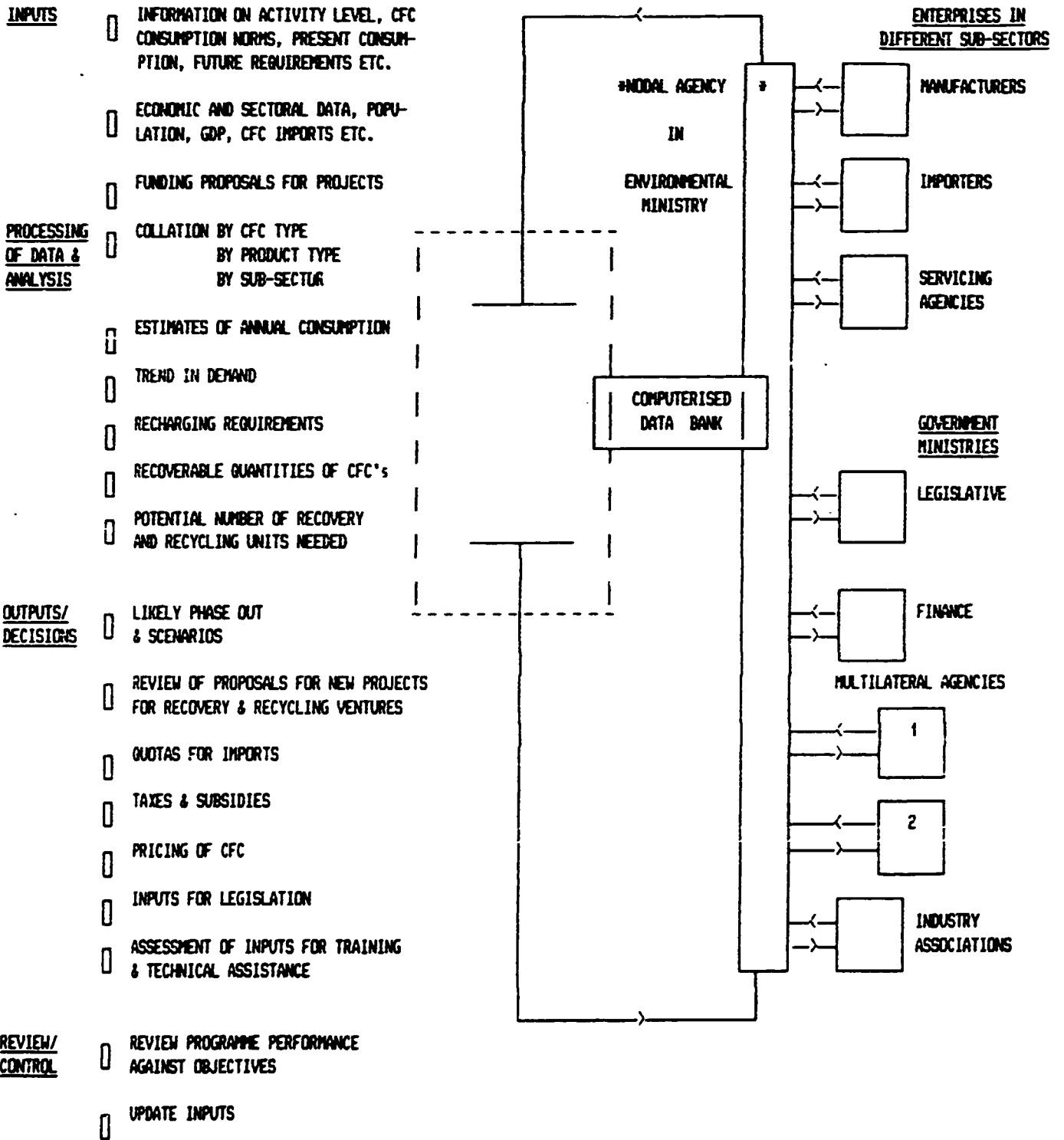
Level 4 : Country level

The primary input to the data bank would be data of each individual enterprise using CFCs. The input proforma for collecting data at enterprise level is shown in Appendix - 2.9. The data bank structure would facilitate aggregating enterprise level data to sub-sectors and sub-sector data to sector level. The country level data would consist of data integrated from sector as well as other inputs on macro-economic parameters. The structure of country level data is shown at Appendix - 2.10.

This data bank will form the heart of a system at country level to formulate policies for phase out programmes with projects for recovery and recycling. The pictorial presentation of such a system is given at Figure 2.5.

FIGURE - 2.5

SYSTEM FRAMEWORK AT COUNTRY LEVEL
FOR REGIONAL POLICY ANALYSIS



The country level data would provide the inputs at the regional level to facilitate comparative analysis of the CFC consumption and conservation under different policy regimes. Figure 2.6 shows the scheme of such a regional information system.

