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Executive Committee of the
Interim Multilateral Fund for the
Implementation of the Montreal Protocol

Eighth Meeting
Montreal, 19-21 October 1992

EGYPT COUNTRY PROGRAMME

This document consists of:

a) Evaluation Sheet (prepared by the Fund Secretariat);

b) Transmittal Letter from the Government of Egypt;

c) The Country Programme.

EGYPT COUNTRY PROGRAMME EVALUATION SHEET

The Egypt Country Programme is submitted to the Eighth Meeting of the Executive Committee as document UNEP/OzL.Pro/ExCom/8/14. The document was revised in accordance with "Guidelines of Country Programme Preparation (UNEP/OzL.Pro/ExCom/5/5/Rev.2).

It consists of:

- Letter of transmittal from the Government of Egypt;
- Country Programme Cover Sheet;
- Executive Summary;
- Introduction;
- ODS use and alternatives (including forecast demand for ODS by sector);
- Institutional framework;
- Policy framework;
- Response to the Montreal Protocol;
- ODS phase-out planning (including cost of substitution (incremental costs to Egypt) and alternative strategies);
- Recommended strategy by the Government;
- Action plan for the implementation of the phase-out (including recommended Government actions, and investment).

The Country Programme also contains ODS phase-out project summary (Annex A) and ODS phase-out alternatives (Annex B).

Egypt does not produce controlled substances. In 1990, Egypt consumed 2,170 tonnes of ODPs, distributed as follows:

- 29 per cent for the manufacture and servicing of domestic refrigerators and large air conditioning systems;
- 29 per cent in the foam industry (cushions, furniture and packaging materials);
- 35 per cent for fire extinguishants (halons);
- 4 per cent in the aerosol sector;
- 3 per cent in the solvent sector.

The following two scenarios for ODS phase-out were developed in order to identify the "optimum" strategy for Egypt:

1. Allowable, in which the transition to ODS substitutes is not undertaken until 2000 but is completed by 2010 as required by the Montreal Protocol; and

2. Accelerated, in which the transition to ODS substitutes (currently underway) is accomplished at a rate consistent with the availability of technology and is fully

accomplished between 1992 and 1998.

The net incremental economic cost to Egypt for the phase-out of ODSs range from $27 million to $129 million, depending on the country's economic growth rate through 2010 and the speed at which the phase-out is implemented. The following depicts the incremental costs commensurate with the phase-out scenario to be followed:

Description of Costs	Incremental Cost (million $) in Scenario		
	Allowable	Accelerated	Optimum
Capital	1.2	2.6	2.6
Operating, administrative	3-10	17-27	19.5
Early replacements (refrig.)	88-117	5.2-5.8	5.3
Total	92-129	24-35	27

The following conclusions arose while developing the proposed scenarios for phasing-out ODSs in Egypt:

- The most significant net incremental costs to Egypt are those associated with the early replacement of domestic refrigerators when virgin CFC-12 is no longer available for recharge (there will be about 10 million refrigerators in service in 2010);

- A significant proportion of the incremental operating and administrative costs relates to the incremental production costs for domestic refrigerators based on HFC-134a;

- The incorporation of a recycling/recovery programme reduces consumption of ODSs.

The Action Plan proposed for Egypt is based on the "optimum" phase-out scenario. The principal agents are the Government of Egypt, which is responsible for establishing a "National Ozone Policy", UNDP, and the World Bank which will be the implementing agencies for investment projects. The Egyptian Environmental Affairs Agency (EEAA) in liaison with the Federation of Egyptian Industries, will be responsible for the co-ordination of ODS phase-out.

The "National Ozone Policy" is aimed, among others, to:

- create the "Ozone Panel", within the Federation of Egyptian Industries, to develop co-ordinated government-industry policies;

- monitor ODS phase-out progress and expedite implementation of specific projects;

- establish a licensing system for ODS users and ODS import monitoring procedures; and

- enforce a ministerial decree to ban the use of CFCs in the aerosol sector and consider other bans on selected end-users.

The Country Programme identified the following investment projects as priority projects:

- Conversion of CFC-12 refrigerator compressors manufacturing plant to one capable of producing HFC-134a compressors (Misr Compressor Manufacturing Co.), with an incremental cost of $2,800,000;

- Replacement of CFC-12 with HCFC-22 in water coolers (Koldair), with an incremental capital cost of $272,000 and incremental operational cost of $141,000 year;

- High-pressure foaming equipment for non-CFC rigid and semi-rigid foam manufacture at:
  - Taki Vita, with an incremental capital cost of $490,000 and incremental operational cost of $90,000 year;
  - Technopol, with an incremental capital cost of $645,000 and incremental operational cost of $45,000 year;

- Improved ventilation to permit safe use of methylene chloride for flexible foam manufacture (Misr Foam Co.), with an incremental capital cost of $415,000 and incremental operational cost of $22,000 year;

- Conversion of polystyrene/polyethylene sheet manufacture to hydrocarbons (Al Sharif Plastic Factories), with an incremental capital cost of $1,715,000 and incremental operational cost of $15,000 year;

- Pilot plant for domestic refrigerators (IDEAL), with an incremental capital cost of $3,134,000 and incremental operational cost of $334,000 year.

The World Bank is designated as the lead implementing agency for the first project, and UNDP as the lead implementing agency for the others. It is expected that about 620 tonnes of ODS representing 30 per cent of Egypt's consumption, would be eliminated once these projects are fully implemented.

RECOMMENDATION

The Fund Secretariat is satisfied with the content and format of this document, and recommends it for approval by the Executive Committee at this meeting, taken the following into consideration:

1. Approval of the Country Programme does not imply approval of funding of all activities and projects listed therein.

2. Several investment projects identified in the Country Programme were submitted for consideration of the Executive Committee at its Sixth Meeting (UNEP/OzL.Pro/ExCom/6/9, 6/9/Corr.1 and 6/9/Corr.2), and its Seventh Meeting (as Annex 2 to the UNDP Progress Report UNEP/OzL.Pro/ExCom/7/5). The Executive Committee authorized the disbursement of $1.5 million to allow Egypt to continue work on the preparation and appraisal of three projects proposed (Taki Vita, Al Sharif, and recycling in the refrigeration sector).

3. Committee's action on "Conversion of Refrigeration Compressors to HCF-134a by MCMC" was deferred pending the outcome of further negotiations between the Government of Egypt and the World Bank. The Fund Secretariat was duly informed that all outstanding issues had been resolved and that the World Bank agreed to implement this project.

MINISTER OF CABINET AFFAIRS

MINISTER OF STATE FOR ADMINISTRATIVE DEVELOPMENT

Dr. Omar El-Arini.
Chief Officer.
Interim Multilateral Fund.
1800 McGill College Avenue
27th Floor
Montreal (Quebec)
Canada H3A 3J6

September 5th, 1992.

Dear Dr. El-Arini,

As a signatory of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer and in view of its commitment to these Conventions, the Arab Republic of Egypt has undertaken the preparation of a comprehensive strategy to phaseout the use of the regulated substances. The initial strategy statement is expressed in the Country Programme for the Phaseout of Ozone-Depleting Substances (ODS) which has recently been finalized and which is being presented to the Multilateral Fund for consideration at its Executive Committee meeting planned for October 1992. The Country Programme outlines the strategy which is being adopted by Egypt and identifies key interventions which are required to minimize the economic and social welfare impacts of eliminating the use of those substances.

In addition to the Country Programme, we are pleased to present to the Multilateral Fund a number of ODS phaseout projects most of which have been prepared with the assistance of the United Nations Development Programme. These projects form the first block of projects to be presented for funding by the Multilateral Fund. Additional projects, which are presently at the concept stage, are being researched and will be prepared for presentation at a later time.

Accept, Dr. El-Arini , the assurances of my highest consideration.

with my best wishes

Yours Sincerely,

Dr. Atef Ebeid.
Minister of Cabinet Affairs, and
Minister of State for Administrative
Development.

EGYPT

COUNTRY PROGRAM
FOR
PHASEOUT OZONE DEPLETING SUBSTANCES

البرنامج القطري المصري
لإستبدال المواد المستنفذة لطبقة الأوزون

THE ARAB REPUBLIC OF EGYPT

جمهورية مصر العربية

SEPTEMBER 1992

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EXECUTIVE SUMMARY

BACKGROUND

1. The Montreal Protocol (MP) is an agreement ratified by over 70 countries worldwide to reduce the emissions of ozone depleting substances (ODSs) through regulation of consumption. Under the Protocol, the participating developed countries have established the Interim Multilateral Fund (IMFMP) to help developing countries with the cost of meeting the Protocol agreements. At the invitation of the Government of Egypt, the World Bank assisted with the preparation of a Country Program[1], a requisite activity for assistance from the IMFMP.

2. Egypt ratified the Montreal Protocol on 2 August 1988, and qualifies under paragraph 1 Article 5 of the Protocol for a ten-year delay in the phaseout of ODSs and for assistance from the IMFMP in accomplishing the phaseout.

3. Since becoming one of the first countries to ratify the Protocol in May 1988, Egypt has demonstrated an active and on-going commitment to phasing out ODS use. Egypt began to reduce ODS consumption in 1986. To date, a reduction of more than 60 percent in demand for ODSs has been achieved primarily through a government ban of the use of chlorofluorocarbons (CFCs) in aerosols.

ODS Use in Egypt

4. Egypt does not produce ODSs, but there are numerous users of ODSs. In 1990, the total consumption was 1,830 tons, or 0.033 kg per capita. The bulk of demand is concentrated in the industries that manufacture and service domestic refrigerators (approximately 7 million units currently are in use) and large air conditioning systems and in the foam industry which produces cushioning, furniture, and packaging materials. These industries contribute to a higher standard of living and, in recent years, have experienced growth exceeding that of the population. Some fire extinguishants and solvents are also ODSs; unfortunately, available data is limited. It is nevertheless estimated that consumption is low.

