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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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FINAL 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)

VOLUME-I: EGYPT COUNTRY STUDY

FOR

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MANTEC CONSULTANTS PVT. LTD., INDIA
(805, VISHAL BHAWAN, 95, NEHRU PLACE, NEW DELHI-110019 TEL: 6429295, FAX: 6447032, TLX: 31-75330)

in association with
S. B. BILLIMORIA & CO., INDIA

and experts from
INDIAN INSTITUTE OF TECHNOLOGY, NEW DELHI, INDIA
ACS, AUSTRALIA

/UNIDO mark/ on the financial viability of the collection and safe disposal of refrigerant /gases in /Egypt/ - given (1) background and objectives (2) CFC audit and /demand/ /forecast/; /supply/ of CFCs; the servicing industry; compliance aspects to meet the National protocol requirements (3) /equipment/ details for collection and /recycling/ of CFCs in various sub-sectors (4) relevant technical options (5) /economic analysis/; /methodology/ (6) /legal aspects/ and /institutional framework/; /financial aspects/. /List of documents/. /Statistics/, /diagrams/ /Included//.

VOLUME I - EGYPT COUNTRY STUDY

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EXECUTIVE SUMMARY

I BACKGROUND

Ozone depletion and its after effects on the life on earth have become a matter of global concern. With the signing of the Montreal Protocol, the international community has come together for taking the necessary steps to stop the damage to the stratospheric ozone layer. This study has been commissioned by UNIDO, as part of an ongoing project, to cover the techno-economic assessment of the financial viability of collection, recycling and/or safe disposal of refrigerant gases and related materials. The field survey has been carried out in Egypt, Kenya & Nigeria, the project area countries to serve as a basis for recommending policy guidelines for Africa as a whole.

II CFC AUDIT & DEMAND FORECAST

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 Sectt.(NES) in Kenya & Federal Environment Protection Agency (FEPA) in Nigeria.

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

Table-I (Contd..)
(MT)

	EGYPT		KENYA		NIGERIA	
	CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12
- Domestic & commercial airconditioning	31	-	-	-	4.7	7.3
- 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	

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.

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) due to the partial or complete switchover to substitutes in the other sectors. The per capita consumption of CFCs in Egypt, Kenya and Nigeria was 33.7 gms, 4.15 gms and 8.5 gms respectively in 1991.

The demand forecast for CFCs in the various sub-sectors of refrigeration and airconditioning, based on industrial growth rates, is summarised below in Table II, for the benchmark years of the Montreal Protocol.

TABLE - II

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

Table-II (Contd.)

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
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

After 1997 the CFC demand will only be for servicing of the existing population of CFC based equipment, as new equipment production will be based on substitutes rather than CFCs.. Inspite of the phasing out of equipment based on CFCs, the CFC requirement is still above the Montreal Protocol limits in the years 2005/2007.

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.

III EQUIPMENT FOR RECOVERY AND RECYCLING OF CFCs

Several manufacturers/users of these equipment were contacted and met by the project team experts, to understand the features and operations of the same. Based on this, a comparative evaluation of the technical features of various representative models of recovery and recycling equipment was carried out.

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.

The indicative price of a portable recovery equipment (capacity upto 0.5 lb per minute) is US $ 1000, while that of a recycling equipment (capacity upto 25 Kg per hour) is US$ 1400 only.

IV TECHNICAL OPTIONS FOR COLLECTION/RECOVERY AND RECYCLING OF CFCs

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.

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

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.

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

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 three or four projects can be considered for Africa as a whole.

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

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 III below :

TABLE - III

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.

Recovery of CFCs from related materials (Insulation Foam)

The recovery of CFCs from insulation foam is logistically and economically not 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 CFC.

Safe Disposal of CFCs

Disposal of CFCs is not 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.

V ECONOMIC VIABILITY

The economic viability of the identified technical options

for recovery and recycling was done at

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

Viability Analysis at Venture level

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 - IV

MAXIMUM NUMBER OF RECOVERY & RECYCLING VENTURES IN THE PROJECT COUNTRIES

	EGYPT		KENYA		NIGERIA	
	Recovery only	Recycling	Recovery only	Recycling	Recovery only	Recycling
Max. annual qty feasible (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 recolvery equipment installed at all the recycling ventures.
@ Taken as 25% higher than the break-even volume

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 viability analysis of ventures for the three countries is summarised in the Table V below :

TABLE - V

SUMMARY OF VIABILITY ANALYSIS AT VENTURE LEVEL

	EGYPT		KENYA		NIGERIA	
	Recovery only	Recy-cling	Recovery only	Recy-cling	Recovery only	Recy-cling
No. of ventures proposed (based on industrial survey)	100	12	40	5	150	10
Project cost per venture(US$)	1352	3224	1366	3244	1352	3223
Cost per kg of CFC processed (US $)	0.92	4.10	1.04	5.80	0.92	4.47
Break even quantity,kg	209	1439	145	1013	205	1306
Internal rate of return (IRR)						
- on project cost	23.5%	78.9%	27.9%	75.6%	47.2%	97.7%

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.

The promotion of these ventures will help each of the countries to comply with the Montreal Protocol. While this would be almost total in Nigeria, in Egypt and Kenya the recovery and recycling programme would have to be supplemented by CFC banks or perhaps use of a drop in substitute for recharging in the years after 2007.

At the enterprise level, the ventures for collection (by plastic bags), recovery (by portable equipment) and recycling will need to be supported with measures such as exemption of import duty and provision of capital subsidy on equipment, increase in import duty on virgin CFCs, and Government sponsored training and publicity compaign, for these venture to become economically viable.

Net National Economic Benefit

The venture level analysis has been aggregated at the national level for each country. The Net National

Economic Benefit has been worked out using the principles of social cost benefit analysis. The annual costs and benefits (at 1992 prices) have been assessed for the period 1993 to 2010. A discounting factor of 2% has been used to determine the "net present value" of the net national economic benefit for each country, as summarised in Table VI below.

TABLE - VI

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.

VI 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.

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 CFC and maintaining records of the same

- Accredition/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.

VII COMPARISON OF COUNTRY CASE STUDIES & FORMULATION OF REGIONAL GUIDELINES

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

TABLE - VII

CFC RECOVERY AND RECYCLING - A COMPARATIVE ANALYSIS

PARAMETERS	EGYPT	KENYA	NIGERIA
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-VII (Con*d..)

PARAMETERS	EGYPT	KENYA	NIGERIA
Cumulative 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 (including collection using plastic bags)from 1993 to 2010 (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-VII (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 manufaucture 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.

VIII REGIONAL GUIDELINES FOR AFRICA AS A WHOLE :

Based on the above comparative assessment of country case studies, the regional guidelines for Africa as a whole have been formulated, as detailed in Volume IV of this report.

Some of the significant guidelines are :

1) 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.

2) 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.

3) Financial support by the concerned Government for making the recovery and recycling activity viable at venture level would be required.

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

4) 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.

5) 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.

6) 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.

IX REGIONAL DATA BANK

The data base for each country can be integrated into a Regional Data Bank, the structure for which has been discussed in detail in Volume IV of this report, and summarised below :

Level 1 : Enterprise level - which would have data on the activity of individual enterprises and the particulars of CFC consumption and utilisation.

Level 2 : Sub-sector level - containing aggregation of enterprise level data and sub-sector specific data.

Level 3 : Sector level - containing an aggregation of sub-sector level data plus sector specific data

Level 4 : National level - in which the data will be aggregation of sector level data as well as country specific data.

From the experience of the project country studies it may be said that the one time audit of CFC supply and use in different African countries integrated into the Regional Data Bank can provide sufficient data at the enterprise, sub-sector and sectoral levels for assistance in formulating required policy measures.

VIII. CONCLUSIONS

The findings of the study indicate that given adequate financial support from multilateral agencies and with appropriate legislation and institutional strengthening for implementation, it is technically, economically and organisationally feasible to have viable programmes for recovery and recycling of refrigerant gases in Africa.

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.

Ozone depletion can lead to increased high energy ultra violet radiations on earth which can result in major problems such as increasing human skin cancer, disrupting the aquatic food chain and adversely affecting food-crops production. In addition, CFCs are generally held to be responsible for some one fifth of global warming.

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.

The 'Open ended working group of the parties to the Montreal Protocol' recommended that 'Country specific studies' be carried out in developing countries in order to understand their specific needs and to estimate the cost of assistance required to comply with the Montreal Protocol.

As a contribution to these efforts UNIDO has embarked upon a project - US/RAF/90/173 with the following 9 sub-programmes with specific reference to countries in Africa.

1. Industrial Country Studies
2. Industrial Sub-sector Background Analyses
3. Techno-economic Appraisal
4. Identification of Industrial Enterprises producing/ assembling CFC-based Products
5. Deployment of Methodology to Appraise Techno-economic Viability and Costs of Substituting Technology
6. Test Methodology to determine cost of replacement
7. Revise Methodology and Computer Software
8. Determine the Cost of Substituting Technologies
9. Funding the Technology Substitution

The first two sub-programmes have been completed and they have brought out that the greatest impact on reductions in CFC consumption in African countries can be made through 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 no. 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". The aims of this assignment are:

- to carry out the background analysis required to allow the UNIDO Secretariat to provide the Governments of three (3) representative African countries : Egypt, Kenya and Nigeria, with policy advice to enable them to enact an efficient system of collection, recycling and/or safe disposal of refrigerant gases and allied materials;

- to provide the basis for the development of a generalised set of technical, economic, political and legislative guidelines valid for Africa as a whole and to strengthen environmental and industrial policy and strategy in the region.

In 1990, a study titled "Costs to Egypt of protecting the stratospheric Ozone layer" was conducted by Egyptian Environment Affairs Agency in cooperation with USEPA.

This project takes off from this stage and 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 STRUCTURE OF THE REPORT

1.3.1 The project report covering the studies related to Egypt, Kenya and Nigeria, is prepared 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

Each of the volumes I, II and III are structured in such a way that it becomes a stand alone comprehensive report of that country, but yet carries with it the overall

Executive Summary and Conclusions, which cover all three country studies. This arrangement permits each country to have its own report but also permits the policy makers of the country to have an overview of the variations from one country to another.

Volume IV carries the regional aspects and provides a set of guidelines and inputs for a policy-making oriented data bank to assist international agencies in formulating a regional policy for recovery, recycling and disposal of CFCs used in the refrigeration and airconditioning equipment.

1.4 APPROACH TO THE EGYPT COUNTRY STUDY

1.4.1 The overall approach adopted 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
- Assessment of technically feasible quantities for recovery and recycling (by type of equipment)
- Practically Recoverable quantities
- Implications on compliance with Montreal Protocol

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

- Schemes for recovery & recycling in various sub-sectors
- Equipment selection
- Logistics and other aspects of technical feasibility
- Identification of types of ventures & framework for national system for recovery & recycling

Step IV : Economic Viability Analysis

- At venture as well as national level
- Sensitivity Analysis

Step V : Framework for Implementation

- Present Scenario

- Proposed measures such as Legislative, Financial support, Market measures, Institutional framework

1.4.2 The basic collection of data has been based on a comprehensive field survey of industrial enterprises, professional bodies and associations, as well as government organisations etc. Suitable questionnaires/ check lists were used for obtaining the necessary information from various sources. Discussions were also held with relevant international organisations including UNEP, World Bank, etc.

Considerable effort was put in towards collection of secondary data from various sources. A list of various reports/documents specially collected and studied is enclosed at Appendix 1.1.

Besides the project team experts, nationals from the country were employed as sub-contractors, to facilitate the conduct of the study and to have local participation.

Based on the field survey, secondary data collection and useful discussions with key officials and country experts, this report analyses and presents the findings and recommendations in line with the objectives.

1.4.3 A brief resume of the coverage is given below :

a) Useful discussions were held with Mr Tharwat Sabry, UNDP; Ms Nadia Makram Ebeid, Programme Officer, UNDP; Mr Salar Hafaz, Deputy Chairman, Dr El-Mohamady Eid and Mr Fouad M Megahed of Egyptian Environment Affairs Agency (EEAA) and local consultants, industrialists, etc.

Egyptian Environment Affairs Agency (EEAA) is the nodal agency responsible to look after the environmental concerns of the country. It plays a very active role in implementing the Montreal Protocol in the country. Dr Mohamady Eid, of EEAA, was actively involved in drafting and signing of the Montreal Protocol. EEAA also coordinates with international agencies for several activities concerning the implementation of the Montreal Protocol. To make people aware about the CFC problems, it is organising seminars, group discussions and also assists the companies in preparing proposals for the cost to them in phasing out of CFCs.

EEAA also assists the Government in framing rules and regulations regarding Environment Management and Pollution Control.

b) A list of various organisations and persons contacted during the field survey in Egypt is enclosed at Appendix - 1.2.

1.5 STRUCTURE OF VOLUME I - EGYPT

1.5.1 This volume is set out as follows :

An executive summary is provided in the beginning giving an overview of the findings and overall conclusions of the study.

Chapter 2 provides description of the present supply and utilisation; future demand projections; and recoverable quantities of CFCs, upto the year 2010, which is the terminal year for complete phasing out of CFCs as per the Montreal Protocol. It also provides an overview of the physical distribution of the suppliers and users of CFCs in Egypt.

Chapter 3 provides details about the various types of equipment available for recovery and recycling of refrigerant CFCs.

Chapter 4 describes the relevant technical options and the feasible structure of the national level programme for recovery and recycling of CFCs.

Chapter 5 describes the Economic Analysis of the ventures for recovery and recycling, at the enterprise as well as the national levels. This analysis includes computation of Net National Economic Benefit.

Chapter 6 deals with evolving a framework for implementation of the recovery and recycling programme in Egypt.

Chapter 7 presents the overall conclusions of the study.

CHAPTER - 2

CFC AUDIT AND DEMAND FORECAST

2.1 INTRODUCTION

2.1.1 A detailed national CFC audit was carried out in Egypt. Maps of Africa and Egypt are enclosed at Appendix 2.1 (A) and (B) for ready reference, showing the location of the country and also the important cities/towns in the country. As, in Egypt, there is no manufacture of CFC, and there is no significant export of CFCs or CFC based products, the consumption in the country is approximately equal to the import of CFCs.

2.1.2 The consumption, has therefore been worked out on the basis of import of CFCs (supply side approach) as well as utilisation/demand of CFCs in each sector, which, in turn, are estimated by building up sub-sectoral demand profiles (demand side approach). The import and utilisation of CFCs are estimated through a comprehensive survey carried out by the project team. The survey covers the following :

- Primary sources such as :
  - * importers/distributors of CFCs
  - * end users viz manufacturers/assemblers/ importers/servicing agencies/installations of CFC based equipment/products
  - * industry experts, associations and government bodies
- Secondary data sources including government bodies and associations

2.1.3 The CFC Audit has been done for the 'Airconditioning and Refrigeration' Sector, which is the largest and most important consumer of CFCs in Egypt, and hence was identified by UNIDO for a CFC audit.

The findings of the survey are presented in the sub-sections which follow :

2.2 SUPPLY OF CFCs

2.2.1 Sources of Supply and Infrastructure

CFCs are not manufactured in Egypt and the demand is met through imports from European countries. There are three major importers of CFCs who account for nearly 75% of CFC

supply in Egypt as follows :

Du Pont, Germany	-	35%
ICI, UK	-	25%
ATOCHEM, France	-	15%

Rest of the demand is met through imports from other sources like Montedison, Italy; Hoechst, Germany and suppliers of blended polyols namely DOW Chemicals, Bayer & ICI, for refrigeration and other foams.

Misrfreon,agent of Du Pont and Misr Engineering Centre for Consultation & Agencies, agent of Atochem, have installed refilling facilities at Port Said and Cairo respectively to transfer the refrigerants into cylinders from large containers. Distribution is done through company outlets and wholesalers, located mainly in Cairo & Alexandria, as well as direct supply to manufacturers/ assemblers.

2.2.2 Level of Imports

No import statistics on CFCs are maintained by Central Agency for Public Mobilisation and Statistics in Egypt and therefore level of imports has been estimated based on CFC importers' feedback. The present as well as past level of imports are summarised in Table - 2.1.

TABLE - 2.1

IMPORTS OF REFRIGERANTS IN EGYPT - BY TYPE (MT)

TYPE OF CFC	1989	1991
CFC-11	1500	1050*
CFC-12	900	800
Others (114, 502 etc)	N.A.	50
		1900

* : Including CFC in blended Polyols.
N.A. : Not Available
Source : Importers of Refrigerants in Egypt

According to the importers, there is almost 45% reduction in CFC imports from 1986 to 1991. The substantial decrease in CFC-11 imports from 1989 to 1991 is primarily due to substitution by Methylene Chloride in foams.CFC-12 imports are expected to decrease once its use in Cosmetics/ Perfumes aerosols is completely stopped by '92. El Beleidy, which accounts for 85% of cosmetics/perfumes market, is installing LPG based facilities at a cost of LE 8 Mn at Ramadan City which is likely to be operational by '92 end.

2.2.3 Prices

The current prices (CIF as well as retail) of refrigerants along with custom duty are indicated in Table - 2.2 below.

TABLE - 2.2

CURRENT PRICES OF REFRIGERANTS (1991) IN EGYPT

REFRIGERANT	CIF (US $/KG)	CUSTOM DUTY (%)	RETAIL PRICES (US $ PER KG)
CFC-11	1.50	10	2.2
CFC-12	2.0-2.2	10	3.5-3.9*
HCFC-22	2.6-3.5	10	4.2-5*

* : Range depending on packing and source.
Source - Importers.

2.3 OVERVIEW OF THE USER INDUSTRY

2.3.1 Refrigeration & Airconditioning

a) Domestic Refrigerators and Deep Freezers :

There are six major manufacturers of domestic refrigerators/deep freezers in Egypt with an installed capacity of about 1 million units per year. The production of refrigerators in the past is given in Table - 2.3. The compressors used for refrigerators are imported while the refrigerator cabinets are indigenously produced and foamed.

TABLE - 2.3

PAST TREND IN PRODUCTION OF DOMESTIC REFRIGERATORS & DEEP FREEZERS IN EGYPT ('000 NOS)

YEAR	1978	'80	'82	'85	'86	'87	'88	'89	'90	'91
Production	145	219	374	514	536	601	693	477	246	300

Source : 1. Central Agency for Public Mobilisation and Statistics (CAPMAS), Egypt.
2. 1991 data based on survey

The largest manufacturer (IDEAL) is a public sector company with an installed capacity of 7,50,000 numbers per annum, while all others are smaller privately owned companies with installed capacity ranging from 40,000 to 80,000 nos per annum. Many of these have been set up with technical assistance from leading international companies like Zerowatt, Zanussi, Leiber etc. These companies have grown rapidly during the eighties and have reduced IDEAL's

market share from 100% in 1979 to less than 50% in 1990. The production has shown a steady growth from 146,000 nos in 1978 to 693,000 nos in 1988. There has been a sharp decline in production from 1989 onwards due to various economic reasons such as devaluation of the currency in 1989 and the Gulf War in 1990. In 1991, the production increased over 1990 and was estimated at about 300,000 nos. Imports of the refrigerators are not allowed in Egypt except by non-resident Egyptians. The present population of domestic refrigerators and deep freezers is estimated as 6.68 million nos. based on past production and import data, and average life expectancy of 20 years.

The most common sizes are 8 cu.ft, 10 cu.ft and 12 cu.ft for refrigerators and 6.5 cu.ft and 8 cu.ft for deep freezers. The average unit consumption of CFC-11 for foam blowing (insulation) is about 880 gms which is about 10% higher than the norm due to wastage and rejections. The refrigerant, CFC-12, charge ranges from 190 gms to 235 gms/unit in refrigerators and 175 gms to 185 gms/unit in deep freezers. The average unit norm of consumption given by users is about 220 gms including 10% towards losses in handling, rejections and reworking.

As a practice, most of the refrigerators are repaired at the users' place, where CFC-12 is also used for flushing and leak testing which results in the refrigerant consumption almost twice the initial charge (about 410 gms) in servicing the equipment. Some established service centres have started using vacuum system and dry nitrogen gas. On an average a refrigerator is serviced once in every 10 years and about 9-10% of the population of refrigerators require recharging every year due to compressor failure or leakages.

b) Commercial Refrigeration

i) Cold Stores :

Cold Stores in Egypt are divided into two categories -

- Walk-in-Coolers - 1 to 50 TR (ton refrigeration) capacity
- Cold Stores - 50 TR and above.

These are used in Hospitals, Hotels, Super Markets, Vegetable Markets, Meat Markets, etc. Refrigerants used are CFC-12. HCFC-22 and CFC-502 depending on the kind of material to be

stored. HCFC-22 is used mostly for above zero temp. and CFC-12 and CFC-502 are used for below zero temperature applications. Majority of the population is, however, based on CFC-12.

There are four companies dealing in walk-in-coolers, namely Refcat, Icon, Misr Panel and Koldair. The refrigeration system is imported mainly from two German Companies, Copeland and Bitzer. Installation is done locally with indigenously built panels.

There is no published data available on production/imports of cold rooms. According to the leading companies, the population is 5,000 nos., 300 nos, and 700 nos for CFC-12, HCFC-22 and CFC-502 based systems respectively. The maximum population is of less than 50 TR. The demand in 1991 was 150 nos.

As per the estimates of companies dealing in cold stores, average consumption norm is 6 Kg for 1-50 TR cold stores and 26 Kg for 50 TR & above but actual consumption norm is about 20% higher due to various handling losses. Similarly consumption norm of CFC-11 for insulation is about 149 Kg/unit for cold stores but actually it is about 20% higher i.e. 178.8 Kg/unit.

Every unit needs recharge once in 9-10 years due to compressor failure or leakage. The average CFC-12 consumption norm for recharging is about 13.2 Kg/unit which is higher than initial charge due to use of refrigerant for cleaning, flushing and leak detection. In addition to the above almost each unit needs topping up every year about 10% of initial charge. The average life of cold store equipment is about 25 years.

ii) Mobile Refrigerated Trucks

There are two major companies namely Misr Panel and Refcat dealing in mobile refrigeration. Misr Panel, which is also a representative of 'Carrier', has about 85-90% market share. The imported refrigeration unit is assembled using fabricated insulated boxes. MICAR, a public sector company producing truck chassis, takes refrigerated boxes from Refcat and supplies to the market.

Three sizes of refrigerated trucks are produced in Egypt : Small (1 TR), Medium (8-10 TR) and large (30 TR). Large size trucks are produced

only by Misr Panel.

There are about 3,000 refrigerated trucks in use in Egypt, of which about 1000 nos. are based on CFC-502. All new units produced by Misr Panel are based on HCFC-22 as a move to reduce ozone depletion. The refrigerant charge and production quantities during 1991 are given in Table - 2.4 below :

TABLE - 2.4

TYPE & PRODUCTION OF REFRIGERATED TRUCKS IN EGYPT

TYPE	REFRIGERANT CHARGE (KG/UNIT)		PRODUCTION '91 (NOS.)	
	CFC-12	CFC-502	CFC-12	CFC-502
1 Ton	2-3	-	225	NIL
8-10 Ton	6-7	3-4	60	30
30 Ton	10	10-12	25	-

Source : Misr Panel

In 1991, about 310 CFC-12 based refrigerated trucks were produced. The average initial charge of CFC-12 is 4.5 Kg/unit but as indicated by producers, the average consumption norm is higher (about 5.4 Kg/unit) due to reworking and handling losses. Most of the Mobile refrigerated trucks have an average useful service life of 20 years. On an average 7% of the units need recharging. The consumption norm of CFC-12 for recharging is about 9.9 Kg/unit. The refrigerated trucks are also being produced by the same companies which are the major producers of cold stores. CFC-11 is used for insulation foam blowing, for which the average consumption norm is 72 kg/unit, including losses and wastages.

iii) Display Cabinets

There are three major producers of display cabinets, namely Refcat, Iceberg and Koldair. Koldair, one of the biggest public sector companies, has comprehensive design & production facilities. However, it has no manufacturing facilities for compressors and all compressors are imported. Rest of the companies import the full refrigeration units. The cabinets produced are mostly of 11 to 22 cu.ft size. There is no published data available on production/imports of these items. The total production of such cabinets per annum is about 700 nos/year with a

population of about 4000 nos which is based on manufacturers' feed back. The average life of display cabinets is taken as 20 years.

The average charge is about 600 gms per unit for initial charge (including 20% handling losses) and 1.2 Kg/unit for recharging. On an average about 20% of the units need recharging each year.

The CFC-11 consumption norm (for insulation) is 1.3 Kg/unit including wastage (20%). The reasons of wastage are same as for cold stores.

In Egypt, these are mostly installed at super markets, butcheries, hotels, canteens and sweets shops.

iv) Water Coolers

Koldair is the only company producing water coolers in Egypt. Two models of coolers are produced, with capacities of 17 GPH (gallons per hour) and 9 GPH respectively. The annual production and per unit charge of these units is given in Table - 2.5.

TABLE - 2.5

PRODUCTION AND PER UNIT CHARGE OF WATER COOLERS

TYPE	PER UNIT CHARGE (CFC-12)	PRODUCTION 1991
9 GPH	450 gms	2000
17 GPH	610 gms	6000

Source : Koldair

It is estimated that about 100,000 units are functional in Egypt and their average life expectancy is 20 years.

The average consumption norm for charging (CFC-12) is 600 gm/unit. Wastage and losses during charging are about 15% of the norm, and hence the actual CFC-12 consumption is about 700 gm/unit. On an average 2-2.5% of population need recharge due to compressor failure/leakage, for which the average consumption is 1.2 kg/unit.

Koldair is planning to introduce HCFC-22 based units. In the first phase 17 GPH model will be produced using HCFC-22 as the compressors for this are available internationally.

v) Industrial Refrigeration (Reciprocating Chillers)

Koldair is the only established company which assembles these units. There are several contractors who procure these units from three major importers namely Carrier, Trane and York. The chiller sizes vary from 25 to 150 TR capacity but the most common size is 100 TR requiring a charge of about 60 Kg per unit of HCFC-22. On an average 210 units/year are installed in Egypt. Estimated population of such units is 2500-3000 nos.

c) Domestic & Commercial Airconditioning

i) Domestic Window & Split Air Conditioners

There are four major companies producing window and split air conditioners, namely Koldair, Miraco, Power-Egypt (SAS), and Abac Carrier. Except Koldair all the other three companies have tie-ups with international firms like York, SAS and Carrier. The primary refrigerant used in these systems is HCFC-22, which is not a controlled substance. There are about 4,50,000-5,00,000 units in operation.

ii) Central Air-conditioning

The central air conditioning (centrifugal) plants are installed in large commercial and industrial buildings including hotels (40%), hospitals (30%) and office buildings (20%) etc. The chilling plants are imported from Carrier, Trane and York, and installed by contracting companies such as Koldair, Miraco and Nile General Engg. The capacity of units installed in Egypt varies from 300 - 1000 TR but the most common size is 400 TR, with an average refrigerant charge of about 500 kg of CFC-11 per unit. Each plant has an inbuilt recovery system. However about 20% of the charge is required every year for 'topping up'. About 20 units are installed each year in Egypt, and total population is about 200 nos. Most of the units are CFC-11 based but some (about 25 nos) units are also based on CFC-12. Trane has installed some units using CFC-113 in the past, but most of these have become obsolete.

iii) Packaged A/c Units

There are two main producers of these units in

Egypt namely Koldair & Miraco. These are installed in medium size hotels, small offices, etc. Koldair supplies mainly water cooled units whereas Miraco supplies air cooled units. The capacity of these units ranges between 5 to 20 TR. The total production of such units is about 900 nos. per year. On an average 10 Kg per unit is the charge of HCFC-22 required. There are about 20,000 such units in operation.

iv) Mobile Airconditioning

In Egypt no company produces car air conditioners and most of the airconditioned cars are also imported. Nasr Automotive manufactures Fiat brand cars but very few of them are air-conditioned. The popular brand of cars in Egypt are Fiat, Peugeot, Mercedez, Mazda, B.M.W, Volkswagon, Honda and Toyota. The maximum population is of Fiat (imported) Nasr (local Fiat), Peugeot and Mercedez. At present there are about 1 million cars in Egypt of which about 15% (150,000 nos) are air-conditioned. In addition about 10,000 cars are air-conditioned every year. The average CFC-12 charge per car is 1.2 Kg. including 20% wastage. The average consumption norm for servicing/ recharging is about 2.2 kg/car due to use of CFC-12 for leak detection, flushing, cleaning and also over charging. As per the estimates from servicing agencies, on an average every equipment needs topping up once in 2-3 years (about 10-15% of initial charge) and recharging once in 4-5 years mainly due to leakages. Air conditioned buses are small in number and these are imported.

As per the feed back from Trane, reciprocating systems using HCFC-22 are used for railways in Egypt which are supplied by Trane and Carrier. There are, in all, 3458 railway coaches in Egypt (CAPMAS, 1990), of which about 600 nos are airconditioned.

The computation of new and recharging demand for various subsectors of refrigeration and airconditioning is shown at Appendix 2.2.

Profiles of major enterprises in the airconditioning and refrigeration sector have been enclosed as per Appendix - 2.3.

2.3.2 Aerosols

Use of CFCs as a propellant was banned in 1991 through a Ministerial Decree. Most of the insecticide units have

already discontinued using CFCs, but the perfumes and cosmetics manufacturers are still using CFC-12, CFC-11 and CFC-114. There are mainly four companies producing these, namely El Beleidy, Parfeco, Misr Cosmetics and Kato-aromatic. The total production of CFC based aerosols was about 11.5 million cans in 1991 of which El Baleidy accounts for 10 million cans/year. El Beleidy is now installing LPG based facility at a cost of 8 million LE which will be operational by 1992 end. This is expected to bring down the consumption of CFC-12, CFC-11 and CFC-114 drastically.

2.3.3 Foams (other than refrigeration)

Both polyurethane and polystyrene foams are produced in the country. Currently the foam industry is in transition and use of CFC-11 is declining. CFC-11 is being used as the blowing agent in rigid polyurethane foam only. A mixture of CFC-12 and HCFC-22 is used for polystyrene extruded foams. Polyurethane flexible foam sector has now completely switched over to Methylene Chloride although some manufacturers have used CFC-11 for part of 1991. The main opportunity for reducing CFC-11 use in rigid/semi-rigid foam upto 50% is provided by new polyol systems. Dow-Chemicals, the supplier of polyol, is undertaking trials of this new polyol system at IDEAL and is expected to introduce this into the market by mid-1992. It is estimated that 640 MT of CFC-11 and 50 MT of CFC-12 were used in 1991 by this sector.

2.3.4 Solvents

The use of CFCs (namely CFC-113) as solvent in Egypt is not common as there are hardly any specialised electronics industries like computer hard disk manufacturing etc. The commonly used solvent for degreasing is Carbon Tetrachloride. Government sources indicated a consumption of about 12 tonnes of CFC-113 in 1990 but as this was not confirmed by importers of CFCs, we have assumed that there is no regular import of CFC-113 at present.

2.4 UTILISATION OF CFCs

The consumption of CFC-11 and CFC-12 for 1991 by sub-sector has been summarised in Table - 2.6.

TABLE - 2.6

CFC UTILISATION BY SUB-SECTOR

SECTOR	SUB-SECTOR	CFC-11		CFC-12		UNIT CONSUMPTION AND COMMENTS
		QTY(MT)	%	QTY(MT)	%	
Air Conditioning & Refrigeration	Domestic Refrigerators & Deep Freezers (including refrigerator foams)					Average of 880 gms of CFC-11 used per refrigerator/deep freezer in foam insulation. On an average 220gms of CFC-12 per unit in charging and 410 gm/unit for recharging.
	- New	264		66		
	- Recharging	-		255		
	- Sub Total	264	24	321	38	
	Commercial & Industrial Refrigeration					CFC-11 is used as blowing agent in foam insulation for cold stores (178.8 Kg/unit), refrigerated trucks (72 kg/unit) and display cabinets (1.3 kg/unit). CFC-12 consumption norm :
	- New	50		9		Cold stores (9.6 kg per unit), refrigerated trucks (5.4 kg/unit), display cabinets (0.6 kg/unit) and water coolers (0.7Kg/unit). Recharging - (CFC-12) - Cold Stores-13.2 Kg/unit - Refrigerated-9.9 Kg/unit Trucks - Display cabinet -1.2 Kg/unit - Water Coolers -1.2 Kg/unit
	- Recharging	-		16		
	- Sub Total	50	5	25	3	
	Domestic & Commercial Airconditioning (Centrifugal Chillers)					Unit charge of CFC-11 is 550 kg/chiller (average) Approx. 80% of refrigerant recovered through in-built system.
	- New	11	-	Neg.	Neg.	
	- Recharging	20	-	Neg.	Neg.	
	- Sub Total	31	3	Neg.	Neg.	

SECTOR	SUB-SECTOR	CFC-11		CFC-12		UNIT CONSUMPTION AND COMMENTS
		QTY(MT)	%	QTY(MT)	%	
	Mobile Airconditioning					Unit average charge is 1.2 Kg per car. Recharging - 2.2 Kg/unit
	- New	-		12		
	- Recharging	-		77		
	- Sub Total	-	-	89	10.0	
	Total	345	32	435	51.0	
Aerosols	Pesticides	-	-	-	-	Phased out by LPG
	Cosmetics & Household products	90	8	360	43	Expected to be replaced by LPG by 1992 end.
Plastic Foams (excluding refrigerator foams)	Polyurethane	640		-		Consumption of CFC-11 is likely to decline due to substitution by water blowing agents; use of CFC-12 in polystyrene is being substituted.
	Polystyrene	-		50		
	Sub-Total	640	60	50	6	
Solvents		-	-		-	
Total		1075	100	845	100	

"-"not used.

Note 1 : This is as per UNIDO format Provided at Annex II of the Terms of Reference

2 : The computations for working out CFC quantities have been shown at Appendix - 2.2.

In addition to CFC-11 & CFC-12, there is also use of R-502 (in commercial refrigeration systems), CFC-113 (in solvents) and CFC-114 (in aerosols). However these are used in small quantities and are expected to be substituted by 1993/94, particularly in aerosols and solvents.

2.5 PROJECTED DEMAND OF CFCs BY SUB-SECTOR

2.5.1 The following steps were followed to estimate the future demand :

Step - I : Future demand and population for airconditioning and refrigeration equipment was estimated based on expected growth rate

in various sub-sectors. The methodology adopted has been explained in Appendix - 2.4.

Step - II : Phase out of CFC based equipment was worked out on the basis of the present trends and awareness among the industry regarding substitutes for CFCs, phasing out initiatives being taken by some sub-sector like mobile refrigeration, water cooler, as well as certain assumptions regarding availability of compressors based on substitute refrigerants. As Egypt does not have any manufacture of CFCs, or of compressors, it is expected that the phase out of CFC based equipment will take place from 1993 onwards for various types of equipment and will be completed by 1997, depending upon the availability of compressors (based on substitute refrigerants) as well as the substitute refrigerants themselves. The manufacturing facilities would require changes, primarily new equipment for charging, foaming and leak detection. The impact of phase-out on demand and population of CFC based equipment has been incorporated in the computation of projected demand for CFCs. Similarly, substitution of CFCs in aerosols, plastic foams (other than for refrigeration) and solvents is already in progress. It is assumed that the CFC consumption, in these sectors will be completely phased out by 1995.

Step - III: CFC refrigerant quantities were estimated for both original equipment as well as recharging demand, on the basis of present (1991) unit consumption norms estimated through field survey.

2.5.2 The projected demand and population figures for CFC based airconditioning & refrigeration equipment as well as demand for CFC refrigerants (OE and recharging) for each sub-sector have been worked out in Appendix - 2.5, which also shows the total recoverable quantities of the refrigerants. The projections of demand for the equipment and the CFCs, are summarised below in Tables - 2.7 and 2.8 respectively.

TABLE - 2.7

FORECAST OF PRODUCTION AND POPULATION OF AIRCONDITIONING & REFRIGERATION EQUIPMENT IN EGYPT

('000)

EQUIPMENT/SUB-SECTOR			1991	1996	2005	2007	2010
DOMESTIC REFRIGERATORS & DEEP FREEZERS	PRODUCTION ('000)	- Total	300.0	483.0	1139.0	1378.7	1835.0
		- CFC based	300.0	193.0	0.0	0.0	0.0
	POPULATION ('000)	- Total	6686.0	8401.0	13432.0	15191.0	18739.0
		- CFC based	6686.0	8023.0	5838.0	4964.0	3494.0
COMMERCIAL & INDUSTRIAL REFRIGERATION - COLD STORES	PRODUCTION ('000)	- Total	0.15	0.20	0.33	0.35	0.39
		- CFC based	0.15	0.05	0.00	0.00	0.00
	POPULATION ('000)	- Total	5.0	5.1	6.1	6.4	6.9
		- CFC based	5.0	4.7	3.6	3.4	3.1
- REFRIGERATED TRUCKS	PRODUCTION ('000)	- Total	0.31	0.36	0.45	0.46	0.49
		- CFC based	0.31	0.0	0.0	0.0	0.0
	POPULATION ('000)	- Total	3.0	4.17	6.47	6.99	7.79
		- CFC based	3.0	3.08	2.34	2.20	2.01
- DISPLAY CABINETS	PRODUCTION ('000)	- Total	0.70	0.91	1.56	1.65	1.81
		- CFC based	0.70	0.23	0.0	0.0	0.0
	POPULATION ('000)	- Total	4.0	7.30	15.86	18.13	21.66
		- CFC based	4.0	5.45	4.22	3.97	3.42
- WATER COOLERS	PRODUCTION ('000)	- Total	8.0	9.3	11.53	11.99	12.72
		- CFC based	8.0	0.0	0.0	0.0	0.0
	POPULATION ('000)	- Total	100.0	127.15	181.75	194.40	213.75
		- CFC based	100.0	99.20	75.41	70.95	64.75
COMMERCIAL AIRCONDITIONING (CFC-11 BASED)	PRODUCTION (Nos.)	- Total	20	26	36	38	42
		- CFC based	20	10	0	0	0
	POPULATION (Nos.)	- Total	200	281	469	515	588
		- CFC based	200	250	190	515	163
MOBILE AIRCONDITIONING	PRODUCTION ('000)	- Total	10.0	14.3	25.8	29.5	36.16
		- CFC based	10.0	0.0	0.0	0.0	0.0
	POPULATION ('000)	- Total	150.2	198.7	285.5	317.5	376.1
		- CFC based	150.2	174.5	81.6	56.5	23.7

TABLE - 2.8

FORECAST OF DEMAND FOR CFC-11/CFC-12 IN EGYPT

(MT)

SECTOR/SUB-SECTOR		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
I. REFRIGERATION & AIRCONDITIONING											
DOMESTIC REFRIGERATORS & DEEP FREEZERS	NEW	264.0	66.0	170.1	42.5	0.0	0.0	0.0	0.0	0.0	0.0
	RECHARGING	0.0	255.0	0.0	306.0	0.0	222.6	0.0	189.3	0.0	133.3
	SUB-TOTAL	264.0	321.0	170.1	348.5	0.0	222.6	0.0	189.3	0.0	133.3
COMMERCIAL & INDUSTRIAL REFRIGERATION	NEW	50.0	9.0	3.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0
	RECHARGING	0.0	16.0	0.0	16.0	0.0	12.2	0.0	11.5	0.0	10.5
	SUB-TOTAL	50.0	25.0	3.3	16.6	0.0	12.2	0.0	11.5	0.0	10.5
DOMESTIC & COMMERCIAL AIR CONDITIONING	NEW	11.0	Neg	5.6	Neg	0.0	Neg	0.0	Neg	0.0	Neg
	RECHARGING	20.0	Neg	25.0	Neg	19.0	Neg	17.9	Neg	16.3	Neg
	SUB-TOTAL	31.0	Neg	30.6	Neg	19.0	Neg	17.9	Neg	16.3	Neg
MOBILE AIR-CONDITIONING	NEW	-	12.0	-	0.0	-	0.0	-	0.0	-	0.0
	RECHARGING	-	77.0	-	89.6	-	41.9	-	29.0	-	12.2
	SUB-TOTAL	-	89.0	-	89.6	-	41.9	-	29.0	-	12.2
SUB-TOTAL	NEW	325.0	87.0	179.0	43.1	0.0	0.0	0.0	0.0	0.0	0.0
	RECHARGING	20.0	348.0	25.0	411.6	19.0	276.7	17.9	229.8	16.3	156.0
	TOTAL	345.0	435.0	204.0	454.7	19.0	276.7	17.9	229.8	16.3	156.0
II. AEROSOLS		90.0	360.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III. PLASTIC FOAMS		640.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV. SOLVENTS		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL		1075.0	845.0	204.0	454.7	19.0	276.7	17.9	229.8	16.3	156.0
		1920.0		658.7		295.7		247.7		172.3	

Note : There is some use of R 502 in commercial refrigeration applications, but the quantity is very small and hence its contribution to total ODP tonnage is negligible.

Table - 2.7 shows that by the year 1996, the production of new equipment in the refrigeration and airconditioning sector would be mainly based on CFC substitutes. However, there would still be a substantial population of CFC based equipment (e.g. even in the year 2010, there would be a population of about 3.5 million domestic refrigerators operated on CFC-12. In line with the above trend, the CFC demand in the year 1996 drops to about 35% of the demand in 1991 and this decline continues thereafter.

2.6 Compliance Aspects to meet Montreal Protocol Requirements

The future demand for CFCs (CFC-11 & CFC-12) vis-a-vis current Montreal Protocol limits has been indicated in Figure - 2.1. It can be observed that the phase out of CFC based equipment manufacturing is sufficient to keep the overall demand of CFCs below compliance limits upto the year 2007. However, a more significant reduction in demand of CFC would be achieved if recovery and recycling programmes are initiated.

The impact of the recovery and recycling programme in enabling compliance with the Montreal Protocol is brought out in the subsequent sections in this report.