FIGURE - 2.6

SYSTEM OUTLINE AT REGIONAL LEVEL

INPUTS

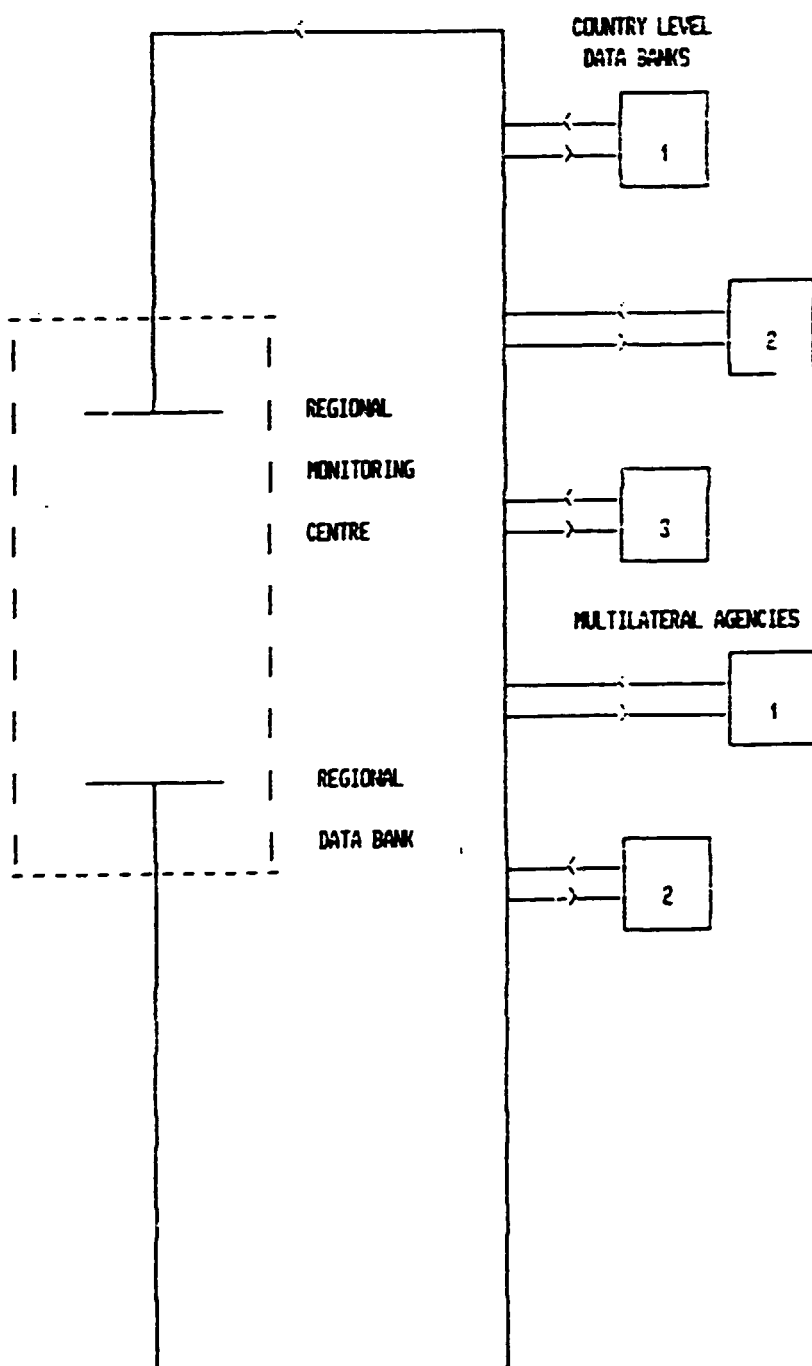
- ECONOMIC PARAMETERS, POPULATION, GDP, GROWTH RATE
- POPULATION AND PRODUCTION OF EQUIPMENT USING CFC'S, GROWTH
- CFC CONSUMPTION FOR NEW EQUIPMENT, FOR RECHARGING
- NO. OF RECOVERY & RECHARGING INSTALLATIONS, ACTIVITY LEVEL
- EXISTING POLICY MEASURES, QUOTAS, DUTIES, SUBSIDY ON EQUIPMENT, INCREASED TAXES
- EXTERNAL FUNDING

ANALYSIS

- REDUCTION IN CFC CONSUMPTION BY SUB-SECTORS-TREND BY COUNTRY
- CFC QUANTITY RECOVERED & RECYCLED IN EACH COUNTRY
 - AS % OF CONSUMPTION
 - AS % OF INVESTMENT

OUTPUT/DECISIONS

- ADVICE TO COUNTRIES ON POLICY MEASURES
- RECOMMENDATIONS FOR FUNDING PRIORITIES
- REVIEW OF REGIONAL CFC CONTAINMENT OBJECTIVES