5. In Egypt, both private and public sector industries use ODSs. Private sector companies are gaining an increasingly larger share of production activities involving ODSs. These companies are eager to be successful in world markets and have significantly increased the supply and quality of products and the attention of export markets in recent years. Refrigerator manufacturers are a prime example of these companies. Many private sector companies already recognize the need to be in compliance with the Montreal Protocol agreements if they are to expand sales into international markets. Many of these companies are also eager to participate in an ODS phaseout program but have concerns about the cost of doing so while remaining economically competitive.

Methodology for Country Program

6. The methodology for the preparation of the Country Program for Egypt

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[1] This country program and report was prepared with the assistance of the World Bank during a preparation mission consisting of Sherif Arif (Task Manager), Kenneth King (Environmental Specialist), and Charles B. Catanach and Adrian Rowan (Consultants), and supported by Ann Van Aken at World Bank Headquarters in Washington. It was subsequently revised to incorporate the comments of the Government of Egypt following their review and to incorporate the UNDP project preparation activities conducted during 1992. The revisions were made by a World Bank mission in August-September 1992 consisting of Charles B.Catanach (Consultant) ably assisted by Eng. Salwa El Tayeb and Abd El Latief M. Hafez of the Egyptian Environmental Affairs Agency.

	Accelerated Phaseout (1992-1998) US$M	Optimum Phaseout (1994-1998) US$M	Allowable Phaseout (2000-2010) US$M
Net Incremental Capital Costs	2.6	2.6	1.2
Net Incremental Operational & Administrative Costs	17 - 27	19.5	3 - 10
Early Replacement Costs for Refrigerators	5.2 - 5.8	5.3	88 - 117
Total	24 - 35	27	92 - 129

ECONOMIC COST TO EGYPT OF PHASEOUT

11. The net incremental economic cost to Egypt for phaseout of ODSs ranged from $26M to $129M (in 1991 US dollars) depending on the speed of the phaseout and economic growth conditions through 2010.

12. The primary conclusion drawn for this analysis is that **a prompt and orderly ODS phaseout minimizes the economic cost to Egypt.** The determination of reimbursement of these economic costs is an issue for IMFMP Executive Committee to decide in accordance with the Montreal Protocol (Annex E).

13. In order of importance to the economic cost to Egypt, the following conclusions were also reached:

(1) The economic cost associated with the forced early replacement of domestic refrigerators is the dominant element in the analysis. This stems from the fact that there will be roughly 10 million refrigerators in service in Egypt in 2010, but replacement costs only apply to those continuing to use CFC-12. Obviously, an early transition to refrigeration by HFC-134a for domestic refrigerators will reduce the population of CFC-12 refrigerators in 2010, and hence reduce early replacement costs. Average age of the CFC-12 refrigerator population in 2010 was also a factor. In the accelerated cases, the average CFC-12 refrigerator was within 2-3 years of replacement while in the delayed case CFC-12 refrigerators had 8-10 years of remaining life.

(2) Operational costs ranged from $16M to $27M, and were primarily reflective of the net incremental costs for HFC-134a domestic refrigerators. The timing of the introduction of these refrigerators was a factor in the magnitude of operational costs.

(3) The incorporation of recycle/recovery into the accelerated phaseout cases had the effect of directly reducing ODS consumption and slightly reducing protocol limits. Its primary benefit was to assure local supplies of CFC-12 at a cost approximately $2/kg below import costs. This savings (up

to $0.7M/yr) reduced net operational costs. Additional savings (not included in the analysis) should be expected from applying recycle/recovery technology to the conservation of HFC-134a.

(4) Capital requirements and administrative costs were minimal in all cases analyzed. The timing of investments only had a small impact on economic cost (approximately $1M).

RECOMMENDED ODS PHASEOUT STRATEGY

14. The optimum strategy for the government of Egypt is to adopt a set of integrated policies and implement a series of projects in a comprehensive program that supports a phaseout of ODS consumption as soon as is technically feasible. This strategy will accomplish the complete phaseout of ODSs at the least economic cost to the country and provide the basis for an officially recognized National Ozone Policy to which industry and government leaders are committed for phasing out ODSs. Funding of the projects is to be financed in the context of the overall NOP.

Policies

15. The following set of integrated policies are proposed to form the National Ozone Policy (NOP) for Egypt:

- Create an "Ozone Panel" within the Federation of Egyptian Industries (FEI) to provide a consultative role in the formulation and promulgation of specific policies forming the NOP. The "Ozone Panel" will develop the voluntary agreements within industry to establish specific end-use bans consistent with the overall objectives of the ODS phaseout program and recommend adoption of Ministerial Decrees to support the voluntary agreements.

- Establish a licensing system for ODS users which encourages environmentally responsible handling practices and restricts distribution to users qualified through approved training programs.

- Establish ODS import monitoring policies and procedures which account for all ODSs as required under the Montreal Protocol and from which progress in reducing ODS consumption is tracked to guide appropriate adjustments in programs and policies.

- Monitor ODS phaseout progress and if not satisfactory, consider selective ODS price increases to levels at or below which ODS substitutes become financially attractive by applying an import tax on CFCs at a level which encourages competitiveness of the substitutes and facilitates development of recycle/recovery enterprises in Egypt.

Projects

16. Projects needed for a complete phaseout of ODS in Egypt have been identified

and are summarized in Annex A. A set of six projects with investment requirements totalling $6.3 million were prepared by the UNDP during 1992 and are to be presented to the Executive Committee of the IMFMP at their October 1992 meeting. The ongoing costs of $313,000 associated with these projects are to be considered for reembursement through the IMFMP according to the guidelines established by the IMFMP Executive Committee. The remaining 23 projects included in the summary need further study and preparation before they are presented for approval. Action will be taken on each item included in the Annex A summary and a timeline developed leading to full implementation.

ACTION PLAN

Objectives and Coordination

17. The objective of the Action Plan is to effectively, efficiently and fairly phase out the consumption of ozone-depleting substances in Egypt in compliance with the Montreal Protocol, as ratified by the Government of Egypt in accordance with the proposed optimum strategy.

18. The Action Plan comprises the investments, policies, implementation and monitoring actions needed to ensure compliance. All components must be synchronized to effect the purpose of the Action Plan, i.e., compliance with the terms of the Protocol.

19. This action plan is consistent with the principles for evaluating and financing incremental costs for the ODS phaseout as detailed in the "Indicative List of Categories of Incremental Costs" adopted by the Second Meeting of the Parties to the Montreal Protocol. These principles state that a proposed action destined to reduce ODS consumption should:

- be cost-effective and attuned to the national industrial strategy
- include a careful review of cost items and avoid double counting
- feature early adoption of ozone protecting technologies.

20. The action plan proposed for Egypt is based on the optimum phaseout strategy. In this strategy, action is initiated in 1992. The phaseout is completed by 2000, and all other ODSs are phased out by 2010.

Summary of proposed actions

21. The following table outlines the key steps and ingredients included in the Action Plan. Further discussion of this plan is included in Section 8 of this report.

ACTION PLAN SUMMARY
EGYPT

Item	1992-1993	1994-1995	1996-2010
"Ozone Panel"	Establish joint industry-gov't. panel within the FEI to encourage dialogue on key issues and to broker agreements on bans and other policies	. Continue functions as outlined.	Continue functions as outlined
Monitoring	Develop a monitoring system for ODS imports within the Customs Dept. which meets the following objectives: - complies with reporting requirements of the Montreal Protocol - tracks progress of ODS phase - supports excise collection	Monitor progress and issue proper reports to UNEP and others. Monitor effectiveness of excise.	. Continue monitoring to assure phaseout completion.
Licensing	Conduct workshops for refrigeration service personnel featuring recovery/recycle	Establish a licensing system for refrigerator service personnel	Extend licensing to all ODS users
Public and Industry Awareness	Direct media attention to demonstration projects on recycle/recovery of CFCs and to the necessity to conserve precious CFC supplies. Communicate features of National Ozone Policy to the public and to industry.	Continue to enhance awareness and outreach activities with workshops and seminars. Announce new policies well in advance of introduction.	Continue to develop support for phaseout activities

ACTION PLAN SUMMARY
EGYPT
(continued)

Item	1992-1993	1994-1995	1996-2010
Recycle/Recovery	. Develop and implement project to demonstrate recycle/recovery for domestic refrigerators, mobile air conditioners and large chillers to encourage public awareness and to secure basic data for replication of similar projects in Egypt. Make feasibility study of regional reclamation facility for CFCs.	. Evaluate initial results and expand application of recycle/recovery to about 15% of the service jobs on domestic refrigerators and to 60% for mobile air conditioners Est. cost - $500,000	. Continue to expand the application of recycle/recovery to cover entire market opportunity. Est. cost: $3,000,000
Excise on CFCs	FEI to consider pro and con of excise on CFCs with goal of discouraging continued use of CFCs where adequate substitutes are available.	Apply excise tax to CFCs if considered necessary to accelerate rate of CFC phaseout. Est. (CFC-11) 20-40 LE/kg (CFC-12) 30-50 LE/kg	. Sustain excise at feasible levels.
Bans	Enforce ministerial decree banning use of CFCs in aerosols. "Ozone Panel" to consider additional bans on select end-users and recommend new bans as needed, e.g. - carbon tetrachloride - CFC-113 solvents - etc.	Prepare to ban servicing of refrigeration devices without using proper recycle/recovery techniques Implementation based on FEI review of recycle/recovery program results	Prepare bans for all CFCs (to take effect in 2000)

OTHER FACTORS OF SIGNIFICANT IMPORTANCE TO THE PHASEOUT

22. The following factors will have a direct bearing on phaseout activities, timing and process:

- The future costs of alternate refrigerants, solvents, and fire extinguishants and their associated appliances is not known precisely, and the feasibility of some technologies remains to be confirmed. However, the cost of alternatives is expected to approach the cost of existing technologies at some point in the future. It is anticipated that the cost of the available ODSs, after an initial period of oversupply, will eventually rise sharply as supplies become greatly diminished with limited production. However, recycled CFC could become available for servicing refrigerators to offset the expected CFC shortages in the mid to late 1990s.