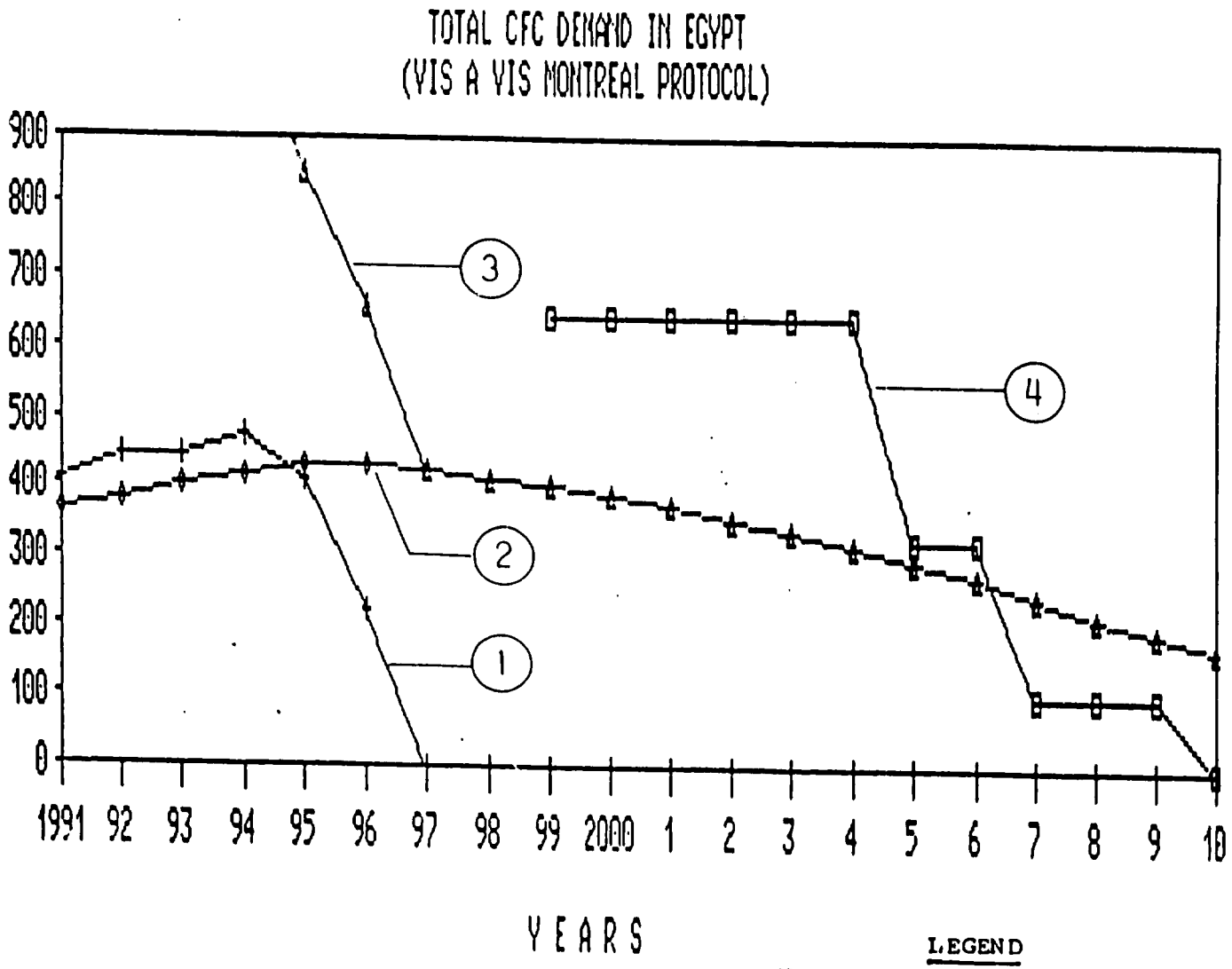
2.7 PHYSICAL DISTRIBUTION OF CFC SUPPLIERS AND USERS

2.7.1 Supply

As indicated earlier in Section 2.2.1 there are three major companies located at Cairo who account for nearly 75% of total imports. Two of them, Misr Freon (agent of Du-Pont) and Misr Engineering Centre for Consultation and Agencies (agent of Atochem) have their refilling facilities at Port Said and Cairo respectively. ICI supplies CFCs in cylinders filled and imported directly from UK. The balance 25% of the imports are accounted for by small agencies located in Cairo as well as direct imports by end users.

All CFC is imported through Port Said. Most of the big end-users of CFC, like refrigerator manufacturers, lift the CFC cylinders directly from filling station or from Port Said (if imported in cylinders like from ICI). Rest of the CFC is sold through distributors mainly located at Cairo and Alexandria.

FIGURE - 2.1



LEGEND

1. NEW DEMAND (A/C & REF. SECTOR)
2. RECHARGING DEMAND (A/C & REF. SECTOR)
3. TOTAL DEMAND (IN ALL SECTORS)
4. CURRENT MONTREAL PROTOCOL

2.7.2 Utilisation

The utilisation/consumption of CFC in 1991 in Egypt is summarised below :

- Domestic Refrigerator & deep freezers 30%
- Commercial refrigeration - 4%
- Mobile Airconditioning 5%
- Domestic & Commercial Airconditioning 2%
- Aerosols 23%
- Plastic Foams (other than refrigeration) 36%

i) Domestic Refrigerators & Deep Freezers

All the six major manufacturers in Egypt are located in the industrial area close to Cairo (3 units at Ramadan City, 1 unit at Nasar City, 1 unit at 6 October City and 1 at Cairo - Alexandria Road. Profiles of these firms are given at Appendix 2.3). One small unit is located at Alexandria also.

The servicing of the equipment is done by OE manufacturers as well as a number of small companies in unorganised sector.

Most of OE manufacturers have their service agencies located at Cairo, Alexandria and Asyut. Cairo centre caters to the need of greater Cairo and part of lower and upper Egypt. Alexandria centre caters to the Delta region (part of lower Egypt). One of the manufacturers, Kiriazi, carries out servicing through mobile trucks which move right from Alexandria to Aswan covering the entire country.

Majority of the population of refrigerators is concentrated in Urban Governerates (Cairo, Alexandria, Port Said and Suez). The private organised repair agencies are mainly located at Cairo, Alexandria, Port Said, Suez, Giza and Asyut.

ii) Commercial and Industrial Refrigeration

All manufacturers/assemblers of these equipment are located in Cairo.

Display cabinets and water coolers are normally serviced by the repairers of domestic refrigerators.

However, mobile refrigerated trucks are repaired primarily by two specialised agencies located at Cairo. Servicing of cold stores is also being handled by 5-6 specialised service contracting agencies located at Cairo.

iii) Commercial Airconditioning

There are three suppliers of these systems and 8-10 contractors in Egypt, all of whom are located in Cairo. Servicing is being done by six agencies which are also in Cairo. Although the systems are located at various places in Egypt, servicing activity is handled from Cairo only. For example Koldair has servicing contracts for about 44 installations - 32 in Cairo, 7 in Alexandria, 2 in Suhag and one each at Elamain, Hurgada and Ismailia.

iv) Mobile Airconditioning

The maximum population of air conditioned cars is in Greater Cairo (50%) followed by Alexandria (20%). Within imported cars, majority of the airconditioned cars are of Fiat, Peugeot, B.M.W. and Mercedez Benz make. Most of these have their authorised service centres located at Cairo, Alexandria and Suez. There are 25 large service centres and the number of cars serviced by each agency varies from 500 to 2000 airconditioned cars per year. Out of these 25 service centres, about 15 are located in greater Cairo, 7-8 in Alexandria and 1-2 in Suez. In addition there are about 50-60 medium size agencies (which repair about 200-500 cars per year) and about 100 small repairers (which repair 200 cars per year) which are again mainly located at Cairo, Alexandria and Suez.

v) Overall

Based on the above it is evident that the refrigeration and airconditioning in Egypt is primarily concentrated in Cairo, Alexandria, Port Said and Suez.

2.8 Based on the survey carried out for assessment of the present and future demand for CFCs, and the structure as well as dispersion of industry, the techno-economic viability of the programmes for recovery and recycling of CFCs has been evolved in the following chapters.

CHAPTER - 3

EQUIPMENT DETAILS FOR COLLECTION AND RECYCLING OF REFRIGERANT GASES

3.1 As the focus of the study is on the collection and recycling of refrigerant gases, a considerable effort was put into obtaining maximum possible information about various types of equipment available for collection/recovery and recycling of refrigerants for different applications.

3.2 The schematic representation of the equipment used for collection/recovery and recycling are shown at Appendix 3.1 (collection/recovery only) and Appendix 3.2 (collection/recovery and recycling).

3.4 The salient features of some of these equipment are briefly described below and the detailed technical literature and pamphlets on the same are enclosed at Appendix 3.3.

A. REFRIGERANT RECOVERY SYSTEMS INC., FLORIDA, USA

i) Recovery System (Model RC-1)

- Designed for residential/commercial contractors
- Recovery & Storage in 50 lbs tank (refillable)
- Indicative Price US $ 1050

ii) Rejuvenator's

- Capable of processing R-12, R-22, R-500, R-502
- UL Certified as per SAE standards
- Patented one step distillation process
- Available in two models

	ST-1000	ST-100
- Recovery rate	3-6 lbs/min	2-3 lbs/min.
- Indicative Price	US$ 5700	US$ 2900

B. SPX CORPORATION, (OTC Division), USA

OTC refrigerant recovery and recycling systems are for cars, trucks, tractors etc.

* OEM 1380 (R-12)

- Recovers 1/2 lb/minute
- Recycling 2 1/2 lbs/minute
- Compatible with all charging stations
- Suitable for Mobile airconditioners/ refrigerators
- Indicative Price USD 4000

* OEM 1396 (R-12)

- Recovers 1/2 lb/min
- Recycles 0.8 lb/min
- Compatible with all charging stations
- Suitable for mobile airconditioners and refrigeration systems
- Indicative Price USD 3000

* OEM 1397

- Portable recovery system
- Recovery rate 0.5 lb per minute
- Can be used alongwith recycling equipment OEM 1396
- Indicative Price USD 1000

C. UNITED TECHNOLOGIES CARRIER, CARRIER CORPORATION, USA/Australia.

Refrigerant Management System for R-11 Centrifugal chillers model (19QA) is popular and conserves existing supplies of CFCs, minimises their leakage during service/maintenance and optimises chiller efficiency with recycled refrigerant.

Indicative price is A$ 10500.

D. ENVIRONMENTAL PRODUCT AMALGAMATED PTY LTD., AUSTRALIA

i) SKYE Split System consists of two separate units - one for recovery & another for recycling. These units, each about the same size as an average vacuum cleaner, can be used together or separately. Purifies R-12 by distillation.

SKYEMITE - Collection/Recovery Unit
SKYEMATE - Recycling Unit
- Compatible with other brands of recovery machines also.

ii) SKYE HIGH CAPACITY COLLECTION/RECOVERY & RECYCLING (for Heavy duty mobile & commercial air-conditioners & refrigeration applications)

- For fast collection/recovery from larger systems

EP-3
- R-12 (recovers both liquid & vapour)
- Collection/Recovery rate is 25 Kg/hr - Combined process of Filtration and Distillation
- Indicative Price A$ 2750

iii) Several other models of recovery and recycling machines are available, as per details given below :

EP4	-	Portable (Ut. 20 Kg)
	-	Recovery rate 25 Kg/hour
EP4HC	-	Portable (Ut. 20 Kg)
	-	Recovery rate 35 Kg/hr.
EP5	-	Portable (Ut. 24 Kg) recycling (25 kg/hr)

The above models are available for R-12, R-22, R-500, R-502 refrigerant gases.

Indicative Price range - A$ 1400 - 1800.

E. JAVAC RECO, AUSTRALIA

Javac Reco Refrigerant Recovery and Recycling Systems are available for cars, refrigerators, chillers, domestic and commercial airconditioning etc. as per following details :

- Recover and Recycle CFC-12, HCFC-22 and CFC-502
- Certified as per SAE standards
- Available in three models

	RECO-1 (Commercial)	RECO-12s (Dom/Auto)	RECO-134s (Dom/Auto)
Recovery Rate			
- R-12	60 kg/hr	33 kg/hr	-
- R-134a	-	-	33 kg/hr
- R-22	30 kg/hr	-	-
- R-502	50 kg/hr	-	-
Recycling Rate	-	1 ltr/min.	1 ltr/min.
Indicative Prices (US $)	2,850	1,990	2,350

F. TECHNICAL CHEMICAL COMPANY, USA

a) Sercon 9000

- For high volume airconditioning/ refrigerating equipments
- Capable of Processing CFC-12, HCFC-22, R-500 and R-502
- Meets S.A.E J-1991 (1989) CFC-12 purity standards
- Recovers 25 lbs/min. (in liquid state)
- Indicative price US $ 3,000

b) Sercon 8000

- For high volume airconditioning/ refrigeration
- Capable of Processing CFC-12, HCFC-22, R-502 & R-500
- Meets S.A.E J-1991 (1989) CFC-12 purity standards
- Recovers 25 lbs/min
- Recycles 40 pounds in 15 min.
- Indicative price US $ 2,200

c) Sercon 5000

- For small shops/auto dismantlers/HVAC/R industry
- UL listed, meets S.A.E J-1991 purity standards
- Capable of processing CFC-12, HCFC-22, R-500 & R-502

- Recovery rate 25 lbs/min.
- Indicative price US $ 1,250

The main features of the above equipment as well as equipment offered by other prominent suppliers in this field are compared at Appendix - 3.4.

3.5 The features incorporated in above recovery and recycling equipment are such that these can be easily operated and maintained by technicians, after initial training input of 1 to 2 weeks. The important operating parameters for these equipments are as follows :

	Recovery equipment	Recycling equipment
- Spares & consumables (US $/kg)	0.31	0.41
- Energy consumption (per kg)	0.05 kwh	0.05 kwh

3.6 The equipment details given at Appendix - 3.4 are representative of the range available for the collection/recovery & recycling of Refrigerant Gases, in terms of technology as well as prices which can be used for considering the technical options and the budgetary costs thereof. These equipment are being successfully used in Australia and USA and have been observed in operation by Mantec's experts to have a first hand experience on their utilisation. The technical options in various sub-sectors where Refrigerant Gases are used, are discussed in the next chapter.

CHAPTER - 4

TECHNICAL OPTIONS FOR COLLECTION/RECOVERY & RECYCLING OF CFCs IN VARIOUS SUB-SECTORS

4.1 Based on the study of the recovery and recycling equipment details and preliminary data collected from the field survey, the various technical options (sub-sector wise) have been evolved for collection/recovery & recycling of refrigerant gases.

4.2 ANALYSIS OF TECHNICAL OPTIONS FOR RECOVERY & RECYCLING

The major sub-sectors of air conditioning and refrigeration industry, from the point of view of recovery & recycling are :

a) Domestic refrigeration/deep freezers and small commercial systems
b) Mobile Airconditioning systems
c) Large Commercial Installations (central air-conditioning plants, cold rooms etc.)

These may be further classified into equipment using CFC-11 such as large centrifugal compressor-based chillers, those using CFC-12 which include domestic refrigeration, deep freezers, small commercial installations (reciprocatory type) and those using HCFC-22 such as domestic airconditioning, large central airconditioning (open system), water coolers etc.

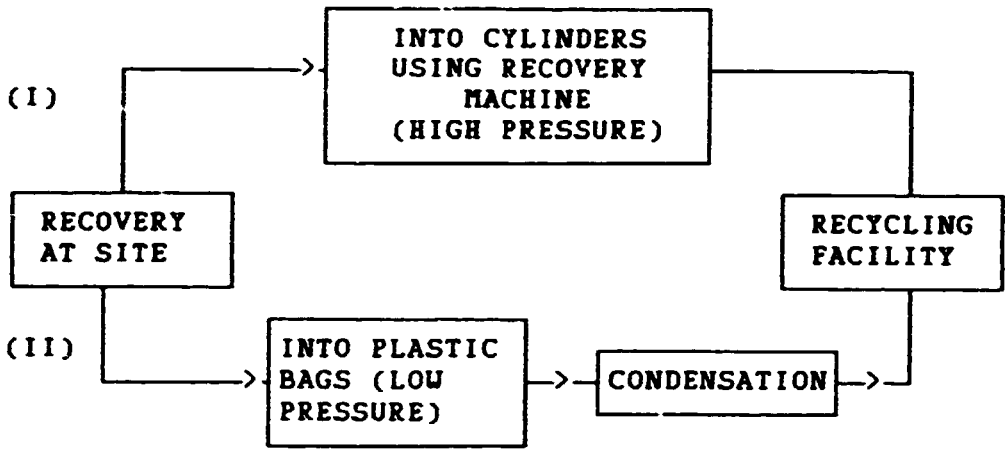
Recovery and re-use of refrigerant has been an established practice for large installations based on CFC-11. This is because CFC-11 at room temperature is a liquid and amenable to recovery and storage at site. It is therefore assumed that such practices will continue.

Our focus therefore is on equipment where CFC-12 and/ or HCFC-22 are used. CFC-12 is a gas at room temperature, requires high level of purity for use in refrigeration and is not usually recovered easily from the equipment. HCFC-22, though not covered under the project, is of interest as similar equipment could be used as for CFC-12 for recovery and recycling.

4.3 The following technical options for each of the above sub-sectors are largely for those using CFC-12 :

4.3.1 Domestic refrigerators/deep freezers and small commercial systems.

A. Repair done at site itself :



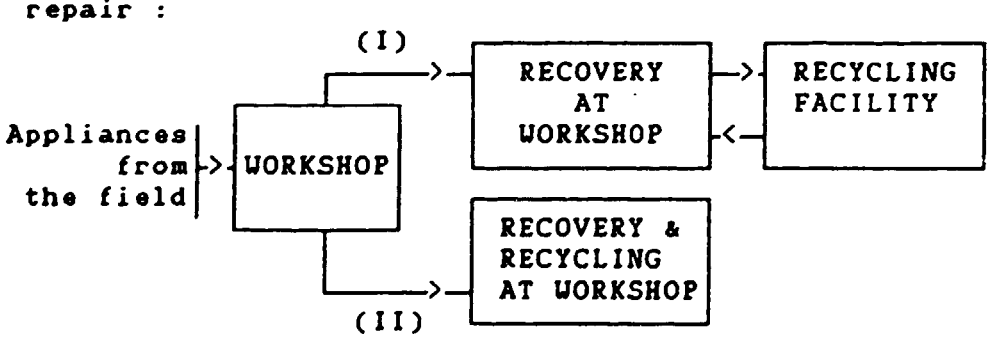
Notes :

Option (I) : The recovery equipment is carried to the site and the refrigerant gas is collected in an empty cylinder under vacuum.

Option (II) : When the servicing agency does not own the recovery equipment, or it is not feasible to transport the same to the site, the technician simply collects the refrigerant gas into a special plastic bag which is brought to his shop. These bags could then be taken to a facility with a recovery machine for condensing and storing in cylinders.

Alternatively a mobile unit (van) fitted with a recovery machine could recover gas from bags at different locations and condense into liquid in a cylinder to make it amenable for recycling.

B. Appliances from the field brought to the workshop for repair :



Notes :

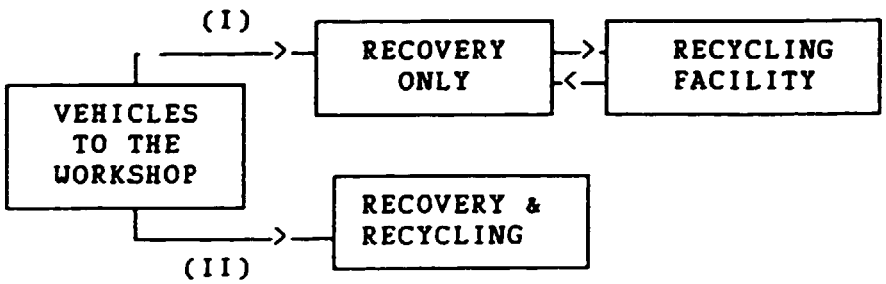
Option (I) : Only recovery done at the workshop and the collected refrigerant is sold for recycling at a separate facility.

Option (II) : Recovery as well as recycling done at the workshop itself. This is feasible for large workshops where the number of appliances repaired is high.

As the appliance manufacturers cannot use recycled refrigerant, the same has to be diverted for use in other subsectors such as commercial refrigeration. Hence large servicing agencies/workshops, which cater to both domestic refrigeration appliances as well as commercial refrigeration systems can have recycling facilities where the refrigerant recovered from domestic refrigerators can be recycled and used for commercial systems.

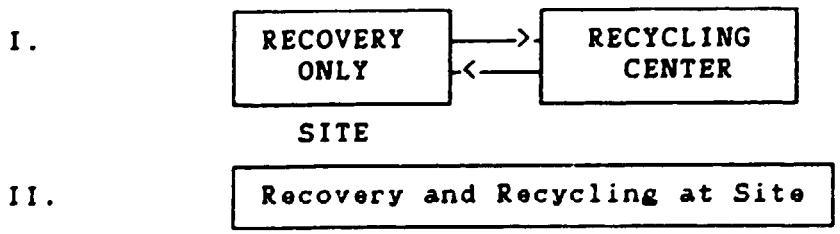
4.3.2 Mobile Airconditioners

In the case of motor vehicles, the repair of airconditioners is always done at the servicing workshop. Depending upon the number of vehicles being repaired the workshop can install either only the recovery equipment (Option I) or recovery and recycling equipment (Option II).



4.3.3 Commercial Installations

In the case of commercial installations the maintenance is always carried out at the site itself. Depending upon the size and number of systems installed at the user's premises and the amount of refrigerant to be recovered, the servicing technician can either recover the refrigerant at the site and send for recycling, or do the recycling also at the site itself for reusing the refrigerant.



4.4 PRESENT SCENARIO IN EGYPT

Egypt, which is a signatory to the Montreal Protocol, has a per capita CFC-consumption levels as given in Table - 4.1 below :

TABLE - 4.1

PER CAPITA CFC CONSUMPTION IN EGYPT

TOTAL CFC CONSUMPTION IN 1991 (MT)	ESTIMATED POPULATION IN 1991	PER CAPITA CFC CONSUMPTION
1920.0	57 Mn	33.70 gms

This is far lower than the limit of 0.3 Kg per capita, for distinguishing the developed and developing countries, and hence Egypt falls into the category of developing countries, as per this criterion as well. In terms of the Montreal Protocol the 100% phase out has to be achieved only by the year 2010, and the base consumption level on which the reductions apply will be known only in 1998 (because the average consumption of CFCs between 1995-1997 is to be considered).

Presently, the CFC requirements in the country is being met through imports which are mainly from France, UK and Germany. Even if these countries stop or curtail the production of CFCs in the next few years, Egypt will not have any problem in terms of availability of CFCs, 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.

The project team, however, saw a considerable amount of enthusiasm to counter the ozone depletion problem and to reduce the consumption/import of CFCs. Initiative taken to sign the Montreal Protocol alongside developed countries is indicative of the positive attitude of the egyptian governments to this issue.

We, therefore expect a favourable response for implementation of recovery & recycling technologies, wherever these are technically feasible & economically viable.

4.4.2 The total consumption of CFCs includes substantial quantity used for flushing/cleaning and leak detection during servicing and repair of the refrigeration and airconditioning equipment. This quantity is considered as technically possible to recover & recycle. However there can be a significant reduction in CFC consumption by introduction of better practices in this regard, i.e. use of dry compressed air or dry nitrogen for flushing and leak testing. This will also reduce the total recoverable quantity, but the extent of reduction will depend on various factors which cannot be quantified at this stage.

4.5 RECHARGING REQUIREMENTS AND RECOVERY OF CFCs

Presently no recovery or recycling of refrigerants is being carried out except in the case of centrifugal chillers where the recovery system is inbuilt with the equipment.

An analysis, covering the demand for refrigerant recharging, quantities of CFCs feasible for collection/recovery (based on 1991 data) and feasible technical options for each sub-sector are presented below :

4.5.1 Demand for Recharging

The sub-sector wise break-up of refrigerant recharging demand in relation to the total CFCs consumption is given in Appendix 2.2.

4.5.2 Recovery Rates and Quantities Feasible for Collection

CFC-11 is used primarily for centrifugal chillers which have built-in recovery systems. About 80% of the charge is already being recovered by pumping down into the receiver tank during servicing/maintenance of such equipment.

The sub-sector wise recovery rates and technically feasible quantities which can be collected are given in

Table - 4.2. This also includes the quantity of CFC used for flushing/cleaning and leak detection.

TABLE - 4.2

TOTAL QUANTITY OF CFC-12 TECHNICALLY POSSIBLE TO COLLECT/RECOVER IN EGYPT (1991)

SUB-SECTOR	AVG. INITIAL REFRIGERANT CHARGE PER UNIT (Kg)	COMPRESSOR FAILURE: NO OF CASES (NOS)	COMPRESSOR FAILURE: TOTAL CHARGE REMAIN (%)	COMPRESSOR FAILURE: TOTAL CHARGE REMAIN QUANTITY (MT)	LEAKAGE: NO OF CASES (NOS)	LEAKAGE: TOTAL CHARGE REMAIN (%)	LEAKAGE: TOTAL CHARGE REMAIN QUANTITY (MT)	FLUSHING&LEAK DETECTION: * TOTAL QTY USED (MT)	FLUSHING&LEAK DETECTION: QUANTITY RECOVERABLE (%)	FLUSHING&LEAK DETECTION: QUANTITY RECOVERABLE QUANTITY (MT)	TOTAL RECOVERABLE QTY. (MT)
DOMESTIC REFRIGERATION AND DEEP FREEZERS	0.20	2,40,000	80	38.4	4,01,000	25	20	126.8	85	107.8	166.2
-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL AND INDUSTRIAL REFRIGERATION	0.82 **	960	80	0.6	3,000	25	0.6	8.7	85	7.4	8.6
MOBILE AIRCONDITIONING	1.0	1500	80	1.2	30,000	25	7.5	37.8	85	32.1	40.8
TOTAL				40.2			28.1			147.3	215.6

* Total recharging demand for compressor failure & leakage cases - quantity refilled in the equipment (equal to no. of cases x initial charge)

** Weighted average

4.6 RECOMMENDED TECHNICAL OPTIONS

The refrigerant requirements can substantially be reduced by better practices for manufacturing and servicing and use of Nitrogen or compressed dry air instead of CFCs for flushing and leak detection.

The recommended technical options for each sub-sector are given below :

Sub-Sector	Recovery	Recycling
A. Domestic Refrigerators & Freezers	- Use of plastic bags during servicing at users end and small workshops.	- Recycling stations with CFC suppliers also equipped with a mobile recovery unit

Sub-Sector	Recovery	Recycling
	- Recovery station at large repairers' shop - Recovery station at all dealers'/ manufacturers' service centres	
B. Commercial Refrigeration	- On site recovery using portable equipment	- Recycling stations with CFC suppliers also equipped with a recovery unit
C. Mobile Air Conditioning	- Recovery at the service center	- Recycling stations with CFC suppliers also equipped with a recovery unit
D. Commercial A/C (Centrifugal Chillers)	- Recovery station (in-situ) Already being done in majority of installations.	- In-situ recycling for capacities above 50 Kg.

4.7 OTHER ASPECTS OF TECHNICAL FEASIBILITY

i) Feasibility of Local Manufacture

Technical capability to produce and/or assemble the required collection and recycling equipment is available in the country but the numbers being small it may not be economically worthwhile to establish a manufacturing line.

ii) Appropriateness of Technology

The technical skills available and the level of awareness among the small service agencies are adequate to adopt the technical options recommended for collection.

Similarly, skills and experience available with the larger agencies can be considered appropriate for successfully managing recycling installations.

However, since collection and recycling technologies would be new to the country, training of the personnel for operation and maintenance of the equipment would be necessary.

iii) Attainable Level of reduction in CFC consumption

The total CFC consumption in Egypt in the airconditioning and refrigeration sector (See Table 2.6) is 780 MT per annum, of which the demand for recharging accounts for 368 MT. The maximum reduction attainable through recycling would be 215.6 MT as brought out in Table - 4.2 above. This amounts to 58% of recharging demand or about 28% of the total demand for CFCs.

iv) Logistics of Collection for On-site Recycling

In the case of centrifugal chillers, which use CFC-11 as refrigerant, on-site recovery and recycling is feasible and is already being practiced in most of the installations.

However, the CFC-12 based equipment are widely dispersed and the recoverable quantity per unit is very small. Hence on-site recycling is not considered economically viable.

4.8 RECOVERY OF CFCs FROM RELATED MATERIALS (INSULATION FOAM)

The recovery of CFCs from related materials comprises primarily of recovering CFC-11 from rigid foam. This requires an air-tight crushing unit which reduces the volume of the foam to approximately one fifth of its expanded size, thereby releasing the entrapped CFC. The released CFC gases are then collected by drawing them through a filter and passing them into a condenser.

However, in many cases, insulating foam needs to be segregated from the product or location in which it is used. This can present major problems as, for example, foam is often found adhering to metal sheets. For the insulating foam contained in domestic refrigerators the most likely recovery method is mechanical grinding or crushing of the complete units within sealed plants with subsequent recovery of the released CFCs.

Thus the recovery and recycling of CFCs from rigid foam in refrigerators for re-use by manufacturers is technically possible. However, the disparate location of the foam "bank", which is the population of discarded and scrapped refrigerators and the way it is used within the the internal structure of the refrigeration units and its volume relative to the CFC content, present significant economic problems in terms of retrieval and

transportation. The difficulties can be overcome, but they make the adoption of the recovery and recycling option economically unattractive. Reported initial estimates from developed countries suggest that the overall cost of CFCs recovered from domestic refrigerators, including the refrigerants and from the rigid foam, would be nearly twenty five times the cost of virgin CFC. Hence the recovery of CFCs from rigid foam is logistically & economically not feasible in Egypt.

4.9 SAFE DISPOSAL

Refrigerants used in various appliances, get contaminated which can be recovered and reused after recycling or reclaiming. However, in some cases the contamination is too heavy and it can not be recycled or reclaimed. Also, in certain applications, such as foams, the recovery of CFCs is not practical, at the time of scrapping of the product. Such CFCs should be destroyed in such a manner that it does not effect the environment. There are many methods available for destruction of CFCs which are given below :

- Thermal incineration
- Catalytic incineration
- Pyrolysis
- Active metal scrubbing
- Chemical scrubbing
- Wet air oxidation
- Super critical water oxidation
- Corona discharge

Out of the above, only thermal incineration is the commercially available method of CFC destruction.

Incineration

The destruction of CFCs can be achieved thermally by exposing to high temperature of about 850°C for long period of time in the presence of excess hydrogen. The necessary heat is supplied through firing supplemental fuel or by co-firing other wastes that have a substantial net heat of combustion.

The thermal decomposition produces either halogen acids or free halogen molecules. The attack of thermal decomposition products on the refractory incinerator walls has been a problem as they are very corrosive. To protect the incinerator walls use of special refractory materials and/or frequent incinerator relining is required. The halogen acids or free halogens must also be scrubbed from the stack gases before emissions and other residue must be properly captured and disposed of.

In the United States, performance standards have been

developed by EPA for incinerator burning CFC wastes. For grant of license, a trial burn must show 99.99% destruction and removal efficiency.

Destruction of CFCs requires high temperature incineration facilities with appropriate treatment of effluent gas. Such facilities cannot be specifically designed for CFCs alone since the size of these waste incineration facilities have to be of a suitable (large) scale for them to be commercially viable. The minimum economic capacity of these incinerators is normally over 15,000 tonnes per annum. The cost of CFC destruction with such a capacity is around US $ 3000 - 3500 per mt. The cost of building a completely new facility is over US $ 40 million.

Considering the minimum scale of capacity required, as well as the high cost of destruction, the possibility of building a destruction facility solely for CFCs in Egypt or even in Africa has to be discounted.

In addition, the necessary technical expertise for managing such a complex and large scale disposal system is lacking.

CHAPTER - 5

ECONOMIC ANALYSIS

5.1 METHODOLOGY

The methodology adopted for Economic Analysis consists of two components. The first is viability analysis at the venture level for collection and recycling, for various type of ventures suggested by the investigation of technical options.

The second is an analysis of the net national economic benefit based on the proposed national system for collection and recycling.

5.2 Viability analysis at Venture level :

In the venture level analysis each venture is treated as an independent entity which is set up as a project. Stemming from the technical options, three kinds of basic ventures have been considered.

a. Venture for collection using plastic bags

b. Venture for recovery only using a portable recovery machine

c. Venture for recycling using a stand alone recycling machine together with a portable recovery unit.

While there is a technically feasible option of having a portable recovery cum recycling unit, our analysis has shown that in Egypt, none of the sector will have sufficient recovery volumes at one location to justify use of such a recovery cum recycling machine. Accordingly this has not been considered for techno-economic viability.

A summary of the various steps is given below.

Step 1 is to establish the dimensions of the venture. For each of the basic ventures this has been arrived at on the following basis.

Type of Venture	Basis
Recovery only using portable recovery machine	A venture assumed to consist of a single unit of equipment (Indicative price - US$ 1000 based on model OEM 1397 of SPX Corpn., USA (Refer Chapter - 3)

Recycling	Venture assumed to consist of a single recycling machine and a portable recovery machine. (Indicative price : Recycling Equipment - US$ 1400 (A$ 1800) based on model EP5 of Environmental Products Amalgamated Pty Ltd., Australia (Refer Chapter 3.) Recovery equipment - same as above Total Equipment cost - US$ 2400

The activity of collection through plastic bags has been excluded in the above categorization as this activity does not involve any investment in capital assets unlike the other ventures. The computation of viability of this activity is fairly straight forward as shown in Appendix - 5.3.

The subsequent steps in the methodology are as follows :

Step 2 : Estimation of the cost of the project and the means of financing.

The costs for each type of project has been worked out in the local currency and on the basis of latest exchange rates for imports in foreign currency.

Likewise, means of financing and the associated costs have been worked out on the basis of current norms for such projects.

The project life is taken to extend till the year 2010 which is the terminal year for elimination of CFC consumption as defined under the Montreal Protocol.

It has also been assumed that the recycling equipment and the portable recovery equipment will have a life equal to the project life.

Step 3 : involves estimating the operating revenues and costs for each type of venture.

Operating revenues are computed on the basis of quantity of CFC processed. (i.e. collected, recovered or recovered and recycled) and the price to be realised for collected CFC gas, CFC liquid and recycled CFC in cylinders.

The typical scale of activity per venture has been based on the present level of activity of the typical service agency who will adopt the venture.

Further, the level of activity in subsequent years is assumed to follow the same pattern as the aggregate quantity of CFC available for recycling which will of course decline over the years. This has been done to assess the viability of the venture over the total project life.

Operating costs include costs of raw material (in this case CFC collected gas, or CFC collected and condensed), consumables and spares, power, labour, transportation (wherever applicable), depreciation, interest and selling & administrative overheads. In the working sheets the costs have been further classified as fixed or variable.

The spreadsheet formats for the viability analysis are furnished in Appendix 5.1 for venture (a) and Appendix 5.2 for Ventures (b) & (c).

The computation of financial viability of the venture has been done in an iterative manner by varying different parameters. These are

- duty on imported equipment
- duty on imported CFC and prices realised for recovered CFC in cylinders or bags as a percentage of landed price of virgin CFC
- interest rates for funding investments
- capital structure of the venture

The output of the first stage is an assessment of financial viability of each type of venture and the associated pricing for recovered and recycled CFC, as also the mode of financing :

The working sheets depicted in the Appendix thus provide the following for each type of venture.

* Costs of recovery per Kg
* Costs of recycling per kg for each alternative
* The capital investment required and desired level of government subsidy by way of grants/soft loans for ensuring viability
* The value of CFC saved

Having established the profile of a venture for recovery and that for recycling the next step is to estimate the total number of ventures in the country.

This has been done by using the following inputs :

- The maximum number of recovery and recycling ventures computed by dividing the total recoverable quantity by the quantity to be handled by one venture (based on break-even analysis).

- The number of ventures so obtained for each country were suitably downscaled, as it is recognised that it is not possible to achieve 100% recovery. Hence the practical number of ventures were arrived at, based on the following considerations.

    - concentration and dispersion of sectors addressed by a particular type of venture. e.g. for garages servicing car airconditioners, the population dispersion of airconditioned cars across the country

    - level of activity, e.g. the number of cars being serviced by a venture

    - the realistic proportion of the target population that would be addressed by the ventures, e.g. there would always be some cars which are not serviced at a garage for logistical or other reasons.

    - manpower available with the individual enterprises, and their technical competence

    - recognition of the fact that the total quantity of CFCs available for recovery and recycling will progressively reduce due to phasing out of CFC based equipment, as well as adoption of better practices. Hence the number of ventures should be such that long term viability is ensured for each venture.

The number of ventures has also been based on eligibility or appropriateness of agencies to set them up.

Based on the above, the number of ventures arrived at is given below in Table-5.1.

TABLE - 5.1

	RECOVERY ONLY	RECYCLING
Maximum annual qty technically feasible(average for 1993to2010)	57 MT	~ 211 MT
Min.economic qty per venture @	261 Kg	1799 Kg
Max.no.of ventures possible	218	117
Proposed no.of ventures based on industrial Survey *	100	$ 12
Avg.annual qty. per venture		
- Maximum	570 Kg	17583 Kg
- Practical as per field survey +	277 Kg	8166 Kg

~ 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 break-even volume

$ The total no. of recycling ventures in relation to recycling quantity is less because the distribution of CFC is concentrated in a smaller geographical area (mainly Cairo, Alexandria & Port Said) and the number of distribution points which can serve as recycling ventures are limited.

* The number of recovery & recycling ventures are indicative based on field survey and can be increased in future years depending upon actual operations.

+ This has been derived from Appendix 5 as the 18 years average (1993-2010) of the annual CFC recoverable quantity.

Having made an assessment of the number of ventures of each kind an assumption has been made that these ventures would be established over a period of three years in.

Once the pattern of ventures is known the assessment of net national economic benefit was carried out.

5.3 RESULTS OF VIABILITY ANALYSIS AT VENTURE LEVEL

The economic viability of various types of collection/ recovery and recycling ventures is shown at Appendix 5.2 attached, and summarised in the following paragraphs.

5.3.1 Types of Ventures :

Table - 5.2 below indicates the types of ventures identified for different sectors for recovery of CFCs.

TABLE - 5.2

SECTOR	TYPE OF VENTURE	PROMOTER OF VENTURE	TOTAL QUANTITY OF CFC RECOVERABLE IN SECTOR (FOR STARTING YEAR 1993) (IN MT)
Domestic refrigerators	-Collection through plastic bags	Small service agencies	164.8
	-Portable recovery equipment	Manufacturers and their authorised service agencies	18.3
Commercial & industrial refrigeration	Portable recovery equipment	Service agencies of large companies	9.0
Mobile airconditioners	Recovery equipment	Garages servicing Car airconditioners	46.0

5.3.2 Institutional Considerations

The success of the recovery and recycling programme will certainly hinge on the effectiveness of collection of CFC from domestic refrigerators as also the recovery from mobile airconditioners.

In the case of the former it has been shown that collection through plastic bags requires the bag costs to be subsidised entirely to make the activity viable. It is also assumed that CFC gas collected through bags will fetch a price/kg approximately 30% that of virgin CFC while CFC recovered through a recovery machine would fetch a price of 50% of that of virgin CFCs.

The Egyptian economy has for a long period witnessed Government controls on prices of various items which are now withdrawn. Thus administering a scheme of supplying plastic bags at a subsidy would not be a constraint.

On the other hand there is the question of how an appropriate price would evolve for collected/recovered/ recycled CFCs.

CFCs being imported are sold almost at free market prices in the country (the duty being a nominal 10%). It is felt that the best agency to determine the prices for recovered/recycled CFC would be the supplier provided there is legislative support to persuade suppliers of CFCs to take back collected/recovered CFCs. This has been covered further in a subsequent chapter on implementation.

Given the level of education and technical manpower, there would not be any major institutional constraint in providing technical inputs and managing the recycling activity.

In terms of a system design therefore, for recycling it is assumed that the suppliers of CFCs will promote ventures involving recycling equipment. These ventures will have equipment to recycle CFCs collected through portable recovery equipment and brought in cylinders and equipment to recover CFCs from plastic bags and feed to the recycling equipment.

The table - 5.3 below summarises the results of the venture level analysis.

TABLE - 5.3

	VENTURE TYPE	
	RECOVERY	RECYCLING
Equipment Cost	LE 3823	LE 9175
Project Cost	LE 4476	LE 10670
Total qty of CFC handled over project life(1993-2010)	4991 Kg	147 MT
Avg. annual qty 18 years)	277 Kg	8,166 Kg
Annualised operation cost (18 years)	LE 841	LE 110910

Table 5.3 (Contd..)

	VENTURE TYPE	
	RECOVERY	RECYCLING
Annualised revenues (value of CFC saved)	LE 2218	LE 130670
Operational cost/kg of CFC processed (avg. annual)	LE 3.04	LE 13.58
Break even volume	209 Kg	1439 Kg
Payback period for venture - equity - total capital	1 year & 6 months 4 years	1 year & 2 months 2 years
Internal Rate of Return (IRR) - equity - total capital	 67.8% 23.5%	 197.2% 78.9%

A sensitivity analysis has also been carried out on specific parameters to assess impact on IRR.