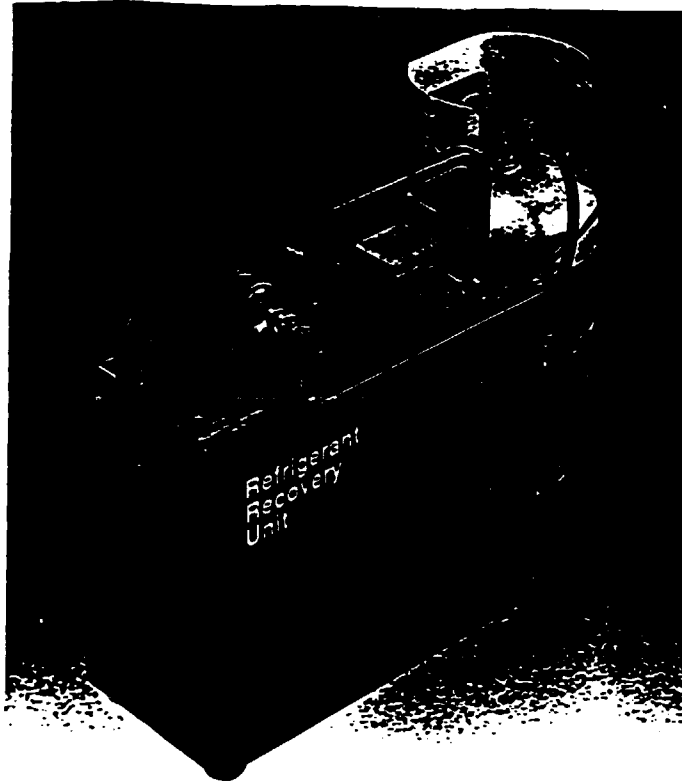


2.10 CONCLUSION

The findings of the study indicate that given adequate financial support from multilateral agencies and with appropriate legislation and institutional strengthening for implementation, viable programmes for recovery and recycling of refrigerant gases can be set up in Africa.

APPENDICES

TECHNICAL DETAILS OF REPRESENTATIVE EQUIPMENT FOR RECOVERY OF CFCs



Portable Recovery Station

The perfect companion to your recovery and recycling system. This portable Freon recovery station saves you the cost of investing in another recovery and recycling unit. It's perfect for use in the body shop or on field service trucks, and at satellite service facilities.

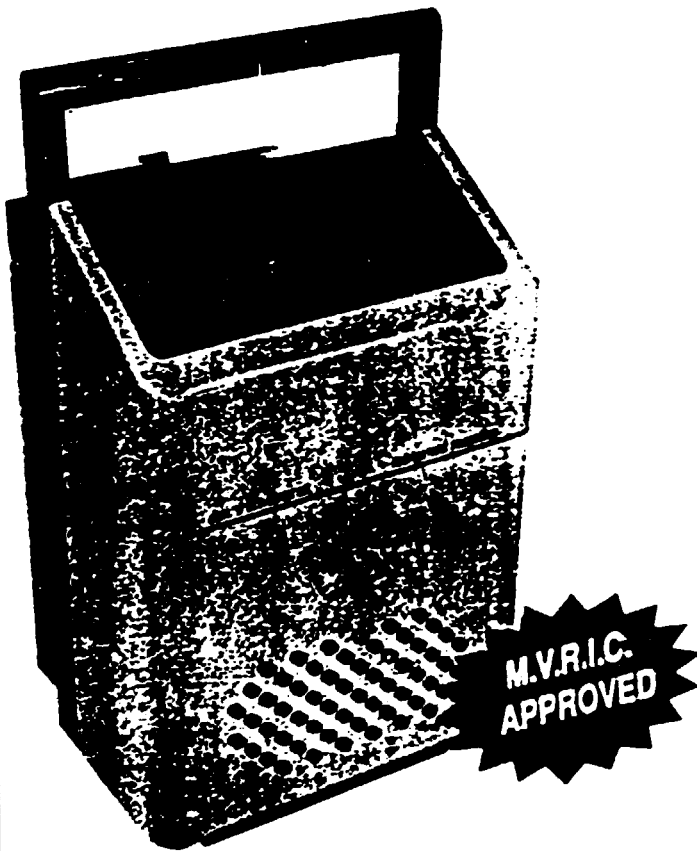
- Recovers ½ lb. per minute.
- Built-in oil separator.
- One 72" hose with "Quick-Seal" fitting.
- One, 30 pound reusable D.O.T. approved refrigerant storage tank with float switch.
- Fully enclosed working components. Cabinet rests on four rubber pads.
- 115 volts A.C.

Dimensions: 15" high x 20" wide x 14" deep. Weight: 53 lbs.

TECHNICAL DETAILS OF REPRESENTATIVE
EQUIPMENT FOR RECYCLING OF CFCs

SKYE EP5 Recycler

Complete with all necessary hoses and fittings for use with EP4**



*The Split System
allows multiple
recovery machines
to be serviced by
one recycler.*

- * REFRIGERANT PROCESSED - R-12, R-22, R-500, R-502
- * RECYCLE RATE - 25 Kg/hr
- * DIMENSIONS - 16" (W) X 14" (D) X 26" (H)
- * WEIGHT - 52 lbs
- * MEETS SAE J 1989, 1990, 1991 (when used in conjunction with a suitable recovery equipment)