- If phaseout is slow in a fast developing economy, the stock of ODS-using plant equipment and product will continue to grow. The result of such buildup will ultimately increase the overall cost of ODS phaseout. Although Egypt is currently in a recession, growth of four to six percent is possible in key industries from 1994 onward.

- The makeup of the NOP will directly influence the cost of phaseout to participating industries. It should be recognized that the eligibility rules under the Fund also will create strategic incentives. To the extent that higher costs incurred by rapid phaseout are reimbursable under the Fund's incremental cost rules, higher costs need not be a burden to the developing country. The best approach for formulating the NOP appears to be a combination of elements representing various approaches in a pragmatic way.

- Whatever the speed of the ODS phaseout, there is the need to control costs and prevent inefficiency and waste. Timing of the transition to non-ODSs is therefore an extremely important element in the Action Plan.

- Recovery and recycle processes and procedures offer the least cost way, at present, to reduce ODS emissions and to simultaneously enhance public/industry awareness of the "ozone issue". The economic benefits of recovery/recycle are direct savings of the cost of ODSs which otherwise would have been imported. Financial incentives for recovery/recycle will be improved by an excise on imported CFCs .

Negative consumer reaction to a CFC phaseout could deter phaseout activities, particularly if CFCs are unavailable for repair of failed refrigerator units and premature replacement is forced. An active recycling program for CFCs is essential to protect the consumer by minimizing premature replacements until the majority of in-service refrigerators no longer require CFCs and installed units reach their normal life expectancy.

PROJECTS

Tranche 1 Program

23. The following set of projects is to be submitted as Tranche 1 together with the country program (see Annex A) for consideration of grant funding by the Interim Multilateral Fund under the Montreal Protocol:

Project	Company	Est. Cost	Objectives
Manufacture of HFC-134a Compressors	MCMC	$2,800,000	· Complete existing facility for manufacture of compressors with facilities for making HFC-134a units upon startup · Provide local source of alternative compressors to reduce transition costs for refrigerator companies.
Replacement of CFC-12 with HCFC-22 & HFC-134a	Koldair	$ 272,000 + $ 141,000/yr	· Eliminate existing demand for CFC-12 by Koldair Company.
Ventilation for Flexible Foam	MISR Foam	$ 415,000 + $ 22,000/yr	· Provide safe working environment so that methylene chloride can be used continuously as a replacement for CFC-11.
Hi-Pressure Mixing heads for Rigid Foams	TAKI-VITA	$ 490,000 + $ 90,000/yr	. Allow phaseout of 34 tons/yr CFC-11 used for rigid foam.
Hi-Pressure Mixing heads for Rigid Foams	Technopol	$ 645,000 + $ 45,000/yr	. Allow phaseout of 55 tons/yr CFC-11 used for rigid foam.
Safe use of Butane for Polystyrene Foam	Al Sherif	$1,715,000 + $ 15,000/yr	· Eliminate growing use of CFC-12 in PS sheet manufacture.

Other Projects

24. Tranche 2-4 projects are tabulated in Annex A. All are at various stages of development. Consideration will be given to developing umbrella projects to cover situations where the technology is similiar in different companies. (e.g. replacement of CFCs with LPG by the aerosol industry and conversion to non-ODS refrigerator designs by both private and public sector companies.).

1.0 INTRODUCTION

Egypt is one of the first countries to prepare a country program as a pre-requisite for assistance from the Interim Multilateral Fund of the Montreal Protocol. This report encompasses all items needed to qualify as a Country Program upon acceptance of the Action Plan by the Government of Egypt.

The Montreal Protocol

1.1 The situation that is commonly called "the Ozone Issue" has evolved over the past 60 years. The initial discovery of chlorofluorocarbons (CFCs) led to the development of applications capable of improving the quality of life for most people in the world. The rapid growth in the use of these compounds has been worldwide. In recent years, concern has increased about the accumulation of these compounds at the interface of the troposphere and stratosphere layers of the atmosphere known as the ozone layer.

1.2 Concerns were first raised in 1970 when a new, highly sensitive electron capture detector was invented for the gas chromatograph; measurable quantities of CFCs were detected in the atmosphere as a result of this new development. In 1974, Molina and Roland proposed that the ultimate fate of CFCs in the atmosphere was ultraviolet photodecomposition in the stratosphere with release of chlorine atoms. They suggested that these chlorine atoms might cause a reduction in the total amount of stratospheric ozone through a series of rapid chemical reactions. As technology did not exist to prove this hypothesis, the scientific community, led by government funded agencies, undertook the development of the body of science required to measure trends and predict future ozone amounts in the stratosphere.

1.3 In 1978, the United States took the first step to stop the continued growth of CFC emissions to the atmosphere by banning so-called "non-essential" uses for CFCs such as aerosol propellants. The United States Environmental Programme (UNEP) became the focal point for international attention with formation of the Coordinating Committee on the Ozone Layer (CCOL). UNEP published scientific assessments and initiated formation of a global convention culminating in the Vienna Convention for the Protection of the Ozone Layer (adopted on 22 March 1985).

1.4 Concurrent scientific evidence that changes were occurring in the atmosphere was inconclusive until significant temporary changes in ozone over Antarctica were discovered by British scientists in late 1985. World attention then focused strongly on the CFC/ozone issue.

1.5 While the aerosol ban in the United States and other countries initially decreased worldwide use of CFCs, rapid growth resumed in the early 1980s. Computer model projections of ozone depletion resulting from sustained growth in CFC emissions at these levels led industry to advocate international efforts to limit long-term growth of CFC emissions. Negotiation of an international agreement began in December 1986, with the support of all of the world's leading CFC producers.

1.6 Ensuing negotiations led to the drafting of the Montreal Protocal in September, 1987. This historic agreement addressed the need to reduce emissions of controlled substances (i.e. CFCs and Halons) to a "safe" level in a way that was acceptable to all countries, including those who were seeking the economic and societal benefits of CFCs enjoyed in developed countries.

1.7 The Montreal Protocol went into effect in 1989; approximately 70 countries have ratified the agreement to date. Principal features of the original Montreal Protocol were:

a) A set of control measures with scheduled reductions in consumption of controlled substances in each member country based on 1986 consumption levels on an Ozone Depletion Potential (ODP) weighted basis (consumption was defined as production plus imports minus exports).

b) A 10-year grace period for developing country compliance with the Protocol control measures, provided their annual consumption of controlled substances is less than 0.3 kilograms/capita. Developing countries conforming to this condition are classified as Article 5 countries.

c) Restriction on trade of controlled substances with non-parties to the Protocol.

d) A requirement to reassess control measures at least once every four years.

1.8 A key provision in the Protocol requiring reassessment of the treaty's control measures was evoked when mounting scientific evidence showed that CFCs were damaging the ozone layer. The Second Meeting of the Parties to the Montreal Protocol in London in June 1990 produced an agreement to completely phase out CFC consumption in developed countries by the year 2000 on a modified time schedule. Controlled substances were expanded to include 1,1,1-trichloroethane (methyl chloroform), carbon tetrachloride, and most fully halogenated CFCs. The parties declared their intent to phase out hydrochlorofluorocarbons (HCFCs) at some time in the future. The London agreement also established a technology and financial assistance resource for developing countries, the Interim Multilateral Fund.

1.9 For the purposes of this report, ozone depleting substances (ODS) are defined as substances currently regulated by the Montreal Protocol as revised in London in June 1990 (Annex C). The ODS most widely used in developing countries are CFC-11 and CFC-12. Methyl chloroform, carbon tetrachloride, CFC-113, CFC-114, CFC-155, Halon 1211, and Halon 1301 are also used but to a significantly lesser extent.

The Interim Multilateral Fund

1.10 The Interim Multilateral Fund (referred to hereafter as the Fund), supported by the developed country Protocol Parties, will provide up to $240 million over the next three years (through the end of 1993) to the Article 5 countries in order to:

a) Help defray the incremental costs of the transition from ozone depleting substances to alternative materials and technologies less damaging to the ozone layer

b) Train people in appropriate disciplines

c) Carry out studies which address the specific needs of each developing country.

1.11 The policies, guidelines and administration of the Fund are to be implemented by an Executive Committee in cooperation with the World Bank, United Nations Environment Programme (UNEP), and United Nations Development Programme (UNDP) or complementary agencies.

1.12 The Executive Committee, composed of seven parties operating under Article 5 of the Protocol and seven parties not so operating, has been developing operational policies, guidelines and administrative arrangements for the Fund since its formation in September 1990. The critical responsibility of the Executive Committee is to consider and, where appropriate, approve country

programs for compliance with the Protocol and approve project proposals and incremental costs for implementation of such programs.

1.13 A secretariat, headquartered in Montreal, Canada, has been established to coordinate activities related to use of the Interim Multilateral Fund (IMFMP).