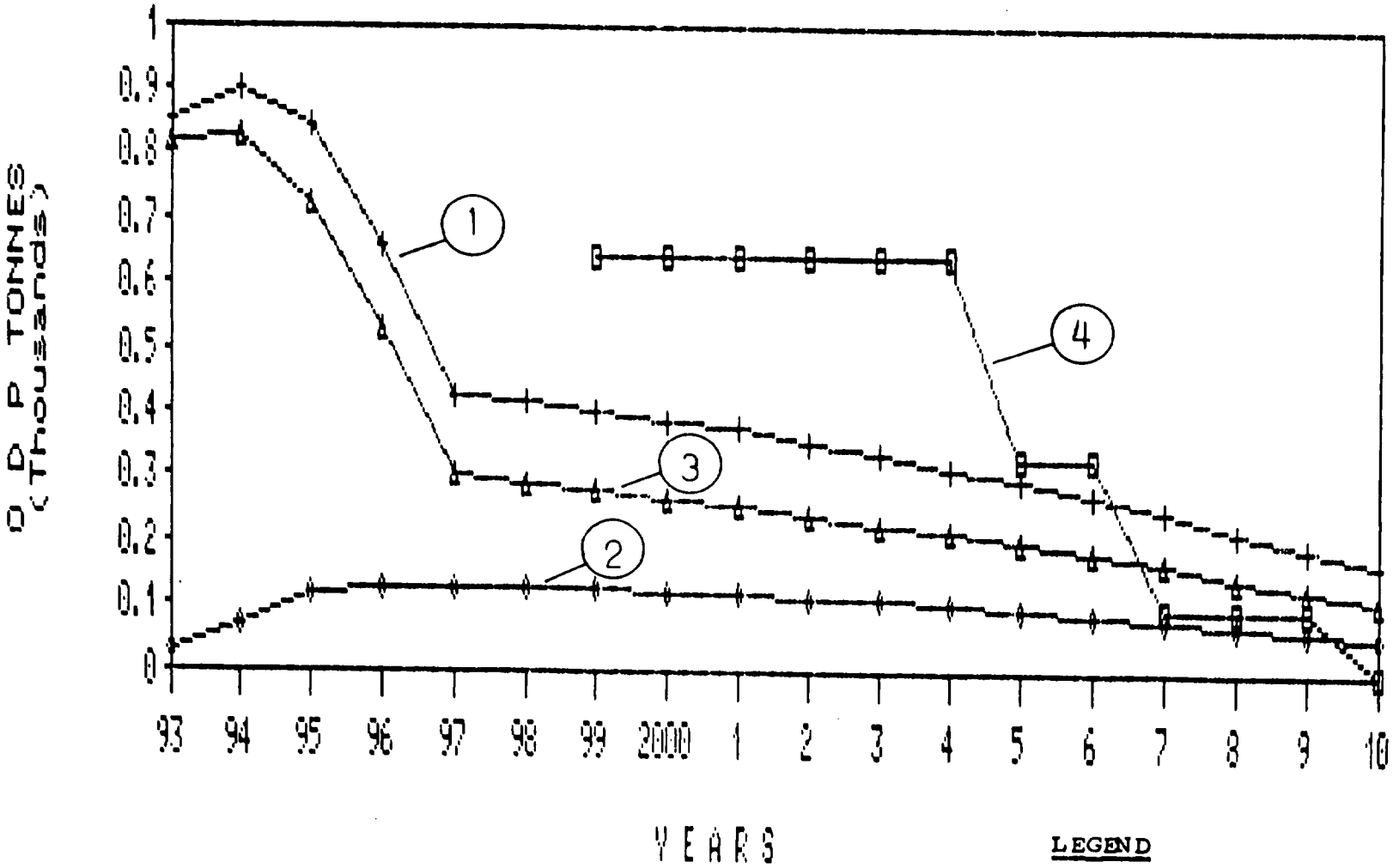
TABLE 5.4
CHANGE IN IRR BY PARAMETERS

VENTURE	PRESENT IRR	10% INCREASE IN CAPITAL COST	10% DROP IN CAPACITY UTILISATION	INCREASE IN SUBSIDY FROM 20 - 30 %	INCREASE IN CFC PRICE BY 10%
RECOVERY					
- equity	67.8%	55.7%	56.3%	108.2%	82.1%
- total capital	23.5%	21.1%	20.2%	23.5%	27.4%
RECYCLING					
- equity	197.2%	175.5%	169.8%	273.3%	249.5%
- total capital	78.9%	73.9%	69.7%	78.9%	96.1%

The impact of recovery and recycling programme on the total CFC consumption, with respect to the requirements of Montreal Protocol, is presented in Figure - 5.1. This is based on the assumption that recovery and recycling programme is implemented immediately.

FIGURE - 5.1

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



LEGEND

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

5.4 NET NATIONAL ECONOMIC BENEFIT ANALYSIS

The second stage of the economic analysis involves computing the net national economic benefit by adopting the recovery and recycling programme.

5.4.1 Methodology

The net national economic benefit has been worked out using the principles of social cost benefit analysis within the limitations imposed by the necessity of confining ourselves to quantifiable variables.

The methodology has been detailed in Appendix - 5.4. Given below is a summary of various costs and benefits considered in the exercise.

Benefits

- Savings in imports of refrigerants (CFCs)
- Increase in employment measured in terms of increased private consumption and investment (taken equal to savings).
- Weighted increase in consumption and investment of owners of enterprises
- Increased Government revenues on duties of CFCs

Costs

- Outflows on account of equipment and consumables
- Training costs and publicity at venture level and Government level
- Increase in costs of overheads and maintenance of ventures
- Duties and taxes foregone by the Govt. on imports of CFC saved.

The above costs and benefits have been assessed till the year 2010 and measured in the local currency at 1991-92 prices.

A discounting factor of 2% has been used to determine the 'net present value' of Net National Economic Benefit, i.e. benefits - costs to the economy in each year from 1993 to 2010.

The working sheets are given at Appendix 5.5 alongwith the basis used for the computations (Appendix 5.6).

The summarised results of the computations of Net National Economic Benefit are presented below in table 5-5, which shows the yearly costs and benefits to the economy.

TABLE 5-5

RESULTS OF COMPUTATION OF NET NATIONAL ECONOMIC BENEFIT IN EGYPT

(IN Mn LE)

YEAR	COSTS	BENEFITS
1993	1.79	1.54
1994	2.31	1.26
1995	3.74	1.96
1996	3.71	2.02
1997	3.68	2.03
1998	3.65	2.04
1999	3.60	2.02
2000	3.53	2.00
2001	3.44	1.94
2002	3.34	1.88
2003	3.23	1.81
2004	3.09	1.72
2005	2.93	1.62
2006	2.75	1.51
2007	2.58	1.41
2008	2.39	1.30
2009	2.13	1.15
2010	1.89	1.02
NPV OF NET BENEFITS (@ 2% DISC.)	LE Mn	-19.69
	US $ Mn	-5.95

CHAPTER - 6

FRAMEWORK FOR IMPLEMENTATION

6.1 This chapter deals with :

a) The present legislative and institutional framework and extent of public awareness, and

b) The proposed organisation and legislative, institutional and other measures to implement recommended recovery and recycling programmes.

6.2 PRESENT LEGISLATIVE AND INSTITUTIONAL FRAMEWORK AND EXTENT OF PUBLIC AWARENESS

Since the world became aware of the problem of Ozone depletion, Egypt has played a leading role in the international efforts to protect the Ozone Layer. It was the 7th country to sign and ratify the Montreal Protocol. Dr El-Mohamady Eid, Chairman EEAA was an active participant in the drafting of the Montreal Protocol.

Even before the Montreal Protocol, being aware of the harmful effects on health and environment resulting from the depletion of the ozone layer, the Egyptian Ministry of Industry had constituted an Ad-hoc committee that included refrigeration, air-conditioning, aerosol and plastic industries vide decree MOI-638/81 to carry out a number of technical and economic studies. The committee was further expanded to include Federation of Industries, Ministry of Health, EEAA and General Organisation for Standardization. The work of this committee resulted in a number of recommendations for limiting the use of CFCs. Subsequently the Ministry of Industry issued a Ministerial Decree No. 9771/1989 dated 8/11/89 banning the use of CFCs in aerosols. The provisions of the decree are highlighted below :

a) Industrial concerns shall not be approved to use CFCs as propellants in any of the various aerosol products.

b) Industrial concerns currently using CFCs shall be permitted a grace period till the close of December, 1990, knowing that the said ban shall be applicable from 1st January, 1991.

While the use of CFCs as propellants in pesticides and insecticides has been phased out since 1986 due to economic reasons the use in cosmetics is now being eliminated by switching over to LPG and mechanical pumps largely as a result of the above ban.

The Egyptian Environment Affairs Agency (EEAA) is responsible for the environmental issues in the country and has taken a number of initiatives in examining the use of CFCs and launched projects for reduction of the same.

The present legislative & institutional framework is however, inadequate in respect of the following :

a) It does not enable in identification of users of CFCs, especially in the service sector.

b) It does not impose an obligation on users of CFCs to report consumption or utilization nor does it require the seller to report sales.

c) There are no established codes of practice for repair/maintenance of equipment using CFCs and no machinery or organisation has been created to evolve such codes.

d) There is no system of accreditation by Government or industry of service mechanics and service stations.

e) There is no law governing disposal of equipment containing CFCs. While, in general, the awareness about CFCs and their harmful nature is high in industry and moderate among the population, the awareness about recovery and recycling methods and equipment as well as their feasibility are almost non-existent.

f) There are no policy measures to ensure that recovery and/or recycling equipment are purchased, installed and used. There are also no measures which will set in motion the recovery and recycling networks and sustain them on an economically viable basis.

6.3 PROPOSED MEASURES FOR IMPLEMENTING A RECOVERY AND RECYCLING PROGRAMME

In the earlier chapters, it has been depicted, the design of the national system for recovery and recycling as also factors determining economic viability which are recapitulated here.

TABLE - 6.1

SYSTEM FOR RECOVERY & RECYCLING OF CFCs

SECTOR	COLLECTION/RECOVERY				RECYCLING	
	COLLECTION AGENCY	COLLECTION METHOD	DELIVER TO	INPUTS FOR ECONOMIC VIABILITY	OPERATING AGENCY	INPUTS FOR ECONOMIC VIABILITY
Domestic Refrigerators	Service Shops (large numbers)	Plastic bags	Selling agencies of CFCs @	* Subsidy on bags * Increased Price for virgin CFC	Existing selling agencies	*Exemption of duty on equipment *Subsidy on capital investment *Increased price of CFC
Commercial & Industrial Refrigeration equipment	Service agencies of companies (few numbers)	Portable recovery equipment	Selling agencies of CFCs @	* Cut in duty on equipment * Increased price for 'recovered' CFC	Existing selling agencies	*Exemption of duty on equipment *Subsidy on capital investment *Increased price of CFC
Mobile Air conditioning	Service Shops (those handling 4 to 8 cars/day)	Portable recovery equipment	Selling agencies of CFCs @	* Cut in duty on equipment * Increased price for 'recovered' CFC	Existing selling agencies	*Exemption of duty on equipment *Subsidy on capital investment *Increase price of CFC

@ Selling agencies of CFCs would also be the recycling agencies who would have separate recovery equipment as well.

It is also pertinent to recall some of the characteristics of the sectors participating in recovery and recycling.

* Large number of agencies servicing domestic refrigerators who operate in the unorganised sector.

* Prevalence of poor maintenance practices including flushing etc. using CFCs.

* Little or no facilities to test CFC purity etc. even with the selling agencies as these agencies are not used to taking back CFCs for recycling.

Considering the present features of the CFC using sectors, the proposed technical systems and the financial incentives suggested to make recovery & recycling systems viable, the following legislative and institutional policy measures are proposed.

6.3.1 Command and Control measures

Legislation related to -

* Supply of CFCs

  Since all CFC are currently imported, an important step is to enact legislation to make it necessary to report the imports and sales of CFCs. Equally important, as the same agencies are thought best suited to be the nodal agencies for recycling CFCs, is legislation which makes it obligatory on the sellers of CFCs to accept recovered CFCs returned by accredited agencies for reprocessing.

  The scope of such legislation would cover :

  * need to maintain records of imports
  * need to maintain records of sales
  * obligation to accept CFCs returned for reprocessing
  * recording of reprocessing activity

  In addition the legislation should also make it obligatory for such importer/seller to maintain detailed records of sector-wise purchasers and quantities purchased by them.

  An illustrative extract of legislation covering the above aspects in the State of Victoria, Australia is presented in Appendix 6.1 (Sections 14, 15, 16 of E.P.Act 1970 - Victoria Govt. Gazette).

* Use of CFCs

  Legislation is also required in respect of use

and users of CFCs with the objective of

* identifying all users (manufacturers as well as maintenance, service and installation agencies)

* restricting use of CFCs to persons/agencies who are accredited/certified on the basis of competence to handle and minimise emission of CFC and having them registered with the appropriate authority.

  Appendix 6.2 shows illustrative provisions of section 23 in Waste Management Policy - State of Victoria, Australia.

* making it obligatory for users to maintain records of purchases & use.

  Appendix 6.3 shows such a provision in the Waste Management Policy of State of Victoria, Australia.

* ensuring enactment and adoption of codes of practice for manufacture, service, and maintenance of installations, which will provide for proper procedures and obligation to recover CFCs to the extent possible.

  In fact it could be made obligatory for large users such as manufacturers or assemblers of refrigerators and installations like chilling plants to have a recovery station/system.

  It can also be made obligatory for prospective/new installations of large centrifugal chillers to provide for a recovery system in their contract.

  An illustrative extract of legislation covering some of the above points in the State of Victoria, Australia is presented in Appendix 6.4 (Sections 32, 33, 34 & 35). Also enclosed is an extract from the rules laid down by South Coast Air Quality Management District, California (presented in Appendix 6.4 A) on Recovery or Recycling of Refrigerants from Motor Vehicle Airconditioners and Reduction of Emission

from Stationery Refrigeration and Airconditioning Systems.

* Furthermore, to encourage compliance, legislation could be introduced which would require all purchases of CFCs by service agencies on the basis that they return a certain quantity of recovered CFC for purchasing new CFC. Suppliers' records would also require to show how much recovered CFC was brought back and how much fresh CFC supplied.

* Disposal

In respect of disposal it may be recognised that in developed countries purchases of white goods are frequent and trading-in is a common practice before the full life of an equipment. In such a situation one could have a mechanism supported by legislation whereby a dealer could take away a used equipment when he delivers a new one (e.g. Swiss Law - see Appendix 6.5). However in Egypt, as is the practice in many developing countries, equipment are retained by the owner as long as it can be kept running and discarded only after all possible measures to salvage the same fail and at that point it is often sold to the service agency who cannibalises it or sells it as scrap.

Thus legislation for disposal of equipment may not be appreciated or logistically feasible to adopt. Furthermore, as discussed in an earlier chapter the costs of recovery of CFCs from discarded equipment especially from foams would be prohibitively expensive as to make it unviable.

Therefore no specific proposal is made on legislation for disposal of CFCs at this stage.

6.3.2 Financial Support Measures

From the economic analysis it is clear that the major factors affecting the viability of a collection/recovery and recycling activity is the price of plastic bags, the cost of equipment and the margin realised by the collectors on the CFC recovered and sold.

The following measures are recommended to

a) Supply bags at nil/low cost to all accredited/ certified service agencies servicing domestic refrigerators. The code of practice should make it obligatory for all such agencies to have plastic bags as part of their standard kit.

b) Finance for purchase of capital equipment for recovery/recycling could be made available on 'soft' terms to accredited agencies willing to install such equipment. In our workings on economic analysis of recovery/recycling enterprises, we have assumed a subsidy of 20% on the cost of equipment which was the minimum to ensure economic viability. It is recommended that the actual subsidy be fixed between 20% and 50% depending on the speed of introduction of ventures desired.

c) Abolish duties on such equipment.

d) Progressively increase duties on virgin CFCs with the objective of discouraging consumption and waste and also provide a means of making recovery & recycling economically viable through a higher price for recovered CFC which will come about when price of virgin CFC is raised.

e) Funding training programmes for familiarising technicians with recovery and recycling as well as promotional campaigns in the initial years.

The national economic benefit analysis worked out indicates that a substantial expenditure would be entailed on those counts. We recommend that this can be met through a fund created and supported by multilateral aid.

6.3.3 Compliance with Requirements of Montreal Protocol

The demand projection for CFCs for Egypt consequent to implementing a recovery and recycling programme shows that in the years 2007-2010, for complying with the Montreal Protocol, Egypt will have to reduce its consumption by about 60-70 MT each year. This can be achieved by creating a 'bank' of CFC by increased imports in the years 2005 to 2006 where demand is below protocol limits. The costs of maintaining such a bank may also be considered for support through aid.

6.3.4 Measures for Increasing Public Awareness

Fortunately the majority of the population lives in 3 major Governerates viz Urban, Lower Egypt and Upper Egypt and is addressable through national media like TV etc.

EEAA as the nodal agency for Environmental related matters should launch a major awareness programme which will educate the public on

* CFCs and the need to conserve/recycle them
* Methods of detection of early leaks
* Possibility and practicability of collection and recycling
* Need to patronise accredited agencies
* Observe correct practices for discarding equipment

6.3.5 Institutional Framework

EEAA, as the nodal agency for environment related matters has to take lead in implementing the recovery/recycling programmes on a national basis. There is a need for establishing a dedicated wing in EEAA or establishing an industry research association or an institution for refrigeration and airconditioning with the following objectives -

a) Evolving codes for better manufacturing and servicing practices

b) Training the mechanics in better manufacturing and service practices and also in recovery/recycling

c) Accreditation of mechanics and service stations

d) Collection and compilation of CFC consumption data

e) Establish demonstration stations for recovery through plastic bags, recovery stations and recycling stations

f) Coordinate with recovery/recycling stations established in a network

g) Provide technical support to industry in (b), (c) above and also in the use of CFC substitutes

h) Organize public awareness programmes

i) Co-ordinate setting up and maintaining a CFC bank

6.4 CONCLUSIONS

The present legislative and institutional framework in the with respect to CFC use recovery and recycling is limited. The country lacks an established machinery to enforce elaborate regulations or legislation.

Unlike in developed countries the public awareness or consumer pull is limited and cannot be counted upon to

'drive' a recovery and recycling program, except perhaps to a limited extent.

On the other hand the economic situation, import dependence and the absence of Government controls make for a case to use a profit driven private sector managed program for recovery & recycling of CFCs.

A combination of regulatory measures (such as licensing of service agencies) combined with encouragement in terms of technical inputs for training could be used to initiate a program for collection by the sector servicing domestic fridges which is a dominant sector.

Specific action would be for the government to

- exempt duty on equipment for recovery and recycling

- provide grants/subsidies to assist in setting up collection/recovery and recycling ventures. Such subsidies would range from 20-50% of capital cost. A minimum of 20% subsidy is necessary for ensuring viability, whereas a higher subsidy of upto 50% would be based on the individual country's approach to the motivational level desired for expediting implementation.

- fund training costs and public awareness programmes

- raise the price of imported CFC 11 & 12 to make recycling attractive.

- Strengthen existing institutions involved in environment and/or industrial activities to have a separate wing for implementing the recovery and recycling programmes.

- enact legislation and a system of quotas to ensure that service agencies and suppliers participate in the collection/recovery and recycling programmes.

The above could be met by creating a fund which could be set up with the help of multilateral aid.

CHAPTER - 7

CONCLUSIONS

7.1 CFC AUDIT

The detailed CFC national audits in the three project countries have shown that the total CFC consumption has reduced substantially in the last few years, mainly due to substitution by other substances in the foam and aerosol sectors.

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.

A summary of the total imports and utilisation of CFCs in the three project countries is given in Table 7.1.

TABLE - 7.1

IMPORT & UTILISATION OF CFCs IN 1991

(MT)

IMPORT	EGYPT		KENYA		NIGERIA	
	CFC-11	CFC-12	CFC-11	CFC-12	CFC-11	CFC-12
I IMPORT	1050	800	18	79	350	700
	1850		97		1050	
II UTILISATION						
- Refrigeration & Air conditioning	345	435	16.5	78.9	71.7	471.3
- Aerosols	90	360	5	4	-	150
- Plastic foams	640	50	-	-	280	-
Total	1075	845	21.5	82.9	351.7	621.3
	1920		104.4		973	

The utilisation in each country has been estimated by building up the demands for each of the sub-sectors, through a comprehensive field survey of industrial enterprises.

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.

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.

The current retail prices of refrigerants in the three project countries area are given at Table - 7.2 below :

TABLE - 7.2

(US$ PER KG)

	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
HCFC 22	4.2 - 5	7.10	3.5 - 4.5

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 foams and aerosols 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.

7.2 DEMAND FORECAST

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. Hence 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.

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 demands for the various sub-sectors of airconditioning and refrigeration in the respective countries, as summarised in Table - 7.3 below.

Substantial part of this demand is on account of recharging and this emphasises the need of recovery and recycling systems as an important means to reduce the consumption further for an eventual phase out.

TABLE - 7.3

PRESENT & PROJECTED DEMAND FOR CFCs IN THE PROJECT COUNTRIES

(MT)

COUNTRY	1991	1996	2005	2007	2010
EGYPT					
- Refrigeration & Airconditioning	780	658.7	295.7	247.7	172.3
- Aerosols	450	-	-	-	-
- Plastic Foams	690	-	-	-	-
- Solvents	-	-	-	-	-
	1920	658.7	295.7	247.7	172.3
KENYA					
- Refrigeration & Airconditioning	95.4	61.4	37.0	29.7	18.3
- Aerosols	9	-	-	-	-
- Plastic Foams	-	-	-	-	-
- Solvents	-	-	-	-	-
	104.4	61.4	37.0	29.7	18.3

Table - 7.3 (Contd.)

COUNTRY	1991	1996	2005	2007	2010
NIGERIA					
- Refrigeration & Air-conditioning	543	408.1	104.2	50.3	11.7
- Aerosols	150	-	-	-	-
- Plastic Foams	280	-	-	-	-
- Solvents	-	-	-	-	-
	973	408.1	104.2	50.3	11.7

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 few of the important cities/towns, where the manufacturers and/or servicing agencies for CFC based equipment are operative.

7.3 EQUIPMENT FOR RECOVERY AND RECYCLING OF CFCs

Equipment for recovery and recycling are available for different applications in various capacity models. These equipments have been in use in developed countries and the technology for the same is well established and brought to a level so that it can be easily adopted.

Since the volumes of CFCs handled by typical individual enterprises in the project countries are very small, it is recommended that the low cost low capacity and portable models of the recovery and recycling equipment would be most appropriate for early adoption in Egypt, Kenya and Nigeria. These equipment are versatile and can be used for recovery and recycling of HCFC-22. Their utility will thus continue even after the CFCs are phased out completely.

Features incorporated in the recovery and recycling equipment are such that these can be easily operated and maintained by local technicians, after initial training input of 1 to 2 weeks. The important operating parameters for these equipments are as follows :

	Recovery equipment	Recycling equipment
- Spares & consumables (US $/Kg)	0.31	0.41
- Energy consumption (per kg)	0.05 KWH	0.05 KWH

7.4 TECHNICAL OPTIONS FOR COLLECTION/RECOVERY AND RECYCLING OF CFCs

7.4.1 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.

7.4.2 All the three project countries - Egypt, Kenya and Nigeria which are signatories to the Montreal Protocol have per capita CFC-consumption levels as given in Table - 7.4 below :

TABLE - 7.4

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 0.3 Kg 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.

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.

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

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

7.4.4 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 requirements. To make local manufacture/assembly in an African country viable, it would be necessary to club local requirements with the neighbouring countries' requirements. Therefore three or four projects can be considered for Africa as a whole.

However, the necessary technical skills and competence exists to operate and maintain the equipment, with necessary training inputs being provided initially.

7.4.5 Attainable Reduction in CFC Consumption

Recovery and recycling programmes in each country will help reduce the CFC consumption substantially. The total consumption of CFCs in each country includes substantial quantity used for flushing/cleaning and leak detection during servicing and repair of the refrigeration and airconditioning equipment. This quantity is considered as technically possible to recover & recycle.

Further, in the cases of compressor failure or leakages in the refrigeration system, some quantity of the refrigerant remains in the system which can be recovered at the time of servicing/repair.

The maximum reductions attainable, based on 1991 field survey data, are given in Table 7.5 below :

TABLE - 7.5

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

	as % of recharging demand	as % of total demand
Egypt	58	28
Kenya	56	26
Nigeria	36	27

Recovery of CFCs from related materials (Insulation Foam)

The recovery of CFCs from insulation foam is logistically and economically not feasible in the project countries, due to the wide dispersal of scrapped refrigeration equipment, and the highly capital intensive nature of requisite facilities.

Safe Disposal of CFCs

Disposal of CFCs is not 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 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.

7.5 ECONOMIC ANALYSIS

7.5.1 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.

7.5.2 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 is estimated at about US $ 1000 and US $ 2400 respectively. This is based on the indicative prices of the specific models which are considered appropriate for adoption in the project countries.

7.5.3 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, consumable & 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, or 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.

7.5.4 The important findings regarding the viability of ventures are summarised at Table 7.6 below :

TABLE - 7.6

SUMMARY OF VENTURE VIABILITY ANALYSIS

VENTURE TYPE		EGYPT	KENYA	NIGERIA
Recovery only	- No. of ventures	100	40	150
	- Cost per kg of CFC recovered(US $)	0.92	1.04	0.92
	- Break-even volume	209 Kg	145 Kg	205 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	- No. of ventures	12	5	10
	- Cost per kg of CFC recycled (US $)	4.10	5.80	4.47

Table - 7.6 (Contd.)

VENTURE TYPE	EGYPT	KENYA	NIGERIA
- Break-even volume	1439 Kg	1013 Kg	1306 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

7.5.5 Based on the venture level viability analysis, the net national economic benefit for each country, for adopting a recovery and recycling programme, has been worked out by taking into account the following :

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 above costs and benefits have been assessed till the year 2010 and net present value obtained by discounting at the rate of 2% for arriving at the net national economic benefit for each country.

The Net National Economic Benefits to the project countries, based on the above analysis, works out to (-) US$ 5.95 million, (-) US$ 0.48 million and (-) US $ 0.97 million respectively for Egypt, Kenya and Nigeria.

7.6 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. 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 at that time.

7.7 FRAMEWORK FOR IMPLEMENTATION

7.7.1 Presently, none of the three project countries have any legislative regulations regarding collection/recovery and recycling of CFCs. Even regarding usage, only Egypt has introduced in 1989, a Ministerial decree banning the use of CFCs for aerosols.

7.7.2 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. 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

7.7.3 Further, the analysis shows that recovery and recycling in the project countries will be economically viable at the venture level, provided that the following financial incentives are given.

- exemption of import duty on recovery and recycling equipment
- subsidy on equipment cost (@ 20% to 50% depending upon individual country's level of motivation to implement the programme)
- increase in import duty on CFCs
- free supply of plastic bags to service agencies for collection from domestic refrigerators and deep freezers
- funding the cost of training programmes on operation and maintenance of recovery and recycling equipment
- funding the public awareness campaign, etc.

7.7.4 In order to initiate and implement the above scheme, it is necessary to strengthen the institutional framework in each country. This would involve creating a specific organisation (which could be under the aegis of the present environmental agencies in each country) for overall coordination and monitoring, as well as creating proper awareness about the harmful effects of ozone layer depletion. The cost of the recovery and recycling programme, based on Net National Economic Benefit Analysis for each country, could be met from multilateral fund.

7.8 COMPARISON OF COUNTRY CASE STUDIES & FORMULATION OF REGIONAL GUIDELINES

The comparison 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 OEM 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 :

- Sales & 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.

7.9 REGIONAL POLICY GUIDELINES FOR AFRICA AS A WHOLE

The regional guidelines for Africa as a whole have been formulated based on the above assessment.

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.

Some of the significant guidelines are :

7.9.1 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.

7.9.2 Legislative

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

7.9.3 Market Measures

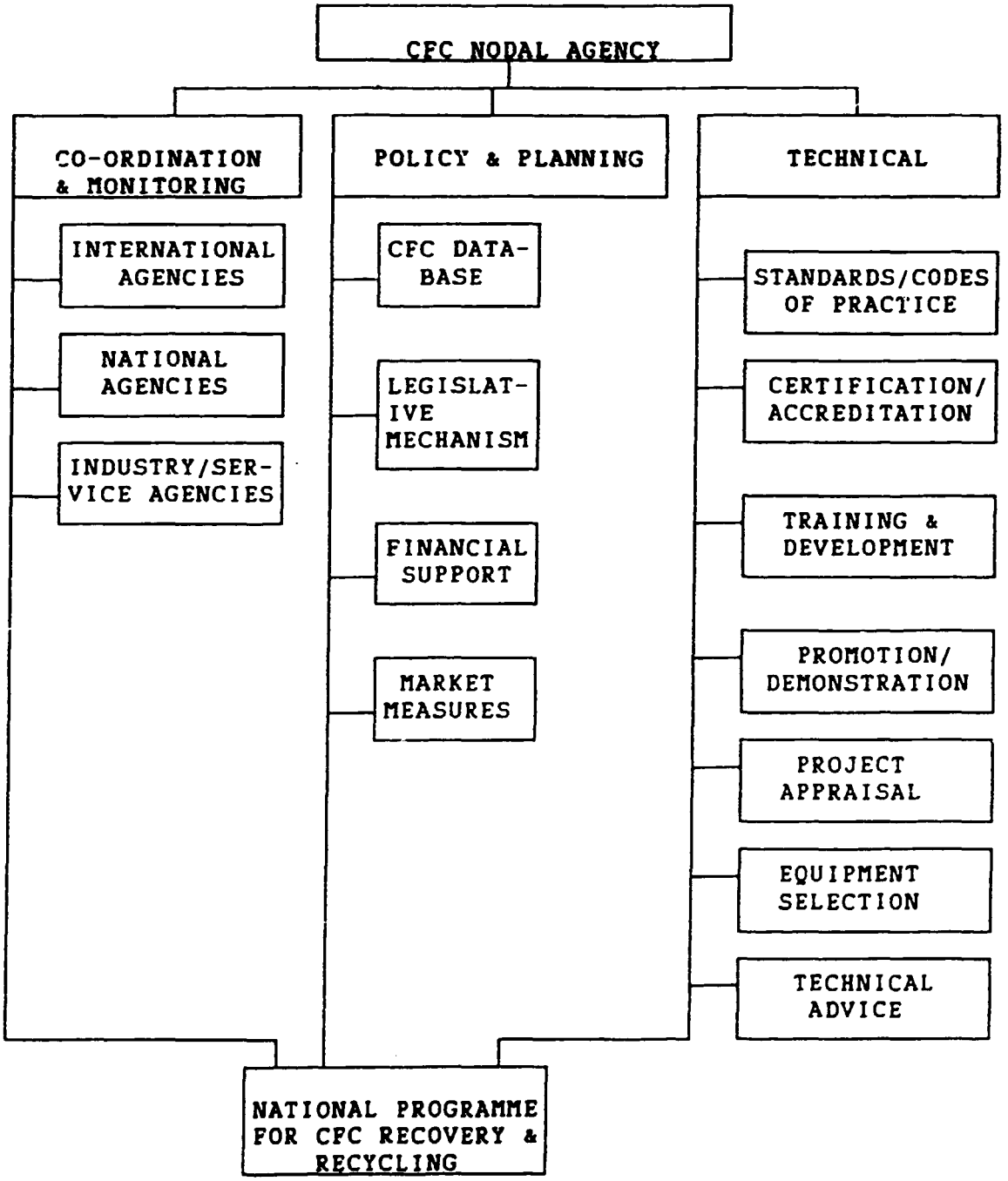
Intervention to raise prices of virgin CFCs, curbing of imports through limited quota allocation, setting up central recycling facilities, creation of public awareness etc.

7.9.4 Financial Support

Subsidies on capital investment for recovery and recycling

FIGURE - 7.1

REGIONAL POLICY MAKING FRAMEWORK



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.

7.9.5 The proposed regional policy making framework is shown in Figure 7.1.

7.10 REGIONAL DATA BANK

7.10.1 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, for which a detailed outline has been presented in this report.

7.10.2 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

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 7.2.

7.10.3 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 7.3 shows the scheme of such a regional information system.

FIGURE - 7.2

SYSTEM FRAMEWORK AT COUNTRY LEVEL
FOR REGIONAL POLICY ANALYSIS

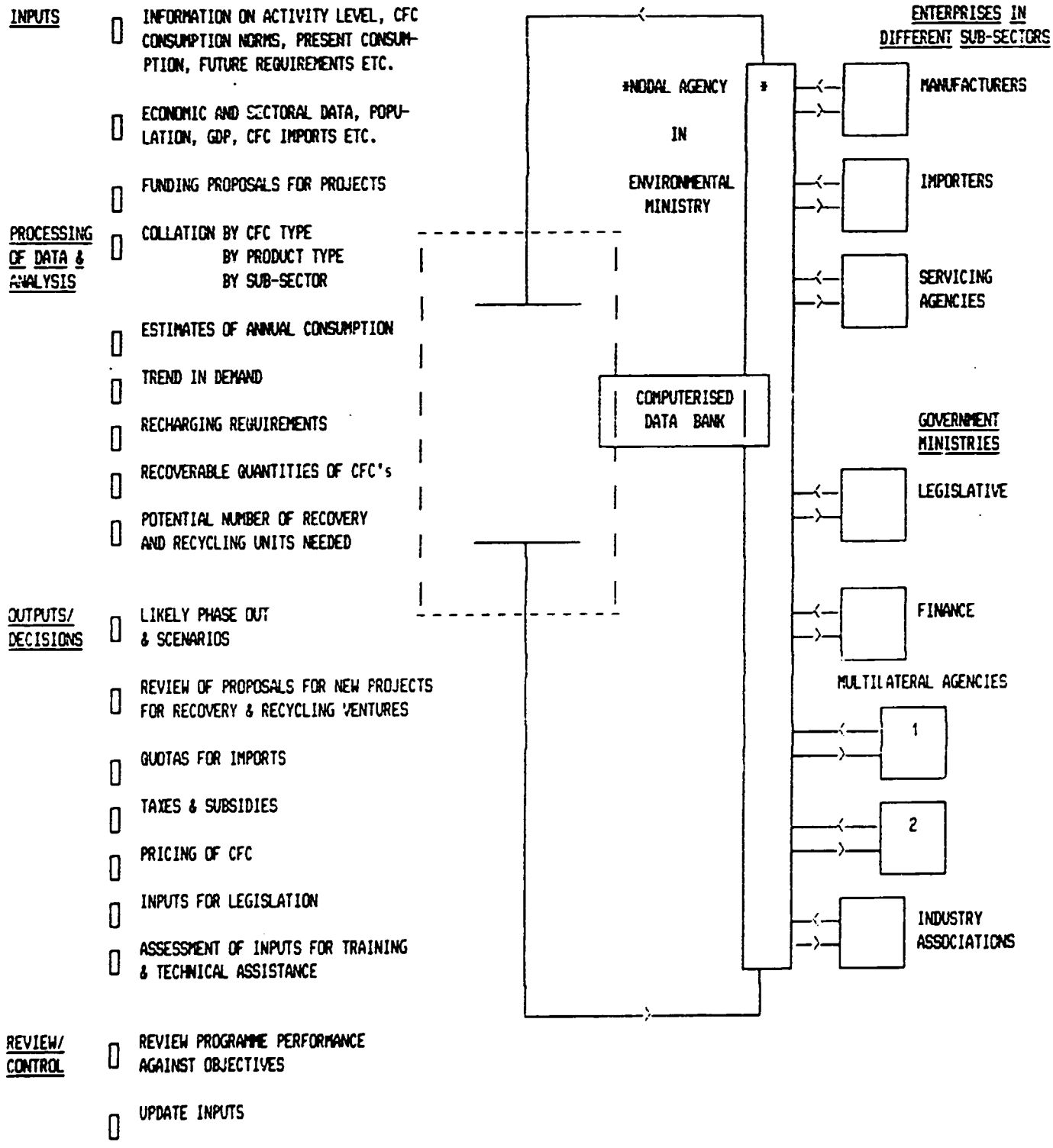
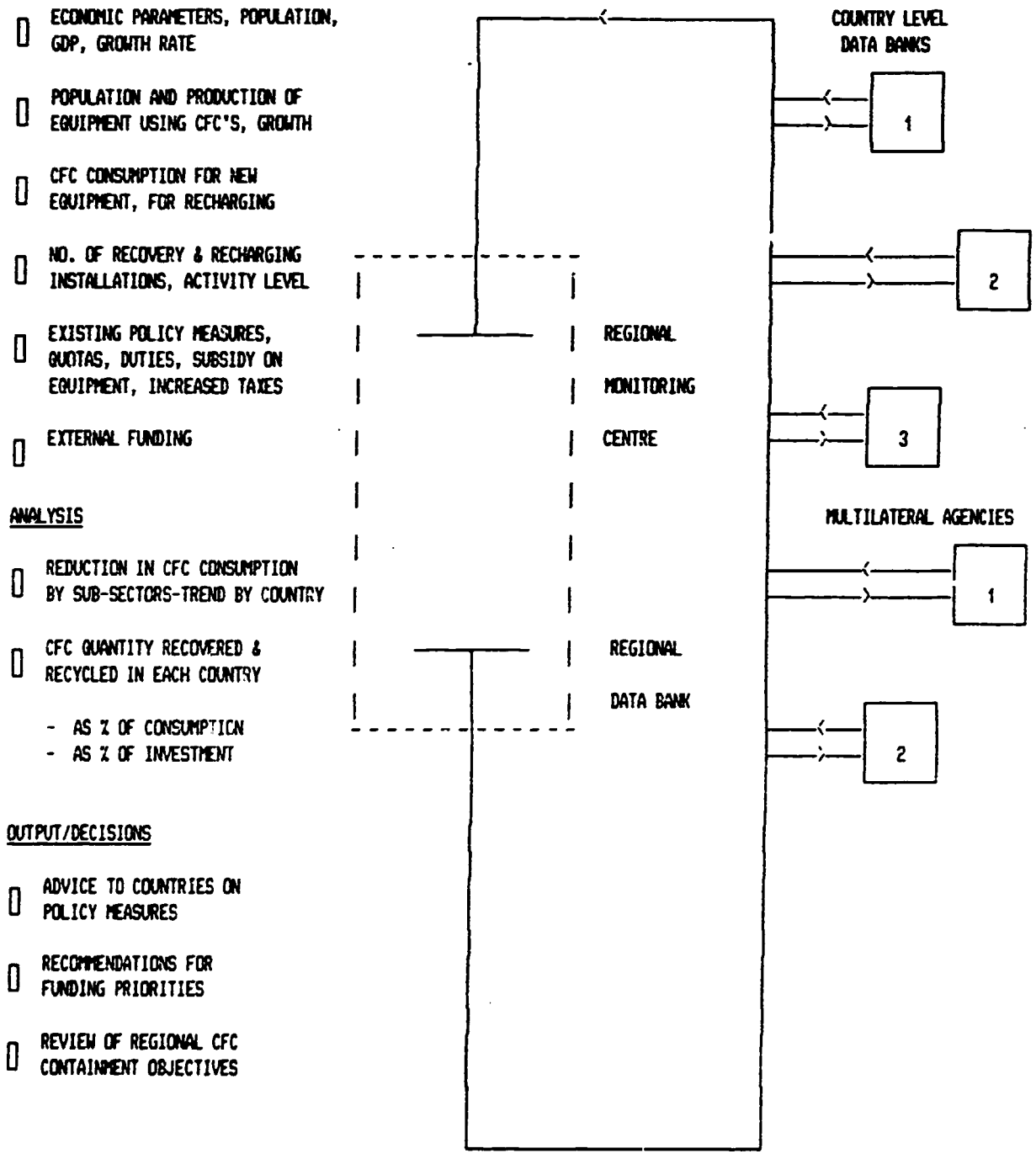


FIGURE - 7.3

SYSTEM OUTLINE AT REGIONAL LEVEL



7.11 SUMMARY

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

APPENDIX - 1.1

LIST OF REPORTS/DOCUMENTS USED AS REFERENCE MATERIALS

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(The World Bank, Africa Region)

23. Environmental Policy and the Public Revenue in Developing Countries.
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(South Coast Air Quality Management Distt Board, California)

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(Mobile Air Conditioning Society, East Greenville, PA 18041, USA).

29. Strategy for Ozone Protection
(Australian Environment Council, August 1989)

30. Technology in Indian Chlorofluorocarbons (CFCs) Refrigerants and their Substitutes Industry
(Department of Scientific & Indusutrial Research, Minisitry of Science & Technology, Government of India).

31. Reducing the consumption of Ozone Depleting Substance in India
(S.B. Billimoria & Co., India)

32. Technical Progress on Protecting the Ozone Layer Report on the Technology Review Panel (Pursuant to Article (6) of the Montreal Protocol on Substances that Deplete Ozone Layer, under the Auspices of the United Nations Environment Programme, June 1989)

33. Project Appraisal & Planning for Developing Countries by I.M.D. Little and J A Mirrlees

34. Swedish Code of STATUTES/SVENSK FOR FATTNINGSSAMLING ORDINANCE ON CFCs, HALONS ETC., (1988:716) (UNEP)

35. United Nations Environment Programme (Pilot Workshop for CFC Officers, Bangkok, Thailand, 30 March - 2nd April, 1992)

36. Reduction Strategy - Austria, Switzerland (Pilot Workshop for CFC Officers) (UNEP)

37. Sweden Experience on Recovery of Refrigerants and better Maintenance - Sweden Pilot Workshop for CFC Officers (UNEP)

38. Automotive Airconditioning

    Pilot Workshop for CFC Officers (UNEP)

39. Automotive Airconditioning - Code of Practice (Pilot Workshop for CFC Officers (UNEP)

APPENDIX - 1.2

LIST OF ORGANISATIONS/PERSONS CONTACTED DURING FIELD SURVEY

IN

EGYPT

SL. NO.	COMPANY	PERSONS
I.	CFC SUPPLY (IMPORTERS)	
01.	Freon Misr 12 Degla St Mohandess, Cairo. (Agent - Du Pont)	Mr Magdi A Attallah Manager
02.	Misr Engineering Centre for Consultation and Agencies 62 El Tahrir St. Dokki (Agent : ATCHOEM)	Mr Sherif Wishahy Director
II.	POLYOL SUPPLIERS	
03.	DOW Export S.A. 3 Abul Feda St. Zamalek	Mr Hussein Turman
III.	AEROSOLS MANUFACTURERS	
04.	United Trading & Agency Corporation CA Member of Beleidy Group of Companies) 45, Champalion Street, Cairo Factory : 10th of Ramadan City	Dr Mohamed Azouz Vice President for Technical Affairs Dr Said Mostafa Factories Manager
IV.	FOAM MANUFACTURERS	
05.	Taki-VITA S.A.E. Tenth of Ramadan Factories Industrial Area A.	Engg. Aly El. Borolossy Director - Board Member
06.	Egyptian Spone Co. (Misr Foam) 32 (H) Mourad St. Guza Tackery 6 October City.	Engg. Ossama Sayed Sleid General Factories Manager

07.	Advanced Chemical System (ADVECHEMS) 6, Geziret El Arab St. Mohandesene Factory : El Sadat City.	Dr Sherif M.El Gaboly Managing Director Engg. Samir Aref Planning Manager Engg. Abu Bakr El Sanady Production Manager
08.	Refcat,24 Zayed St. Cairo	Mr Adel Guindi General Manager
09.	ICEBERG	Engg. Yassin Kamel General Manager

V. DOMESTIC REFRIGERATION (MANUFACTURER)

10.	Delta Ind Co. (IDEAL) NasarCity Factory:Cairo	Engg. Badip El Din Affia Technical Director Engg. Abdel Halim Al Hadidi Production Manager
11.	Alaska (Office Service Centre) Cairo Ismailia Desert Road P.O.B. 2468, Horria Helipolis Factory : 10th 6 Ramadan City.	Maher Saad Managing Director
12.	Industrial Co. for Industrialisation (Siltal) 10th of Ramadan City (Al)	Engg. Badr. E. El. Bahaie General Manager
13.	Kiriazi 10th of Ramadan City B2, P.O. Box 90	Raymond Stepho Kiriazi Managing Director Kamal Wadie Da Woud Production Manager

VI. COMMERCIAL REFRIGERATION

Cold Stores/Walk-in-Coolers

14.	The Egyptian Co. for Cold Storage Industries S.Q.E. 32H Mourad Str (10th JI) Giza	Dr Alaeldin Gamel Arun

15. Mohamed Aly Bishara
P.O. Box 2928,11361
Heliopolis, Cairo.

16. United Cold Stores & Air Conditioning
21 Goumboria St
Cairo.
Mr M M Mowaty

VII. REFRIGERATED TRUCKS

17. The Egyptian Co. for Cold Storage Industries
(Misr Panal)
32 H Mourad Str.
Dr A Laddin Gammal Arun
(Manufacturer of Trucks and Importer of Carrier Units)

18. Refcat
24, Zayed St.
Cairo.
Mr Adel Guindi
General Manager

19. Misr Engineering and Tool.Co.(Micar)
2, Champollion St.
CAiro.
Engg. Mohey El Din Mohamed
Manager

20. Misr Milk & Food Co.
(User of Refrigerated Trucks)
Elsawh Amenia
Cairo.
Engg. Atel Hamouda

VIII. WATER COOLERS

21. Koldair
P.O.B. 431
Cairo
Engg. Aly Fahmy El-sawh
Chairman
Engg. Salah Eldin Soliman
Head of A/c Sector
Engg. Sadek M. Bushra
R&D General Manager

IX. WINDOW & SPLIT A/C PRODUCERS

22. Koldair
P.O.B. 431
Cairo.
Engg. Aly Fahmy El. Sawah
Chairman

23.	Abac Carrier Ltd 10th of Ramadan City Industrial Zone A2	Mr Ebrahim El Ziftawi Facotry Manager
24.	Power Egypt (SAS) 112 El Mirghani St. Heliopolis	Dr Magdi Mokhfar Youssef
25.	Misr Air Conditioning Mfg. Co. KM 28 Cairo Alexandria Desert Road.	Engg. Samy Shalaby
26.	MIRACO Service 174 Sudan St. Mohandessin	Engg. M.Labib Attiah General Manager Service & Installation Engg. Ahmed Mostafa Elhabal.