COMPARATIVE FEATURES OF REPRESENTATIVE EQUIPMENTS
FOR COLLECTION AND RECYCLING OF REFRIGERANT GASES

SL. NO.	EQUIPMENT	APPLICATION AREA	SIZE	WEIGHT	RECOVERY	RECYCLING	REFRIGERANTS HANDLED	FEATURES
1.	REFRIGERANT RECOVERY SYSTEM INC., USA							
(a)	MODEL RC-1	RESIDENTIAL/COMMERCIAL CONTRACTORS	16"x12"x18"	40 lbs	0.5 lb/min	-	R-12, R-22, R-500, R-502	RECOVERY UNIT ONLY
(b)	REJUVENATOR'S ST-100 A/1	COMMERCIAL AIR CONDITIONING	29"x32"x14"	105 lbs	2-3 lbs/min	-	R-12, R-22, R-500, R-502	MEETS & EXCEEDS SAE STANDARDS DESIGNED FOR MOBILE A/C MARKET RECOVERY UNIT ONLY
2.	SPI CORPORATION, USA (OTA Division)							
(a)	DEM 1380	AUTOMOBILES	45"x23"x25"	150 lbs	0.5 lb/min	2.5 lbs/min	R-12	RECOVERY & RECYCLING UNIT
(b)	DEM 1396	AUTOMOBILES	45"x21"x24"	115 lbs	0.5 lb/min	.8 lb/min	R-12	RECOVERY & RECYCLING UNIT
(c)	DEM 1397	AUTOMOBILES	15"x20"x14"	53 lbs	0.5 lb/min	-	R-12	RECOVERY UNIT ONLY
3.	UNITED TECHNOLOGY CORPORATION, U.S.A.							
(a)	198A RMS - 20	CHILLERS	4'-9"x3'-8 3/4"x2'-5'	275 kg	LIQUID 14 kg/hr	18 kg/hr	R-11, R-113, R-123	INCLUDES RECHARGING OF RECYCLED REFRIGERANT RECOVERY & RECYCLING UNIT
4.	ENVIRONMENTAL PRODUCTS MANUFACTURING LTD, AUSTRALIA "SKYE"							
(a)	EP-3	MOBILE COMMERCIAL AIRCONDITIONING & REFRIGERATION APPLICATIONS	400x500x1000 (mm)	56 kg	25 kg/hr	25 kg/hr	R-12, R-22, R-500, R-502	PORTABLE MODEL (FILTER & DISTILLATION), RECOVERY & RECYCLING UNIT
(b)	EP-4	-DO-	400x500x1000 (mm)	20 kg	25 kg/hr	-	R-12, R-22, R-500, R-502	HAND CARRY, RECOVERY UNIT

APPENDIX 2.3 (Contd..)

SL. NO.	EQUIPMENT	APPLICATION AREA	SIZE	WEIGHT	RECOVERY	RECYCLING	REFRIGERANTS HANDLED	FEATURES
(c)	EP-4IC	-DO-	350x220x 440 (mm)	20 kg	35 kg/hr	-	R-12,R-22, R-500,R-502	- HAND CARRY,RECOVERY UNIT
(d)	EP-5	-DO-	400x350x	24 kg	*	22 kg/hr	R-12,R-22, R-500,R-502	- HAND CARRY,RECOVERY &
5.	JAVAC RECO, AUSTRALIA							
(a)	RECO - 1	COMMERCIAL AIR CONDITIONERS	390x440x 600 (mm)	48 kg	60 kg/hr	-	R-12,R-22, R-502	- MEETS REFRIGERANT STANDARD AS-1677 & SAE J1991/89/90 - RECOVERY UNIT
(b)	RECO-12S	DOMESTIC/ AUTOMOBILE	390x440x 600 (mm)	35 kg	33kg/hr	1 lit/min	R-12	- VAPOUR FORM REFRIGERANT - RECOVERY & RECYCLE
(c)	RECO-134S	DOMESTIC/ AUTOMOBILE	390x440x 600 (mm)	35 kg	-	1 lit/min	R-134a	- RECYCLING UNIT ONLY
6.	TECHNICAL CHEMICAL CO., U.S.A							
(a)	SERCON 9000	HIGH VOLUME AIR CONDITIONING/ REFRIGERATION EQUIPMENTS	20"x20"x45.5"	175 lbs	25 lbs/min	2.7 lbs/min	R-12,R-22, R-500,R-502	- RECOVERY & RECYCLING UNIT
(b)	SERCON 8000	-DO-	20"x20"x45.5"	160 lbs	25 lbs/min	2.7 lbs/min	R-12,R-22, R-500,R-502	- RECOVERY & RECYCLING UNIT
(c)	SERCON 5000	SMALL SHOPS/AUTO DISMANTLERS/AIR CONDITIONERS & REFRIGERATION EQUIPMENTS	9"x19"x24"	70 lbs	25 lbs/min	-	R-12,R-22, R-500,R-502	- RECOVERY UNIT ONLY

APPENDIX 2.4

ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE
MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING
SUBSTANCES) NO. 1U.1B

PROVISIONS RELATING TO SALE OF CFCs

1. Any distributor or wholesaler selling chlorofluorocarbons or halons must keep written records of sales.
2. Any distributor or wholesaler of chlorofluorocarbons must-
 - a) accept, wherever practicable, all reclaimed chlorofluorocarbons returned for reprocessing.
 - b) Keep written records of quantities of chlorofluorocarbon returned for reprocessing.
3. Accurate information on chlorofluorocarbon and halon consumption will be achieved as follows :
 - a) All records must include the name and address of the purchaser, the end use category, the quantity of ozone-depleting substances supplied and the quantity of ozone-depleting substances returned. The end use categories which must be recorded are -
 - foam production
 - solvents use
 - dry cleaning
 - vehicle air conditioning
 - commercial/industrial air conditioning and refrigeration
 - domestic refrigeration
 - domestic air conditioning
 - portable fire extinguishers
 - halon fire suppression systems
 - miscellaneous (if none of the above, specify the application or activity)
 - b) Written records must be sent to the authority no later than 14 days after each of the quarters ending 31 March, 30 June, 30 September and 31 December and must be available for inspection at any time by an authorised officer upon request.