Country Programs

1.14 Implementation Guidelines and Criteria for Project Selection were approved by the Executive Committee at its Third Meeting in April 1991. In these guidelines, Article 5 countries were invited to develop Country Programs (CP) and projects leading to a complete phase-out of ODSs. The Executive Committee established the development of a CP as a prerequisite for assistance from the Fund. The implementing agencies (UNEP, UNDP and the World Bank) requested that Egypt prepare a CP which could also serve as a model for other developing country CPs.

1.15 Egypt was selected as a country well suited to expedite implementation of the Fund on the basis that an ODS assessment had been conducted in Egypt by the World Bank in November 1990, and that the Country Program could build on the report summarizing the findings of that mission.

Purposes of the Mission

1.16 To accomplish the objective in the CP development plan, the Government of Egypt, with World Bank assistance, undertook the following tasks in accordance with the Terms of Reference for country programs established by UNEP.

Institutional and Policy Framework. Define the organization and functions of government agencies with possible roles in ODS phase-out, including data gathering, policy and standards setting, and enforcement.

Phase-out Requirements and Alternatives. Estimate the optimum phase-out of ODS consumption and time limits for a complete ODS phase-out.

Costs and Benefits of ODS Phase-out. Calculate full and incremental costs for each recommended action in the ODS phase-out.

Phase-out Scenarios. Identify promising alternative scenarios for accomplishing the ODS phase-out expeditiously within the Protocol time-frame and Government of Egypt strategy.

Action Plan. Recommend an Action Plan to achieve the ODS phase-out based on the findings of the mission.

Project Proposals. Conduct feasibility studies on specific projects needed for demonstration of ODS phase-out technology.

Methodology for phaseout planning

1.17 The methodology used in developing the phase-out planning process was structured to identify the least cost phase-out option for Egypt. The process involved:

i) development of forecasts of ODS demand unconstrained by the Montreal Protocol thru the year 2010. This provided a base level demand to be serviced by ODSs and their alternatives throughout the transitional period.

ii) identification of probable substitutes (alternative chemicals and technologies) for ODSs in order to estimate future availability ; probable timing patterns for introduction of the substitutes, and probable unit costs or investments to accomplish the substitution.

iii) development of scenarios which span a full range of actions open to Egypt for Protocol compliance as a framework for comparison of costs.

iv) identification of projects necessary for accomplishing a phase-out of ODSs in coordination with each phaseout scenario. Financial prefeasibility studies were prepared for such projects in order to identify appropriate costs.

v) construction of a spreadsheet model with which to estimate incremental and other economic costs to Egypt for select scenarios over a range of economic growth rates, and with internal options such as recycle-recovery, and alternative rates of transition to ODS substitutes.

1.18 The anticipated rate of transition to alternatives was estimated based on interviews with industry leaders in Egypt and the United States and adjusted to reflect the particular scenario being developed. A standard formula was used to calculate demand for forecastable items was:

$$Vn = Vo\ (1+Gn)\ (1-Tn)$$

where:

Vo = ODS Volume in base year (1990)
Vn = ODS Volume in year (n)
Gn = Compound growth rate (base yr ->n)
Tn = Fraction of ODS demand converted to substitutes

In the period following the institution of Protocol limits, the demand was constrained to conform with the Protocol limits.

Phase-out Scenarios

1.19 Two scenarios were chosen to cover a range of options open to Egypt for compliance with the Montreal Protocol. Within each scenario the effect of three (3) GDP growth rate patterns spanning a range are utilized to account for uncertainties in current estimates. The scenarios were:

- Allowable under Montreal Protocol - All transitions to ODS substitutes are delayed until the last possible instance without violating the phase-out requirements under the Montreal Protocol.
- Accelerated - The transition to ODS substitutes is accomplished sector by sector within 1-2 years of the technology becoming available.

Project Identification

1.20 Methodology for selection of projects for incorporation in the country program is incorporated in the discussion of project proposals in Annex A.

Methodology for Evaluating the Cost of ODS Phaseout

1.21 Evaluating the cost to Egypt for phasing-out ODSs required development of a set of optional phase-out scenarios against which to measure such costs. In the current climate of rapid change within ODS-user industries, such forecasting is at best an inexact science. The knows are where we are today, and the limits to be imposed on ODS use by the Montreal Protocol (Annex E). In order to make a forecast, assumptions must be made regarding (1) the growth of demand for products currently produced with the aid of ODSs, and (2) the timing and rate at which ODSs are replaced with alternative chemicals and technologies over the forecast period (1990-2010).

1.22 Constraints on demand estimates were Protocol limits (Annex E). One point to note is that the constraint is partly determined by the plan adopted -- an accelerated phase out actually reduces the 1995-1997 baseline from which Article 5 countries derive their phase-out targets.

1.23 An approximation of overall country cost was made (exclusive of Fund grants) by using a bottom-up approach based on the major identifiable economic costs. For Egypt, these costs and related assumptions were:

- Investment projects likely to qualify for grants from the Multilateral Fund.
- Incremental operational costs for imported components (e.g. compressors) and alternate refrigerants. These costs are uncertain, but are likely to decline.
- Incremental administrative costs for the EEAA, FEI, Customs Department and licensing authorities.
- Offsetting saving (from the reduced need to import ODS or substitutes due to recycling) are valued as a benefit.
- The economic loss due to premature replacement of a refrigerator in any given year after its manufacture was determined based on straight line depreciation discounted back to 1990 at 10% interest. In the year of manufacture, a refrigerator is valued at $320 (before sales tax). It was assumed that refrigerators are retired prematurely in 2010 for cost estimating purposes.
- Import costs of recycling/recovery equipment. (Customs duties and sales taxes are transfer costs and are not included.)
- An interest rate of 10% was used to reflect the time-value of money in the different scenarios.
- No incremental cost is ascribed to alternative propellants and foam blowing agents as ODS substitutes are economically viable.
- The incremental part of the retooling costs for refrigerator, air conditioner and water cooler manufacture is negligible.

- As mobile air conditioners have a five to seven year life and will soon be replaced by types that use HFC-134a, it was assumed there will be no premature obsolescence. Domestic air conditioners are mainly based on the alternate HCFC-22 already, and existing CFC chillers can be serviced until the end of their service life.

- Cost calculations were based on the production of ODS-using appliance required for only the domestic market. Definition of country cost did not include any incremental costs incurred in making products suitable for export to other countries. Subsequent export development (mostly for refrigerators in the Middle East) was regarded as a new business opportunity.

2.0 ODS USE AND ALTERNATIVES

This section of the report deals with technical options open to Egypt in preparing for and implementing the complete phase-out of ODSs in accordance with the Montreal Protocol.

ODS USE IN EGYPT

Background

2.1 Egypt does not produce ODSs, it is mostly imported through authorized distributors of international ODS producers. Although there are numerous users of ODSs, the bulk of the demand is concentrated in the industries that manufacture and service domestic refrigerators and air conditioning systems and in the foam industry which produces cushioning, furniture and packaging materials. These industries contribute to a higher standard of living and, in recent years, have experienced growth exceeding that of the expanding population. Some fire extinguishants and solvents, also ODSs, are used in small quantities; however, available data is limited.

2.2 In 1990, consumption of CFCs in Egypt was 1830 tonnes, a decrease of 545 tonnes from 1989. The decrease was primarily due to a depressed economy, which decreased production of home refrigerators and other consumer goods, and to a Ministerial Decree that now prohibits the use of CFCs in the aerosol industry.

2.3 An early case study of the use of ODSs was undertaken in 1989-90 by the Egyptian Environmental Affairs Agency with assistance of the US Environmental Protection Agency (EEAA, 1990). This was complemented by a World Bank ODS Assessment (Arif and Catanach, World Bank, 1990). This introductory chapter is a summary based on the Bank's assessment, where greater detail may be found.

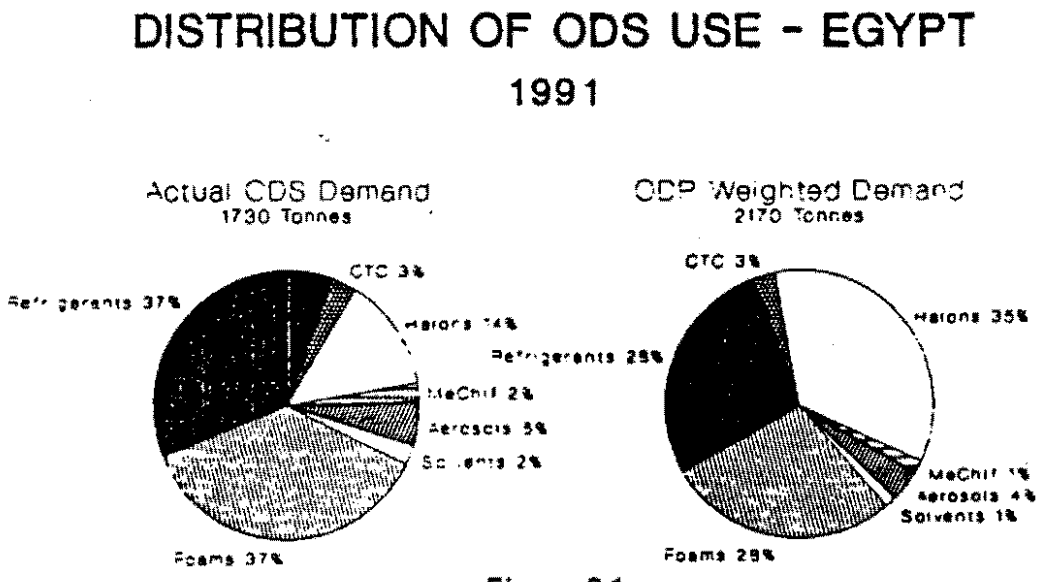

Figure 2.1

2.4 During 1991, foam applications (including those use for insulation of domestic refrigerators) consumed the largest quantity of CFCs followed by refrigerants, aerosols and solvents. When other ODSs are included, Halon consumption is significant, particularly when viewed on an Ozone Depletion Potential (ODP) weighted basis (Figure 2.1).