X. CENTRAL A/C (IMPORTER)

27.	York, (Miraco) 48, El Batal Ahmed Abdel Aziz St. Mohandessin Giza	Engg. Alaa Aly Head of Section Central Air Conditioning Deptt.
28.	Trane 1095 Comich El Nil Apt-1, Garden City Cairo.	Mr Alan. W. Wolf
29.	Carrier Air Conditioning Egypt Ltd 11, Dr Mohamed Mandour St. Masr City, Cairo	Mr Amin Mongy Mohamad Sales Manager Mr Nagy Beniameen Service Labor Manager Mr Raouf Rizk Commercial Refrigeration Manager.

XI. MOBILE AIR CONDITIONERS (SERVICE CENTRES)

30.	Peugeof Center of Development and Commerce 114 El-Khalig El Masry Street Ghamra.	Mr Mohamed Salek

31.	Sobhi A Farid Co. 29 Khaliq El Khor Str., Emad El Din Cairo.	Mr Sobhi A.Farid
32.	B M U Helioplis Service Centre Al Fotauh Automotive Co. Al Horia-Helioplis.	Mohamed Emam
33.	Mercedeze Benz Service Centre Al Horia - Heliopolis	Engg. Mohmed Embenur
34.	Mercedeze Agency Khalig El Masry St. Ghamra.	Engg. Said Kamal

XII. DOMESTIC REFRIGERATOR SERVICE CENTRES

35.	Kiriazi Service Centre Heliopotis, Cairo	Engg. Naggi Nagib General Manager
36.	Engg. Hossen El Said Down Town, Cairo.	
37.	Mr Sahaha, Down Town, Cairo.	
38.	Ideal Service Centre El Din. Down Town, Cairo.	
39.	Mr Sammiat, Talat Harb Street, Cairo.	
40.	Mr Padak, Down town, Cairo.	

XIII. GOVERNMENT DEPTTS.

41.	Mr Saler Hafaz Chairman Egyptian Environmental Affairs Agency	
42.	Dr Eid Under Secretary Egyptian Environmental Affairs Agency	
43.	Mr Fauad M Megahed Egyptian Environmental Affairs Agency	

XIV. UNDP & OTHERS

44. Ms Nadia Makaram Ebeid
Programme Officer
United Nations Development Programme
Cairo.

45. Mr Tharvat Sabry, UNDP, Cairo.

46. Dr M Shiva Murti, UNDP, Cairo.

47. Dr Sharma, UNDP, Cairo.

48. Frank J Pinto
Principal Technical Advisor
(Environment and National
Resources Management Group)
UNDP, 1 United Nations Plaza
New York.

49. Mr Akbar H Usmani
Management Auditor
UNDP, 1 United Nations Plaza
New York.

50. Mr Frederick Gazzoli
Management Auditor
UNDP, 1 United Nations Plaza
New York.

51 Mr Husamuddin Ahmadzai
Head of Section
Naturvardsverket
The National Environmental Protection Board
Sweden.

52. Engg. Hatem H Karam
Chairman
Karamco Trading Co.
34, Talaat Harb St.
APT. 13, Cairo.

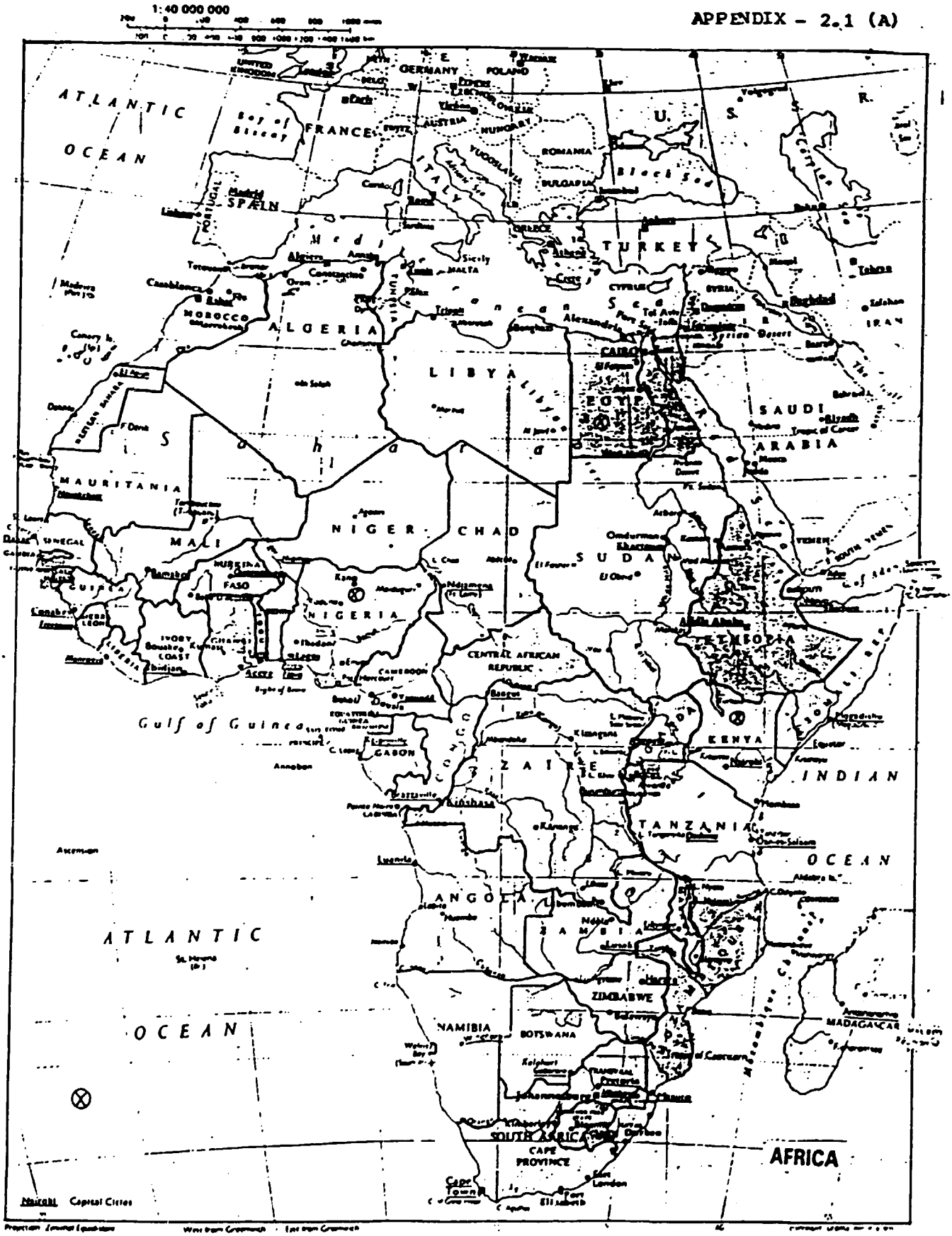
53. Engg. Nalin K Bamzai
Director
Karamco Trading Co.
34, Talaat Harb St.
APT. 13, Cairo.

54. Dr Alaa Ezz
TIPS
34, Talaat Harb St.
Suite 10
Cairo, Egypt.

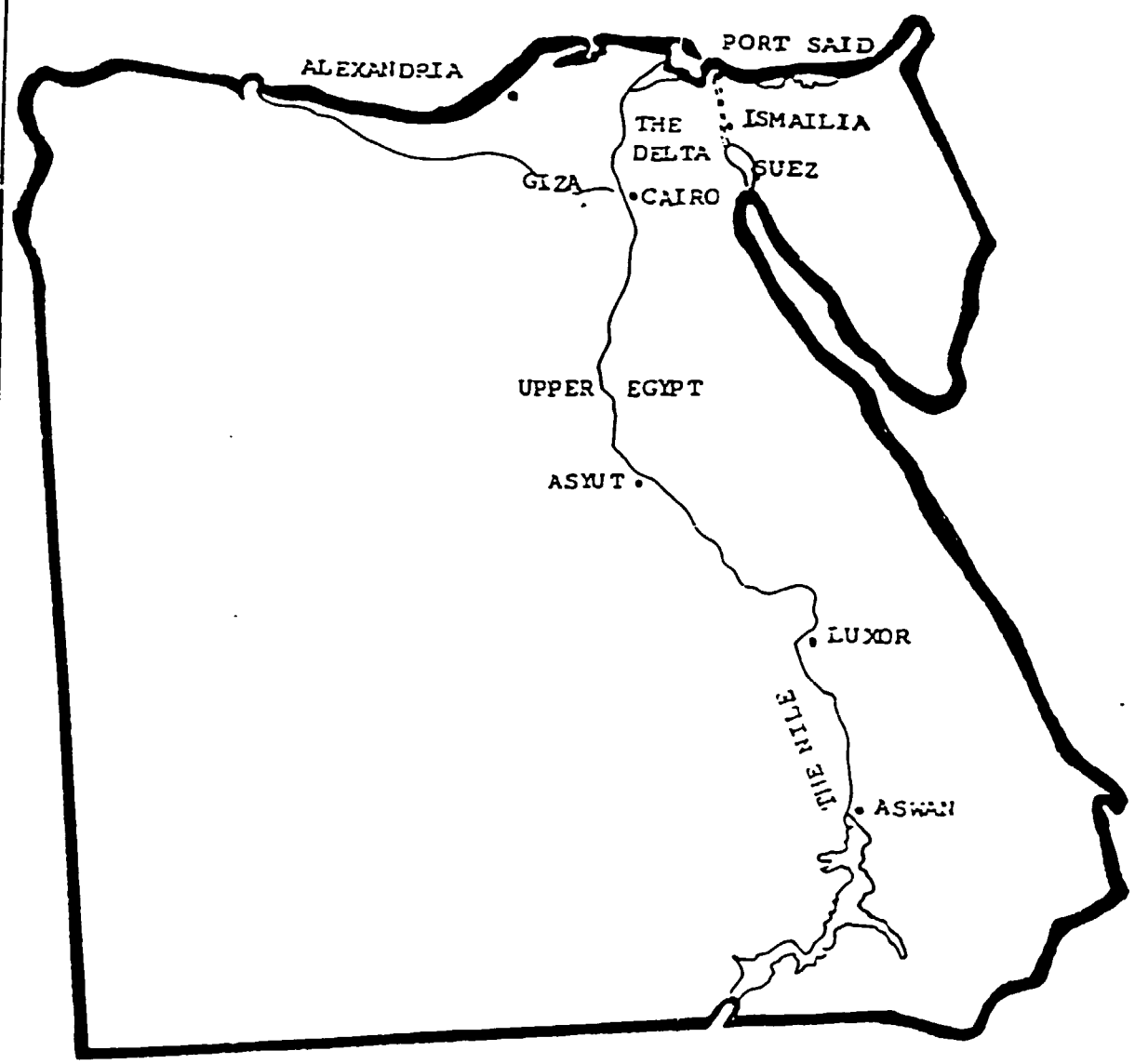
55. Mr Soliman Hamdy Soliman
General Manager
Egyptian German Air
Treatment Co. - Egat
62, Lebanon Street
Dokky, Cairo.

56. Mr S P Mann
First Secretary
Embassy of India
37, Talaat Harb St., Cairo.

APPENDIX – 2.1 (A)



APPENDIX - 2.1 (B)



EGYPT

A. COMPUTATION FOR DEMAND OF CFCs IN NEW EQUIPMENT PRODUCTION - NEW DEMAND (1991)

SUB-SECTOR	TYPE OF CFC	AVG. UNIT NORM OF CONSUMPTION (KG)	WASTAGE FACTOR (%)	ACTUAL UNIT AVERAGE CONSUMPTION (KG)	DEMAND OF NEW EQUIP (NOS)	CONSUMPTION OF CFC FOR NEW DEMAND (MT)
DOMESTIC REFRIGERATION AND DEEP FREEZERS	CFC - 12	0.20	10	0.22	300000	66
	CFC - 11	0.80	10	0.88	300000	264
COMMERCIAL AND INDUSTRIAL REFRIGERATION						
-COLD STORES	CFC - 12	8 *	20	9.6	150	1.4
	CFC - 11	149	20	178.8	150	26.8
-REFRIGERATED TRUCKS	CFC - 12	4.5	20	5.4	310	1.7
	CFC - 11	60	20	72	310	22.3
-DISPLAY CABINETS	CFC - 12	0.5	20	0.6	700	0.4
	CFC - 11	1.1	20	1.3	700	0.9
-WATER COOLERS	CFC - 12	0.6	15	0.7	8000	5.5
	CFC - 11	-	-	-	-	-
SUB TOTAL	CFC - 12					9
	CFC - 11					50
COMMERCIAL AIRCONDITIONING (CENTRIFUGAL CHILLERS)	CFC - 12 **	-	-	-	-	-
	CFC - 11	500	10	550	20	11
MOBILE AIRCONDITIONING (CARS)	CFC - 12	1.0	20	1.2	10000	12
	CFC - 11	-	-	-	-	-

* THE AVERAGE UNIT CONSUMPTION NORM IS TAKEN AS 6 Kg FOR 1-50 TR CAPICITY AND 26 Kg FOR 50TR & ABOVE CAPICITY

** THERE WAS NO IMPORT OF CFC-12 BASED CENTRIFUGAL CHILLERS IN 1991

B. COMPUTATION FOR RECHARGING DEMAND IN 1991

SUB-SECTOR	POPULATION ('NOS)	CFC USED	COMPRESSOR FAILURE: NO OF CASES (NOS)	COMPRESSOR FAILURE: % OF POPULATION	COMPRESSOR FAILURE: QTY PER UNIT Kgs	COMPRESSOR FAILURE: TOTAL QTY (MT)	LEAKAGE @: NO OF CASES (NOS)	LEAKAGE @: % OF POPULATION	LEAKAGE @: QTY PER UNIT Kgs	LEAKAGE @: TOTAL QTY (MT)	TOPPING UP: % OF POPULATION	TOPPING UP: NO OF CASES (NOS)	TOPPING UP: QTY PER UNIT Kgs	TOPPING UP: TOTAL QTY (MT)	TOTAL (MT)
DOMESTIC REFRIGERATION AND DEEP FREEZERS	6686000	CFC-12	240000	3.5	0.41	98.4	401000	6	0.41	156.39 ^	0	0	0	0	254.79
	-	CFC-11	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL AND INDUSTRIAL REFRIGERATION															
-CT&T STORES	5000	CFC-12	200	4	13.2	2.64	250	5	13.2	3.3	90	4500	0.6	2.7	8.64
	-	CFC-11	-	-	-	-	-	-	-	-	-	-	-	-	-
-REFRIGERATED TRUCKS	3000	CFC-12	60	2	9.9	0.59	150	5	9.9	1.48	100	3000	0.45	1.35	3.42
	-	CFC-11	-	-	-	-	-	-	-	-	-	-	-	-	-
-DISPLAY CABINETS	4000	CFC-12	200	5	1.2	0.24	600	15	1.2	0.72	0	0	0	0	0.96
	-	CFC-11	-	-	-	-	-	-	-	-	-	-	-	-	-
-WATER COOLERS	100000	CFC-12	500	0.5	1.2	0.6	2000	2	1.2	2.4	0	0	0	0	3
	-	CFC-11	-	-	-										
COMMERCIAL AIRCONDITIONING (CENTRIFUGAL CHILLERS)	NEG.	CFC-12	-	-	-	-	-	-	-	-	-	-	-	-	-
	200	CFC-11	-	-	-	-	-	-	-	-	100	200	100	20	20
MOBILE AIRCONDITIONING (CARS)	150200	CFC-12	1500	1	2.2	3.3	30000	20	2.2	66	40	60000	0.13	7.8	77.1
	-	CFC-11	-	-	-										

@ - Quantity of refrigerant per unit for recharging including the requirement for flushing & leak detection (where ever applicable)
^ In 10% of cases nitrogen is being used for flushing & leak detection purposes.

C. SUMMARY

SUB-SECTOR	TYPE OF CFC	NEW DEMAND (MT)	RECHARGING DEMAND (MT)	TOTAL DEMAND (MT)
DOMESTIC REFRIGERATION AND DEEP FREEZERS	CFC - 12	66	255	321
	CFC - 11	264	-	264
COMMERCIAL AND INDUSTRIAL REFRIGERATION	CFC - 12	9	16	25
	CFC - 11	50	-	50
COMMERCIAL AIRCONDITIONING (CENTRIFUGAL CHILLERS)	CFC - 12	-	-	-
	CFC - 11	11	20	31
MOBILE AIRCONDITIONING (CARS)	CFC - 12	12	77	89
	CFC - 11	-	-	-

APPENDIX - 2.3

PROFILES OF MAJOR INDIVIDUAL ENTERPRISES ENGAGED IN IMPORTING/ASSEMBLING/PRODUCING AIRCONDITIONING AND REFRIGERATION EQUIPMENT IN EGYPT

1. NAME & ADDRESS :
ALASKA, P.O.B. 2468 HORRIA, HELIOPOLIS
Factory : Cairo Ismailia Desert Road

TYPE OF ENTERPRISE :
Domestic Refrigerators & Deep Freezers Manufacturer

CONTACT PERSON :
Mr Maher Saad, Managing Director

ACTIVITY :
Domestic Refrigerators and Deep Freezers : Company produces a range of domestic refrigerators (106, 203, 233 & 252 ltrs) and deep freezers (140, 180, 200, 340, 470 and 600 ltrs). Installed capacity is 80,000 units per year and production was about 47,000 units in 1991. It is mainly producing deep freezers (about 80% of its production). Has technical tie-up with Lieher, Germany.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm			Utilisation (MT) 1991	
	CFC-11 (Insulation)	CFC-12		CFC-11	CFC-12
- Domestic Refrigerators and Deep Freezers	Avg.800 Gms/Unit	Avg.200 Gms/Unit for deep freezer	New Recharging	41.0 -	11.0 3.0

GENERAL :
The company was set up in 1978. Since then its production has been increasing steadily reaching a peak in 1987 which fell thereafter due to various economic reasons. At present company has about 13% market share with a turnover of about LE 25 Mn. It has only one service centre located at Cairo.

2. NAME & ADDRESS :
CARRIER AIR CONDITIONING EGYPT LTD, 11 DR MOHAMED MANDOUR ST. NASAR CITY, CAIRO

TYPE OF ENTERPRISE :
Import and Installation of Commercial Airconditioning System.

CONTACT PERSONS :
Mr Amin Mongy Mohamed, Sales Manager
Mr Raouf Rizk, Commercial Refrigeration Manager

ACTIVITY :
Commercial Airconditioning : Carrier Egypt imports centrifugal airconditioning system, reciprocating aircondition system from its principals Carrier Corporation Syracause, New York and also undertakes the installation and servicing contracts. Central airconditioning system are primarily CFC-11 based whereas reciprocating system are HCFC-22 based. Carrier accounts for 35-40% market share of central airconditioning system. Part of the system imported by Carrier are installed by one public sector company Koldair.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm (Kgs)		Utilisation (MT) 1991		
	CFC-11	CFC-12		CFC-11	CFC-12
- Commecial air-conditioning (Centrifugal)	Avg.500 per unit	Avg.500 per unit	New	2.5	-
			Recharging	5.0	-

GENERAL :
Carrier has planned to import and supply the commercial refrigeration system required for cold stores from 1992 end. CFC-11 phased out programme of the company depends on its principals.

3. NAME & ADDRESS :
THE DELTA INDUSTRIAL COL (IDEAL), 18 EMAD EL DIN ST, CAIRO.
Factory : Nasr City - Cairo.

TYPE OF ENTERPRISE :
Domestic Refrigerators & Deep Freezers Manufacturer

CONTACT PERSONS :
Engr Badr El din Altia, Technical Director
Engr Abdel Halim Al Hadidi, Production Manager

ACTIVITY :
Domestic Refrigerators and Deep Freezers : Ideal is one of the largest and oldest public sector company of Egypt producing domestic refrigerators in various sizes with an installed capacity of 7,50,000 units/annum. Due to entry of various new companies producing refrigerators, its market share has came down substantially but still has maximum market share of about 45%, as its products are the cheapest in the market. Has a service centre at the plant and in various cities, but most of its products are serviced in unorganised sector.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm (Insulation) CFC-11	Unit Consumption Norm (Insulation) CFC-12	Utilisation (MT) 1991	CFC-11	CFC-12
- Domestic Refrigeration & Deep Freezers	Avg.800 Gms/Unit	Avg.200 Gms/Unit	New Recharging	119 -	30 N.A

GENERAL :
Ideal is already assessing the use of substitutes for CFCs and are also keen to install CFC recovery and recycling equipment at their plant.

It has also volunteered to undertake trial of new polyol requiring 50% less CFC, which has been developed by Dow Chemicals.

4. NAME & ADDRESS :
ELECTRO-STAR FOR REFRIGERATION (ZANUSHI), 6 El SABAH STREET, GIZA
FACTORY : 6 OCTOBER CITY

TYPE OF ENTERPRISE :
Domestic Refrigerators & Deep Freezers

CONTACT PERSON :
Eng. Farouk Hosni, General Manager

ACTIVITY :
Domestic Refrigerators and Deep Freezers : The company was established in 1986 for the production of domestic refrigerators and deep freezers, under licence from Zanussi, Italy with an installed capacity of 40,000 units/annum. It produces various sizes of refrigerators & the maximum production is of 9.5 cuft and 12 cuft size domestic refrigerators.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm (Insulation) CFC-11	Unit Consumption Norm (Insulation) CFC-12	Utilisation (MT) 1991	CFC-11	CFC-12
- Domestic Refrigerators & Deep Freezers	Avg.800 Gms/Unit	Avg.200 Gms/Unit	New Recharging	22 -	5.5 1.0

GENERAL :
The sales of its products are through distributors/ authorised dealers. However after sales services is provided by the company through its service centres. In the beginning of '92,Zanussi,(Italy) has withdrawn its licence.

5. NAME & ADDRESS :
THE EGYPTIAN CO. FOR COLD STORAGE INDUSTRIES S.A.E. (MISR PANAL), 32 H. MOURAD STR. (10TH FT), GIZA.

TYPE OF ENTERPRISE :
Commercial Refrigeration manufacturing

CONTACT PERSON :
Dr Alaeldin Gamal Aurn

ACTIVITY :
Commercial Refrigeration (Mobile Refrigerated Trucks : The biggest company, imports fabricate and install the mobile refrigeration systems (MRS). Panels for insulation is produced by the company. MRS are imported from Carrier France. Three size of trucks 1 TR, 8-10 TR, 30 TR are supplied by the company. The total production of R-12 based refrigerated trucks in 1991 was 180 nos (1 TR), 60 Nos (8-10 TR) and 25 Nos (30 TR) and cater to about 85-90% market demand.

Company also fabricate cold stores using the insulated panels prodeluced by the company whereas the refrigeration system are imported. It fabricate about 25 cold stores per annum.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm			Utilisation (Kgs) 1991		
	CFC-11 (Insulation)		CFC-12		CFC-11	CFC-12
- Commercial refrigeration (Mobile Refrigeration) and Cold Stores	Avg.640 gm per sq.mtr	1TR 8-10 TR 30TR Cold Sto-res	3 6-7 10 6 Kg/ unit	New Recharging	14.0 -	2.0 3.0

GENERAL :
Company has well trained and experienced personnel who are actively working on substituting CFC-12 with HCFC-22. However they are more dependent on their principals 'Carrier'. It is expected that by '92 end they would start supplying the HCFC-22 based units.

6. NAME & ADDRESS :
INTERNATIONAL COMPANY FOR REFRIGERATION AND APPLIANCES (IBERNA), 20A GAWAD HOSNI ST., CAIRO
Factory : KM 28 CAIRO/ALEX DESERT ROAD

TYPE OF ENTERPRISE :
Domestic Refrigerator & Deep Freezer Manufacturer

CONTACT PERSON :
Mr Mahfouz Nabih Youssff, Chairman

ACTIVITY :
Domestic Refrigerators and Deep Freezers :One of the leading man-ufacturers of domestic refrigerators and deep freezers. Has set up the plant with the installed capacity of 45000 Refrigerators and 15,000 Deep freezers. Has technical tie-up with IBERNA, Italy.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm		Utilisation (MT) 1991		
	CFC-11 (Insulation)	CFC-12		CFC-11	CFC-12
- Domestic refrigerators & deep freezers	Avg.800 Gms/Unit	Avg.200 Gms/Unit	New Recharging	14 -	3.5 1.0

GENERAL :
Company has no compressor manufacturing and repairing facility and so it has to depend on imports to meet its new and replacment demand.

7. NAME & ADDRESS :
ISLAMIC CO FOR INDUSTRIALISATION (SILTAL),
20 A MANSHIET EL BAKRY ST., P.O. BOX 5983 HELIOPOLIS,
FACTORY : 10TH RAMADAN CITY (A-1)

TYPE OF ENTERISE :
Domestic Refrogerators & Deep Freezers Manufacturer

CONTACT PERSON :
Engr Badr E El Bahaie, General Manager

ACTIVITY :
Domestic Refrigerators and Deep Freezers : One of the Faisal Islamic Egyptian Bank Co., it was established in 1984 for the production of domestic refrigerators and chest freezers. Produces six models of refrigerators varying from 130 ltres to 430 litres capacity and two models of chest-freezers of 130 & 180 litres capacity. The production of chest-freezer was started in 1990-91. The installed capacity of the plant is 32,000 nos/annum and the production in 1991 was about 24,000 refrigerators and 4,000 chest freezers.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm		Utilisation (MT) 1991		
	CFC-11 (Insulation)	CFC-12		CFC-11	CFC-12
- Domestic Refrigerators & Deep Freezers	Avg.800 Gms/Unit	Avg.200 Gms/Unit	New	24	6.0
			Recharging	-	2.0

GENERAL :
The company has appointed many distributers in different cities. The after-sales-service back-up is provided by its three service centres located at Cairo, Alexendria, and upper Egypt (Asyut) which are equipped with required servicing equipments supported by small moving service trucks.

The company plans to double its production capacity in near future depending upon market need. The company also propose to switch over to CFC-134a base compressors once it is easily available from compressor suppliers.

8. NAME & ADDRESS :
KIRIAZI REFRIGERATORS MANUFACTURING CO., 10TH OF RAMADAN CITY, AREA B2, P.O. BOX 90, EGYPT

TYPE OF ENTERPRISE :
Domestic Refrigerators & Deep Freezers Manufacturer

CONTACT PERSONS :
Mr Raymond Stepho Kiriazi, Managing Director
Mr Kamal Wadie Dawoud, Production Manager

ACTIVITY :
Domestic Refrigerators and Deep Freezers : Kiriazi Company was started in 1985 with the technical assistance from Zerowatt, Italy. Within short span of time (6th year of operation) it has established its name in the market and at present, is considered one of the leading manufacturers of household refrigerators and deep freezers in Egypt. The company producers 3 models each of domestic refrigerators and chest freezers in the sizes of 220, 330 & 440 litres and 140, 180 & 220 litres respectively. Out of its total production 75% is of domestic refrigerators and 25% of deep freezers.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm		Utilisation (MT)* 1991		
	CFC-11 (Insulation)	CFC-12		CFC-11	CFC-12
- Domestic Refrigerators & Deep Freezers	Avg.800 Gms/Unit	Avg.210 Gms/Unit	New	44	12
			Recharging	-	2**

* including wastage
**using Nitrogen for flushing and cleaning purposes

GENERAL :
The company has appointed one distributor for coordinating the total sales. However after-sales-service is provided by Kiriazi service centre located at Cairo which takes care of the servicing need of whole of Egypt with the help of 15 well equipped mobile trucks.

It plans to installed a compressor repairing centre and CFC-12 recovery & recycling system. This system is proposed to be installed with the assistance of the Egyptian Government for demonstration purposes. It also plans to start using CFC-134a based compressors instead of CFC-12 depending on its availability.

9. NAME & ADDRESS :
KOLDAIR, P.O. BOX 431, CAIRO

TYPE OF ENTERPRISE :
Commercial Refrigeration Equipment Manufacturer & contractor for commercial refrigeration and airconditioning equipment.

CONTACT PERSONS :
Eng. Aly Fahmy EL-Sawah, Chairman
Eng. Salah Eldin Soliman, Head of A/c Sector

ACTIVITY :
Commercial refrigeration and airconditioning : Koldair is one of the biggest public sector company producing varied range of Commercial refrigeration and domestic/industrial air conditioning equipments. The CFC-12 based equipments produced by the company mainly includes Water Cooler (17 GPH Capacity, Annual Production, 6000 Nos and 9 GPH Capacity, annual production 2000 nos) and display Cabinet (11 cu.ft, annual production 200 nos and 22 cu.ft. annual production 100 nos). These products are manufactured completely based on design and know-how developed by the company.

In addition to above manufacturing activity, 'Koldair' Undertakes refrigeration/airconditioning contracting work. Services offered included design, installation and maintenance of commercial airconditioners/refrigeration systems. The commercial airconditioning system (centrifugal) is mainly procured from Carrier, USA.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm		Utilisation (MT) 1991		
	CFC-11	CFC-12		CFC-11	CFC-12
- Commercial and Industrial Refrigeration and airconditioning	Avg.500 Kg/unit	Display Cabinet Water Coolers -17GPH 610 gms/unit - 9GPH 450 gms/unit	Avg.500 gms	New 2.5 Recharging 2.5	5.5MT 0.5MT

GENERAL :
Koldair is assessing the Technical, Commercial and Economic feasibility of new substitute as HCFC-22 or CFC-134a for products usisng CFC-12 with necessary testing procedures, plus maintenance problems for both units using CFC-12 or CFC-11 to use recycling processes for such products in service now. It will be producing 17 GPH Water Cooler using HCFC-22 by 1993.

10. NAME & ADDRESS :
MISR AIR CONDITIONING MFG CO., S.A.E.(MIRACO)
48 EL BATAL AHMED ABDEL AZIZ ST. MOHANDESSIN, GIZA.

TYPE OF ENTERPRISE :
Import,Manufacture and Contractor of Domestic and Commercial airconditioning equipment.

CONTACT PERSONS :
Eng. Samy Shalaby, General Manager-Production
Eng M Labib Attiah, General Manager Service & Installation
Eng. Alaa Aly, Head of Section Central Air-conditioning Dept.

ACTIVITY :
Commercial Airconditioning : Miraco's activity presently includes, manufacturing, sales, maintenace and service of all types of airconditioning equipments. It is one of the largest domestic airconditioner manufacturer and supplier of central airconditioning plant. Miraco has about 30% market share of window airconditioners, 70% of split airconditioners and about 40% of central airconditioning. It has technical tie-up with York, USA from whom Miraco imports Centrifugal Chillers, Reciprocating Chillers and specialised airconditioning and refrigeration equipments. Except Centrifugal Chillers company's products are HCFC-22 based.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm (Kgs) CFC-11	CFC-12	Utilisation (MT) 1991	CFC-11	CFC-12
- Commercial air-conditioning (Central air-conditioning)	Avg.500 per unit	-	New	4.5	-
			Recharging	11.0	-

GENERAL :
Miraco employs about 735 personnel out of which 115 are engaged in contracting and 263 in Sales & Service. Micaro has set up one well equipped sales & service centre at Giza which cater to total servicing need of its equipment all over country. In case of central airconditioning company undertakes servicing contract of the equipment of other make, also.

11. NAME & ADDRESS :
MISR ENGINEERING CENTRE FOR CONSULTATION AND AGENCIES
62 El TAHRIR ST. DOKKI, GIZA

TYPE OF ENTERPRISE :
Importer of Mobile Airconditioning Systems and Refrigerant Gases.

CONTACT PERSON :
Mr Sherif Wishahy

ACTIVITY :
Commercial Airconditioning : It imports, assembles and service Mobile air-conditioners. About 3000 Mobile conditioners are imported by the company in 1991 which accounts for about 1/3 of total mobile airconditoning demand of the country. The Mobile airconditioners are imported from various European Companies.

In addition to the imports of Mobile airconditioners, it is one of the major importer of refrigerant gases representing ATOCHEM in Egypt.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm CFC-11	CFC-12	Utilisation (MT) 1991)	CFC-11	CFC-12
- Mobile air-conditioners	-	Avg. 1 Kg/ Car	New	Nil	2.0
			Recharging	-	3.0

GENERAL :
The head of the company is aware of CFCs negative impact but for phasing out more dependent on market forces. As no phased out programme been made by the company.

12. NAME & ADDRESS :
MISR ENGINEERING AND TOOLS (MICAR), 2 CHAMPOLLION ST., CAIRO

TYPE OF ENTERPRISE :
Commercial Refrigerators (Mobile Refrigerated Trucks) assembling.

CONTACT PERSON :
Eng. Mohey El Din Mohamed, Manager

ACTIVITY :
Commercial Refrigeration (Mobile Refrigerated Trucks) : A public sector company engaged in production of a wide range of products, mainly producing trailer, semi trailers chassis, Oil & Water trucks etc. Mobile refrigerated trucks are being assembled by procuring insulated panels from Refcat, Cairo and refrigeration systems from Carrier and Thermoking. Company produces about 75 mobile refrigerated trucks per annum of 7 & 20 TR.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm		Utilisation (MT) 1991		
	CFC-11	CFC-12		CFC-11	CFC-12
- Commercial and Industrial Refrigeration	-	7TR - 5Kg per unit 20TR-10.6 Kg/unit	New Recharging	Nil -	0.5 -

GENERAL :
MRT not being the main stream product, company is more depended on supplier of refrigeration system as far as phase out of CFC-12 is concerned. Company is also planning to start producing airconditioned mini buses.

13. NAME & ADDRESS :
REFCAT 24 ZAYED ST., ABBASSIA, CAIRO

TYPE OF ENTERPRISE :
Manufacturer of Commercial and Industrial Refrigeration Equipment

CONTACT PERSON :
Mr Adel, Guindi, General, Manager

ACTIVITY :
Commercial Refrigeration : It mainly produces the panels for Display Cabinet, Cold Rooms and refrigerated trucks. Refrigeration syster are imported and assembled by the company. The display cabinet are produced from 21 cu.ft to 60 cu.ft size (about 250 nos/annum), cold rooms (3 cu.mt to 20,000 cu.mt) (150 nos/annum of 3 cu.mt size) and refrigerated trucks 1 tonne to 4 tonne size (20 nos/annum).

CFC UTILISATION:

Sub-sector	Unit Consumption Norm (Kgs)		Utilisation (Kgs) 1991		
	CFC-11 (Insulation)	CFC-12		CFC-11	CFC-12
- Commercial Refrigeration	Avg.640 gms per sq.mtr.	Display Cabinet Avg.500 gms/unit Cold Stores Refrig-erated trucks Avg.6 kg/ unit Avg.3 kg/ unit	New Recha-rging	16.0 -	1.2 1.0

GENERAL :
Company provides after-sales service through trainee service personnel.

14. NAME & ADDRESS :
TRANE, 1095, CORNICH El NIL APT.1, GARDEN CITY, CAIRO

TYPE OF ENTERPRISE :
Import and Installation of Commercial Airconditioning System.

CONTACT PERSON :
Alan U. Wolf, Service Supervisor

ACTIVITY :
Commercial Airconditioning : Trane is one of the major importer of commercial airconditioning systems (central airconditioning) in Egypt. The system supplied by Trane are CFC-11 and CFC-12 based but primarily it is CFC-11 based system. The CFC-12 system are imported on specific demand of the user. In the past it has also imported CFC-113 based chillers which are not being imported now. Trane accounts for about 15% market share and supplies 3-4 system per year.

CFC UTILISATION:

Sub-sector	Unit Consumption Norm (Kgs)		Utilisation (Kgs) 1991		
	CFC-11	CFC-12		CFC-11	CFC-12
- Commercial air-conditioners (Centrifugal)	Avg.500gm per unit	Avg.500gm per unit	New	1.5	-
			Recharging (Topping up)	2.5	0.4

GENERAL :

Trane Egypt being a subsidiary of Trane International, phase out programme of the company will be as per the direction of parent company which is in the process of developing CFC-11 substitute based chillers. All servicing and installation activity of the company are coordinated from Cairo only.

APPENDIX - 2.4

METHODOLOGY FOR PROJECTING DEMAND OF AIR CONDITIONING & REFRIGERATION EQUIPMENT

I. For the purpose of projecting demand, the airconditioning and refrigeration equipment have been classified into two broad categories, defined as follows :

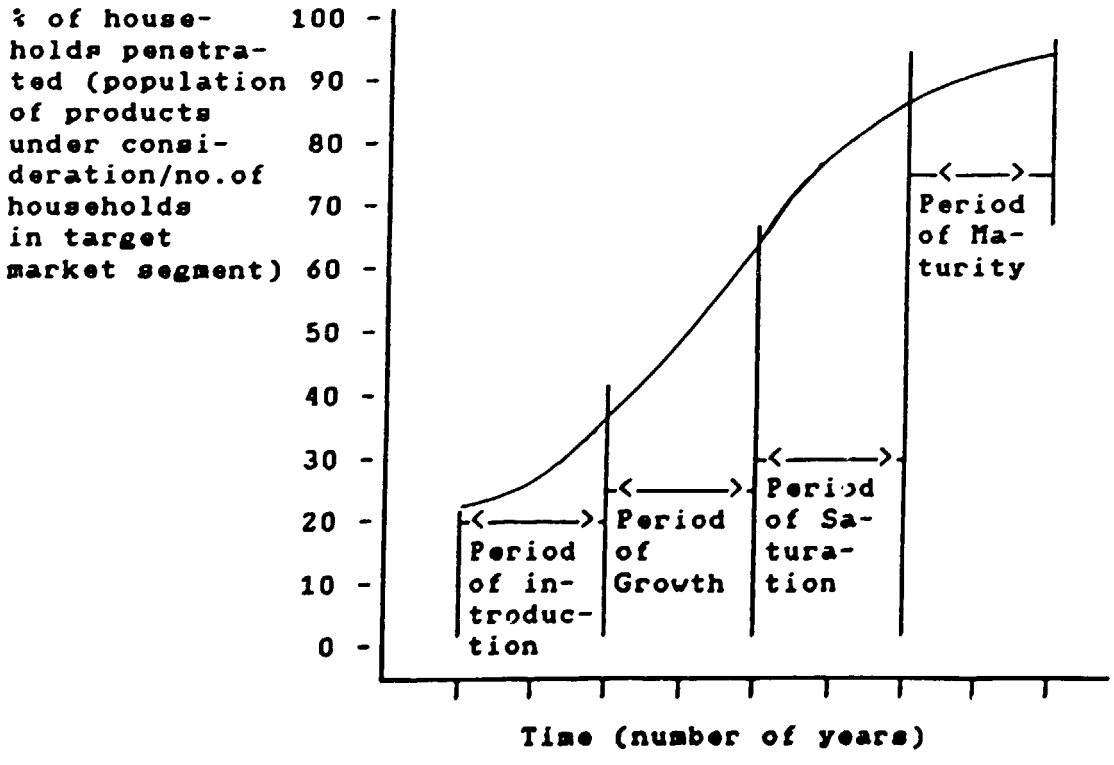
- Consumer Products : Those controlled by consumer driven markets. In case of products under the study, these would be include a domestic refrigerators & deep freezers and car-airconditioners.