APPENDIX 2.5

ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE
MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING
SUBSTANCES) NO. 1U.1B

PROVISIONS RELATING TO ACCREDITATION OF USERS OF CFCs

1. On and from 1 January 1991 any person who uses any ozone-depleting substance for or with respect to any industry or activity listed in Schedule C must be accredited by -
 - 1) an appropriate Industry Board : or
 - 2) by the Authority :
 - a) where there is no appropriate Industry Board; or
 - b) following a successful application for accreditation made under clause 26.
2. Accreditation shall be granted where the appropriate Industry Board or the Authority, as the case requires, is satisfied that the applicant has -
 - 1) an adequate appreciation of -
 - a) the role of ozone-depleting substances in depleting stratospheric ozone; and
 - b) the consequences of the depletion of stratospheric ozone; and
 - 2) a proven ability to take effective measures to minimise emissions of any ozone-depleting substances.
3. Where the appropriate Industry Board receives an application for accreditation, the appropriate Industry Board must not later than 60 days after receiving the application -
 - 1) refuse to grant accreditation; or
 - 2) grant accreditation subject to such conditions, if any, as the appropriate Industry Board considers appropriate.
4. A person who has been refused accreditation by the Industry Board may apply to the Authority for accreditation.
5. Where the Authority receives an application for accreditation, the Authority must, not later than 60 days after receiving the application -
 - 1) refuse to grant accreditation; or
 - 2) grant accreditation subject to such conditions, if any, as the authority considers appropriate

APPENDIX 2.5 (Contd..)

6. On and from 1 January 1991, any person who purchases any ozone-depleting substance for or with respect to any industry or activity listed in Schedule C must be registered by -
- 1) an appropriate Industry Board; or
 - 2) by the Authority :
 - a) where there is no appropriate Industry Board; or
 - b) following a successful application for registration made under Clause 4.
7. Registration shall only be granted where the appropriate Industry Board or the Authority, as the case requires, is satisfied that -
- 1) any ozone-depleting substance purchased will only be supplied for use by an accredited person; and
 - 2) the person applying for registration has access to the necessary equipment to minimise the emissions of any ozone-depleting substance.

APPENDIX 2.6

ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE
MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING
SUBSTANCES) NO. 1U.1B

PROVISIONS RELATING TO PURCHASE OF CFCs

1. Any person who purchases any ozone-depleting substance must maintain, in respect of each purchase, written records which must -
 - 1) contain the following details :
 - a) the quantity of the ozone-depleting substance;
 - b) the name of the ozone-depleting substance; and
 - c) the name and address of the person from whom the ozone-depleting substance was purchased.
 - 2) be made available for inspection upon request at any time by an authorised officer.

APPENDIX 2.7

ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE
MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING
SUBSTANCES) NO. 1W.1B

PROVISIONS RELATING TO ADOPTING PROPER PRACTICES IN USE OF CFCs

Domestic Refrigeration

1. From the date of declaration of this policy, any person who designs or services domestic refrigeration units must comply with the "Code of Practice for the Design and Service of Domestic Refrigeration Units" endorsed by the Authority.

Motor Vehicle Air Conditioning

2. To reduce the emission of chlorofluorocarbons from motor vehicle air conditioning units -
 - 1) on and from the date of declaration of this policy, any person who designs or services motor vehicle air conditioning units must comply with the "Code of Practice for the Design and Service of Motor Vehicle Air Conditioning Units" endorsed by the Authority; and
 - 2) on and from 1 January 1991, services or maintains motor vehicle air conditioning units must reclaim chlorofluorocarbons whenever units are being serviced and maintained; and
 - 3) any chlorofluorocarbons reclaimed must be returned to the distributor or wholesaler for reprocessing, or recycled on-site or securely stores pending destruction.

Industrial/Commercial Air Conditioning and Refrigeration

3. To reduce the emission of chlorofluorocarbons from industrial and commercial air conditioning and refrigeration units -
 - 1) on and from the date of declaration of this policy, any person who designs or services industrial and commercial air conditioning and refrigeration units must comply with the Code of Practice for the Design and Service of Industrial and Commercial Air Conditioning and Refrigeration Units" endorsed by the Authority.

APPENDIX 2.7 (Contd..)

- 2) on and from 1 January 1991, any person who services or maintains industrial and commercial air conditioning and refrigeration units must reclaim chlorofluorocarbons whenever units are being serviced, maintained and decommissioned; and
 - 3) Any chlorofluorocarbon that is reclaimed must be returned to the distributor or wholesaler for reprocessing, or recycled on-site or securely stores pending destruction.
4. On and from the date of declaration of this policy refrigeration and air conditioning units containing chlorofluorocarbons must be labelled in such a manner that the refrigerant can be identified by service perscnnel at all times.

Domestic Air Conditioning

5. To reduce the emission of chlorofluorocarbons from domestic air conditioners -
- 1) on and from the date of declaration of this policy, any person who services or maintains domestic air conditioners must reclaim chlorofluorocarbons whenever units are being serviced and maintained at a central service premises; and
 - 2) any chlorofluorocarbon that is reclaimed must be returned to the distributor or wholesaler for reprocessing or recycled on-site or securely stored pending destruction.