INDUSTRY STRUCTURE

2.5 The industries involved with ODS use in Egypt are mainly engineering industries which manufacture household refrigerators, freezers, room air conditioners (window and split types), commercial air conditioning units; systems for industrial refrigeration; aerosol sprays (for insecticides and cosmetics); foams; and Halons for fire extinguishers and central systems. Minor uses of ODSs (e.g., as solvents) also exist.

2.6 Egypt's engineering industries generally have not performed to their full potential, and this applies particularly to the refrigerator and air conditioner manufacturers. Despite large investments which had been made in the public sector during the 1980s and rapidly growing demand for finished products, output stagnated and exports were negligible. Koldair, which specializes in the manufacture of air conditioners, actually commenced as a private sector company in 1946 but was nationalized in 1961. Ideal, which manufactures domestic appliances including air conditioners and household refrigerators, was established as a public sector enterprise in 1963 with assistance from Bosch, Germany. These two public sector enterprises (PSEs) enjoyed a monopoly of the domestic market until 1980 but suffered from the general constraints on PSEs -- administered prices (generally below cost), over-employment, etc. Although both firms invested heavily in expanding their production capacity, demand was so high that consumers had to wait years for ordered units to be produced.

2.7 There are at least seven refrigerator-freezer manufacturers in Egypt with an installed capacity of about 1,000,000 units per year for use in homes, restaurants, stores, and other establishments. The largest manufacturer (IDEAL) is a public sector company; all others are smaller, privately owned companies which have grown rapidly during the 1980s and reduced IDEAL's market share from 100 percent in 1979 to less than 50 percent in 1990.

2.8 In Egypt, overcapacity is now a serious problem in the refrigerator industry. Demand for refrigerators was high and growing during the 1980s, peaking in 1987 at 660,000 units. When conditions for market entry were relaxed, a number of private sector firms established medium-sized operations, which added capacity to produce 250,000 units annually. Ideal, the public sector enterprise, met this competition by investing heavily in further capacity, spending $80M to bring its plants up to a capacity of 750,000 units annually. Total capacity now exceeds a million units annually -- even this is measured on a single shift basis, so it could be doubled by introducing a second shift -- at a time when demand slumped to 350,000 units in 1990. Undoubtedly, one reason for the fall in demand has been general economic conditions which have affected sales, especially in the luxury end of the market for which much of the additional capacity has been placed. Nevertheless it is clear that there is presently a vast overcapacity. This view was confirmed by site visits -- Ideal's Nasr City plant, for example, was operating at about 30 percent capacity on a single shift basis.

2.9 In the 1980s, a number of private sector companies were formed to supply the shortfall. They began as medium-sized operations, also operating with assistance from overseas suppliers, e.g., Electrostar (licensed by Zanussi, Italy), Miraco (a joint venture with York, USA) and Kiriazi (licensed by Zerowalt, Italy, and Aspera, Italy). This entry completely transformed the industry resulting in increased supply, a wide range of models, competition in price and quality, and the development of export markets in the region.

2.10 Private sector refrigerators are now readily available and their prices are market-determined. As their prices are comparable to those found overseas, this suggests refrigerator manufacture enjoys a comparative advantage. For example, Electrostar's 1991 price for its main product, a two-door 12 cu. ft. refrigerator, is LE 1,195 ($361)[1] which compares well to currently advertised American models (e.g., a two-door, 14.6 cu. ft. refrigerator available from Lowe's for $397).

Current Demand by Sector

Refrigeration

Domestic Refrigerators and Freezers

2.11 Domestic refrigerators and freezers are significant uses of CFCs in Egypt. In 1991, 100 tonnes of CFC-12 were used as refrigerant, and an even greater quantity, 420 tonnes of CFC-11, were used to make the rigid foams that provide insulation for refrigerator and freezer compartments. Additionally, about 350 tonnes of CFC-12 were used during the servicing of the existing stock of seven million refrigerators and freezers used in Egypt.

2.12 At present all refrigerator compressors for production of refrigerators and freezers in Egypt are imported. The Misr Compressor Manufacturing Company (MCMC) is building a factory to make compressors in Egypt. The International Finance Corporation (IFC) has recently acquired a 12% equity interest in MCMC. The factory is planned for start production in April 1994. MCMC plans to make both HFC-134a and CFC-12 compressors initially and phaseout of the CFC-12 compressor business as demand declines. Their immediate concerns are for the thermodynamic efficiency of HFC-134a, and the effects that HFC-134a will have on compressor parts, and noise levels as well as the need for special lubricating oils. They have a technology agreement and license from Whirlpool Italia, a 100% subsidiary of Whirlpool US and have access to all of the latest technology and technical assistance for their operation. They will produce units on a par with those made in US and Europe.

Air conditioners

2.13 The primary refrigerant gas used in air conditioners in Egypt is HCFC-22 (a non-controlled substance with a much lower ozone-depleting potential than the CFCs). The demand for HCFC- 22 has increased steadily to about 1,050 tonnes in 1991. However, CFC-11 and CFC-12 are used as the primary refrigerant of mobile and stationary air conditioners.

Mobile air conditioners

2.14 There are approximately 150,000 air conditioned cars and trucks in service in Egypt. Approximately one-third of the cars require air conditioner service each year. All car air conditioners use CFC-12 as the refrigerant fluid. Servicing of these units consumes approximately 75 tons of CFC-12 per year.

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[1] Converted at the current rate of exchange ($1 = LE3.31), which is close to the free-market rate.

Stationary air conditioners

2.15 Air conditioners for hotels and office buildings are usually large central systems that operate by circulating chilled water. (The systems are called "chillers.") These systems use either CFC-11, CFC-12 or HCFC-22 depending on the specific design, with newer units using HCFC-22. The annual use of CFCs is about 100 tonnes per year, mainly for make-up and losses associated with system maintenance. There are two major companies producing air conditioner units in Egypt (Koldair and Miraco). The easiest ODS reducing options are recycling which involves incremental capital and operating costs, and gradual replacement of systems with established HCFC-22 designs.

Water coolers

2.16 One company (Koldair) manufactures a water cooler and is planning to introduce a new model that uses HCFC-22 instead of CFC-12. This is a speciality business producing many small units to service public needs in offices, hotels, industrial facilities, and small businesses.

Foams

2.17 Two basic types of foams are used in Egypt: polyurethanes for cushioning, insulation and special automotive applications and polystyrenes for insulation and food packaging. CFCs have been used as blowing agents where their properties make them useful for removing the heat of the foaming reaction and for forming the bubbles required. The foam industry is growing at a rate in excess of 10% per year, particularly the polystyrene foams which have recently doubled capacity and are planning further increases.

2.18 Currently the foam industry is in transition and the use of CFCs is declining. It is estimated that 733 tonnes of CFC-11 were used in 1991 for foam manufacture.

2.19 The main options for reducing CFC use are of new polyol systems (which can eliminate half the CFC-11 needed for a given amount of foam). The incremental costs are of the order of 5 to 10 percent of the current cost of making foam. As the foams have insulation efficiencies about 8% lower than the all-CFC foams, there will also be some incremental costs imposed on refrigerator manufacturers for system redesign.

Aerosols

2.20 A full line of aerosol products is used in Egypt. The products include insecticides, paints, hair sprays, perfumes and a wide variety of specialty household and cosmetic items. The use of CFCs as a propellant has been banned since the beginning of 1991 under a Ministerial Decree, and the most common propellant is LPG. Conversion from CFC to LPG requires investment in facilities designed for handling flammable materials. Savings resulting from using the less costly LPG usually pay back investment in 2 years or less.

2.21 Remaining issues are the incremental costs of new entrants, for reversion to older technologies (e.g., hand pumps), and protecting export markets, with financing of costs retroactively.

Other ODSs

2.22 In Egypt ODSs CFC-11 and CFC-12. Methyl chloroform (a metal cleaning solvent and degreaser), halons (fire extinguishant) and small quantities of CFC-113 and carbon tetrachloride are also used. Industry statistics don not indicate the exact quantities used. It is expected that these uses will be addressed later once the basic problem of CFC has been solved.

FORECAST DEMAND BY SECTOR

2.23 The demand for ODSs, as forecast by the mission is expected to grow at a rate 1-2% faster than the economy. Figure 2.2 which follows illustrates that in the absence of ODS substitutes, demand will peak in 1999 at 3,000 ODS weighted tonnes just prior to the imposition of Protocol limits. Subsequently, demand would decline as industries transition to non-ODS substitutes. This demand forecast, referred to as "allowable" scenario establishes an upper limit on forecast demand with Protocol constraints, however, it is unlikely that Egypt's indusries will tolerate such a slow transition to non-ODSs.