- Industrial Products : Those controlled by growth in end use industries/sectors; these would include :

  * Commercial & industrial refrigeration (cold rooms, refrigerated trucks, industrial chillers etc)
  * Commercial airconditioning (chillers)

CONSUMER PRODUCTS

The type of consumer products being considered by us can be classified more specifically as "consumer durables" since these products have a long life (equal to or greater than 10 years). Since the bulk of the demand is for domestic household use, the household can be identified as the idependent entity which influences demand. The demand for household goods of a durable nature can often be predicted by adopting a s-shape penetration curve, as shown below :



The likely penetration in the future has been modelled by us using the S-shaped curve on the basis of two forecasts of growth - high and low. The methods considered by us to forecast growth were

- Multiple regression analysis; this consists of the following steps :

  * identification of factors likely to influence demand such as real per capita income of different consumer classes, real private final consumption expenditure of different consumer classes, price trend of products under consideration etc.

  * establishing statistical co-relation of above factors (independent variables) with past trend in demand of products under consideration (dependent variable)

  * projection of future values for independent variable(s) and, consequently for, dependent variable viz demand of products under consideration.

  The desired data on independent variables (such as class wise real per capita income) was not available separately for each country. Also, the past trend in demand of dependent variable (viz product under consideration) was available only for a limited number of years. Therefore, no meaningful statistical regression analysis could be obtained for any country.

- Judgements based on estimates given by manufacturers, industry experts and industry associations in respective countries. These estimates given by manufacturers, industry experts and associations were based on the experience/judgement of these agencies/ individuals regarding :

  * factors incluencing demand and expectations governing growth

  * supply constraints operating in the industry such as high cost of imported components and infrastructure constraints.

  In the absence of statistical analysis of past data, these estimates were used for estimating future demand for each country.

- Forecast of demand arrived at from judgement of manufacturers and industry experts was then used to compute population of the products under consideration based on their life expectancy. The product population estimates were used to generate alternative penetration curves. The curve which had a reasonable continuity with past trends, as well as was in line with general expectation of experts, was selected to make the final forecast on projected demand. The representative curve for Egypt is enclosed as Appendix 2.4 (A). This curve shows deviations from the 'S' curve model due to the fact that normative estimates of growth have been taken. This curve is used only as a counter-check.

INDUSTRIAL PRODUCTS

The growth of these products can normally be linked to the growth of end use industries/sectors in which these products are being used after taking into account the following factors :

- Relative penetration/share of usage of product in different end-use industries/sectors.

- Presence/absence of any "substitution effects" viz impact on demand due to substitution by/of alternative products.

The level of data available on end-use distribution was not sufficient in any of the project countries to do a detailed end-use wise analysis of future demand. Therefore, estimation of future demand, has been based largely on discussions with manufacturers and industry experts, also by taking into account qualitatively the likely impact of above mentioned factors.

II. Basis used for demand projections for equipment as well as refrigerants, are as follows :

1. Demand for equipment has been taken as equivalent to production + imports, and computed for each year on the basis of an annual growth rate.

2. Two growth rates have been taken for projectionof 'High' & 'Low' demands. These growth rates are based on the estimates given by the industry/associations and/or Government bodies. Higher rates are mainly indicated by industry. Keeping in view that industry estimates are normally higher than practically and economically achievable, the lower growth rates have been taken as half of higher rates.

3. The Phase out (of CFC based equipment) has been indicated as a proportion (% age) of demand which is expected to be replaced by equipment based on CFC substitutes for the respective years.

4. The population of the equipment has been estimated for :

   a) Total population comprising of equipment based on both CFCs as well as substitutes.
   b) Population of only CFC based equipment

5. The population estimates have been carried at on the basis of age of the industry and life of expectancy of the equipment, and after adjusting for number of equipment expected to be scrapped.

6. The demand for CFCs has been categorised as follows :

   a) Refrigerant
      i) New Demand for original equipment manufactured/ assembled/imported.
      ii) Recharging demand for the arising from servicing of the existing population

   b) Foaming Agency — New Demand for original equipment manufactured/imported

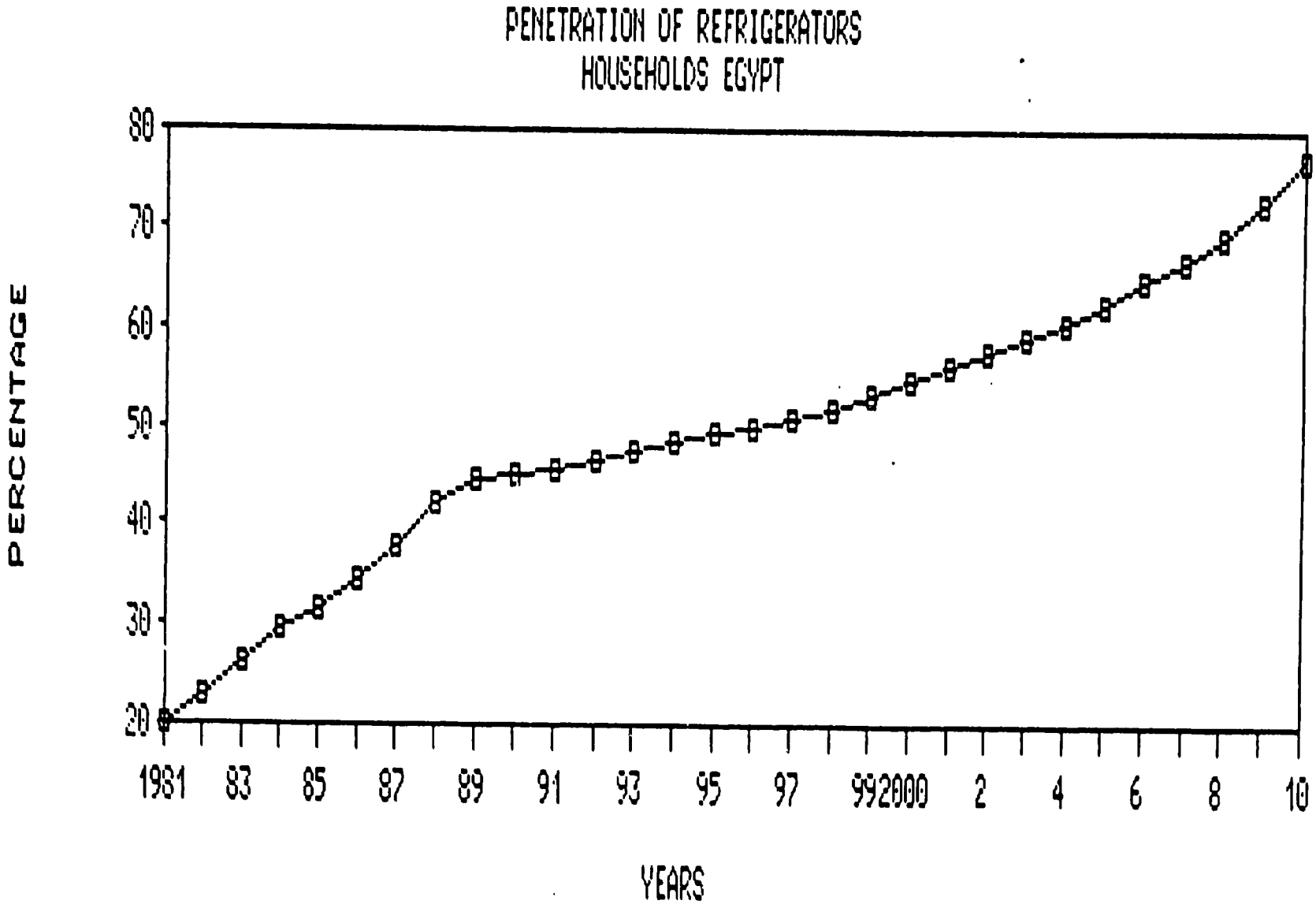
7. The ratio of new CFC demand to equipment demand (CFC based) in 1991 has been used for computation of new CFC demand for future years.

8. Similarly, the ratio of recharging CFC demand to equipment population (CFC based) in 1991 has been used for computation of recharging CFC demand in future years.

9. The computation of recoverable quantities of refrigerant CFCs comprises of -

   a) Recovery during servicing of existing population which is based on the ratio of recoverable quantity in 1991 to recharging demand in 1991. The norms for recoverable quantities for each sub-sector in 1991 are given in Chapter - V.

   b) Recovery from CFC based equipment which is scrapped each year.


PENETRATION OF REFRIGERATORS
HOUSEHOLDS EGYPT
PERCENTAGE
80
70
60
50
40
30
20
1981
83
85
87
89
91
93
95
97
992000
2
4
6
8
10
YEARS

CONSUMPTION PATTERN FOR CFCs IN AIRCONDITIONING & REFRIGERATION SECTOR IN EGYPT

APPENDIX - 2.5

		1991	1993	1995	1996	1997	1999	2005	2007	2010
A. DOMESTIC REFRIGERATORS AND DEEP FREEZERS										
1. Total demand of ref. ('000) *	High	300	363	439	483	531	643	1139	1378	1835
	Low	300	331	365	383	402	443	594	655	758
2. Population for ref. ('000) @	High	6686	7295	8032	8401	8800	9697	13432	15191	18739
	Low	6686	7248	7858	8127	8397	8932	10374	10780	11477
3. Phase-out of CFC12 based equipment (%)		0	0	20	60	100	100	100	100	100
4. Number of CFC12 ref. ('000)	High	300	363	351	193	0	0	0	0	0
	Low	300	331	292	153	0	0	0	0	0
5. Population of CFC12 ref. ('000)	High	6686	7295	7944	8023	7891	7561	5838	4964	3494
	Low	6686	7248	7785	7824	7692	7362	5639	4765	3295
6. Number of aged ref. ('000)	High	90	110	135	150	180	260	539	610	246
	Low	90	110	135	150	180	260	539	610	246
7. No. of ref. reinstalled ('000) @ 60% of aged ref.	High	54	66	81	90	108	156	323	366	148
	Low	54	66	81	90	108	156	323	366	148
8. No. of scrapped ref. ('000) @ 40% of aged ref.	High	36	44	54	114	132	176	387	473	422
	Low	36	44	54	114	132	176	387	473	422
9. Demand for CFC12 (MT)										
- OE Demand	High	66.0	79.9	77.3	42.5	0.0	0.0	0.0	0.0	0.0
	Low	66.0	72.8	64.2	33.7	0.0	0.0	0.0	0.0	0.0
- Recharging Demand	High	255.0	278.2	303.0	306.0	301.0	288.4	222.6	189.3	133.3
	Low	255.0	276.4	296.9	298.4	293.4	280.8	215.0	181.7	125.7
- Total Demand	High	321.0	358.1	380.3	348.5	301.0	288.4	222.6	189.3	133.3
	Low	321.0	349.2	361.1	332.1	293.4	280.8	215.0	181.7	125.7
10. Demand for CFC11 (for insulation) (MT)										
- OE Demand	High	264.0	319.4	309.2	170.1	0.0	0.0	0.0	0.0	0.0
	Low	264.0	291.1	256.7	134.8	0.0	0.0	0.0	0.0	0.0
- Recharging Demand	High	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Total Demand	High	264.0	319.4	309.2	170.1	0.0	0.0	0.0	0.0	0.0
	Low	264.0	291.1	256.7	134.8	0.0	0.0	0.0	0.0	0.0
11. Total CFC Demand (MT)	High	585.0	677.5	689.5	518.6	301.0	288.4	222.6	189.3	133.3
	Low	585.0	640.2	617.8	466.9	293.4	280.8	215.0	181.7	125.7
12. Recoverable CFC-12 (MT)	High	166.2	182.2	198.5	201.7	198.8	191.5	152.8	132.9	95.3
	Low	166.2	181.0	194.6	196.8	193.8	186.5	147.9	127.9	90.3
12. CFC-12 recoverable from $ scrapped car ACs (MT)	High	0.7	0.9	1.1	2.3	2.6	3.5	7.7	9.5	8.4
	Low	0.7	0.9	1.1	2.3	2.6	3.5	7.7	9.5	8.4
13. Total CFC-12 recoverable (MT)	High	166.9	183.1	199.6	204.0	201.4	195.0	160.6	142.3	103.7
	Low	166.9	181.9	195.7	199.0	196.5	190.0	155.6	137.4	98.8

Notes :

* Growth rate for refrigerators demand taken as 10% per annum on high estimate and 5% per annum on low estimate based on industry estimates and penetration levels

@ Initial life of refrigerators taken as 20 years and life of reinstalled refrigerators taken as 5 years

$ Recovery from scrapped equipment @ 10% Of total initial charge.

	1991	1993	1995	1996	1997	1999	2005	2007	2010
B. COMMERCIAL REFRIGERATION									
I. COLD STORES									
1. Total demand of units	150	165	182	196	211	243	334	354	387
- Growth rate of demand (%) *		5.0	5.0	7.5	7.5	7.5	5.0	3.0	3.0
2. Population for units	5000	5023	5077	5120	5177	5335	6103	6430	6964
3. Phase-out of CFC12 based equipment (%)	0	40	60	75	90	100	100	100	100
4. Number of CFC12 units	150	99	73	49	21	0	0	0	0
5. Population of CFC12 units	5000	4957	4821	4725	4604	4332	3609	3395	3099
6. Number of scrapped CFC12 units @	146	150	147	145	142	134	112	105	96
7. Demand for CFC12 (MT)									
- OE Demand	1.4	0.9	0.6	0.4	0.2	0.0	0.0	0.0	0.0
- Recharging Demand	8.6	8.6	8.3	8.2	8.0	7.5	6.2	5.9	5.4
- Total Demand	10.0	9.4	9.0	8.6	8.1	7.5	6.2	5.9	5.4
8. Recoverable CFC (MT)	4.6	4.6	4.4	4.3	4.2	4.0	3.3	3.1	2.9
9. Recv. CFC from scrapped units (MT)$	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
10. Total recoverable CFC (MT)	4.7	4.7	4.5	4.4	4.3	4.1	3.4	3.2	2.9
II. REFRIGERATED TRUCKS									
1. Total demand of units	310	329	349	359	370	393	447	465	493
- Growth rate of demand (%) *		3	3	3	3	3	2	2	2
2. Population for units	3000	3461	3934	4176	4420	4922	6471	6995	7792
3. Phase-out of CFC12 based equipt. (%)	0	60	90	100	100	100	100	100	100
4. Number of CFC12 units	310	132	35	0	0	0	0	0	0
5. Population of CFC12 units	3000	3264	3172	3077	2984	2808	2339	2201	2008
6. Number of scrapped CFC12 units @		97	97	95	92	87	72	68	62
7. Demand for CFC12 (MT)									
- OE Demand	1.7	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0
- Recharging Demand	3.4	3.7	3.6	3.5	3.4	3.2	2.7	2.5	2.3
- Total Demand	5.2	4.4	3.8	3.5	3.4	3.2	2.7	2.5	2.3
8. Recoverable CFC (MT)	1.8	2.0	1.9	1.9	1.8	1.7	1.4	1.4	1.2
9. Recv. CFC from scrapped units (MT)$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10. Total recoverable CFC (MT)	1.8	2.0	2.0	1.9	1.9	1.8	1.5	1.4	1.3
III. DISPLAY CABINETS									
1. Total demand of units	700	772	851	915	983	1136	1559	1654	1807
- Growth rate of demand (%) *		5.0	5.0	7.5	7.5	7.5	5.0	3.0	3.0
2. Population for units	4000	5248	6575	7292	8057	9742	15858	18133	21661
3. Phase-out of CFC12 based equipment (%)	0	40	60	75	90	100	100	100	100
4. Number of CFC12 units	700	463	340	229	98	0	0	0	0
5. Population of CFC12 units	4000	4940	5381	5448	5383	5065	4219	3970	3623
6. Number of scrapped CFC12 units @		138	156	161	163	157	130	123	112
7. Demand for CFC12 (MT)									
- OE Demand	0.4	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0
- Recharging Demand	1.0	1.2	1.3	1.3	1.3	1.2	1.0	1.0	0.9
- Total Demand	1.4	1.5	1.5	1.5	1.4	1.2	1.0	1.0	0.9
8. Recoverable CFC (MT)	0.6	0.7	0.8	0.8	0.8	0.8	0.6	0.6	0.5
9. Recv. CFC from scrapped units (MT)$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10. Total recoverable CFC (MT)	0.6	0.7	0.8	0.8	0.8	0.8	0.6	0.6	0.5

	1991	1993	1995	1996	1997	1999	2005	2007	2010
IV. WATER COOLERS									
1. Total demand of units	8000	8487	9004	9274	9552	10134	11525	11990	12724
- Growth rate of demand (%) *		3	3	3	3	3	2	2	2
2. Population for units	100000	110570	121519	127148	132886	144710	181747	194398	213754
3. Phase-out of CFC12 based equipment (%)	0	60	90	100	100	100	100	100	100
4. Number of CFC12 units	8000	3395	900	0	0	0	0	0	0
5. Population of CFC12 units	100000	105478	102264	99196	96220	90534	75412	70955	64759
6. Number of scrapped CFC12 units #	2760	3157	3135	3068	2976	2800	2332	2194	2003
7. Demand for CFC12 (MT)									
- OE Demand	5.5	2.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0
- Recharging Demand	3.0	3.2	3.1	3.0	2.9	2.7	2.3	2.1	1.9
- Total Demand	8.5	5.5	3.7	3.0	2.9	2.7	2.3	2.1	1.9
8. Recoverable CFC (MT)	1.6	1.7	1.6	1.6	1.5	1.4	1.2	1.1	1.0
9. Recv. CFC from scrapped units (MT)$	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
10. Total recoverable CFC (MT)	1.8	1.9	1.8	1.8	1.7	1.6	1.3	1.3	1.2
TOTAL FOR COMMERCIAL REFRIGERATION									
- OE Demand CFC12 (MT)	9.0	4.2	1.7	0.6	0.3	0.0	0.0	0.0	0.0
- Recharging Demand CFC12 (MT)	16.0	16.6	16.3	16.0	15.5	14.6	12.2	11.5	10.5
- Total Demand CFC12 (MT)	25.1	20.9	18.0	16.5	15.8	14.6	12.2	11.5	10.5
- Recoverable CFC12 (MT)	8.9	9.0	8.8	8.6	8.4	7.9	6.6	6.2	5.7
- OE Demand CFC11 (For insulation	50.0	23.7	9.4	3.3	1.4	0.0	0.0	0.0	0.0
- Recharging Demand CFC11 (MT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Total Demand CFC11 (MT)	50.0	23.7	9.4	3.3	1.4	0.0	0.0	0.0	0.0

Notes :

* High and low estimates of growth rate have not been considered since the CFC quantities are very low
# Number of units scrapped at the rate of 3% of population each year on the basis of life of 25 years for cold stores and 20 years for refrigerated trucks, water coolers & display cabinet
$ 10% Of CFC (initial charge) is recoverable from scrapped units

C. COMMERCIAL AIRCONDITIONING									
1. Total demand of units	20	22	24	26	27	30	36	38	42
- Growth rate of demand (%)		5	5	5	5	5	3	3	3
2. Population for units	200	231	264	281	300	339	469	515	588
3. Phase-out of CFC based equipment (%)	0	10	40	60	100	100	100	100	100
4. Number of CFC11 units *	20	20	15	10	0	0	0	0	0
5. Population of CFC11 units	200	228	247	250	243	228	190	179	163
6. Number of scrapped CFC11 units #		6	7	7	8	7	6	6	5
6. Demand for CFC11 (MT)									
- OE Demand	11.0	10.9	8.0	5.6	0.0	0.0	0.0	0.0	0.0
- Recharging Demand	20.0	22.8	24.7	25.0	24.3	22.8	19.0	17.9	16.3
- Total Demand	31.0	33.8	32.8	30.6	24.3	22.8	19.0	17.9	16.3
7. Recoverable CFC11 (MT) $	0.0	2.6	2.9	3.0	3.0	2.8	2.4	2.2	2.0

Notes :

* Number of R12 units in commercial airconditioning sector in Egypt is negligible
# Number of units scrapped at the rate of 3% of population each year on the basis of life expectancy of 35 years
$ Only external recovery figures are shown on the basis of refrigerant recoverable from scrapped units @ 80% of total charge contained in the system

		1991	1993	1995	1996	1997	1999	2005	2007	2010
D. MOBILE AIRCONDITIONERS										
1. Total demand of cars		-	-	-	-	-	-	-	-	-
2. Demand for AC cars *	High	10000	11449	13108	14026	15007	17182	25785	29522	36165
	Low	10000	11025	12155	12763	13401	14775	19799	21829	25270
3. Population for AC cars @	High	150200	169849	189457	198733	207640	225630	285540	317552	376127
	Low	150200	169225	187206	195219	202520	216116	250036	267654	298284
4. Phase-out of CFC12 based equipment (%)		0	10	50	100	100	100	100	100	100
5. Number of CFC12 AC cars	High	10000	10304	6554	0	0	0	0	0	0
	Low	10000	9923	6078	0	0	0	0	0	0
6. Population of CFC12 AC cars	High	150200	168704	179308	174558	168458	153208	81608	56508	23679
	Low	150200	168123	177711	172961	166861	151611	80011	55011	22881
7. Number of Aged cars	High	1000	3000	6500	8500	10200	12000	11500	10700	6554
	Low	1000	3000	6500	8500	10200	12000	11500	10500	6078
8. Number of cars reinstalled (@50%)	High	500	1500	3250	4250	5100	6000	5750	5350	3277
	Low	500	1500	3250	4250	5100	6000	5750	5250	3039
9. Number of Aged cars scrapped (@50%)	High	500	1500	3250	4750	6100	8500	12500	12850	9027
	Low	500	1500	3250	4750	6100	8500	12500	12750	8789
10. Demand for CFC12 (MT)										
- OE Demand	High	12.0	12.4	7.9	0.0	0.0	0.0	0.0	0.0	0.0
	Low	12.0	11.9	7.3	0.0	0.0	0.0	0.0	0.0	0.0
- Recharging Demand	High	77.1	86.6	92.0	89.6	86.5	78.6	41.9	29.0	12.2
	Low	77.1	86.3	91.2	88.8	85.7	77.8	41.1	28.2	11.7
- Total Demand	High	89.1	99.0	99.9	89.6	86.5	78.6	41.9	29.0	12.2
	Low	89.1	98.2	98.5	88.8	85.7	77.8	41.1	28.2	11.7
11. Recoverable CFC (MT)	High	40.8	45.8	48.7	47.4	45.8	41.6	22.2	15.3	6.4
	Low	40.8	45.7	48.3	47.0	45.3	41.2	21.7	14.9	6.2
12. CFC-12 recoverable from $ scrapped car ACs (MT)	High	0.1	0.2	0.3	0.5	0.6	0.9	1.3	1.3	0.9
	Low	0.1	0.2	0.3	0.5	0.6	0.9	1.3	1.3	0.9
13. Total CFC-12 recoverable (MT)	High	40.9	46.0	49.0	47.9	46.4	42.5	23.4	16.6	7.3
	Low	40.9	45.8	48.6	47.5	45.9	42.0	23.0	16.2	7.1

Notes :

* Growth rate for demand of AC cars taken as 7% per annum on high estimate and 5% per annum on low estimate based on industry estimates

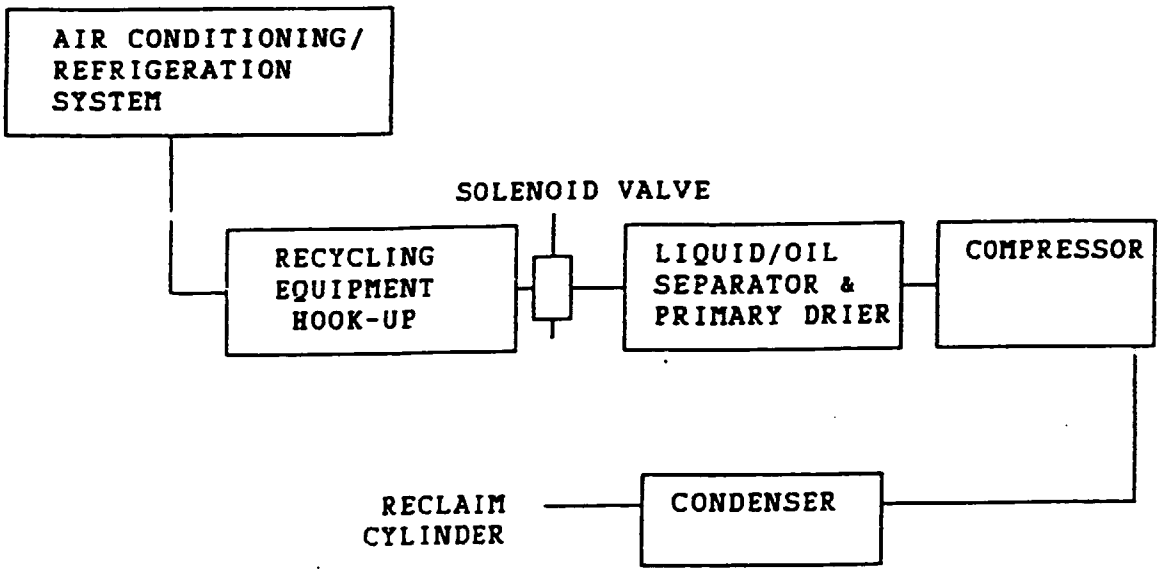
@ Initial life of cars AC units has been taken as 15 years and life of reinstalled AC cars is taken as 5 years

$ Recovery from scrapped equipment @ 10% of total initial charge contained in scrapped equipment

		1991	1993	1995	1996	1997	1999	2005	2007	2010
TOTAL DEMAND FOR CFC12 (MT)										
1. OE DEMAND	High	87.0	96.5	86.9	43.1	0.3	0.0	0.0	0.0	0.0
	Low	87.0	88.9	73.2	34.3	0.3	0.0	0.0	0.0	0.0
2. RECHARGING DEMAND	High	348.1	381.5	411.3	411.5	403.0	381.6	276.7	229.8	155.9
	Low	348.1	379.4	404.4	403.1	394.6	373.2	268.3	221.4	147.9
3. TOTAL CFC12 DEMAND	High	435.2	477.9	498.2	454.7	403.2	381.6	276.7	229.8	155.9
	Low	435.2	468.3	477.6	437.4	394.8	373.2	268.3	221.4	147.9
4. RECOVERABLE CFC12	High	216.6	238.1	257.5	260.5	256.2	245.4	190.6	165.2	116.7
	Low	216.6	236.7	253.1	255.1	250.8	240.0	185.2	159.8	111.5
TOTAL DEMAND FOR CFC11 (MT)										
1. OE DEMAND	High	325.0	354.0	326.6	179.0	1.4	0.0	0.0	0.0	0.0
	Low	325.0	325.7	274.1	143.7	1.4	0.0	0.0	0.0	0.0
2. RECHARGING DEMAND	High	20.0	22.8	24.7	25.0	24.3	22.8	19.0	17.9	16.3
	Low	20.0	22.8	24.7	25.0	24.3	22.8	19.0	17.9	16.3
3. TOTAL CFC11 DEMAND	High	345.0	376.9	351.4	204.0	25.7	22.8	19.0	17.9	16.3
	Low	345.0	348.5	298.9	168.7	25.7	22.8	19.0	17.9	16.3
4. RECOVERABLE CFC11	High	0.0	2.6	2.9	3.0	3.0	2.8	2.4	2.2	2.0
	Low	0.0	2.6	2.9	3.0	3.0	2.8	2.4	2.2	2.0

APPENDIX - 3.1

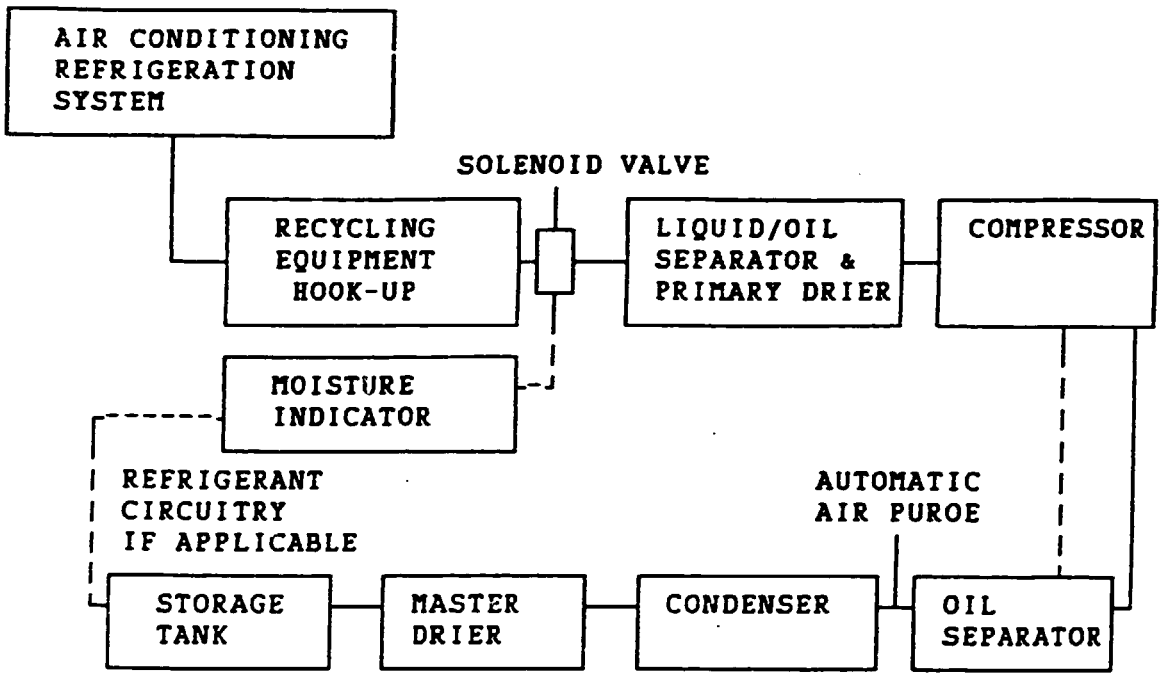
SCHEMATIC FOR REFRIGERANT RECOVERY EQUIPMENT



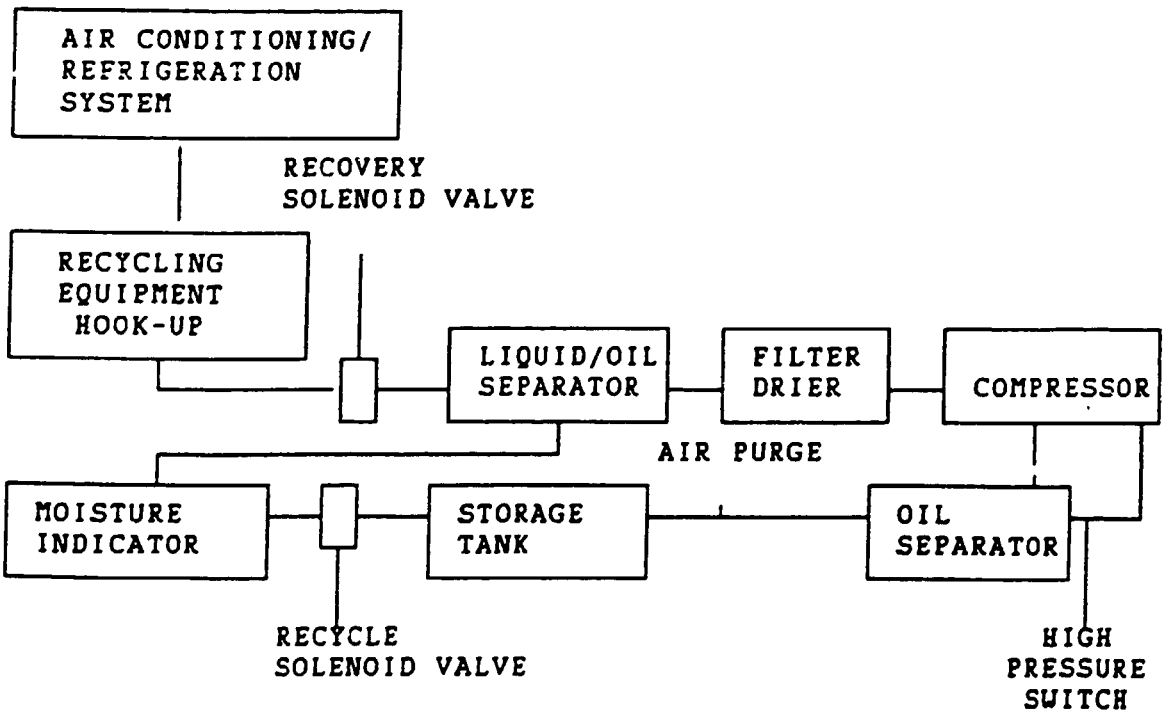
APPENDIX - 3.2

SCHEMATIC FOR REFRIGERANT RECOVERY & RECYCLING EQUIPMENT

A. SINGLE PASS



B. MULTI-PASS



BROCHURES/TECHNICAL DETAILS OF RECOVERY AND RECYCLING EQUIPMENT

1. Refrigerant Recovery System Inc., USA

   - Recovery system
     Model RC - 1

   - Rejuvenator (Recycling)
     Model ST - 1000
     Model ST - 100

2. SPX Corporation, USA

   - Model OEM 1380
   - Model OEM 1396
   - Model OEM 1397

3. United Technologies Carrier

   - Model 19 Q 4

4. Environmental Products Amalgamated Pty Ltd, Australia

   - Skyemite (recovery unit)
   - Skyemate (recycling unit)
   - High Capacity recovery & recycling

     - Model EP3HC
     - Model EP3HCM
     - SKYE 134a
     - EP4
     - EP4HC
     - EP5

5. Javac Reco, Australia

   - Model Reco - 1 (Recovery Unit)
   - Model Reco - 12S (Recovery & Recycling Unit)
   - Model Reco - 134S (Recycling Unit)

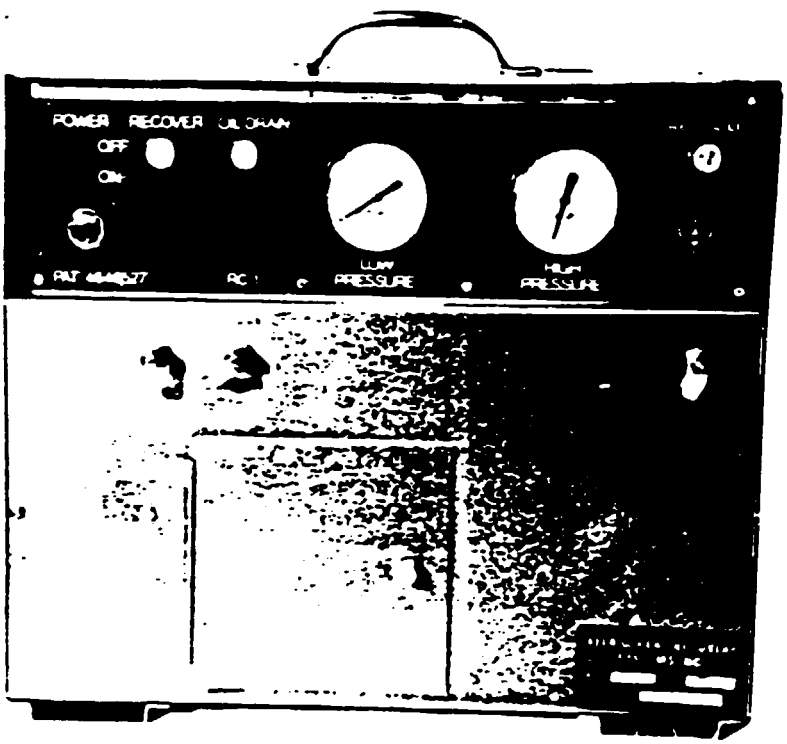
6. Technical Chemical Company, USA

   - Sercon 9000
   - Sercon 8000
   - Sercon 5000

New!

The RC-1

Recovery System



Specially Designed For Portability

REFRIGERANT RECOVERY SYSTEMS, INC.
P.O. Box 360298 • Tampa, FL 33673

Never Release Refrigerant In Shop Or Air Again

The Rejuvenators • Easy • Safe • Cost Effective

WHY RECOVER REFRIGERANTS "CFC'S": *Several years ago Mr. Taylor, a parts manufacturer and owner of auto air conditioning repair facilities in the State of Florida, recognized the need to recover the large amount of refrigerant (R-12) being used at his facilities. Since that time, it has become increasingly evident that there is another need for recycling refrigerants and that is the continuing destruction of our earth's ozone layer.*

The Ozone layer, often called a screen or shield, roughly 10 - 30 miles above the earth's surface has been credited with protecting us, the earth, from the damaging Ultra Violet Rays of the Sun.

We must act quickly to stop the destruction of our ozone shield, or canopy by recovering as many CFC'S as possible.

Join with Refrigerant Recovery Systems, Inc., the Company with the technology and experience to make a difference, in helping to eliminate this threat to the entire world.

INTRODUCTION

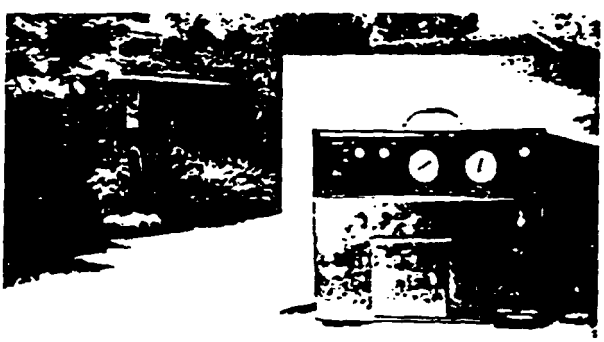
Refrigerant Recovery Systems, Inc., realizing the very special needs of the residential/commercial contractor is proud to present the RC-1.

Designed with the residential/commercial contractor in mind, the RC-1 will recover the refrigerants thru the day and allow you to process it at your facility later.

Weight, portability, and cost have been a factor long overlooked by the machine manufacturers. Here is the system for those jobs that are too small for the costly high tech recovery & recycle systems.

- Prewired and prepiped at the manufacturers facility.
- Easy access to filters for changing
- Cabinet: Aluminum construction with gauges, valves, and controls easily accessable for viewing and operation.
- Tank: D.O.T. 4BA-260 Tank Rated 47.6 W.C. 20.3 TW (50 lb.) for safe operation.

SAVE VALUABLE TIME AND LABOR COSTS WHEN RECOVERING REFRIGERANT FROM SMALLER UNITS



SPECIFICATIONS:

Dimensions: 16" High x 12" Deep x 18" Wide

Weight: 40 lbs.

For Information On How To Order, Call Your Local Dealer or Call Toll-Free Numbers: Florida Wats - 1-800-533-2845

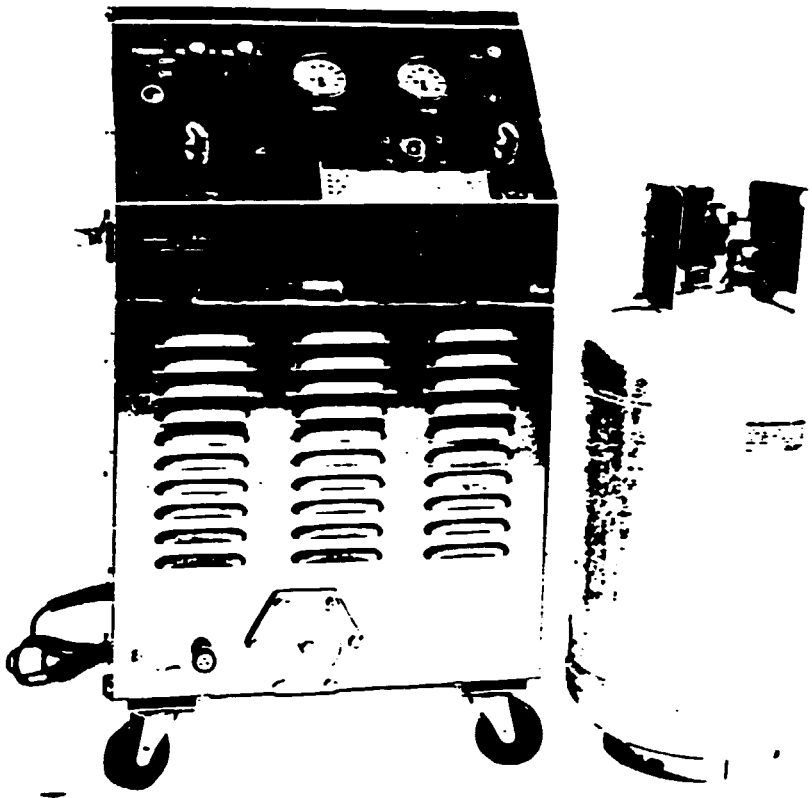
Outside Florida - 1-800-327-9142 • Local - (813) 237-1266

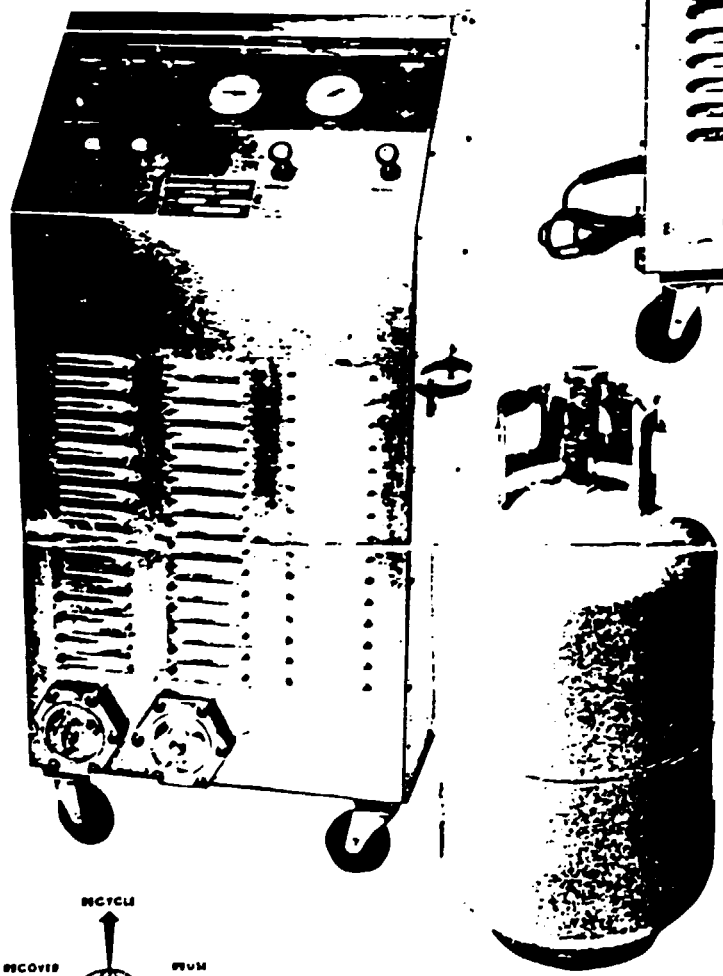
WARRANTY THE RC-1 HAS A 1 YEAR WARRANTY
Contact your distributor for full warranty information

The Rejuvenator

Removes And Cleans Contaminated Refrigerant

RECOVER





RECYCLE

REUSE

STOP POLLUTION

REFRIGERANT RECOVERY SYSTEMS, INC.