South Coast Air Quality Management District, California, has introduced the following rules which are indicative of the requirements in the USA.

a) Rule 1411: Recovery or Recycling of Refrigerants from Motor Vehicle Air-conditioners

This rule prohibits, w.e.f. 1/1/92, release or disposal of refrigerants used in Motor Vehicle .PA Air-conditioners and prohibits the sale of refrigerant in containers carrying less than 20 pounds of refrigerant. This rule is applicable to any person engaged in installation, replacement and servicing of Motor Vehicle Air-conditioners or any other vehicle repairs that could cause release of refrigerants. This rule also applies to refrigerant retailers.

Certified recovery/recycling equipment is required to be installed and the technicians operating the machines required certification from competent authorities regarding adequate training for proper use of the equipment.

The Mobile Air Conditioning Society (MACS) have devised a program to impart proper training to technicians for proper use of equipment, understanding of the recovery process, equipment servicing requirements. A written test is administered (at a nominal cost of \$ 20 per person) and certificate issued to successful technicians.

b) Rule 1415 : Reduction CFC Emission from Stationary Refrigeration and Airconditioning Systems

The purpose of this rule is to reduce CFC emission from Stationary Emission and Air-conditioning Systems by requiring the owners or operators of such systems to reclaim recover and/or recycle the refrigerants and minimize leakages. This is also applicable to any persons who replace, service or relocate a refrigerant system.

On or after 1st January, 1992, persons covered under this rule are required to recover or recycle the refrigerant using approved equipment and employ specified procedures for the use of equipment. All installations of refrigerant systems require an inspection by a certified auditor to determine that the system is operating as per specifications and there are no refrigeration leakages. Such an inspection is required every 12 months.

The full text of the rules are available with us and the above is an extract to indicate the nature and coverage of the legislation in force regarding the recovery and recycling of refrigerants.

APPENDIX 2.8

PROVISIONS IN SWISS ORDINANCE ON ENVIRONMENTALLY
HAZARDOUS SUBSTANCES

DISPOSAL OF EQUIPMENT CONTAINING CFCs

1. The regulation inter alia contains special provisions for disposal, which means e.g. that refrigerants must be removed from discarded refrigerators and properly disposed of. On January 1st 1992, a concept for the elimination of used refrigerators and deep freezers, elaborated by the concerned industry, has become operational nationwide. According to this scheme, the consumer will give his old refrigerator back to the supplier, against a unit fee. The supplier will then pass on the refrigerator to a specialised elimination unit, that recovers the CFC from the refrigeration circuit and the insulating material.

Source : Ordinance of 9 June, 1986 relating to Environmentally Hazardous Substances (Ordinance on Substances; Rs 814.013).

LEVEL - 1

ENTERPRISE LEVEL DATA

<u>SL.NO.</u>	<u>DATA ELEMENT</u>	<u>DATE OF UPDATE</u>	
			/ /
01.	SERIAL NO.	:	
02.	NAME AND ADDRESS OF ENTERPRISE	:	
03.	YEAR OF INCEPTION	:	
04.	NAME OF PROMOTER	:	
05.	NAME OF CONTACT PERSON	:	
06.	SUB-SECTOR APPLICABLE		
	6.1 DOMESTIC FRIDGES & DEEP FREEZERS (INCLUDING FOAMS)	:	
	6.2 COMMERCIAL AND INDUSTRIAL REFRIGERATION	:	
	6.3 COMMERCIAL AIRCONDITIONING	:	
	6.4 MOBILE AIRCONDITIONING	:	
	* If enterprise is in more than one sub-sector then a record will exist for each sub-sector.		
07.	TYPE OF ENTERPRISE	:	a) Manufacturer b) Importer/Assembler c) Installation Contractor d) Repairer/Service Agency
	7.1 NO. OF EMPLOYEES	:	
	7.2 BREAK UP OF EMPLOYEES BY ACTIVITY	:	
	- MANUFACTURE		
	- SERVICE*		
	-- OTHERS		

* Sales and distribution including service

APPENDIX - 2.9 (Contd.)

08. TECHNICAL TIE-UPS :
- 8.1 NAMES OF TECHNO- :
LOGY SUPPLIER/
COLLABORATOR
 - 8.2 NATURE OF :
COLLABORATION
 - 8.2.1 DESIGN & DRAWINGS:
 - 8.2.2 EQUIPMENT SUPPLY :
 - 8.2.3 ANY OTHER :

INFORMATION ON ACTIVITY AND LEVELS

09. 9.1 MANUFACTURE/ASSEMBLY (FOR EACH SUB-SECTOR)
- 9.1.1 PRODUCT TYPES & :
MODELS UNDER
EACH PRODUCT
TYPE
 - 9.1.2 INSTALLED CAPA- :
CITY(NOS/ANNUM)
[BY MODEL OR
BY PRODUCT TYPE)
 - 9.1.3 ACTUAL PRODUC- :
TION
 - 9.1.4 ANNUAL GROWTH :
IN DEMAND
(PROJECTED)
 - 9.1.5 PRESENT INSTA- :
LLED BASE
[POPULATION]
AS OF YEAR END
[BY PROD.TYPE]
 - 9.1.6 SALES QTY (BY :
PRODUCT TYPE)
 - 9.1.7 PRESENT MARKET :
SHARE [BY
PRODUCT TYPE]
 - 9.1.8 ANNUAL CFC QUA- :
NTITY CONSUMED
 - CFC-12 :
 - CFC-11 :
 - OTHER CFCs :
(if any)
 - TOTAL :

APPENDIX - 2.9 (Contd.)