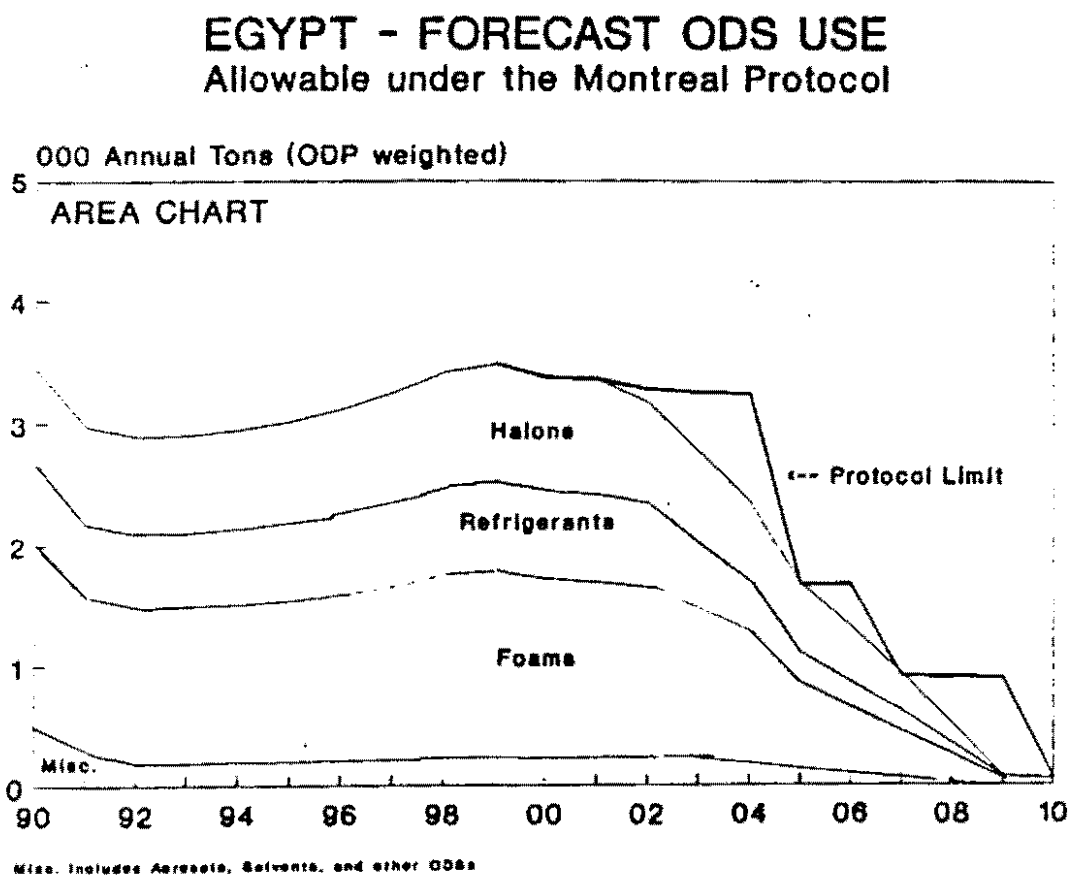

Figure 2.2

3.0 INSTITUTIONAL FRAMEWORK

This section of the report evaluates institutional capabilities available for implementing the ODS phaseout in Egypt.

GOVERNMENT AGENCIES

Minister of Cabinet Affairs and Minister of State for Administrative Development

3.1 In 1982 a decree was issued to establish an agency for the protection of the environment, the Egyptian Environmental Affairs Agency (EEAA). This agency was placed under the Ministry of Cabinet Affairs to ensure coordination of the efforts of many ministries. There is a five-year environment plan which provides an overall assessment of the environment, allocates financial and manpower resources for environmental protection, and establishes priorities.

Egyptian Environmental Affairs Agency (EEAA)

3.2 The EEAA is the main government central body responsible for the environment in Egypt. The EEAA was established under the Cabinet of Ministers in 1982 by the Presidential Decree No. 631 to form a link between the Cabinet and different Ministries to coordinate environmental protection. The EEAA is mandated to cooperate with other international organizations, to safeguard Egypt's environment and fulfill the nation's global environmental commitments.

3.3 EEAA is at an early stage of its institutional development and currently appears to lack the technical manpower (in numbers), financial resources and functional organizational structure needed to tackle the environmental problems and challenges in Egypt. UNDP and the World Bank assisted with the establishment of a International Cooperation Unit (ICU) within the EEAA in 1991 to coordinate the development of the Environmental Action Plan for Egypt and to facilitate cooperation with the international community on the environment. The ICU is acting as a liaison between local and international organizations to mobilize the necessary financial resources to implement the Action Plan.

Ministry of Finance (MOF)

3.4 The Ministry of Finance would play a key role in administering any tax instruments of NOP. In particular the Sales Tax Department of MOF would be responsible for any excise levied on CFC, and the Customs Department would actually be responsible for collection since all CFCs are imports. (The Customs Department would also be responsible for administering exemptions to customs duties and sales tax that apply to the import of capital equipment financed by the Fund and for monitoring imports of ODSs.)

Federation of Egyptian Industries (FEI)

3.5 The FEI was founded in 1922 and is now established under legislation passed in 1958 to organize Egyptian industry. The main objectives of FEI are to represent the interests of industry to the government, the labor unions and international organizations. (The FEI has also played an influential role in shaping Egypt's industrial strategy, although the importance of general industrial strategy will now diminish under the economic reform program).

3.6 The FEI draws strength from the fact that it is truly representative. It has a membership of about 13,000 -- all firms employing more than 25 workers or capitalized to more than LE 5,000 (about $1,700) are required to join -- and this includes both public and private enterprises. Its influence is likely to increase during Egypt's transition to a more liberal, outward-looking private sector oriented economy.

3.7 The FEI is likely to play a key role in the formulation and promulgation of National Ozone Policy by providing a ready made forum where ozone layer protection issues can be discussed, a consultative mechanism for gauging industry reactions to draft policy proposals and standards, and facilities for industry training and awareness programs. Two of its chambers will be principally involved:

> Chamber of Engineering Industries, which covers the manufacturers of foam products, compressors, refrigerators, air conditioners, water coolers, and fire extinguishers, and the main users of ODS solvents in industry; and
>
> Chamber of Chemical Industries, which covers the aerosol industries.

3.8 The FEI proposes to establish an Ozone Consultative Panel comprising representatives of affected industries to consider National Ozone Policy proposals and to broker voluntary agreements for ODS phase outs among lesser industrial users in cases where this is a viable option.

3.9 The FEI is also willing to play a role in the implementation of projects financed by the Fund. The model for this is the FEI's management unit established and staffed under a USAID project for energy conservation. That project has many parallels to the Ozone Action Plan -- it required implementation of a large number of small projects in industry, response to policy proposals, and promotional activities.

Ministry of Industry

3.10 The Ministry of Industry was founded in 1956 and is responsible for designing and implementing industrial development plans and supervising public business industries in six subsectors, including the engineering industries subsector which includes the manufacture of refrigerators and air conditioners. This particular subsector is managed in the public business sector by the Engineering Industries Corporation (EIC), a holding company established in 1983 to manage investment and production in public business sector companies in that subsector. Overall planning for the industry sector is the responsibility of the General Organization for Industrialization (GOFI) while standards are handled by the Egyptian Organization for Standardization and Quality Control (EOS), also within the Ministry. The Chairman of the Federation of Egyptian Industry (FEI), an independant body representing both public and private enterprise, reports to the Minister of Industry but in practice has considerable and growing independence.

3.11 While the direct role of the Ministry of Industry in company affairs continues to diminish, the Ministry still has a key role in National Ozone Policy as almost every policy action is affecting the industry sector.

Engineering Industries Corporation (EIC)

3.12 The EIC was created under a 1983 law designed to consolidate the supervision of all public sector production units. The EIC is one of six holding companies within the industry sector, each of which is the sole shareholder on behalf of the government in the enterprises belonging to a

particular industry sector. EIC is responsible for, among other enterprises, the public sector corporations that manufacture refrigerators and air conditioners, i.e., Ideal and Koldair.

3.13 The two main advantages of the existing system are the composition of the Enterprise Boards and the powers assigned to the holding company. The Board of EIC, for example, has members who are chairmen of engineering companies. EIC, as the other holding companies, has the power to shift funds, foreign exchange and inventories between enterprises, and to manage joint procurement. Company controls are now counter to the thrust of the government's new economic reform program and it is probable that they will be gradually dismantled. The remaining role of EIC is managing the portfolio of companies, restructuring, amalgamation and possibly privitization.

3.14 Under the previous centrally planned system EIC might have played an important role in ushering in alternative technologies and ODS substitutes in the public sector corporations under their control. EIC might have enforced environment regulations directly at the enterprise level concerning procurement of substitute refrigerants and their associated compressors, the manufacture of new products to use the substitutes and so on. However, in order not to run counter to the thrust of the economic reform, implementation of National Ozone Policy would be better handled by direct contacts with the key enterprises.

General Organization for Industrialization (GOFI)

3.15 GOFI has been responsible for industry sector planning. Part of this responsibility was to ensure that industrial capacity and production were compatible with the needs of the economy and that targets of the National Development Plan were taken into consideration. GOFI also had power to approve new private companies and industrial projects.

3.16 GOFI has played an important role in developing current Ozone Policies. GOFI has, for example, studied the ozone problem since 1986 and made the first preliminary assessment of the situation in Egypt although this has since been superseded by the EEAA study of 1990 and the Bank's subsequent report in 1991. GOFI had also been instrumental in obtaining the Ministerial Decree banning the use of CFCs in aerosols in 1989. While GOFI might still play a part in promulgating new technologies and ODS substitutes, it is probable that the FEI of Egyptian Industries, a more representative and consultative industry forum, will also have a say in the new economic environment.

Egyptian Organization for Standardization and Quality Control (EOS)

3.17 The EOS was established, within the Ministry of Industry, in 1957 to elaborate standards and to certify the conformity of products to national standards. EOS also offers technical advice and training to industrial establishments on specifications, industrial quality control, measurements and metrology. As a general rule, EOS harmonizes Egyptian standards with those issued in other countries by adopting international agreed standards after consulting industry through committees.