P.O. Box 360298 • Tampa, FL 33673

Never Release Refrigerant
In Shop Or Air Again

The Rejuvenators • Easy • Safe • Cost Effective

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The Ozone layer, often called a screen or shield, roughly 10 - 30 miles above the earth's surface has been credited with protecting us, the earth, from the damaging Ultra Violet Rays of the Sun.

We must act quickly to stop the destruction of our ozone shield, or canopy by recovering as many CFC'S as possible.

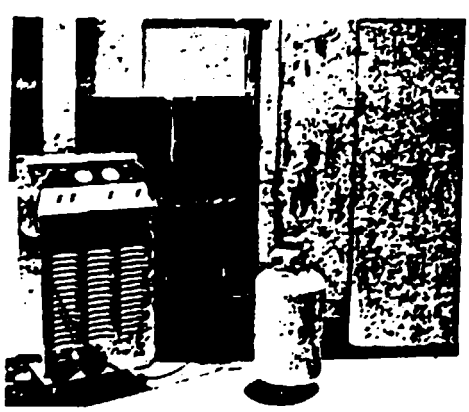
Join with Refrigerant Recovery Systems, Inc., the Company with the technology and experience to make a difference, in helping to eliminate this threat to the entire world.

INTRODUCTION:

Refrigerant Recovery Systems, Inc. Tampa, Florida, known to many as "The Company ahead of its time" with the *Rejuvenator*, a remarkably efficient refrigerant recovery machine. Now, "The Company ahead of everyone else" with both technology and quality, introduces the *"Rejuvenator"*.

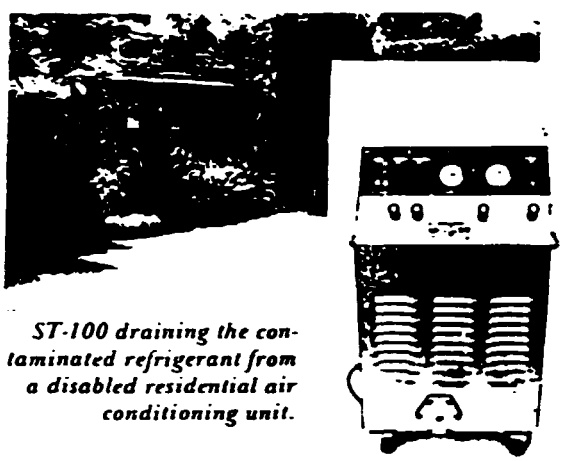
- UL Certified to meet SAE Standards.
- U. patented distillation process, the Rejuvenator will recov. igerants at a rate of 3-6 lbs. per minute for the ST-1000 and 2-3 lbs. per minute for the ST-100, depending on the amount of liquid available and the ambient temperature.
- Pre-wired and pre-piped at the manufacturers facility.
- Corrosions resistant copper tubes and fittings; Copper tube and aluminum fin condenser.
- High Pressure Relief Valve.
- Automatic Operation.
- Easy Access to filters for changing.
- Cabinet: Aluminum construction with guages, valves, and controls easily accessable for viewing and operation.

SAVE VALUABLE TIME AND LABOR COST WHEN RECOVERING REFRIGERANT FROM LARGER UNITS:



ST - 1000 Draining the contaminated refrigerant from a commercial air conditioning unit.

SAVE ON REFRIGERANT COSTS IN YOUR SERVICE CALLS:



ST-100 draining the contaminated refrigerant from a disabled residential air conditioning unit.

SPECIFICATIONS:

Refrigerants:	R-12; R-22; R-500; R-502
Dimensions:	ST-1000 — 34" High x 18" Wide x 14" Deep; ST-100 — 29" High x 18" Wide x 14" Deep.
Weight:	ST-1000 — 130 lbs. approximate; ST-100 — 76 lbs. approximate.
Storage Tank:	ST-1000 — 70 lb. refillable. ST-100 — 70 lb. refillable.

For Information On How To Order, Call Your Local Dealer or Call Toll-Free Numbers: Florida Wats - 1-800-533-2845
Outside Florida - 1-800-327-9142 • Local - (813) 237-1266

WARRANTY ALL REJUVENATORS HAVE A TWO (2) YEAR WARRANTY Contact your distributor for full warranty information

U.S. PATENT #4,646,527

PATENTED IN THE UNITED STATES AND 14 FOREIGN COUNTRIES

The Solution: OTC

The majority of these CFC's come from the refrigerant used in mobile air conditioning units. They are released into the atmosphere from leaky A/C's and from recharging and service operations.

The United States, along with 48 other countries, has taken steps to limit production and use of CFC's, including the R-12 type used in vehicle air conditioning units. The plan is to eventually eliminate them completely.

Like you, we are concerned about the depletion of the ozone layer. But we know you can't afford to quit servicing air conditioners, either. We think we can help solve both problems.

INTRODUCING. . .
the OTC Refrigerant Recovery and Recycling System!

We've got two new units to help you in your quest for faster, safer, cleaner Freon recovery and recycling. Introducing the OEM1380 and OEM1396, each with features designed to make refrigerant recovery less of a chore!

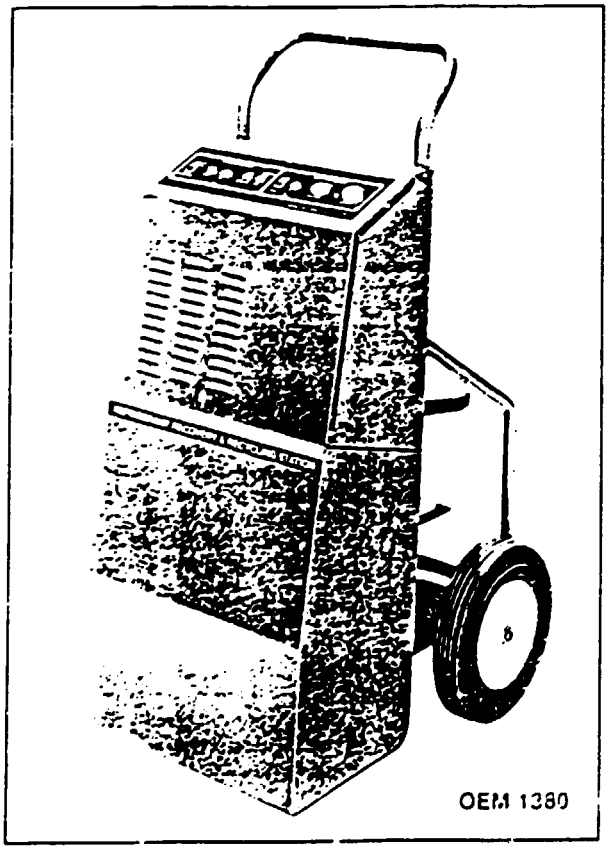
They can be used on cars, trucks, tractors, and RV's (using R-12 refrigerant), so your service potential isn't limited. The speed of recovery of both units means less chance of tying up your shop with vehicles just waiting to be serviced.

Both the OEM1380 and OEM1396 are U.L. approved – actually exceeding set U.L. specifications of air, oil, and moisture content of recycled refrigerant! Each also has: a patented heat exchange oil separator with catch bottle (oil separation occurs during recovery sequence); moisture level monitoring control; compressor cooling fan; compressor oil separator; portable cart design for easy transport; and continuous loop recycling. The built-in safety features – refrigerant tank overflow protection, automatic high pressure cut-off switch – make refrigerant recovery a much safer operation.

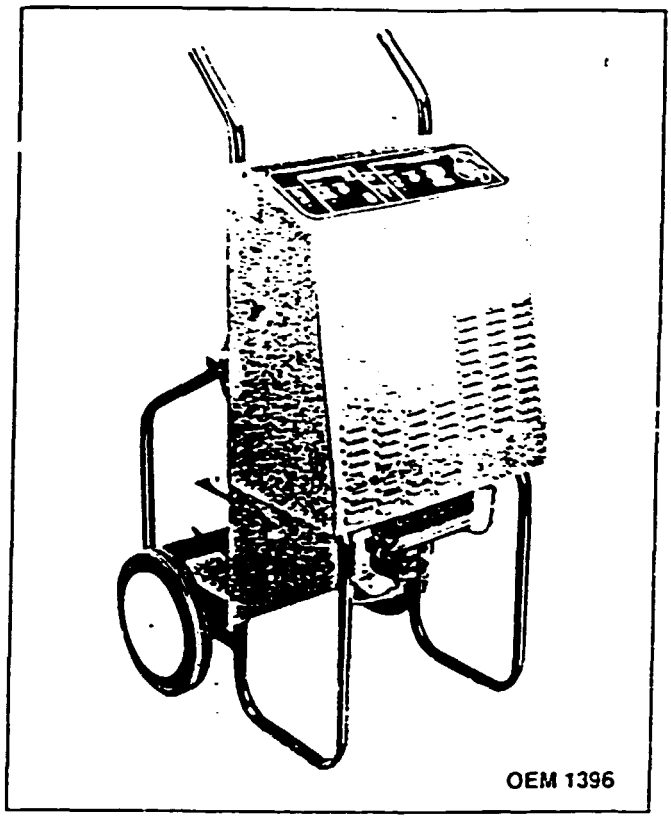
PLUS, these other features:

OEM 1380:

- U.L. approved.
- Ideal for high-volume shops. Recovers 1 lb. per min.; recycles 2½ lbs. per min. Reduces air conditioning system to a vacuum.
- Compatible with all charging stations. No additional equipment needed.
- Filter pressure monitor and high pressure light.
- Automatic air purge.
- Easy-to-use controls with moisture indicator. Multiple liquid recycling method assures complete purity.
- Shipped complete – only assembly required is insertion of a filter. Uses easy-to-change cartridge filter.
- Two 30 lb. D.O.T. approved refillable tanks included.
- Three "Quick-Seal" connecting hoses, 72" long. Can be used to update your current equipment.
- Full housing encloses all working components.
- Operating video and manual included.
- 115 volts A.C.
- Dimensions: 48" high x 23" wide x 25" deep. Weight: 140 lbs.



OEM 1380



OEM 1396

OEM 1396:

- U.L. approved.
- Lower-cost mocel for shops doing fewer A/C service jcbs.
- Recovers ½ lb. per min.; recycles .8 lb. per min. Reduces air conditioning system to a vacuum.
- Compatible with all charging stations: no additional equipment needed.
- Manual air purge. with gauge.
- Easy-to-use controls with moisture indicator. Single multiple vapor recycling method.
- Shipped complete. Uses easy-to-change canister type filter.
- Two 30 lb. D.O.T. approved refillable tanks included.
- Three "Quick-Seal" connecting hoses, 72" long. Can be used to update your current equipment.
- Operating video and manual included.
- 115 volts A.C.
- Dimensions: 45" high x 21" wide x 24" deep. Weight: 115 lbs.

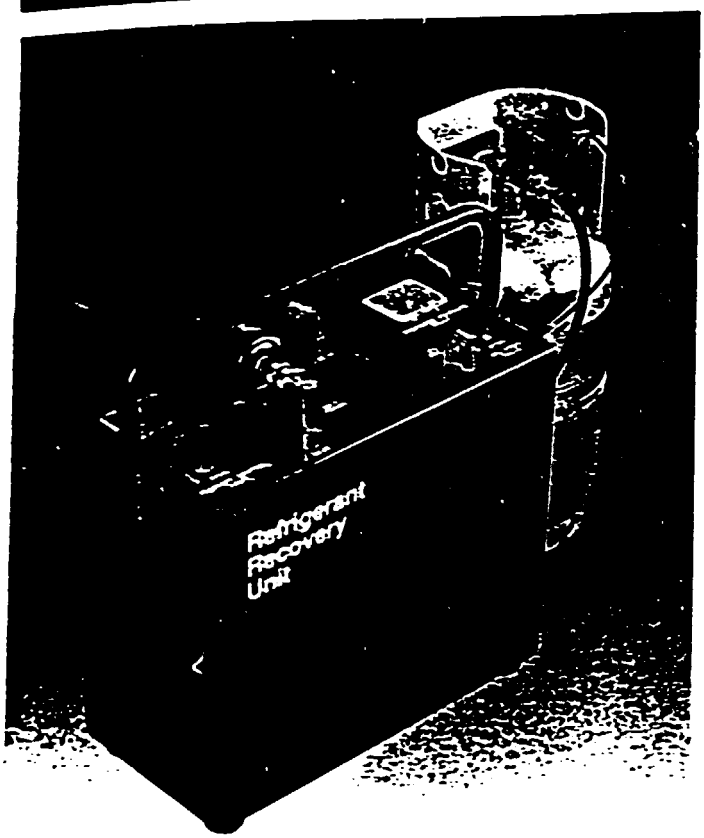
So why recycle? Because of the current agreement to cut CFC production, limited supply of refrigerants means limited availability. And that's practically a guarantee the price will go up. Plus, a new Federal tax of $1.37 per pound of Freon has been imposed, applying to all existing stock and new purchases. Air conditioners will continue to need recharging, and until an alternative for Freon is developed, recycling is the only practical, economical answer.

And what about Return on Investment? The following is a sample comparison between two different service shops:

	Shop A	Shop B
1. Systems serviced per week during 12 week* A C season	5	10
2. Average amount of Freon (R-12) per system	4 lbs.	4 lbs.
3. Amount recovered from systems being serviced (many systems are low on refrigerant)	10 lbs.	20 lbs
4. Amount of Freon (R-12) recovered from pressure check charge.	10 lbs.	20 lbs.
5. Total refrigerant recovered per week (#3 + #4 =).	20 lbs.	40 lbs.
Cost per lb.:	$5.00	$5.00
Savings per week:	$5 x 20 lbs. = $100.00	$5 x 40 lbs. = $200.00
6. Payback of cost of recycling equipment:	2 years	1 year

*Estimated minimum season

OEM-1397



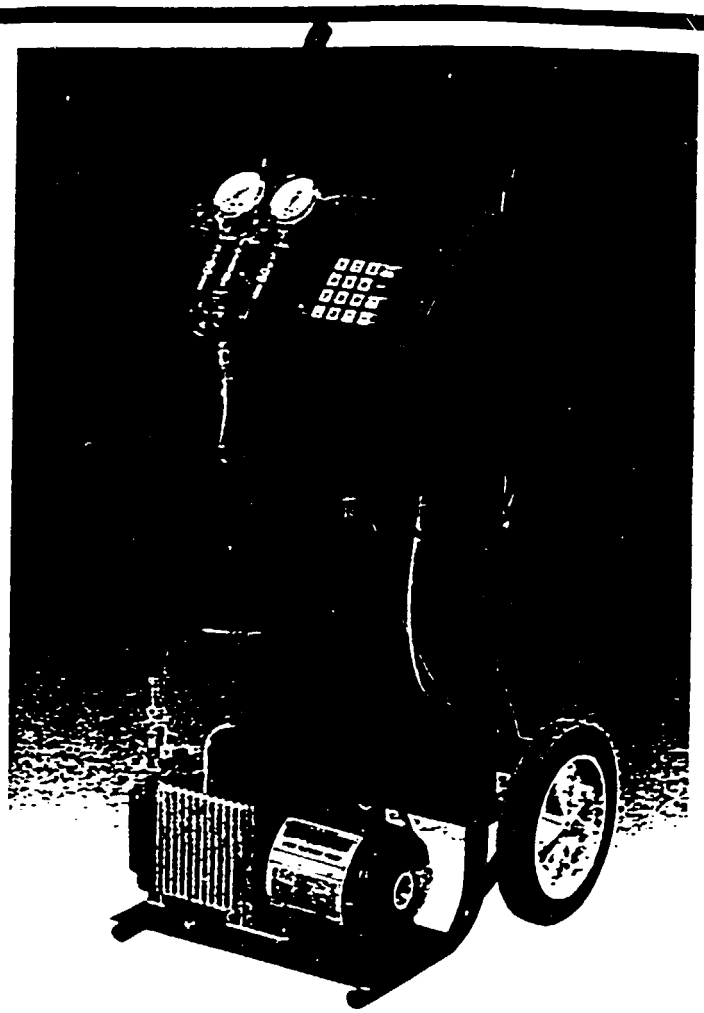
Portable Recovery Station

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

OEM-1365



Charging Station

To make your shop even more profitable, you'll want to add this charging station. Today's vehicles require a "precise" charge. With its computerized controls and solenoids to monitor the evacuation and charging processes, you won't waste a drop of refrigerant. You can even add refrigerant in .2 lb. increments for partial charging, leak checking or "topping off". An electronic strain gauge scale ensures the weight accuracy and easily handles 30 lb. bulk tanks.

- Manifold gauge set and two, 96" color-coded hoses with "Quick-Seal" fittings are included.
- Adapter fittings package.
- Heater blanket for faster, more complete charging.
- Refrigerant capacity: 30 lb. bulk tank.

Dimensions: 42" high x 21" wide x 20" deep. Weight: 96 lbs.

THE TIME IS NOW

LEGISLATION ENVIRONMENT PROFITS

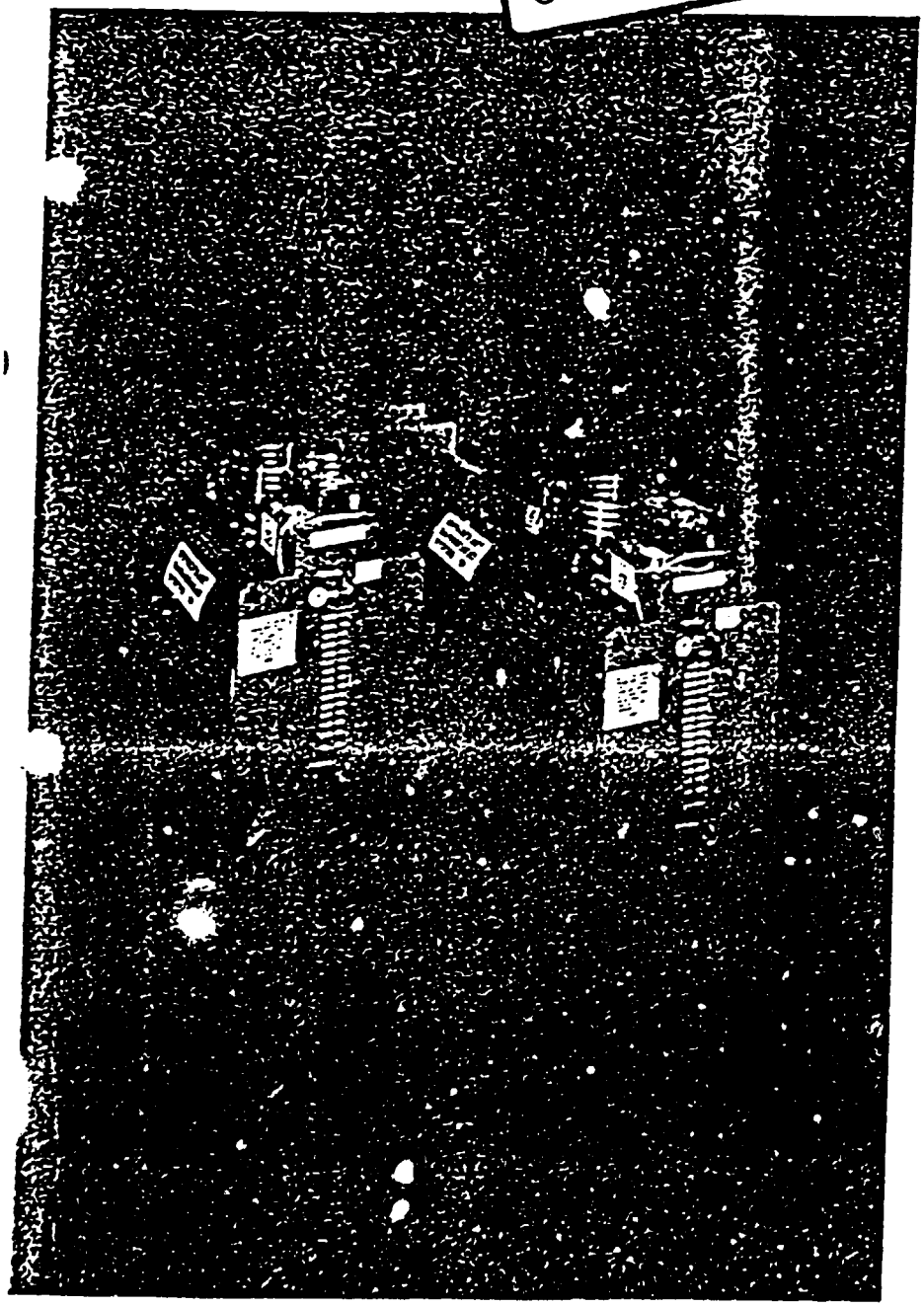
Carrier
HEATING & COOLING

Product Data

19QA Refrigerant Management System

50/60 Hz

HCFC-123 COMPATIBLE



Carrier's 19QA Refrigerant Management System Conserves Existing Supplies of CFC's and Minimizes Their Leakage During Centrifugal Chiller Service and Maintenance

- Minimizes CFC emissions
- Conserves refrigerant and reduces costs
- Removes oil, water and acids from refrigerant
- Optimizes chiller efficiency with recycled refrigerant
- Designed for use on any manufacturer's R-11 centrifugal chiller
- Safely holds refrigerant during extensive chiller servicing.

Features/Benefits

Carrier's 19QA Refrigerant Management System (RMS) provides a timely solution to the problem of refrigerant loss during chiller servicing

Efficient refrigerant management

The RMS is a closed loop transfer pumping system and storage tank that isolates R-11 during routine chiller servicing or emergency repairs. By containing the refrigerant during maintenance operations, the RMS prevents evaporation of the refrigerant into the atmosphere. In addition to helping preserve the environment, use of the system can help conserve refrigerant and reduce costs. Contaminated refrigerant can be recycled on site, and excess oil, water or acids removed. Recharging the chiller with recycled refrigerant will optimize chiller performance and extend the life of the machine. The RMS can also be used with R-113 refrigeration systems.

Developed for application flexibility

The 19QA RMS is available in 2 sizes. Rigging holes are provided for crane lifting, as well as slots for use with a forklift. Connections to a chiller are made easy with the charging hoses and valves provided with the unit.

In the case of a single chiller application, the 19QA can be permanently installed and hard-piped to the chiller, if desired. Or, on sites with multiple chiller installations, a single RMS can be used to service several machines by temporary connection to each chiller using the hoses and valves provided. Optional field-installed casters for use with the smaller tank (19QA size 020) aid in the portability of the RMS.

Component description

The storage tank is designed for 15 psig working pressure and comes equipped with a one-in. rupture disc. A reflex type sight glass indicates when the tank is 90% full. The exact liquid level can be determined by use of the level gage provided. The smaller tank has a storage capacity of 1600 lbs (725 kgm) of R-11; the larger tank has a capacity of 3300 lbs (1500 kgm) of R-11.

Tube-in-tube condenser allows refrigerant vapor to be condensed when evacuating a chiller or when distilling refrigerant that contains excess oil. Garden hose connections (¾-in.) are provided for condenser water.

The 500-Watt electric heater is attached to the bottom of the storage tank. The heater is controlled by a toggle switch and is required when oil is being separated from the refrigerant by distillation. It is insulated and protected by a cover.

Four ½-in. charging hoses with shutoff connections allow easy interconnection of components. Two ½-in. ball valves with couplers are provided for use with the charging hoses to prevent the loss of the refrigerant in the hoses at the end of a transfer process. The hoses are designed to withstand high vacuum without collapsing.

The ½-hp diaphragm-type vacuum pump is equipped with a permanent split capacitor motor controlled by a toggle switch. Motor voltage is 115-1-50/60 Hz.

Manual reset high-pressure switches are provided to protect against overpressurization. One switch limits the tank pressure by shutting off the tank heater. The second switch limits the vacuum pump discharge pressure by shutting off the vacuum pump.

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Machine Components	3
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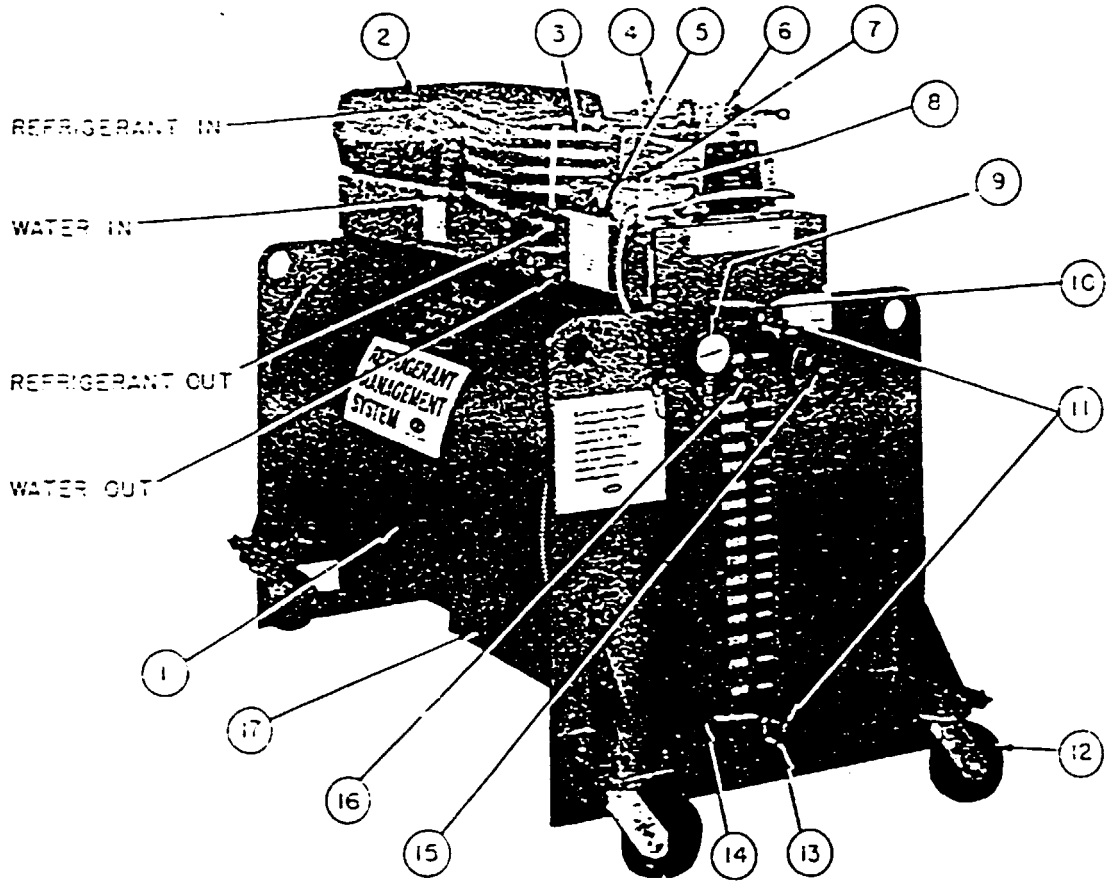
Physical data

19QA	ENGLISH			SI		
	Size	020	040	Size	020	040
DRY WEIGHT	lbs	605	820	kg	275	370
TANK SIZE	cu ft	20	40	cu meters	57	1.13
TANK STORAGE CAPACITY R-11 Liquid	lbs	1600	3300	kg	725	1500
DESIGN PRESSURE	psig	15		kPa	103	
MAX. OPERATING PRESSURE	psig	10		kPa	69	
CONNECTION SIZES	in.	½		in.	½	
HIGH PRESSURE SWITCHES						
Tank Heater and Vacuum Pump Cutout	psig	10		kPa	69	
Manual Reset	psig	<4		kPa	<28	
VACUUM PUMP PSC Motor Hp		½			½	
Max. Discharge Pressure	psig	10		kPa	69	
Max. Vacuum	in. Hg			kPa		
One Pump		25.5			86	
2 Pumps In Series		29			98	
Flow Rate	cfm			m^3/s		
60 Hz		3.6			.0017	
50 Hz		3.0			.0014	

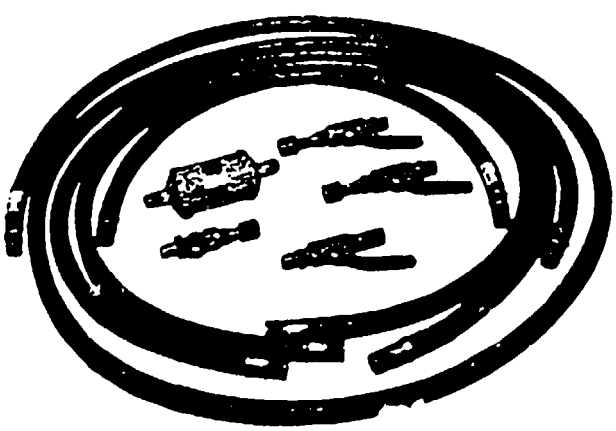
PSC — Permanent Split Capacitor

Machine components



NO.	ITEM
1	— Storage Tank
2	— Accessory Case
	Charging Hose, 3 ft
	Charging Hose, 6 ft (2)
	Charging Hose, 12 ft
	Valve With Coupler (2)
	Chiller Vapor Valve
	Liquid Ind. With Coupler
	Filter-Drier ¼-in. Flare
	¼-in. MPT x ¼-in. Male Flare
3	— Tube-in-Tube Condenser
4	— Vacuum Pump
5	— Heater High Pressure Switch

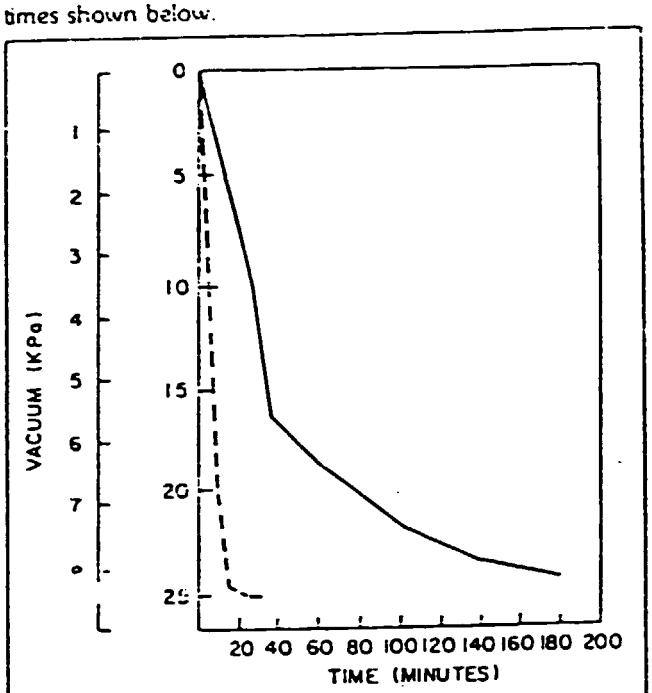
NO.	ITEM
6	— Vacuum Pump High Pressure Switch, Hidden
7	— Vacuum Pump Switch
8	— Heater Switch
9	— Pressure Gage
10	— Vapor Valve
11	— Level Gage Valve
12	— Optional Casters — Available for Small (20 cu ft) Tank Only
13	— Liquid Valve
14	— Water Separation Glass
15	— Rupture Disc
16	— Maximum Level Glass
17	— Heater



ACCESSORY CASE CONTENTS

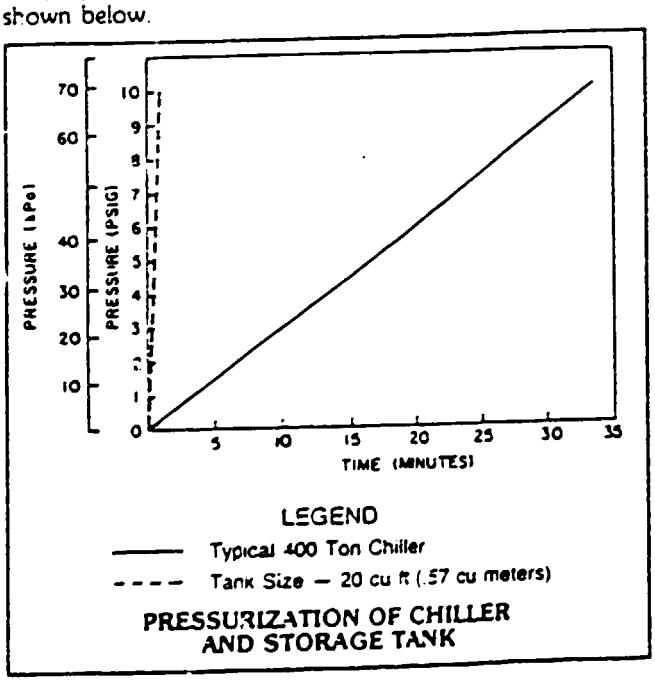
The 19QA RMS provides complete refrigerant management

Evacuation — To minimize refrigerant vapor loss, refrigerant-containing vessels such as chillers and storage tanks must be completely evacuated before charging. The 19QA vacuum pump can be used to evacuate these vessels in the times shown below.



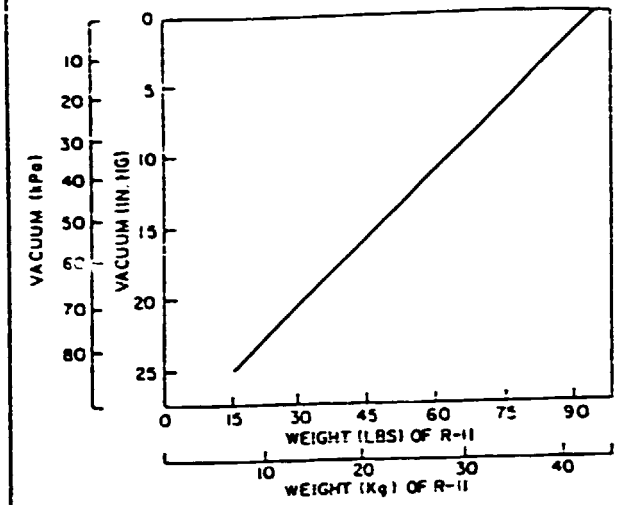
EVACUATION OF CHILLER AND STORAGE TANK

Pressurization — The vacuum pump can be easily used to pressurize a chiller or storage tank to 10 psig (69 kPa) for the purpose of leak testing. Typical pressurization times are shown below.

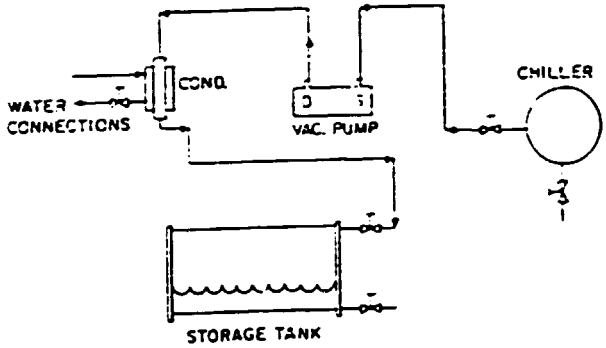


PRESSURIZATION OF CHILLER AND STORAGE TANK

Refrigerant Vapor Transfer — A typical 400-ton chiller contains about 95 lb (43 kg) of refrigerant vapor once the liquid refrigerant has been removed. With the 19QA Refrigerant Management System, it is possible to reclaim almost all of this refrigerant by evacuating the chiller and condensing the vapor.

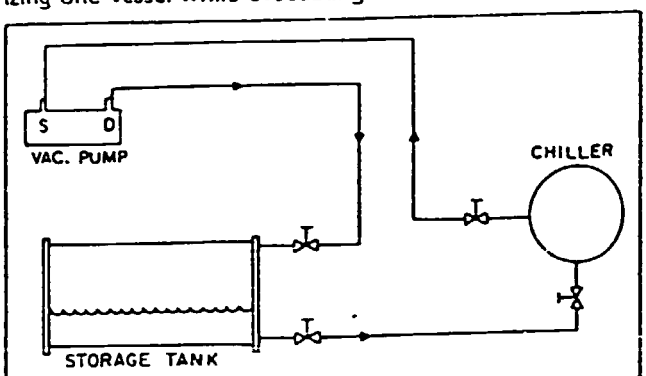


REFRIGERANT VAPOR REMAINING IN CHILLER AFTER REMOVAL OF LIQUID REFRIGERANT (400 Ton Unit)



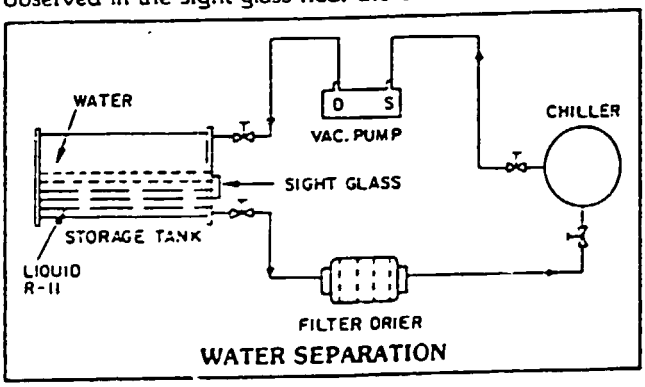
REFRIGERANT VAPOR TRANSFER/EVACUATION

Liquid Refrigerant Transfer — Liquid refrigerant can be transferred from the storage tank to a chiller (approximately 40 lbs [18 kg] per minute) or from a chiller to the storage tank (approximately 30 lbs [14 kg] per minute) by pressurizing one vessel while evacuating the other.



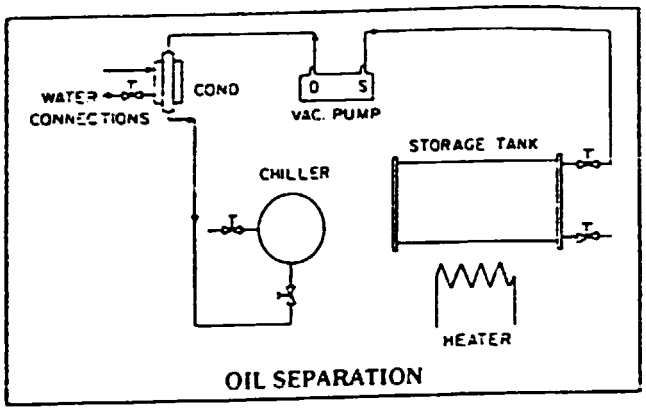
LIQUID REFRIGERANT TRANSFER
(From Storage Tank to Chiller)

Water Separation — Water is only slightly soluble in refrigerant (approximately 110 ppm) at typical temperature levels. Most of the water present will float on top of the refrigerant. This free water can be easily removed by stopping the transfer process when the water/refrigerant interface is observed in the sight glass near the bottom of the tank.



WATER SEPARATION

Oil Separation — The RMS can be used to separate oil from refrigerant through the process of distillation. The refrigerant is first transferred from the chiller to the tank and then distilled back into the chiller or another tank.



OIL SEPARATION

Application data

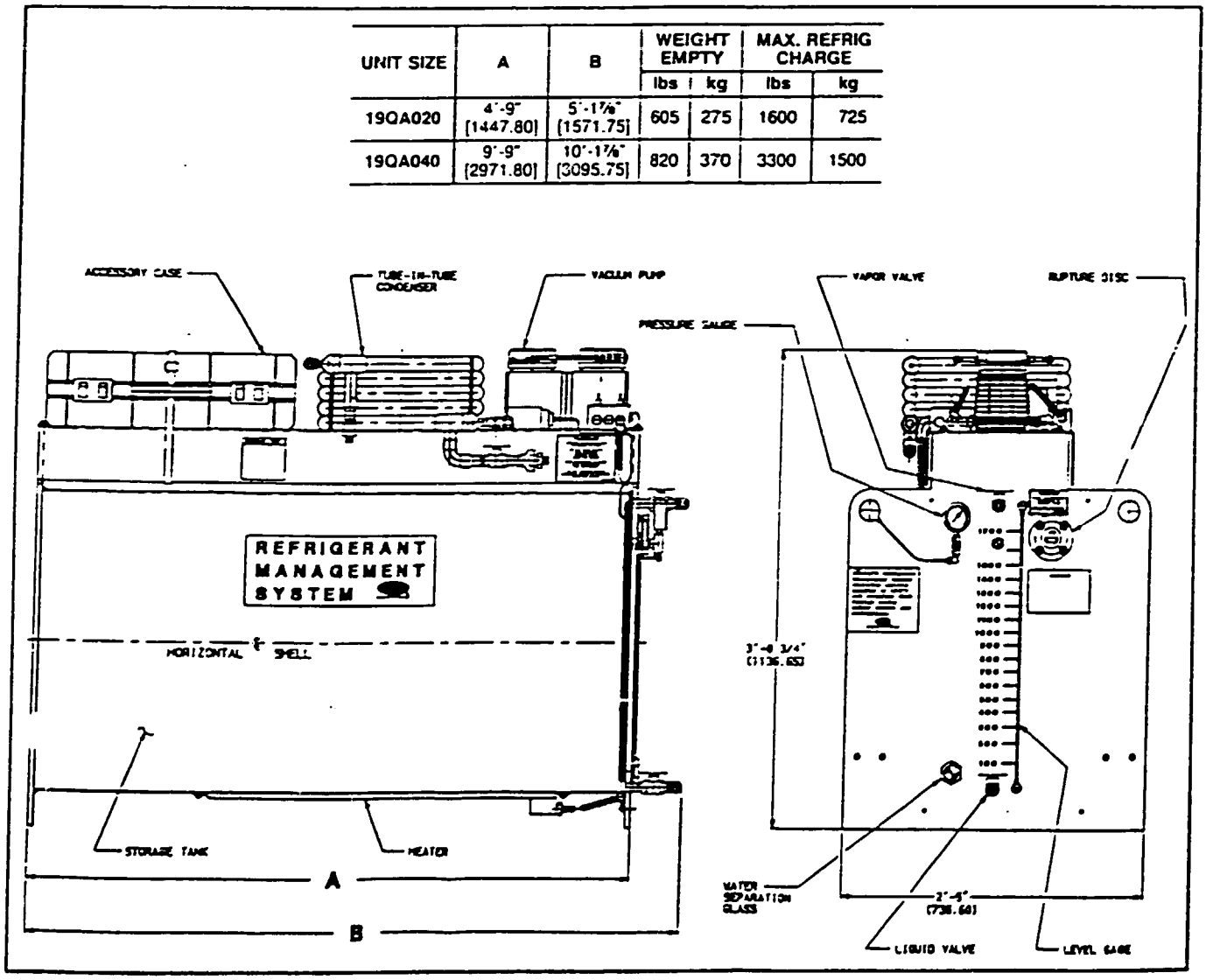
Vacuum pump — The diaphragm-type vacuum pump design reduces the probability of refrigerant leaks. The flow rate for this pump (free air) is 3.6 cfm (.0017 m^3/s) for 60 Hz and 3.0 cfm (.0014 m^3/s) for 50 Hz. The approximate maximum vacuum is 25.5 in. Hg (86 kPa) for a single pump and 29 in. Hg (98 kPa) for two pumps in series. The pump is capable of discharging to a pressure of 10 psig (69 kPa).