- 9.1.9 CFC CONSUMPTION:
NORM PER UNIT
- FOR FRESH
CHARGE BY
MODEL

- FOR FRESH
CHARGE BY
PRODUCT TYPE
BASED ON
WEIGHTED AVG.
- 9.1.10 CFC CONSUMPTION:
NORM
- FOR FOAM
BLOWING BY
MODEL

- FOR FOAM
BLOWING BY
PRODUCT TYPE
BASED ON
WEIGHTED AVG.
- 9.1.11 ESTIMATED LIFE :
OF PRODUCTS
BEFORE SCRA-
PPING (BY PRO-
DUCT TYPE)
IN YEARS
- 9.1.12 WARRANTY PERIOD:
BY PRODUCT TYPE
- 9.1.13 % AGE OF SALES :
AS RETURNS IN
WARRANTY PERIOD
BY PRODUCT
TYPE REQUIRING
RECHARGING
- 9.1.14 CFC QUANTITY :
USED FOR REC-
HARGE (BY
PRODUCT TYPE
OR MODEL)

CFC QUANTITY :
USED BY RECHARGE
(BY PRODUCT TYPE
BASED ON WEI-
GHTED AVERAGE)

APPENDIX - 2.9 (Contd.)

9.1.15 FOAM INSULATION:
USED BY MODEL
(IN KGS)

FOAM INSULATION:
USED BY PRODUCT
TYPE BASED ON
WEIGHTED AVE-
RAGE (IN KGS)

9.2 REPAIR/SERVICING (FOR EACH SUBSECTOR)

9.2.1 TYPES OF PRO- :
DUCTS SERVICED

9.2.2 NUMBER OF :
PRODUCTS SERVI-
CED PER YEAR

9.2.3 PRODUCTS SERVI- :
CED AT SITE
(BY PROD. TYPE)

9.2.4 PRODUCTS SERVI- :
CED INHOUSE (BY
PROD. TYPE)
AT OWN CENTRES

9.2.5 CONSUMPTION :
NORM OF CFC (BY
TYPE) FOR
PRODUCT TYPE
(KG/UNIT)

9.2.5.1 AVERAGE CFC (BY :
TYPE) RECOVE-
RABLE FOR PROD.
TYPE AS % OF
ORIGINAL
CHARGE)

9.2.6 CFC CONSUMPTION:
BY TYPE (QUAN-
TITY)

9.2.7 CFC CONSUMPTION:
BY TYPE VALUE

APPENDIX - 2.9 (Contd.)

9.3 INFRASTRUCTURAL FACILITIES

9.3.1 FACILITIES AVAILABLE FOR CHARGING AND HANDLING OF CFCs

9.3.1.1 STORAGE :

9.3.1.2 MEASUREMENT OF CHARGE :

9.3.1.3 LEAK DETECTION

9.3.1.4 FLUSHING

9.3.1.5 ESTIMATE OF CFC WASTAGE PER ANNUM (BY TYPE OF CFC) QTY/BY CAUSE PAST 1 YR) :

9.3.1.6 WHETHER ANY FACILITY EXISTS :

- FOR RECOVERY :
(YES/NO),
NUMBER OF

- FOR RECYCLING:
(YES/NO),
NUMBER OF

- COST OF EQUIPMENT :

9.3.1.7 QUANTITY OF CFC: (BY TYPE)

- RECOVERED/YR :
- %AGE OF TOTAL: USAGE
- RECYCLED YR :
- % OF TOTAL : USAGE

9.3.1.8 IF PLASTIC BAGS: USED FOR RECOVERY (Y/N)

- NUMBER OF BAGS USED :

- COST PER BAG :

APPENDIX - 2.9 (Contd.)

9.3.1.9 FOR RECOVERY, :
USING MACHINE

- TYPE OF UNIT :
- CIF PRICE :
- DUTY (%) :
- INSTALLED :
COST
- SUBSIDY REC- :
EIVED, IF ANY

9.3.1.10 FOR RECYCLING :
USING MACHINE

- TYPE OF UNIT :
- PRICE CIF :
- DUTY (%) :
- INSTALLED :
COST
- SUBSIDY REC- :
EIVED, IF ANY

10. CFC CONSUMPTION

10.1 SOURCES OF :
SUPPLY

10.2 BREAK-UP OF CFC:
PROCURED BY
DIRECT IMPORT
BY TYPE,

- QTY :
- BASIC PRICE :
- TAXES AND :
DUTIES
- FREIGHT :

10.3 SIZE OF CONTAIN:
ERS PROCURED IN

10.4 % QUANTITY PR- :
OCURED BY SIZE
OF CONTAINER

10.5 PROCUREMENT :
PRICE BY CFC
TYPE & CONTAI-
NER SIZE

APPENDIX - 2.9 (Contd.)