3.18 EOS has a clear and supportive role in the transition to ODS substitutes. This role is to promulgate internationally accepted health and safety standards that pertain to the substitute chemicals (e.g., to control for toxicity flammability and/or explosiveness of the substitutes) and to quality standards for associated equipment (e.g., operating pressure and other specifications). Model standards would probably come from the International Standards Organization, but relevant international agreements on standards under the auspices of the Montreal Protocol or other international treaty would be equally authoritative as a model and initiator. For example, the standards for aerosol safety (subsequent to the changeover to LPG and other aerosol propelling techniques) were set when GOFI and EEAA made such a recommendation pursuant to the Montreal

Protocol. This supportive role is part of EOS's normal work program, requires no special Government action, and probably incurs very little incremental cost.

3.19 A wider role for EOS (such as using its standard-setting powers to require recycling of CFCs or to treat CFCs as "toxic waste" in order to restrict access) would not be appropriate given their specific mandate on standards and quality control. At present EOS enjoys reasonable autonomy; accepting tasks based on policy imperatives rather than on clearly defined technical issues related to health and safety which could subvert their mission and reduce their credibility.

Ministry of the Interior

3.20 The Ministry of the Interior is the agency having the responsibility and power to enforce environmental legislation (EEAA has no enforcement power). However, partly because existing environmental legislation is very ambitious and partly because enforcement is highly manpower-intensive, many of the laws and decrees related to the environment are not uniformly enforced.

Ministry of State for International Cooperation

3.21 Established under Presidential Decree No.551 in 1987, the Ministry of State for International Cooperation (MSIC) has the following responsibilities:

O Communicate with all international and regional finance organizations (such as the World Bank) as well as foreign countries in order to negotiate on loans and grants.

O Sign all agreements of loans and grants.

O Following up on legislative procedures to ratify loan and grant agreements by the People's Assembly.

All funds granted to Egypt through the Montreal Protocol must be transferred through the MSIC.

Industry Associations and NGOs

3.21 Other than the Egyptian-American Chamber of Commerce, there are no industry associations which have directed public attention to the "ozone issue" and the Montreal Protocol. The Chamber of Commerce has incorporated basic literature on the ozone issue in its periodical publication and has provided a forum for discussion of the ozone issue by industry leaders.

3.22 Dr. Yusef Mazhar, First Undersecretary in the Ministry of Industry, writes a weekly column in the Cairo newspaper on environmental issues and has discussed the ozone issue on several occasions. Dr. Mazhar also hosts a weekly television show on the environment.

4.0 POLICY FRAMEWORK

The policy framework within Egypt is evaluated in this section of the report with emphasis on those items impacting economic and financial costs for ODS phaseout.

BACKGROUND

4.1 The policy environment will affect ODS phaseout costs at both the country level and at the individual enterprise level. An understanding of existing policies and available policy options is therefore needed to estimate comparative incremental costs. The cost to Egypt (or minimum adjustment cost given the existing economic policy and industrial strategy of Egypt) depends on the implementation plan constrained by policies which are institutionally feasible for Egypt while the incremental financial costs of individual enterprises depend also on overall economic policy, especially tax provisions, and eligibility rules of the Fund.

4.2 This report considers Egypt's overall economic policy and the general economic situation of the country and the industry strategy including industry protection, competition policy, price controls, restriction on ownership, investment and imported components and materials, and tax incentives for particular industries.

POLITICAL SYSTEM AND TRENDS

4.3 Egypt, officially known as the Arab Republic of Egypt (ARE), is a socialist republic. Executive power is vested in the President who has the power to appoint all ministers and heads of the 24 governates. Policies are the responsibility of the Prime Ministry.

4.4 The intention of the Government of Egypt (GOE) is now to transfer the economy from a highly interventionist centrally planned one with its accompanying distortions to a decentralized, outward- oriented, market economy. This economic reform program has begun and is expected to continue up to 1995, i.e., the same period during which the major adjustments will be made to implement the Montreal Protocol. At least in the next few years, this period will be characterized more by restructuring than by growth, and it may thus be difficult to fine-tune an action program to implement the Protocol.

ECONOMIC CONDITIONS

4.5 Egypt is currently in a recession: During the first phase of implementing the Protocol, projected economic growth[2] is forecast to be negative (minus 0.9% p.a. between FY91 and FY93) and projected consumption per capita (minus 2.3% p.a. in the same period). This will make it harder for industries to bear the additional economic burdens associated with the ODS phase out but dampen consumer demand for ODS related products, such as refrigerators, thereby holding down overall costs associated with premature obsolescence.

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[2] World Bank projection.

4.6 Exports and feeder industries have been inhibited by foreign exchange and trade policies leaving the industries with inefficiencies that add to costs. Investment decisions and expected rates of return on the new technology have been influenced by the high inflation rate and low real interest rates.

4.7 Inflation has declined from 20% in 1991 and is currently 8%, even so companies contemplating investments in recycling and ODS alternatives are demanding high nominal rates of return (to cover both inflation and the risk of a change in the inflation rate).

Interest Rates

4.8 Until early 1991 there had been two major distortions in the Egyptian money markets:

(a) Nominal ceilings on all interest rates were well below inflation, which encouraged wealth holders to maintain wealth in foreign currencies. The real interest payable on funds borrowed by private sector refrigerator and air conditioner manufacturers is between -2% p.a. and +2% p.a.

(b) Credit rationing to curb the excess demand for credit. Until 20 July 1991, when a new law took effect, the Public Service Enterprises (PSEs) reportedly had easier access to credit (and foreign exchange) than the private companies.

4.10 The low real interest rates may be partly responsible for the very low productivity of capital in the ODS industries where capacity, even on a single shift basis, is almost three times present production levels. Credit rationing and the need to obtain investment approvals have probably had more of a restraining influence on the private sector than the public sector which has reportedly enjoyed favored access to and premium rates for credit and foreign exchange.

Price Controls and Subsidies

4.11 Egypt's industry strategy has required price controls on a number of items including refrigerators and air conditioners. In relation to refrigerator models, this has directly affected Ideal (a PSE) models and indirectly affected the private sector firms models. Ideal's simple model refrigerator (220 liter) had been kept at a price below manufacturing costs for many years. While the market at the controlled price was estimated to be about 300,000 units per year, Ideal made far fewer units (e.g., in 1988/89 only 100,000 units) in order to minimize losses. Private companies of course avoided the simple model altogether and concentrated on the upper end of the market where prices were uncontrolled in 1990.

4.12 Price controls, had they been maintained, would have been a major issue for implementing the Protocol because they might prevent incremental operating costs of a changeover to non-ODSs from being recovered in the market.

TAX STRUCTURE AND POLICY

4.13 In Egypt, the tax system is complex, having grown by accumulation over many years and expressing diverse economic and industrial policy aims. Since late 1989 though, all aspects of tax administration (which come under the Ministry of Finance) have been under

review: the Customs Department has been receiving technical assistance from US Customs and other departments from a USAID-sponsored consulting team.

4.14 Tax policy, because it affects the level of transfer payments between enterprises and the government, is a major factor in determining the net incremental financial costs borne by enterprises. Tax policy affects the net cost of investing in new capital equipment, investment and depreciation allowances allow the investment cost to be offset against taxable income. Taxes and duties on imported capital goods (such as recycling machines, machine tools for refrigerator factories) and on intermediate goods (such as compressors suitable for alternative refrigerants, foams, ODSs, and ODS replacements) also affect incremental capital and operating costs.

Credits and Allowances

4.15 In Egypt, there is both an investment credit and a depreciation allowance which have the effect of reducing incremental financial costs to firms installing equipment to change over to non-ODS substitutes. The value of these provisions in tax law depends on:

- Type of Enterprise - Whether the firm in question is a manufacturer or merely a provider of a service. The former is also granted a concessional rate of corporate profits tax;

- Rate of Inflation - The allowances (which are computed in nominal terms) are seriously eroded by Egypt's high rate of inflation (around 8 percent p.a.); and

- Tax holidays - Those firms already enjoying a tax holiday for some other reason (e.g., industrial strategy or regional development goals) will not benefit from the allowances.

4.16 The relevant provisions of the Egypt tax law are:

- Investment Allowance. An immediate 25 percent write off is permitted in the year the investment is made.

- Depreciation Allowance. Equipment can be depreciated with a straight-line or declining balance method (straight-line is generally used). There are over 50 asset categories, each with its own allowable depreciation period, so it is difficult to choose a "representative" asset for illustration. Also, under proposed rationalization of the tax regime, it is expected that the number of categories and special provisions will be reduced, and that the depreciation period will closely correspond to the actual economic life of the asset. Thus for purposes of illustration, it is assumed that the investment is depreciated over its economic life, taken as seven years (as in the case of recycling machines). Depreciation, under present provisions, is calculated on the full value of the original investment, not the amount net of the investment allowance.

Corporate Profits Tax

4.17 A general flat rate of 40 percent applies. However, for firms engaged in manufacture or export, a concessional rate of 32 percent applies. Firms located in special development zones enjoy various tax holidays of up to ten years.

Sales Taxes

4.18 The direction of tax reform is towards neutrality, with the burden of revenue raising falling on a value-added tax. At present, sales tax is 10 percent across-the-board and rebated on resale of the product incorporating the component (i.e., the tax is on value added). Sales tax is levied on the value of an imported good including the duties payable (i.e., the tax is compounded).