With heavy use, it may be necessary to replace the vacuum pump diaphragm. Repair kits are available. The vacuum pump also has internal filters which can be replaced.

Condenser — Condensing water temperature should be as low as possible to minimize the time required to complete an operation. A water flow rate of one gpm (.00006 m^3/s) at 70 F (21 C) is normally adequate.

Dimensions

UNIT SIZE	A	B	WEIGHT EMPTY		MAX. REFRIG CHARGE	
			lbs	kg	lbs	kg
19QA020	4'-9" [1447.80]	5'-1⅞" [1571.75]	605	275	1600	725
19QA040	9'-9" [2971.80]	10'-1⅞" [3095.75]	820	370	3300	1500



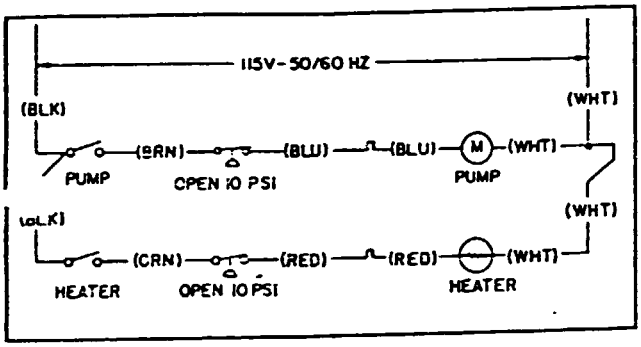
Electrical data

VOLTS-PH-HZ	115-1-60	115-1-50
MCA	12	12
MOCP (Amps)	15	15
HEATER Amps	4	4
VACUUM PUMP MOTOR Hp Amps	½ 4.9	½ 5.5

MCA — Minimum Circuit Amps
MOCP — Maximum Overcurrent Protection (Amps)

NOTE: Use time-delay fuse.

Control wiring schematic



Guide specifications

Refrigerant Management System

HVAC Guide Specifications

Carrier Model Number: 19QA

Part 1 — General

1.01 SYSTEM DESCRIPTION

A. The chiller manufacturer shall provide and install Refrigerant Management System (RMS) when using a CFC with an Ozone Depletion Potential of greater than 0.05.

B. Refrigerant Management System is designed for use with any low-pressure centrifugal chiller. The RMS shall provide conservation of low-pressure CFC's and prevent the release of CFC's into the atmosphere during routine servicing. In addition to safely holding the refrigerant during servicing, the RMS will recharge centrifugal chillers with recycled refrigerant. By means of a distillation/separation system, excess oil and water will be removed from the refrigerant to provide optimum chiller efficiency.

1.02 QUALITY ASSURANCE

Equipment and installation shall be in compliance with the Safety Code for Mechanical Refrigeration, ANSI/ASHRAE 15-1989.

1.03 DELIVERY, STORAGE AND HANDLING

Unit shall be stored and handled in accordance with manufacturer's recommendations.

Part 2 — Products

2.01 EQUIPMENT

A. General:

1. The RMS shall consist of a condenser, vacuum pump, storage tank and heater unit. Additional components shall include a filter drier, safety devices and all required instrumentation and interconnecting hoses.
2. All connections shall be by ½-in. charging hoses unless otherwise specified.

B. Storage Tank:

1. The storage tank shall be of sufficient capacity to contain the entire refrigerant charge of one chiller when 90% full at 90 F (32 C) in accordance with ANSI/ASHRAE 15-1989.
2. The storage tank shall be rated for a design pressure of 15 psig (103 kPa) and equipped with a rupture disc.
3. Means shall be provided for rigging and for use with a forklift.

C. Condenser:

The condenser shall be a copper tube-in-tube type rated for a minimum 450 psig (3103 kPa) refrigerant side and 300 psig (2069 kPa) water side design pressure.

Guide specifications (cont)

D. Heater:

The heater shall be a permanent strap-on type with a minimum 500-Watt rating at 115 v, one phase, 50/60 Hz, and shall be operated by means of a toggle switch.

E. Vacuum Pump:

1. The pump shall be a diaphragm type with ½-hp, 115-v, one-phase, 50 or 60 Hz motor and shall be capable of pulling a vacuum of 25.5 in. Hg (86 kPa) (ref. 30 in. barometric pressure). The pump shall be capable of maintaining a pressure differential of 9 to 10 psig (62 to 69 kPa) between the storage tank and the interconnected chiller.
2. The pump shall be equipped with a permanent split capacitor motor which shall be controlled by a toggle switch.

F. Safety Devices:

1. Pressure relief valve sized in accordance with ANSI/ASHRAE 15-1989.
2. Two high-pressure switches to protect the storage tank against over-pressurization. One switch shall limit the tank pressure to 10 psig (69 kPa) by shutting off the tank heater. The second switch shall limit the vacuum pump discharge pressure to 10 psig (69 kPa) by shutting off the vacuum pump.

G. Contaminant Removal:

The system shall be capable of removing contaminants from the refrigerant charge in accordance with the following requirements:

1. Oil separation shall occur through a distillation process and shall provide recycled refrigerant with less than 1000 ppm oil.
2. Water separation and removal shall provide recycled refrigerant with less than 50 ppm water.

H. Additional chillers:

The RMS shall be able to accommodate multiple chillers when the proper crossover connections are supplied, and the storage tank is to be capable of containing the entire refrigerant charge of the larger of the 2 units, when 90% full at 90 F (32 C).

I. Special Features:

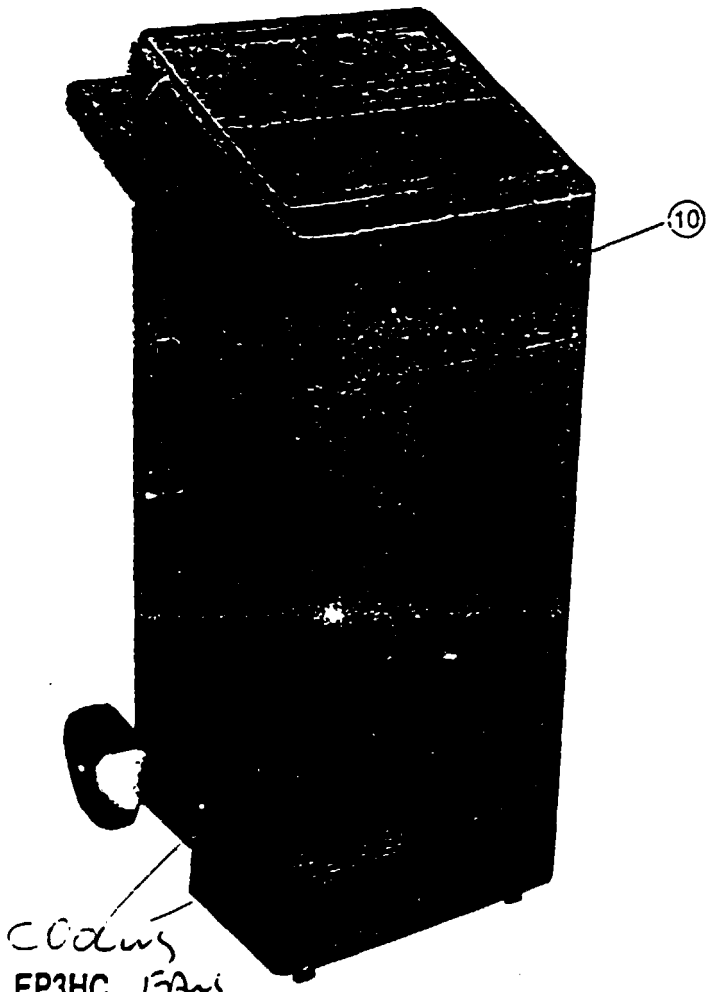
Casters:

Accessory package for use with 20-cu ft (.57-cu meters) storage tank shall include four 6-in. diameter swivel casters with wheel locks, mounting brackets and hardware.

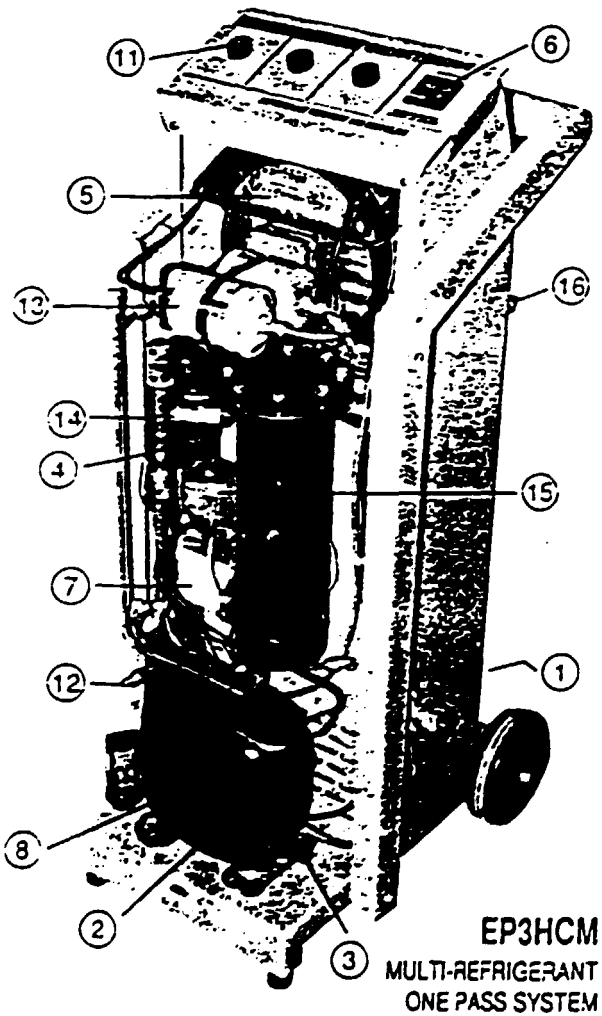
HT – CAPACITY

REFRIGERANT RECOVERY & RECYCLING

MACHINES



EP3HC



EP3HCM
MULTI-REFRIGERANT
ONE PASS SYSTEM

FOR HEAVY DUTY MOBILE & COMMERCIAL AIR CONDITIONING AND REFRIGERATION APPLICATIONS
BUSES, TRUCKS, TRAINS, AIRCRAFT, REFRIGERATED TRANSPORT

EP3HC OUR HEAVY DUTY RECOVERY/RECYCLING MACHINE FOR FAST RECOVERY FROM LARGER SYSTEMS RECOVERS BOTH LIQUID AND VAPOUR

FEATURE	BENEFIT
① Cylinder Weighing Platform	*Prevents dangerous overfilling of cylinders.*
Large ½ hp heavy duty Danfoss compressor ②	*For fast recovery and recycling (R12 up to 1kg/min).*
Set and forget operation	*No supervision required during recovery.*
Compressor oil change ③ and oil return system ④	*Returning compressor oil to the crankcase and making provision for changing the compressor oil ensures years of trouble free service.*
Fan forced fin and tube condensor ⑤	*Liquifying the refrigerant before it is stored in the cylinder prevents dangerous overheating of the recovery cylinder.*
Hourmeter ⑥	*Allows you to monitor oil change and filter change intervals.*
High pressure ⑦ high temperature ⑧ cut out switch	*Protects the machine and the operator.*
Scavenge effect	*Our machine will restart every two minures after completion of recovery to "scavenge" any refrigerant that may have boiled out of the compressor oil or the accumulator and drier(s).*
*TX valve ⑨ (not fitted to EP3HCM)	*Controls refrigerant flow during recycling.* *Note purity exceeds SAE standard J1991.*
Stylish steel ⑩ powder coated cabinet	*Tough, durable and easy to clean.*
ltage	*Available in 220 volt 50Hz and 110V 60 HZ (Export).*
electrical ⑪	*Aporoved by all Australian Electrical Authorities. We use quality Siemens electrical components.*
A choice of refrigerants	*Available for R12, R22, R500, R502 and can be easily converted.*

EP3HCM A MULTI REFRIGERANT ONE PASS VERSION OF THE UNIT ABOVE WITH THE FOLLOWING ADDITIONAL FEATURES.

FEATURE	BENEFIT
Multi Refrigerant	*Designed where there is a need to switch quickly and simply to either R12, R22, R500, R502.*
Minimum emissions during change over to another refrigerant	*A loop circuit allows this machine to recover the refrigerant in 98% of its high side circuit. Only 100mm of 6mm tubing ⑫ needs to be vented during changeover.*
One pass punfication	*Adding dual filtration ⑬ to the high side (after the condensor) means that by simply recovering the refrigerant it is immediately ready to be reused.***
Crankcase pressura regulator ⑭	*Provides added protection for the compressor from high inlet pressures.*
Accumulator flow control ⑮	*A level sensitive control system monitors level to ensure proper low side vaporization and filtration.*
Large ⅜" inlet ⑯	*For fast vapour and liquid recovery.*
Patents	*Our patent applications protect you from poor quality copies which will not operate effectively.*

COMPLETE READY TO USE

The following accessories are included:

■ Two 25kg recovery cylinders and hoses with anti-blow back fittings ■ One Manifold gauge and 72" hose set

*** Highly contaminated refrigerant may need recycling*

DISTRIBUTED BY:

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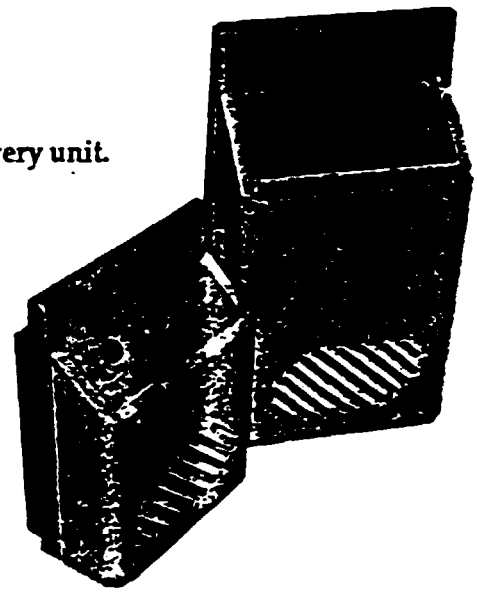
A SIMPLE SYSTEM FOR MAKING GOOD MONEY OUT OF USED REFRIGERANT.

The SKYEMITE recovery unit.



The SKYEMATE recycler.

Announcing a new concept in recycling refrigerant. The SKYE Split System. Two units working together or apart.

The SKYEMITE is a simple and compact *recovery unit*, the SKYEMATE *recycles* R12 by removing contaminants. Both units are about the size of an average vacuum cleaner and are just as easy to use.

The SKYE Split System.

Nothing could be simpler. You keep your SKYEMATE recycling unit in a central location, where it quickly and efficiently removes the contaminants from R12, producing a purified refrigerant which is ready to use again!

You keep the SKYEMITE recovery unit in your ute or van ready to go out to factories, farms and workshops, to recover refrigerants. Then it's back to your SKYEMATE to complete the recycling.

You have a choice- invest in a SKYEMITE now and buy a SKYEMATE later.

Of course, you can run a number of SKYEMITES with only one SKYEMATE which reduces capital outlay and increases your flexibility.

And a bonus, your SKYEMATE Recycling unit can be run with other brands of 'recovery only' machines.

It will soon be compulsory to at least recover refrigerants, under laws designed to preserve the atmosphere.** However, the SKYE Split System can improve your profits right now! Why wait?

SKYE

Good for the world. Great for business.

-CHECK WITH LOCAL AUTHORITY

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Environmental Products Amalgamated Pty Ltd

5/23-27 Callister Street, Shepparton, Victoria, 3630, Australia

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For details of your nearest distributor, telephone (within Australia) toll free 008 039092

JAVAC RECO

The Javac range of RECO refrigerant recovery and recycling units is, we believe, the most comprehensive and advanced on the market today.

The investment required in a quality recovery/recycling unit is quite substantial, so it is important that you get the features, service backup and accessories you need. It is also important to select the particular model with the features and capabilities to best suit your requirements.

Javac has produced three models with quite specific applications in mind, and with features which in many cases are available only on the RECO range

When you choose a Javac RECO, you are also choosing the support of Australia's largest manufacturer of high vacuum pumps, respected for its innovation and quality in the refrigeration and vacuum industries for over 20 years.

Three models:

RECO–1

A true, multi-purpose workhorse, compact, fast, efficient, designed to rapidly remove large volumes of types R12, R22 and R502 refrigerants.

The only commercial unit available with built-in sub-cooling to actually chill the dumped refrigerant, for improved efficiency and safety. The RECO–1 features a belt drive compressor with oil recirculation, and multiple refrigerant recovery capability. Access is easy, servicing simple.

RECO–12S and RECO–134S

Specifically for the recovery of R12 and R134a, these units are also compact, but utilise high-capacity twin filtration systems with replaceable filter drier cores. Both units use commercial size hermetically sealed compressors, modified for simple oil checking and re-filling.

No-fuss recovery ensures minimum down-time and fast repair of domestic, and automotive installations.

The RECO–12S and 134S are both capable of vapour recycling, and can be connected as shown on the back page. This means that refrigerant can be cleaned and dried, thus providing real cost-saving benefits by enabling the re-use of costly refrigerants.

Service and support

In every detail, the RECO range exemplifies Javac's reputation for quality, no-nonsense engineering, reliability, and service. We provide, through our extensive distribution network, product support which is the envy of our competitors — our whole service and parts operation reflects a thorough, long-term commitment to excellence.

Engineering

All RECO units use proven and tested refrigeration components and feature interchangeability and user serviceability.

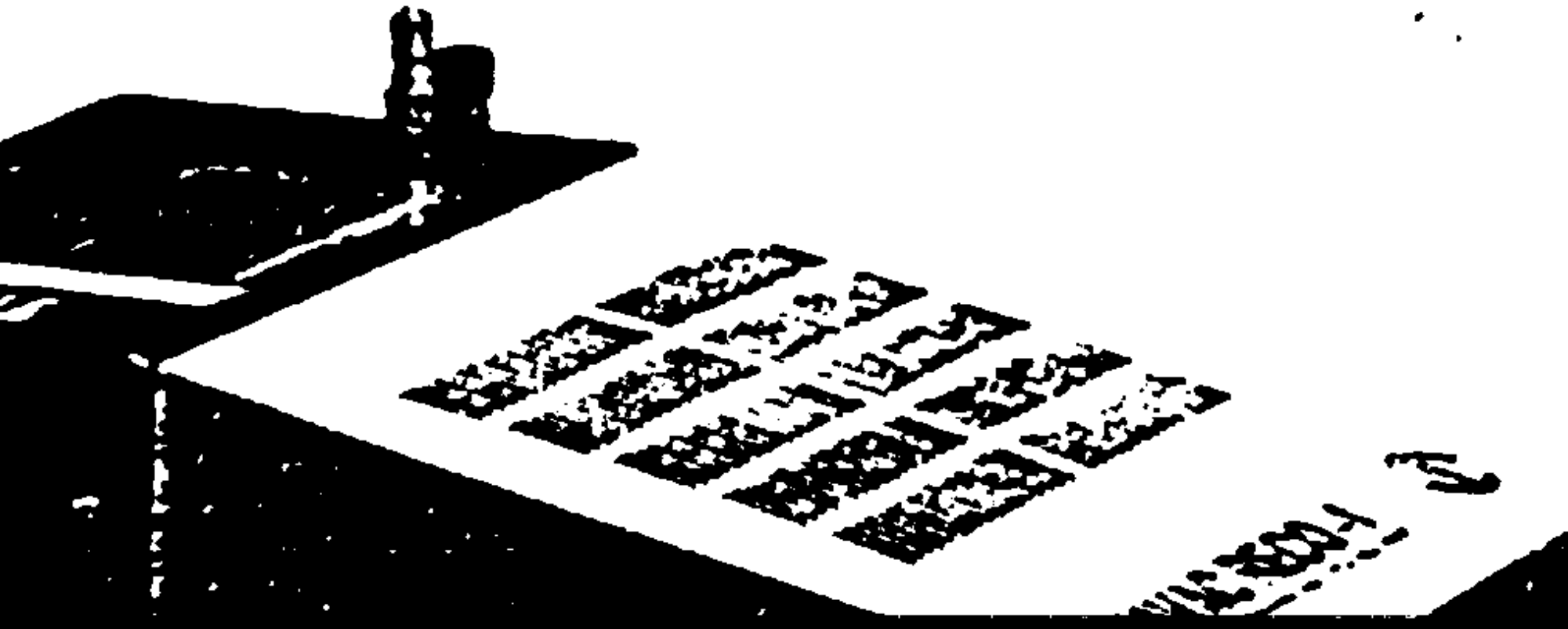
All units have fully variable high pressure safety cutouts, and adjustable low-pressure switching provides the choice of pressure or vacuum cutout.

All RECO units are fully automatic in operation and can be 'set and forget.' If required, full manual override and adjustment ensure the RECO units are adaptable to any task.

Air-cooled condensers, oil separators, sequence indication lamps and quick-connect no-loss fittings feature heavily.

Automotive application using a RECO–12S

ored to your
ds



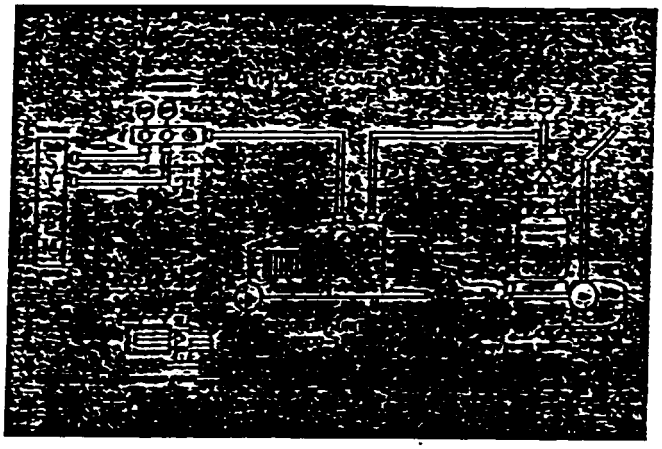
AVAC RECO

Designed and Manufactured in Australia by
Javac Pty Ltd
A.C.N. 004 477 543

Typical recovery

Connect the RECO unit to the vapour side of the system. Use a Javac ALTOFF beneath the recovery cylinder to prevent overfilling.

A vacuum pump installed via a systems analyser can be used to evacuate lines to prevent air entering the recovery cylinder. More than 95% can be recovered in this mode.



Final evacuation/ recovery (optional)

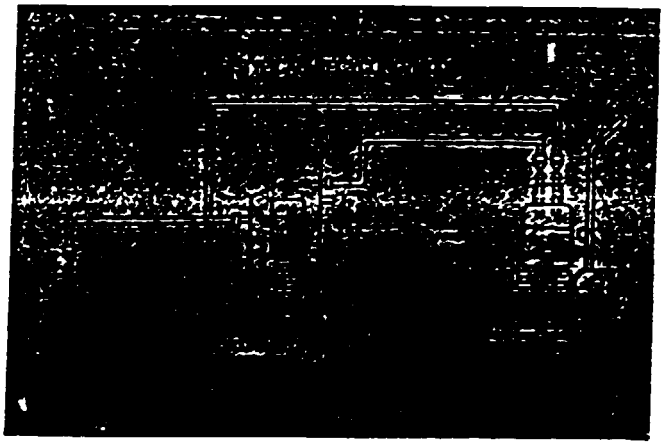
(A feature unique to Javac)!

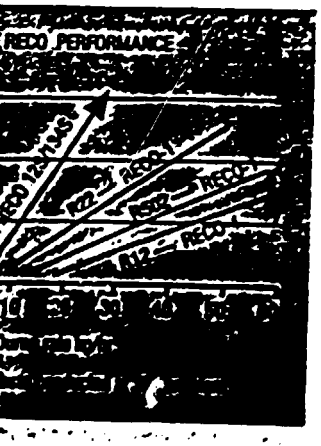
If desirable, use a Javac Wombat vacuum pump as shown to remove the final traces of refrigerant. Prior to recharging, exhaust the Wombat into the inlet of the RECO unit; adjust range switch for maximum run time and dwell.

Always use an empty cylinder or a Javac ALTOFF during this optional final recovery.

Typical recycle

Using only a RECO-12S or 1345 as shown, connect the inlet of the RECO-12S/1345 to the vapour side of the recovery cylinder, and the discharge of the RECO-12S/1345 to the liquid side of the recovery cylinder. If using two cylinders, use vapour side on both. Monitor until the liquid and moisture indicator shows dry.





In line with its policy of continual product improvement, Javac Pty Ltd reserves the right to alter specifications without notice

ACTROL

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A.C.N. 004 784 301

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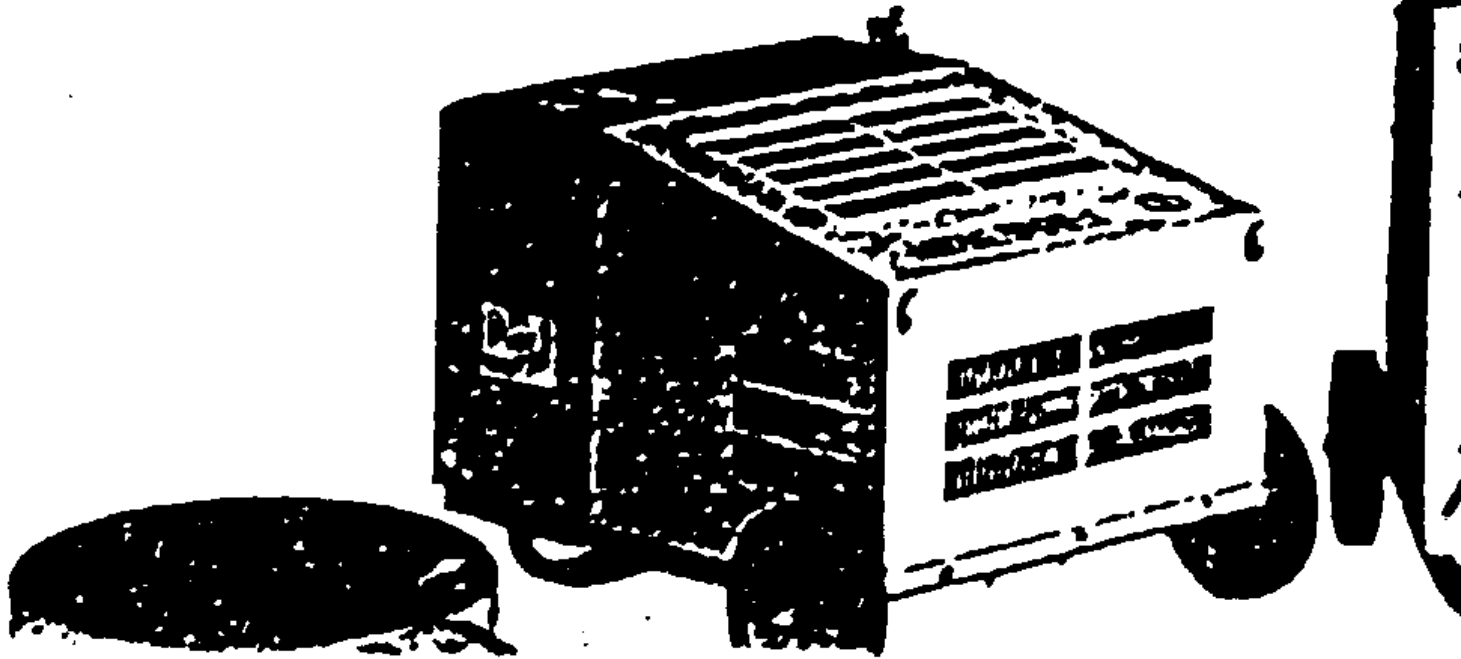
Perth	09 277 5922
Canberra	062 80 4176
Darwin	089 84 4877
Launceston	003 44 7088

AUSTRALIAN MADE

Standard fitted •

Not applicable –

*The RECO1 and 125 are certified to comply with these SAE standards. Tests were performed by Sharp & Howells Pty Ltd Melbourne
**MRIC Approval No. 5



Accessories

Autoff

A stand-alone automatic cut-off device designed to switch off the recovery unit when a specific cylinder weight reaches 80% capacity.

Suitable for P (28kg), Q (49kg), R (79kg) size cylinders, switchable. The Autoff can be used with any Javac RECO unit, or 240 volt recovery unit.

Cat. No. R30057

Cylinder trolley
(Incorporating AUTOFF)

A sturdy, folding trolley designed to transport P (28kg), Q (49kg) and R (79kg) cylinders. The trolley folds for easy storage and incorporates the AUTOFF automatic cutoff facility.

In practice, both the Javac RECO and cylinder trolley can be easily wheeled into position and connected up. The folding trolley is ideal for service personnel, as it takes minimum space in the service van.

Cat. No. R30087 (without AUTOFF)

Hermetically-sealed
High Vacuum pump

The Javac Wombat series of high vacuum pumps are designed to be used in conjunction with Javac RECO units at the last stage of recovery. By using appropriately, evacuation and final recovery of up to 100% can be achieved in the one operation. The Wombat is available in single or double stage.

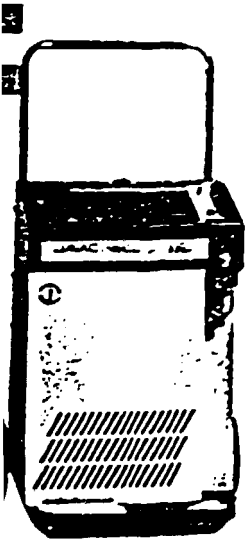
Cat. No. ODS040H (single stage)
Cat. No. ODD040H (double stage)

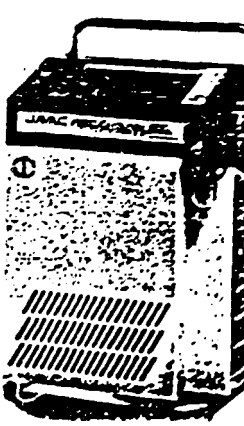
Analyser

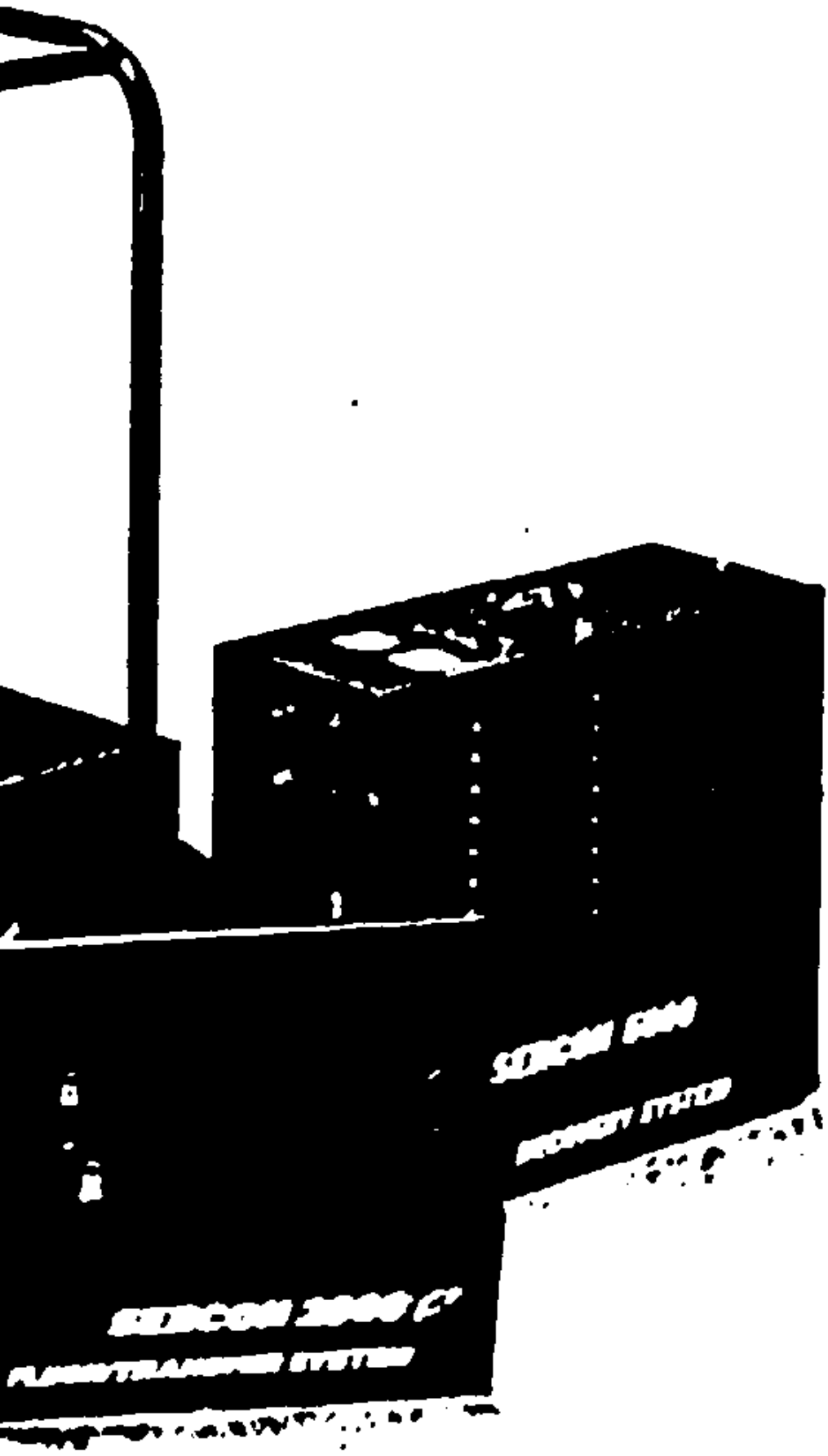
The Javac manifold/analyser can be optioned on a Javac high vacuum pump, or as an option for use with any refrigeration system. The analyser incorporates HP and LP gauging, valves, plus a vacuum pump valve.

Custom manufacture

Javac also offer custom designed and manufactured recovery, recycling and charging facilities. Information on request.



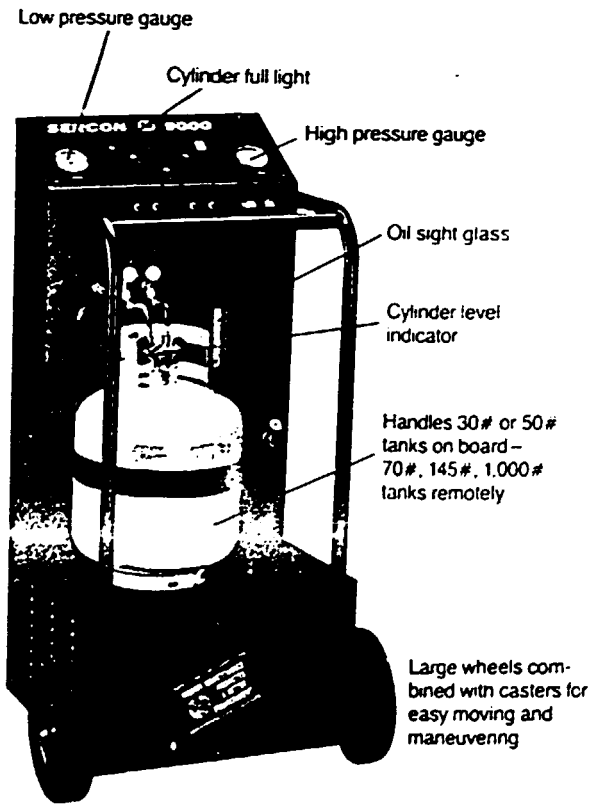




REFRIGERANT RECOVERY & RECYCLING SYSTEMS

FROM TECHNICAL CHEMICAL COMPANY

Technical Chemical Company is the industry leader in Refrigerant Recovery and Recycling Systems. Sercon products are manufactured using only top-quality components; a complete inventory of parts and accessories is maintained. Sercon Refrigerant Recovery and Recycling Systems include a "hassle-free" one-year limited warranty.



Rugged 16-gauge steel construction

SPECIFICATIONS:

Size: 20" x 20" x 45.5"
Weight: 175 lbs.
Connections: 1/4" flare
Power: 115/120 VAC, 60 Hz
Control Lamps: Green-Recovery, Red-Tank Full, Amber-Flush, Recycle
Current: 9 amps

Safety Equipment: Low/high pressure controls, cylinder full shut-off, pressure relief valve, safety valves, check valves, crank case pressure regulator

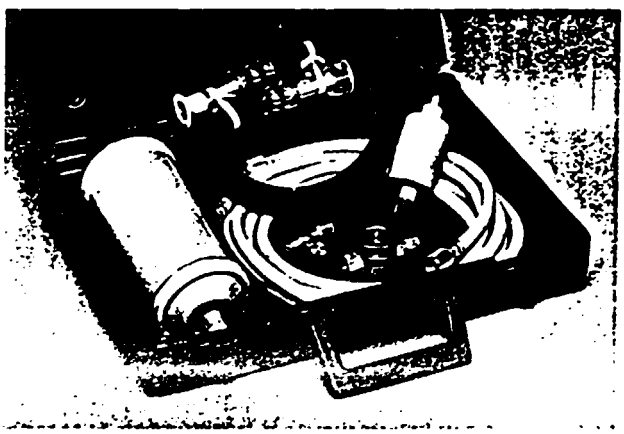
SERCON 9000

The Sercon 9000* is the industry standard in fast, safe, dependable Refrigerant Recovery & Recycling Systems for high-volume operations. It is UL listed and can be used with R-12, R-22, R-500 and R-502 refrigerants.

It boasts a powerful 1/4 horsepower Copeland compressor with a liquid pump that speeds recycling time and prolongs compressor life. The "continuous-loop filtration" system can recycle 40 pounds of refrigerant in just 15 minutes; dual filter blocks increase recycling efficiency.

Built-in high and low pressure gauges allow continuous monitoring of system pressures during recovery – once the system is completely evacuated, the Sercon 9000 shuts itself off. It has a Cylinder Full Light and Cylinder Level Indicator to show how much refrigerant has been recovered at any time. Meets S.A.E. J-1991 (1989) R-12 purity standards.

An oil sight glass makes the amount of oil recovered easily visible. An external drain on the front of the Sercon 9000 makes it easy to drain.



* Basic Flush kit (Part #S12445) for 9000/9220 systems. Optional adapters are available for use with many auto makes and models.

The Sercon 9000 boasts a unique flush cycle that with the *Basic Flush Kit uses recovered refrigerant to flush the system. It's easy for one person to operate, saves time and material, and is environmentally responsible.

Some commercial equipment contains a large quantity of refrigerant. The transfer capabilities provide the mechanic a method of moving refrigerant in a liquid state at a high rate of up to 25 lbs. per minute. This means substantial time savings to the mechanic.

Sercon 9134

The Sercon 9134* is a dedicated machine for R-134A. It has the same specifications as the 9000, with a synthetic oil in the compressor.

SERCON 9220

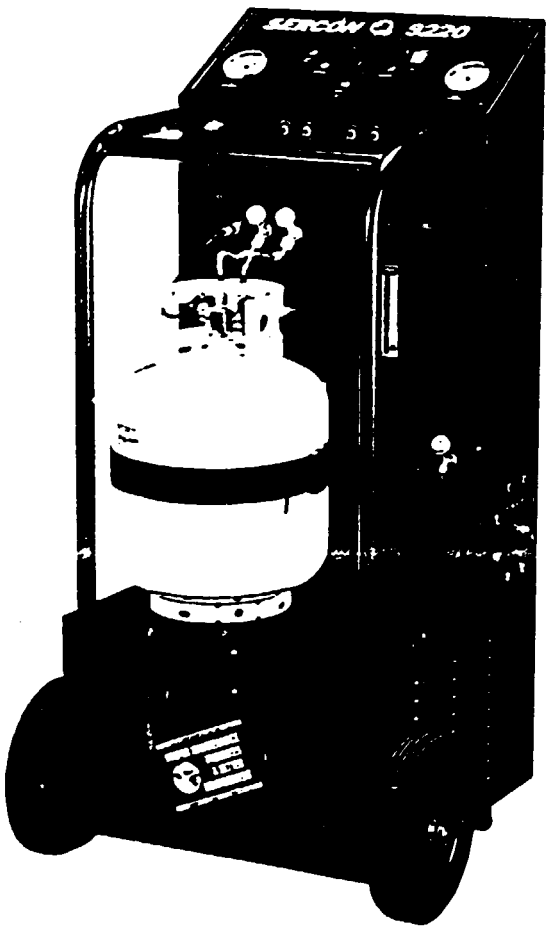
Designed with the world market in mind, the Sercon 9220* offers the same quality, features and performance as the Model 9000, but operates on 220/240 VDC, 50 Hz. And like the Sercon 9000, it is UL listed, easy to operate, efficient and environmentally responsible.