- 10.6 IF CFC RECOVERED, :
CONSUMED OR SOLD
- 10.7 IF SOLD, MODE OF :
SALE (CYLINDERS,
PLASTIC BAGS)
- 10.8 PRICE OBTAINED FOR:
RECOVERED CFC
 - IN BAGS
 - IN CYLINDERS
- 10.9 IF CFC RECYCLED :
AND SOLD (Y/N)
- 10.10 PRICE OBTAINED :
FOR SALE OF
RECYCLED CFC

11. ORGANISATION RELATED

- 11.1 NO.OF EMPLOYEES:
- 11.2 AVERAGE YEARLY :
WAGE RATE (AVG.
FOR ALL
EMPLOYEES)
 - FOR :
 - SUPERVISORS
 - FOR :
 - TECHNICIANS
- 11.3 TOTAL INVEST- :
MENT IN PLANT
& EQUIPMENT

12. GENERAL

- 12.1 STEPS TAKEN
TO REDUCE CON-
SUMPTION OF CFCs
 - 12.1.1 BY TECHNICAL
IMPROVEMENTS
 - 12.1.2 BETTER HANDLING:
PRACTICES
 - 12.1.3 BY SUBSTITUTION:

APPENDIX - 2.9 (Contd.)

12.1.4 BY RECOVERY & :
RECYCLING TYPE
OF EQUIPMENT
USED

12.2 APPROXIMATE % :
OF REDUCTION
ACHIEVED IN CFC
CONSUMPTION/
UNIT OF PRODUCT
BY PRODUCT TYPE)

12.3 PLANS OF COLLA-:
BORATOR TO
SWITCH OVER TO
SUBSTITUTES
(PRODUCT TYPE
AND SUBSTITUTE
PLANNED)

Note : 1. The data for previous years may please be
provided as available.
2. Records be kept so as to provide data for
multiple years in future.

APPENDIX - 2.10 (Contd.)

12. TOTAL IMPORTS OF CFCs :
BY TYPE)

TYPE :	(ODP) :	YEAR :	QTY :	:	:	:
:	:	:	IN EQUIV:	:	:	:
:	:	:	ODP TONS:	CIF :	DUTY :	TOTAL
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:

- 12.1 PRICE OF RECOVERED/ RECYCLED CFC'S :
- RECOVERED IN BAGS : (3) 12.1
 - RECOVERED IN CYLINDERS : (3) 12.2
 - RECYCLED : (3) 12.3

13. CFC CONSUMPTION PER CAPITA (ODP GMS) :

14. CFC CONSUMPTION PER GNP (ODP TONS) :

USE OF CFCs

15. CONSUMPTION OF CFCs BY SECTOR (BY CFC TYPE) (3) 3

CFC CONSUMPTION QUANTITY

SECTOR :	CFC-11:	CFC-12 :	CFC-113:	CFC-114 :	CFC-115
:	:	:	:	:	:
:	:	:	:	:	:
:	:	:	:	:	:
TOTAL :	:	:	:	:	:

16. GROWTH IN DEMAND OF CFCs BY SECTOR (BY CFC TYPE) :

SECTOR :	GROWTH RATE %
:	:
:	:
:	:

APPENDIX - 2.10 (Contd.)

17. CFC RECOVERED AND RECYCLED (LAST 2 YRS) (BY CFC TYPE) : (3) 5
18. TOTAL CFC INVENTORY (LAST 2 YEARS) (BY CFC TYPE) : (3) 7
19. CFC LOST IN SCRAP & RECHARGING, EMISSION : (3) 8

CFC LOST

SECTOR	PRESENT YEAR			PREVIOUS YEAR			PRESENT YEAR-2		
	SCRAP	RECYCLING	EMISSION	SCRAP	RECYCLING	EMISSION	SCRAP	RECYCLING	EMISSION

20. TOTAL NUMBER OF VENTURES EXISTING FOR RECOVERY AND RECYCLING :
- WITH PLASTIC BAGS
 - WITH RECOVERY UNIT ONLY : (3) 10
 - WITH RECYCLING UNIT
 - PRESENT YEAR
 - YEAR - 1
21. TOTAL INVESTMENT IN RECOVERY AND RECYCLING VENTURES :
- WITH RECOVERY UNIT ONLY : (3) 13.1
 - WITH RECYCLING UNIT : (3) 13.2
22. TOTAL SUBSIDY GIVEN FOR RECOVERY/RECYCLING UNITS : (3) 13.1, 13.2

APPENDIX - 2.10 (Contd.)

23. FUNDING FROM MULTILATERAL SOURCES FOR EQUIPMENT :

POLICY MEASURES ADOPTED FOR CFC REDUCTION

24. IMPORT QUOTAS (Y/N) :
REDUCTION PLANNED OVER NEXT 3 YEARS AS PERCENTAGE OF 1991 CONSUMPTION

25. ARE QUOTAS TRADEABLE (Y/N) :

26. MARKET PREMIUM ON QUOTAS :

27. SUBSIDY ON EQUIPMENT USING SUBSTITUTES IF ANY (Y/N) :

EXTENT OF SUBSIDY

28. INCREASED TAXES ON CFC BASED EQUIPMENT, IF ANY (Y/N) :

EXTENT OF TAX INCREASE

29. TOTAL EXPENDITURE ON TRAINING & PROMOTION :

AMOUNT SPENT

NUMBER OF PERSONS TRAINED :

AMOUNT OF SUBSIDY FROM EXTERNAL SOURCES :

- Note : 1. The data for previous years may please be provided as available.
2. Records be kept so as to provide data for multiple years in future.