SPECIFICATIONS:

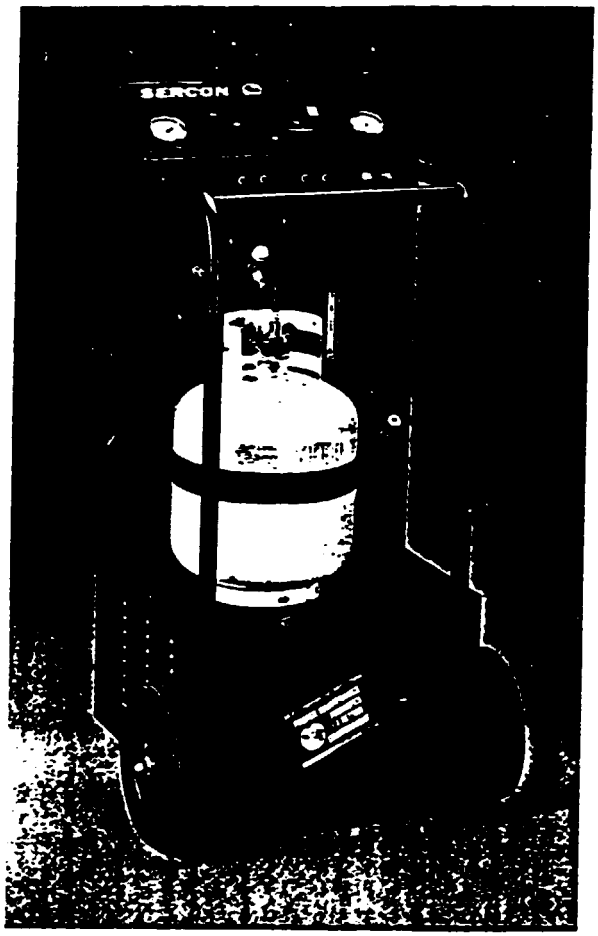
Size: 20" x 20" x 45.5"
Weight: 175 lbs
Connections: 1/4" flare
Power: 220/240 VDC, 50 Hz Current: 5 amps

Control Lamps: Green-Recovery
Red-Tank Full
Amber-Flush, Recycle

Safety Equipment: Low/high pressure controls, cylinder full shut-off, pressure relief valve, safety valves, check valves, crank case pressure regulator.



SERCON 8000



The Sercon 8000 Single Pass Recovery and Recycling System is U.L. Listed and can be used with R-12, R-22, R-500 and R-502. This system meets S.A.E. J-1991 (1989) R-12 purity standards. The Sercon 8000 is the same quality you have come to expect with all our other equipment.

SPECIFICATIONS:

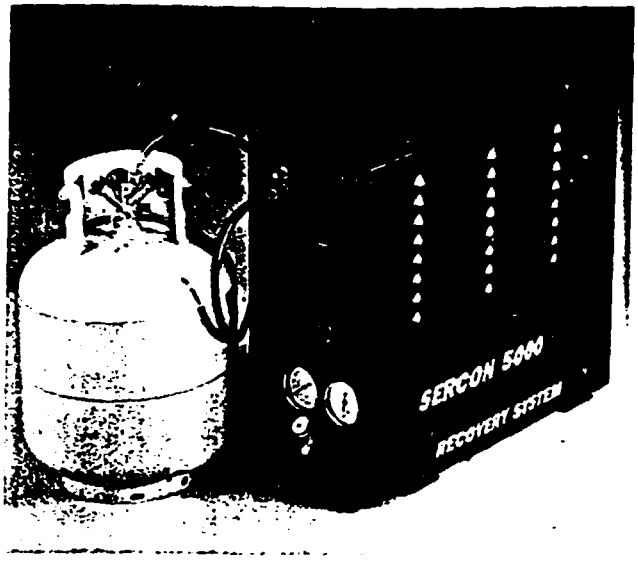
Size: 20" x 20" x 45.5"
Weight: 160 lbs.
Connections: 1/4" flare
Power: 115/120 VAC, 60 Hz Current: 9 amps

Control Lamps: Green-Recovery
Red-Tank Full

Safety Equipment: Low/high pressure controls/cylinder full shut-off, pressure relief valve, safety valves, check valves, crank case pressure regulator.

* Patent Pending

SERCON 5000



SPECIFICATIONS:

Size: 9" x 19" x 24" Control Lamps: Green-Recovery
Weight: 70 lbs. Red-Tank Full
Connections: 1/4" flare
Power: 115/120 VAC. 60 Hz Current: 9 amps

Safety Equipment: Low/high pressure controls, cylinder full shut-off, pressure relief valve, safety valves, check valves, crank case pressure regulator.

The Sercon 5000* Refrigerant Recovery System allows smaller shops, auto dismantlers, and the HVAC/R Industry to have a portable, well balanced, and easily operated recovery system. A single 9000 and several 5000 systems are an economical option for larger service operations. A 5000 allows the HVAC/R industry access to roof top installations and remote jobs. The 5000 contains a full condensing section with dimensions that make it easily carried.

The UL listed 5000 provides the same efficient recovery capability as the Sercon 9000 without the additional expense of the recycling system. Recovered refrigerant is stored in 30 to 1,000 lb. capacity cylinders. It may then be recycled through a Sercon 9000, or sold to an off-site recovery center.

Sercon Acid Test Kit

Features:

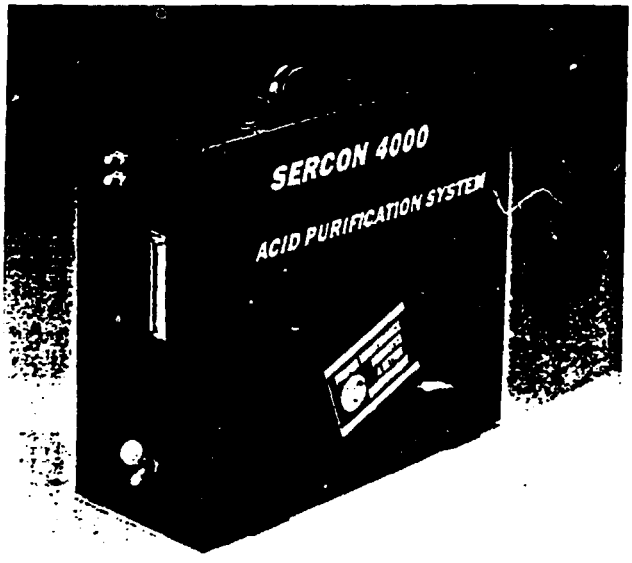
- *Simple* – just two bottles to work with
- *Complete* – each kit has everything you need to do the job. After the test just discard the kit.

SERCON 4000

ACID PURIFICATION SYSTEM

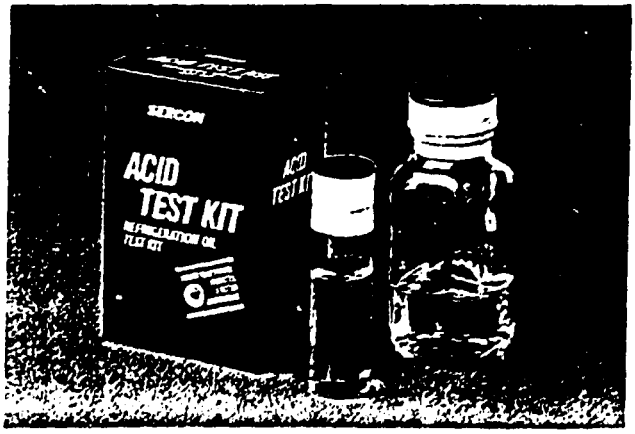
The Sercon 4000 is specially designed with the HVAC/R industry in mind, for filtering refrigerant from systems with a high acid or moisture content. It is used in conjunction with the Sercon Refrigerant Recovery Systems.

The 4000 is UL recognized and features a special oil separator/accumulator and filter/drier blocks to remove the acid and moisture from the refrigerant before it enters the recovery system.



SPECIFICATIONS:

Size: 9" x 19" x 24" Weight: 55 lbs. Current: 1 amp
Power: 115/120 VAC. 60 Hz Connections: 1/4" flare



- *Sure* – no need to guess anymore. Color changes are easy to detect for positive indication of acid level.
- *Convenient* – handy small size package allows easy storage in your tool box.

SERCON 2000

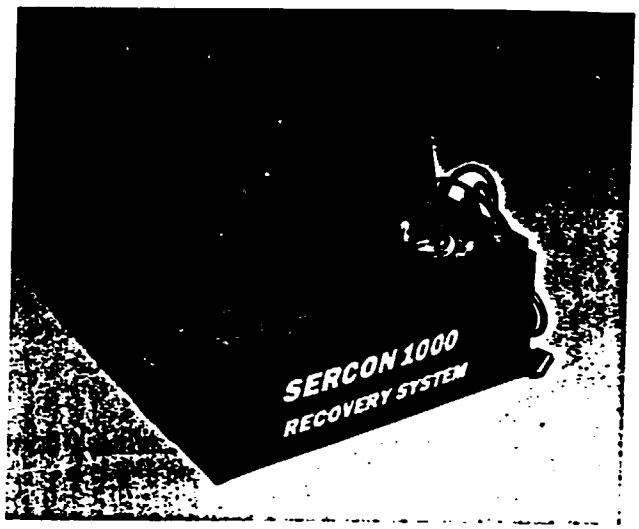
The UL listed Sercon 2000 Flush/Transfer* unit contains a high volume liquid pump that provides the service technician a way to flush an air conditioning system or transfer/off load a large quantity of liquid refrigerant without venting CFC's into the atmosphere. This system weighs only 25 pounds and is contained in a 8" x 9-1/8" x 18" tool box for portability. The Sercon 2000 can be used with all refrigerants.

SPECIFICATIONS:

Size: 8" x 9-1/8" x 18"
Weight: 25 lbs.
Connections: 3/8" flare
Power: 115/120 VAC, 60 Hz Current: 1 amp
Control Lamps: Green-On
Red-Tank Full

Safety Equipment: Pressure relief valve, check valve

SERCON 1000



The UL listed Sercon 1000 Vapor Recovery System offers the small shop and the appliance industry an affordable, efficient way to recover R-12. The system recovers approximately 1/2 pound per minute utilizing a 1/6 horsepower compressor. The unit weighs only 35 pounds.

SPECIFICATIONS:

Size: 8" x 9-1/8" x 18"
Weight: 35 lbs.
Connections: 1/4" flare
Power: 115/120 VAC, 60 Hz Current: 3 amps
Control Lamps: Green-Recovery
Red-Tank Full

Safety Equipment: Low/high pressure controls, pressure relief valve, check valves

In addition to Refrigerant Recovery and Recycling equipment, Technical Chemical also offers a complete line of air conditioning supplies and accessories.

14159 OXNARD STREET
VAN NUYS, CA 91401
818-782-3501 • FAX 818-782-1824

roud members of:

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	2-3lbs/min	-	R-12,R-22,R-500,R-502	- MEETS & EXCEEDS SAE STANDARDS - DESIGNED FOR MOBILE A/C MARKET - RECOVERY UNIT ONLY
2.	SPX CORPORATION,USA (OTA Division)							
(a)	OEM 1380	AUTOMOBILES	45"x23"x25"	150 lbs	0.5 lb/min	2.5 lbs/min	R-12	- RECOVERY & RECYCLING UNIT
(b)	OEM 1396	AUTOMOBILES	45"x21"x24"	115 lbs	0.5 lb/min	.8 lb/min	R-12	- RECOVERY & RECYCLING UNIT
(c)	OEM 1397	AUTOMOBILES	15"x20"x14"	53 lbs	0.5 lb/min	-	R-12	- RECOVERY UNIT ONLY
3.	UNITED TECHNOLOGY CARRIER U.S.A							
(a)	19GA 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.	ENVIRONMENT PRODUCTS AMALGAMATED PTY LTD,AUSTRALIA "SKYE"							
(a)	EP-3	MOBILE & COMMERCIAL AIR CONDITIONING & REFRIGERATION APPLICATIONS	400x500x 1000 (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-	400x500x 1000 (mm)	20 kg	25 kg/hr	-	R-12,R-22,R-500,R-502	- HAND CARRY,RECOVERY UNIT
(c)	EP-4HC	-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 &

SL. NO.	EQUIPMENT	APPLICATION AREA	SIZE	WEIGHT	RECOVERY	RECYCLING	REFRIGERANTS HANDLED	FEATURES
5.	JAVAC RECO, AUSTRALIA							
(a)	RECO - 1	COMMERCIAL AIR CONDITIONERS	390x440x600 (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	390x440x600 (mm)	35 kg	33kg/hr	1 lit/min	R-12	-VAPOUR FORM REFRIGERANT RECOVERY & RECYCLE
(c)	RECO-134S	DOMESTIC/AUTOMOBILE	390x440x600 (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	19"x19"x24"	70 lbs	25 lbs/min	-	R-12,R-22,R-500,R-502	- RECOVERY UNIT ONLY

APPENDIX 5.1

FORMAT FOR VIABILITY ANALYSIS FOR COLLECTION USING PLASTIC BAGS
(VENTURE TYPE A)

(in LE)

	1993	1995	1996	1997	1999	2005	2007	2010
Max. collection of CFC 12 using plastic bags (@ 90%)								
Practical qty. recoverable through plastic bags								
- Percentage								
- Quantity (MT)								
Number of plastic bags required (@ 1.2 Kg per bag and 25% wastage)								
Sale price of recovered CFC using bags								
- Per Kg								
- Total sales								
Operating costs for recovering CFC (Labour cost)								
- Per Kg								
- Total cost								
Contibution (per Kg)								
Total operating profit								

APPENDIX 5.2

FORMAT FOR VIABILITY ANALYSIS FOR RECOVERY USING PORTABLE EQUIPMENT
(VENTURE TYPE B)

(IN LE)

DESCRIPTION	1993	1995	199e	1997	1999	2005	2007	2010
Quantity of CFC 12 recovered (Kg per annum)								
A. Material Costs								
1. Raw Material (Recovered CFC) @ 0 LE per kg								
2. Spares and Consumables @ 0.31 US$ per Kg								
Total material cost (A)								
B. Power (@ 0.07 LE per KWH & 0.05 KWH per Kg)								
C. Labour								
Wages								
Manhours/Kg								
Wage Rate (per manhour)								
Total Wages								
Supervision salaries								
Manhours/Kg								
Rate (per manhour)								
Total salaries								
Total labour (C)								
D. Overheads								
Repairs & maintenance (@ 5% of equipment cost)								
Administrative & selling expenses								
Contingencies at 5%								
Total overheads (D)								
E. Estimate of cost of operation (A+B+C+D)								
F. EXPECTED SALES (@ 8 LE /Kg)								
G. GROSS PROFIT BEFORE INTEREST & DEP. (F-E)								
H. TOTAL FINANCIAL EXPENSES **								
I. DEPRECIATION & AMORTISATION (@ 10% St. line)								
J. OPERATING PROFIT (G-H-I)								
K. TAX (40%)								
L. NET OPERATING PROFIT (J-K)								
Add: Depreciation								
Minus: Loan repayment								
NET CASH ACCRUALS								

APPENDIX 5.3

ECONOMIC VIABILITY OF VENTURES FOR COLLECTION/RECOVERY AND RECYCLING IN EGYPT

1. ESTIMATED COST OF PROJECT & SCHEME OF FINANCE (for each type of venture)

(in LE)

Item of cost *	RECOVERY ONLY	RECYCLING
1. Equipment		
(i) Imported		
- FOB Value (US$)	1000	2400 ****
- Insurance and Freight (US$) @ 5% Of FOB Value	50	120
- CIF Value (US$)	1050	2520
- CIF Value (local currency)**	3476	8341
- Import Duty		
in %	0	0
in local currency	0	0
- Port Handling and Inland Shipment @ 10% of cif value (local currency)	348	834
Landed Cost of Equipment	3823	9175
(ii) Indigenous	0	0
(iii) Machinery stores & spares @ 5% of cif value	174	417
2. Expenses on training of local technicians.***		
Wage Rate (per manday)	12	12
No. of mandays	6	9
Total Training Cost	72	108
3. Provision for contingencies (@ 10% Of above)	407	970
Total Cost	4476	10670
FINANCED BY		
1. Equity	1026	2433
2. Secured medium-term loans	2685	6402
3. Other sources (Subsidy on equipment @ 20% of landed cost)	765	1835
Total	4476	10670

* Venture type A .i.e collection using plastic bags has not been shown above, as it does not involve any investment

** EXCHANGE RATE : 1 US$ = 3.31 LE

*** Expenses on foreign technicians taken at national level

****For recycling venture, cost of equipment includes one equipment for recycling and one for recovering CFC

2. ECONOMIC VIABILITY ANALYSIS FOR COLLECTION USING PLASTIC BAGS
(VENTURE TYPE A)

(in LE)

	1993	1995	1996	1997	1999	2005	2007	2010
Max. collection of CFC 12 using plastic bags (@ 90%)	164.79	179.64	183.60	181.26	175.50	144.54	128.07	93.33
Practical qty. recoverable through plastic bags								
- Percentage	10	50	50	50	50	50	50	50
- Quantity (MT)	16.48	89.82	91.80	90.63	87.75	72.27	64.04	46.67
Number of plastic bags required (@ 1.2 Kg per bag and 25% wastage)	17166	93563	95625	94406	91406	75281	66703	48609
Sale price of recovered CFC using bags								
- Per Kg	5	5	5	5	5	5	5	5
- Total sales	79099	431136	440640	435024	421200	346896	307368	223992
Operating costs for recovering CFC (Labour cost)								
- Per Kg	3	3	3	3	3	3	3	3
- Total cost	52733	287424	293760	290016	280800	231264	204912	149328
Contibution (per Kg)	2	2	2	2	2	2	2	2
Total operating profit	26366	143712	146880	145008	140400	115632	102456	74664

3. ECONOMIC VIABILITY ANALYSIS FOR RECOVERY USING PORTABLE EQUIPMENT
(VENTURE TYPE B)

(IN LE)

DESCRIPTION	1993	1995	1996	1997	1999	2005	2007	2010
Quantity of CFC 12 recovered (Kg per annum)	300	300	339	356	376	240	183	104
A. Material Costs								
1. Raw Material (Recovered CFC) @ 0 LE per kg	0	0	0	0	0	0	0	0
2. Spares and Consumables @ 0.31 US$ per Kg	308	308	348	365	386	246	188	107
Total material cost (A)	308	308	348	365	386	246	188	107
B. Power (@ 0.07 LE per KWH & 0.05 KWH per Kg)	1	1	1	1	1	1	1	0
C. Labour								
Wages								
Manhours/Kg	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Wage Rate (per manhour)	2	2	2	2	2	2	2	2
Total Wages	113	113	127	134	141	90	69	39
Supervision salaries								
Manhours/Kg	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Rate (per manhour)	3	3	3	3	3	3	3	3
Total salaries	23	23	25	27	28	18	14	8
Total labour (C)	135	135	153	160	169	108	82	47
D. Overheads								
Repairs & maintenance (@ 5% of equipment cost)	191	191	191	191	191	191	191	191
Administrative & selling expenses	200	200	200	200	200	200	200	200
Contingencies at 5%	42	42	45	46	47	37	33	27
Total overheads (D)	433	433	436	437	439	428	424	418
E. Estimate of cost of operation (A+B+C+D)	877	877	937	964	996	784	695	572
F. EXPECTED SALES (@ 8 LE /kg)	2400	2400	2712	2850	3012	1920	1466	832
G. GROSS PROFIT BEFORE INTEREST & DEP. (F-E)	1523	1523	1775	1886	2016	1136	770	260
H. TOTAL FINANCIAL EXPENSES **	483	363	302	242	121	0	0	0
I. DEPRECIATION & AMORTISATION (@ 10% St. line)	448	448	448	448	448	0	0	0
J. OPERATING PROFIT (G-H-I)	592	713	1025	1196	1448	1136	770	260
K. TAX (40%)	237	285	410	478	579	455	308	104
L. NET OPERATING PROFIT (J-K)	355	428	615	718	869	682	462	156
Add: Depreciation	448	448	448	448	448	0	0	0
Minus: Loan repayment	0	336	336	336	336	0	0	0
NET CASH ACCRUALS	803	540	727	830	981	682	462	156

** SCHEDULE FOR INTEREST AND REPAYMENT OF TERM LOANS - 18% rate of interest and 8 years repayment period after moratorium of one year

4. SENSITIVITY OF BREAK EVEN VOLUME TO SALE PRICE RECOVERED CFC
(Venture type B)

(in LE)

	Scenario 1	Scenario 2	Scenario 3
1. Sale Price of recovered CFC	4.80	8.00	11.20
(as % of selling price of vergin gas)	(30%)	(50%)	(70%)
2. Variable Costs			
- Raw material costs	0.00	0.00	0.00
- Consumables cost	1.03	1.03	1.03
- Utilities cost	0.00	0.00	0.00
- Labour cost	0.45	0.45	0.45
Total variable costs	1.48	1.48	1.48
Contribution	3.32	6.52	9.72
3. Fixed Costs			
- Repairs & Maintenance(Including overheads)	233	233	233
- Selling & Administration expenses	200	200	200
- Financial expenses	483	483	483
- Depreciation	448	448	448
Total Fixed Costs	1364	1364	1364
4. Break-even Analysis			
- Breakeven quantity in Kg	411	209	140
- Breakeven level of sales	1972	1673	1571
- Breakeven level as % of sales	137	70	47

NOTE : Scenario 2 has been adopted for economic viability analysis of the venture

5. IMPORTANT PROJECT PARAMETERS
(Venture type B)

		YEAR							
		1993	1994	1995	1996	1997	1998	1999	2002
Total Capital Employed	4476	0	0	0	0	0	0	0	0
Total Equity Employed	1026								
Net Cash Inflows (On Equity) @	-1026	803	504	540	727	830	918	981	1195
Internal Rate of Return (On Equity)	67.8%								
Pay Back Period (On Equity)	About one and half years								
Net Cash Inflows (On Capital Cost) #	-4476	1093	1093	1093	1244	1310	1362	1389	1195
Internal Rate of Return (On Capital Cost)	23.5%								
Pay Back Period (On Capital Cost)	About four years								

@ Cash inflows (On Equity) = Net profit + Depreciation - Loan repayment
# Cash inflows (On Capital Cost) = Net profit + Depreciation + Interest * (1-Tax Rate)

6. ECONOMIC VIABILITY ANALYSIS FOR RECYCLING WITH ADDITIONAL RECOVERY UNIT
(VENTURE TYPE C)

(In LE)

	1993	1995	1996	1997	1999	2005	2007	2010
Quantity of CFC 12 recycled (KG per annum)	2623	9985	10475	10521	10450	8023	6863	4755
- Quantity externally recovered (Kg)	1250	2500	2825	2968	3138	2000	1527	867
- Quantity internally processed (kg)	1373	7485	7650	7553	7313	6023	5336	3889
A. Material Cost								
1. Raw Material (Recovered CFC 12)								
a) Externally from recovery units @ 8 LE per Kg	10000	20000	22600	23747	25100	16000	12213	6933
b) Internally processed @ 9.11 LE per Kg **	12517	68223	69727	68838	66651	54893	48638	35444
Total Raw Material Cost	22517	88223	92327	92585	91751	70893	60851	42378
2. Spares and Consumables @ US$ 0.41/Kg	3560	13551	14215	14278	14182	10887	9314	6454
Total material cost (A)	26077	101773	106542	106863	105932	81780	70165	48831
B. Power (@ 0.07 LE per KWH & 0.05 KWH per Kg)	9	35	37	37	37	28	24	17
C. Labour								
Wages								
Manhours/Kg	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Wage Rate (per manhour)	2	2	2	2	2	2	2	2
Total Wage	984	3744	3928	3945	3919	3008	2574	1783
Supervision salaries								
Manhours/Kg	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Rate (per manhour)	3	3	3	3	3	3	3	3
Total salaries	787	2996	3143	3156	3135	2407	2059	1427
Total labour (C)	1771	6740	7071	7102	7054	5415	4632	3210
D. Overheads								
Repairs & maintenance (@ 5% of eqipment cost)	459	459	459	459	459	459	459	459
Administrative & selling expenses	3500	3500	3500	3500	3500	3500	3500	3500
Transportation & Storage (@ 10% of sales)	4197	15976	16760	16833	16720	12836	10981	7609
Contingencies @ 5%	1801	6424	6718	6740	6685	5201	4488	3181
Total overheads	9957	26359	27437	27532	27364	21996	19427	14749
E. Estimate of cost of operation (A+B+C+D)	37813	134907	141087	141533	140386	109219	94249	66807
F. EXPECTED SALES (@ 16 LE/kg)	41972	159760	167600	168333	167200	128360	109807	76087
G. GROSS PROFIT BEFORE INTEREST & DEP. (F-E)	4159	24853	26513	26801	26814	19141	15558	9280
H. TOTAL FINANCIAL EXPENSES **	1152	864	720	576	288	0	0	0
I. DEPRECIATION & AMORTISATION (@ 10% St. line)	1067	1067	1067	1067	1067	1067	1067	1067
J. OPERATING PROFIT (G-H-I)	1939	22921	24726	25157	25458	18074	14491	8213
K. TAX (40%)	776	9169	9890	10063	10183	7230	5796	3285
L. NET OPERATING PROFIT (J-K)	1164	13753	14836	15094	15275	10844	8695	4928
Add: Depreciation	1067	1067	1067	1067	1067	1067	1067	1067
Minus: Loan repayment	0	800	800	800	800	0	0	0
NET CASH ACCRUALS	2231	14020	15102	15361	15542	11911	9762	5995

** SCHEDULE FOR INTEREST AND REPAYMENT OF TERM LOANS - 18% rate of interest and 5 years repayment period

7. COMPUTATION OF COST OF INTERNALLY PROCESSED CFC FOR RECYCLING VENTURE
(FOR CFC RECOVERED THROUGH PLASTIC BAGS)
(Refer item A.1(b))

	(in LE)
A. Material Costs	
1. Raw Material (Recovered CFC gas) @ 4.8 LE per kg	4.80
2. Spares and Consumables @ 0.31 US$ per Kg	1.03
Total material cost (A)	5.83
B. Utilities	
- Power (@ 0.07 LE per KWH & 0.05 KWH per Kg)	0.00
C. Labour	
Wages	
Manhours/Kg	1.50
Wage Rate (per manhour)	1.50
Total Wage	2.25
Supervision salaries	
Manhours/Kg	0.025
Rate (per manhour)	3.00
Total salaries	0.08
Total labour (C)	2.33
D. Transportation cost (@ 20% Of raw material cost)	0.96
Total per Kg cost of liquified gas (A+B+C+D)	9.11

8. SENSITIVITY OF BREAK EVEN VOLUME TO COST RAW MATERIALS
(Venture type C)

(In LE)

	Scenario 1	Scenario 2	Scenario 3
1. Sale Price of CFC	16.00	16.00	16.00
2. Variable Costs			
- Raw material costs	4.80	8.00	11.20
-(as % of selling price of recycled cfc)	(30%)	(50%)	(70%)
- Consumables cost	1.36	1.36	1.36
- Utilities cost	0.00	0.00	0.00
- Labour cost	0.68	0.68	0.68
- Transportation and Storage	1.60	0.42	0.40
Total variable costs	8.44	10.46	13.63
Contribution	7.56	5.54	2.37
3. Fixed Costs			
- Repairs & Maintenance(Including overheads)	2259	2259	2259
- Selling & Administration expenses	3500	3500	3500
- Financial expenses	1152	1152	1152
- Depreciation	1067	1067	1067
Total Fixed Costs	7979	7979	7979
4. Breakeven Analysis			
- Breakeven quantity in Kg	1055	1439	3373
- Breakeven level of sales	16877	23027	53969
- Breakeven level as % of sales	40	55	129

NOTE :Scenario 2 has been adopted foreconomic viability analysis of the ventures

9.IMPORTANT PROJECT PARAMETERS
(Venture type C)

(In LE)

		YEAR							
		1993	1994	1995	1996	1997	1998	1999	2002
Total Capital Employed	10670	0	0	0	0	0	0	0	0
Total Equity Employed	2433								
Net Cash Inflows (On Equity) @	-2433	2231	7554	14020	15102	15361	15531	15542	14797
Internal Rate of Return (On Equity)	197.2%								
Pay Back Period (On Equity)	About one year and two months								
Net Cash Inflows (On Capital Cost) #	-10670	2922	8959	15339	16335	16507	16590	16515	14797
Internal Rate of Return (On Capital Cost)	78.9%								
Pay Back Period (On Capital Cost)	About two years								

@ Cash inflows (On Equity) = Net profit + Depreciation - Loan repayment
# Cash inflows (On Capital Cost) = Net profit + Depreciation + Interest * (1-Tax Rate)

NET NATIONAL ECONOMIC BENEFIT

The Net National Economic benefit has been worked out using the principles of social cost benefit analysis, to the extent quantification of various variables has been possible. Th analysis is confined to activities directly associated with the Recovery and Recycling programme.

GENERAL POINTS REGARDING COMPUTATION OF BENEFITS AND COSTS

All items have been measured at constant prices that is those prevailing in the year 1991/92. These items have been initially measured in terms of the local currency and then converted into dollar terms at the exchange rate prevailing at present, i.e. in the year 1991/92. Future benefits and costs have also been measured at the 1991/92 prices and converted at the exchange rate prevailing in this year, since it is extremely difficult to predict accurately, both inflation in the future and future exchange rates.

BENEFITS

Savings in Imports of Refrigerants :

This item is quantified as the quantum of foreign exchange saved through the recycling of CFCs and thereby avoiding the imports of these gases.

Increase in Employment :

Even though most developing ecomomies are faced with under employment or unemployment and though most governments value the creation of employment opportunities, it is difficult to quantity in monetary terms the value of employment generation. Moreover, even though employment generation can be an important objective of government policy, the more basic objective is increasing the welfare of people in the society. A measure of the increase in welfare is obtained by estimating the increase in consumption that comes about through increase in personal disposable incomes generated by employment. It is often the case that one will not be able to observe the exact increase in consumption that will come about through increased personal disposable incomes. In such a case it is necessary to obtain some parameter which will enable to estimate the increase in consumption that comes about. Thus estimating the following regression equation will be useful :

$$PFCE = A' + B'*PDI$$

where,

PFCE = private final consumption expenditures measured at constant prices

PDI = personal disposable income measured at constant prices

A', B' are the parameters to be estimated.

B' is the marginal propensity to consume and is the parameter of importance. This parameter tells us the amount of additional consumption that will take place for every unit increase in personal disposable income. For the present study A' and B' have been estimated through the regression equation

$$PFCE = A + B * GDP$$

This was done as the UN National Accounts Statistics for the project countries did not provide PDI for sufficient number of years to carry out a regression. Estimating A and B using GDP in the equation was taken as best alternative though this would yield a value of B slightly understated than if PDI were used. The values of B for 3 countries are given in the input tables in Appendix - 3.5 (A), (B) and (C). From the venture level analysis the exact increase in incomes (net of taxes) accruing to the employees can be used with the estimated B to compute the increase in consumption that will occur. The B computed at a national level from the national accounts statistics has been employed to compute the consumption of the owners and employees of the ventures.

In this case however an additional consideration will play a role.

From the point of view of the government, increasing the consumption of the relatively disadvantaged sections of the population has a high social value as compared to increasing the consumption of the relatively better off. Thus the factor by which income levels of the owners exceeds that of the employees is used to adjust the consumption figures of the owners. The consumption of the owners have been given a weight which is the reciprocal of the factor by which the incomes differ.

The other aspect of increased incomes due to the setting up of recovery and recycle ventures, apart from the increase in consumption, is the increase in savings that come about. These savings constitute investible funds.

The relation between savings and investment is set as follows :

$$INV = GS + CI$$

where,

INV = gross domestic capital formation at constant prices
GS = gross savings at constant prices
CI = capital inflows from abroad

Thus there are only two sources of investible funds : domestic and foreign. In the above relation ship both GS and CI appear with weight equal to unity i.e a unit increase in savings will increase investment by the same amount and similarly for capital inflows. In this cost benefit analysis, the focus is only on domestic savings. Since the above equation has to hold, whatever the conditions prevailing in the economy, the savings in the aggregation of benefits has been incorporated with a weight equal to unity.

Government Expenditures related benefits :

Increase in Government expenditures such as publicity, training & administrative expenses generate incomes via the mutliplier, so that

$$d Y = K \; dGE$$

where dY = change in incomes
dGE = change in Government Expenditure
K = Multiplier

K is estimated as the reciprocal of the marginal propensity to save (MPS). MPS to be on the conservative side, the multiplies computed for each country has been halved to take into account leakages prevailing in a economy. MPS was computed as the difference of I-B* (computed earlier) since B* represents the marginal propensity to consume (MPC), and by the standard rule of economics MPS + MPC = 1.

The incomes so generated are divided by the income-recepient into consumption and savings on the basis of their MPC and MPS respectively. These then constitute the consumption and savings benefits of Government expenditure.

Increase in Government Revenues :

The establishment of recovery and recycling programmes

could constribute to increased Government revenues by way of the following :

- Increase in collections of corporate tax which will be payable by the ventures.

- Revenue from duties on imports of Capital equipment and consumables as well as increased duties on CFCs. Both of the above represent inflows to the Government which can be used for welfare activities. In our working we have recommended waiver of duty on all equipment and spares for recovery and recycling. To that extent these will not appear in the computation of benefits.

Salvage value of the equipment :

This item is considered for each type of venture over the time horizon of the project.

COSTS

Outflows on Account of Imports :

This item is quantified on the basis of costs of equipment and consumables.

Increase in Training Costs and Publicity :

This includes training costs at a venture level plus training costs and publicity at national level for each country.

Increase in Wage Costs :

From a social cost benefit analysis point of view, wage cost is understood as the opportunity cost of employing an input (e.g. labour) in a particular project rather than in the next best alternative project. The 'cost' is the amount of output sacrificed in the other alternative by employing the unit of input in the project of interest. This estimation of costs is crucially dependent on the extent of unemployment in the economy. If there is no involuntary unemployment in the economy then employment of the input in the project of interest necessarily takes place at the cost of lost production elsewhere. Under the assumption of perfectly competitive markets the per unit cost to the society of employing the input is the market wage rate that is earned. If markets are not perfectly competitive or, more importantly, if there is unemployment then the market wage rate does not correctly indicate the cost per unit of the input. A shadow wage rate (SWR) for labour will have to be estimated. If a previously unemployed person is given a job in the project then, since there is no loss of production in any other line of

activity,the opportunity cost to society of employing this unit of labour is zero, i.e. its SUR is zero. Generally, however,the SUR is not set equal to zero and a postive value is attached to it. In the case of the recovery and recycle units, it is anticipated that an existing employee will take on additional work that will be involved at the venture level.The assumption here is that this employee is underemployed at the current job, i.e. if the duty of the employee is set at 8 hours,he may be productively employed for only 6 hrs. In this case,therefore, by working productively for an additional two hours, no loss of production occurs in any other line of activity. Hence from the point of view of society there is no opportunity cost inolved here and the shadow wage rate should be zero.However,so as not to underestimate the social cost,a weight of 0.2 on the wage bill of the ventures has been considered reasonable.

Increase in Cost of Operating Costs (Utilities) Overheads, Maintenance etc. :

This item is computed by aggregating the venture level costs.

Decrease in Government Duties and Taxes :

The reduction in the imports of CFCs, while it results in savings of foreign exchange, at the same time reduces the import duties that will be collected by the government. Thus government welfare activites will be curtailed to the extent that revenues fall off. Thus in summary the following benefits and costs have been considered in computing the Net National Economic Benefit.

BENEFITS

- Savings in imports of refrigerants
- Employement related benefits in terms of increased consumption and savings
- Government expenditure related benefits in increased consumption and savings.
- Increase in Government in revenues

COSTS

- Outflows on acccount of equipment & consumables imports
- Training costs and publicity at venture and Government level
- Increase in wage costs
- Increased operating costs
- Duties and taxes foregone by the government on imports of CFC saved.
- Subsidies on equipments

The above benefits and costs have been estimated annually till the year 2010 and discounted to present value.

APPENDIX 5.5

NET NATIONAL ECONOMIC BENEFIT ANALYSIS

(For Egypt)

(IN LE)

	1993	1995	1996	1997	1999	2005	2007	2010
TOTAL NUMBER OF VENTURES								
- Recovery only	50	100	100	100	100	100	100	100
- Recycling only	12	12	12	12	12	12	12	12
A. BENEFITS								
1. Savings in import of CFC refrigerants								
- Quantity (in MT ; equal to recycled quantity)	31	120	126	126	125	96	82	57
- CIF price (in LE per MT)	7282	7282	7282	7282	7282	7282	7282	7282
- Value saved (in LE ; quantity * CIF price)	229230	872529	915347	919353	913163	701038	599709	415547
2. Employment related benefits								
- Increase in consumption	123519	584158	602610	598634	585053	469781	411181	294566
- Increase in saving	37944	179447	185115	183894	179722	144312	126310	90488
- Total increase	161462	763605	787725	782528	764775	614093	537491	385054
3. Government expenditure related benefits								
- Increase in consumption	864961	143444	129301	129301	129301	129301	129301	129301
- Increase in saving	265707	44064	39720	39720	39720	39720	39720	39720
- Total increase	1130668	187508	169021	169021	169021	169021	169021	169021
4. Increase in government revenues								
- Increase in duties on equipments	0	0	0	0	0	0	0	0
- Increase in corporate taxes								
- Series 1 Ventures *	21155	124285	139183	144681	151160	109484	84962	44617
- Series 2 Ventures	0	6527	7131	10249	13430	13221	9508	4093
- Series 3 Ventures	0	5923	6527	7131	11962	15129	11364	5846
- TOTAL INCREASE IN TAXES	21155	136735	152841	162061	176553	137834	105834	54556
TOTAL BENEFITS (A)	1542515	1960377	2024935	2032963	2023512	1621986	1412055	1024178

	1993	1995	1996	1997	1999	2005	2007	2010
B. COSTS								
1. Additional outflows on account of imports (net of duties and taxes)								
- Capital equipment	273869	86888	0	0	0	0	0	0
- Consumables & spares	58112	193391	205372	207884	208813	155274	130562	88114
- Plastic bags (@ 1.2Kg per bag; US$ 6.25 per bag; 25% wastage)	468750	2554958	2611280	2577999	2496076	2055743	1821496	1327401
2. Capital investment (excluding (1) above)	64268	20661	0	0	0	0	0	0
3. Government expenditures								
a. Training cost incurred in foreign currency	99300	0	0	0	0	0	0	0
b. Training cost incurred in local currency	27387							
c. Publicity expenses	358387	8669	0	0	0	0	0	0
d. Administrative Expenses	145640	79440	79440	79440	79440	79440	79440	79440
e. Subsidy on equipments	52166	16550	0	0	0	0	0	0
4. Increase in wage costs (total wages and salaries weighted by 0.2)	4743	22431	23139	22987	22465	18039	15789	11311
5. Increase in operating costs (excluding raw material,consumables and labour)								
- Series 1 Ventures *	121729	318866	331977	333181	331241	266193	235105	178565
- Series 2 Ventures	0	1070	1070	1146	1205	1010	898	735
- Series 3 Ventures	0	1070	1070	1070	1179	1067	954	788
- TOTAL OPERATING COST	121729	321007	334117	335396	333625	268269	236957	180088
6. Decrease in government duties on import of CFCs								
- Rate of duty (%)	50	50	50	50	50	50	50	50
- Quantity of CFC import reduced (in MT)	31	120	126	126	125	96	82	57
- Value of reduced duties	114615	436265	457674	459676	456581	350519	299855	207774
TOTAL COSTS (B)	1788966	3740278	3711022	3683382	3597001	2927284	2584098	1894128
NET NATIONAL ECONOMIC BENEFIT								
- ANNUAL	-246451	-1779901	-1686087	-1650419	-1573489	-1305299	-1172043	-869949
- PRESENT VALUE (@ 2.0% discounting) LE	-19692496							
US $	-5949395							

* Series 1 Ventures - Those starting in 1993
Series 2 Ventures - Those starting in 1994
Series 3 Ventures - Those starting in 1995

APPENDIX - 5.6

EXPLANATORY NOTE FOR NATIONAL ECONOMIC ANALYSIS

BENEFITS :

1. Employment related benefits (Item 2) : Refer Appendix - 5.4

2. Government expenditure related benefits (Item 3) : Refer Appendix - 5.4
The Govt. expenditure which will result in benefits are the items 3 (b), (c) and (d) under costs.

COSTS

3. Additional outflows on account of imports

   - Capital equipment: CIF value of equipment including spares

4. Capital Investment (Item 2) : Local currency part of the project cost, including port & handling charges, training & contingency provision.

5. Govt. expenditures :

   a) Training cost in foreign currency : One time expense on foreign experts @ 30 man-days and US $ 1000 per manday

   b) Training cost in local currency : @ 10% of value of equipment

   c) Publicity expenses : One time expense of US $ 100,000 in the first year
   Recurring annual expense @ 10% of value of equipment

   d) Administrative expense : One time expense of US$ 20,000 in first year for infrastructure creation
   Recurring annual expense of US$ 24,000 for staff and other regular expenses

   e) Subsidy on : @ 20% of landed value of equipment

6. Increase in wage costs : Refer Appendix - 5.4

7. Increase in operating costs : Operating costs of the various types of ventures as per working sheets in Appendix - 5.3

8. Decrease in Govt. duties on import of CFCs	: Due to decrease in import of CFC resulting from recovery & recycling programme
NET NATIONAL ECONOMIC BENEFITS	: Discounting rate for computation of Net Present Value (NPV) of net benefit is taken @ 2% based on reference provided in Background Analysis (UNIDO Project No. US/RAF/90/173, Page 37).

APPENDIX 6.1

ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING SUBSTANCES) NO. 1W.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 6.2

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

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 6.3

ILLUSTRATIVE PROVISIONS OF THE INDUSTRIAL WASTE MANAGEMENT POLICY (CONTROL OF OZONE DEPLETING SUBSTANCES) NO. 1W.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 6.4

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.

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 personnel 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 6.5

PROVISIONS IN SWISS ORDINANCE ON ENVIRONMENTALLY HAZARDOUS SUBSTANCES

DISPOSAL OF EQUIPMENT CONTAINING CFCs

1. The regulation interalia 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 Environmentaly Hazardous Substances (Ordinance on Substances; Rs 814.013).