Customs Duties

4.19 Under the tax reform it is expected that customs duties will be designed purely to protect specific industries and not as a means of raising revenue -- that will be the function of the sales tax. At present, though, most goods attract a duty. Typically, this is 30 percent, but the relevant intermediate goods have a wide range of applicable duties, e.g.,:

Compressor	30%
Condenser	60%
Thermostat	5%

Duties are rebatable upon re-export.

Exemptions

4.20 Duties and taxes on items financed under the Fund are to be waived under UN exemptions. The Fund does not finance these transfer payments to the government.

4.21 Energy prices were highly subsidized for about 12 years and although energy prices were raised considerably during the 1980s, most of the increase was nullified by subsequent inflation. For FY91 the total implicit subsidy for energy was 9.6% of GDP, almost half the public sector borrowing requirement. The Government adjusted electricity tariffs in May 1991, bringing them from about 40% of long-run marginal cost (LRMC) to about 59%. The Government intends to raise tariffs further in order to cover LRMC by June 1995. Highly subsidized electricity probably added to demand for household appliances - including refrigerators, freezers, and air conditioners.

5.0 RESPONSES TO THE MONTREAL PROTOCOL

Government Responses to the Protocol

5.1 Egypt was an initial signatory of the Vienna Convention(22 March 1985) which they subsequently ratified (9 May 1988). Egypt was the seventh country to sign (16 September 1987) and ratify (2 August 1988) the Montreal Protocol. The government of Egypt has been represented at all international meetings dealing with the Montreal Protocol , and has worked diligently to encourage its proper development. Egypt is also represented on the Executive Committee of the Interim Multilateral Fund.

5.2 Egypt has moved aggressively to reduce CFC consumption . The Ministry of Industry issued a decree on 8 November 1989 that banned the use of CFCs in aerosols starting January 1991.

5.3 An early case study of the use of ozone-depleting substances was undertaken in 1989-90 by the Egyptian Environmental Affairs Agency with the assistance of the U.S. Environmental Protection Agency (EEAA, 1990). This was complemented by the subsequent World Bank Assessment of ODS Use in Egypt (Arif and Catanach, World Bank, 1990).

5.4 In 1992, the EEAA together with UNDP and with the cooperation of industry representatives developed six projects for initial consideration by the Executive Committee (EC) of the Interim Multilateral Fund under the Montreal Protocol. Most of these projects are to be submitted with the country program at the October 1992 meeting of the EC.

Industry Responses

5.5 Industry in Egypt has cooperated fully with the assessment of ODS use and the generation of project concepts and feasibility studies for phaseout of ODSs. The Ministerial Decree banning the use of CFCs in aerosols was developed with full industry cooperation.

5.6 The Federation of Egyptian Industries actively support the initatives by industry in accelerating the transition to non-ODS materials and have convened meetings to communicate the requirements of the Montreal Protocol (MP) to all members. They have also arranged discussions between the World Bank mission and companies affected by the MP to facilitate developments of plans and projects for the ODS phaseout.

6.0 ODS PHASEOUT PLANNING

Background

6.1 The planning of a cost effective ODS phaseout required determination of incremental costs for substitution of alternative chemicals and technologies in processes currently served by CFCs. Availability of alternative technologies was considered along with the indigenous capabilities of local industries. Strategies which provide a framework upon which overall costs can be rigorously compared serve as an analytic tool over a range of conditions considered to be within the realm of probability. The discussion which follows covers the details of the planning process used to provide a cost basis for recommendations incorporated in the recommended phaseout strategy.

AVAILABILITY OF TECHNOLOGY

6.2 With the exception of rigid insulating foams, Halons, and specific medical devices using CFCs, well developed technology exists today to accomplish a complete phaseout of ODSs over a period of 2-4 years.

Refrigerators/Freezers/Air Conditioners

Technology Status

6.3 There are 5 key technologies needed to displace ODS use in industries which use ODS refrigerants:

Refrigerant Fluid
Lubricating Oil (compatible with refrigerant)
Compressor
Insulation
Servicing Procedures

Refrigerant Fluid

6.4 HFC-134a will most likely be the refrigerant of choice to replace CFC-12 in domestic refrigerators, automobile air conditioners, and CFC-12 chillers. Alternative refrigerants such as HFC-152a and "blends" (HCFC-22/124/HFC152a mixtures) will penetrate specific markets but are unlikely to have much impact on Egypt for the foreseeable future. Supplies of HFC-134a are commercially available today. DuPont and ICI, large global fluorocarbon producers, have major HFC-134a capacity in operation with expansions due on line in 1993. Others will probably follow as markets for HFC-134a expand. Supplies will most likely be adequate into the late 90s and price will decline to about 4-5 X that of CFC-12.

Lubricating Oil

6.5 Two oils, PAG and Polyolester, have demonstrated compatibility with refrigerant HFC-134a. The oils currently used with CFC-12 refrigerant systems are totally inadequate for HFC-134a service. The alternative oils are commercially available today although the price is up to 20 times higher than that for the CFC-12 oils. The choice of oil type is made by the user based on his estimate of equipment life and service conditions. The Polyolester Oils are higher priced and generally last longer than the PAGs and will find application in most new domestic refrigerators. Auto air conditioners will probably use PAGs.

Compressors

6.6 The thermodynamic properties of HFC-134a are different enough from those of CFC-12 to require that compressors used in domestic refrigerators be redesigned. Together with the new oil and HFC-134a, the new compressors will operate with the same energy efficiency as comparable CFC-12 systems. Any loss in efficiency will derive from other factors (e.g. insulation). Several compressor manufactures (Danfos,Embraco, Unite L'Hermetique) are producing the newly designed HFC-134a compressor today. Other factories are due on line soon. Egypt is building a new compressor factory which should will have the capability to produce the new world class HFC-134a compressors. Supply of HFC-134a compressors should not be a limitation for Egypt, today or in the future.

Insulation

6.7 Domestic refrigerators use 4-5 times as much CFC to create the insulation for the refrigerator cabinet as they do to charge the refrigerant-compressor system. Technology to eliminate CFC use in this application is lagging. The commonly used Isocyanate\Polyol\CFC-11 foaming systems used by most refrigerator manufacturers have been modified to reduce the CFC-11 requirement by up to 50%. Egyptian manufacturers have tested these new systems but have not converted their facilities because of cost considerations. The complete elimination of CFC-11 will probably require use of HCFCs such as HCFC-141b,HCFC-142b, and HCFC-22 as an interim solution while awaiting the development to technologies to employ HFC-134a or HFC-152a as the blowing agent for the rigid foams used in refrigerators.

Servicing Procedures

6.8 Home refrigerators have a useful life of 20-30 years but require servicing every 5-7 years in Egypt to correct poor performance. At the present time, CFC-12 is the only acceptable material for servicing, thereby creating a long-term demand, through the term of the Protocol and on to the end of the useful life of the refrigerator. Special "blends" which are compatible with CFC-12 have been developed and are undergoing life tests but won't be commercially available until 1995. It has been assumed that these "blends" will only penetrate a small portion of the refrigerator service market and CFC-12 use may continue until year 2005, following which refrigerators unable to be serviced will either be scrapped or will be recharged with "blends". Earlier adoption of "blend" technology will be an issue for the market to decide.

Recovery - Recycle - Reclamation of CFCs

Technical Options

6.9 Significant opportunities to conserve existing supplies of CFC by recapturing and reusing CFCs from existing facilities exist primarily in the refrigerant sector. Full implementation of recycle/recovery in the refrigerant sector of Egypt would reduce CFC-12 imports by over 400 tonnes (i.e. over 20% of the 1991 ODP weighted consumption)

6.10 There are three terms which best define the various phases conservation activities in the refrigeration and air conditioning sector - recovery, recycle, reclaim.

Recovery: To remove refrigerant in any condition from a system and store it in an external container without testing or processing.

Recycle: To purify refrigerant for reuse by oil separation, filtration, drying, and/or chemical treatment. This procedure is usually (but not necessarily) performed on a job site or in a service shop and the purified CFC is returned to the equipment from which it was originally recovered.

Reclaim: To reprocess recovered refrigerant by distillation and other means so that it meets new product specifications. Reclamation is usually performed in a large scale centrally located facility with extensive analytical capabilities.

6.11 Recovery is the essential first step that must be taken before the refrigeration system is opened to the atmosphere. By definition the quantity of refrigerant recovered will not exceed its initial charge (e.g. 150-300 grams for a home refrigerator). Recovery of small quantities of refrigerant is possible but is generally not cost effective at current CFC prices. One system uses evacuated bags into which the refrigerant is vented. The bags are then sent to a central facility where their contents are pumped into a storage tank for recycle or reclamation .

6.12 To recycle refrigerants, specially designed machines are directly coupled to the refrigerant system charging line; refrigerant is processed through a variety of purification devices in the machine; the system is evacuated of all residual gases; virgin refrigerant is added to replace system losses, and the recycled refrigerant is returned to the system. In 1991, there were over 40 companies producing and marketing recycle/recovery machines in the United States.

6.13 The recycle procedure is particularly useful for large systems which are pre-equipped with the necessary valves and recovery tanks (e.g. large centrifugal chillers). Special recycle machines are available from major manufacturers for minimizing refrigerant loss during periodic maintenance. Owners of large systems are often reluctant to use recycle procedures because they believe the risk of inadequate purification is excessive. In such instances, it is feasible to recover the used refrigerant for reclamation and reuse in other facilities.

6.14 Reclamation of used refrigerant is a complex task requiring precise identification of all materials being handled to avoid cross contamination with other refrigerants and/or acceptance of dangerous substances in combination with the refrigerants. Purification generally requires large distillation facilities similar to those used during CFC manufacturers.

Economics

6.15 Recovery and recycle processes and procedures offer a low cost opportunity, at present, to significantly reduce ODS emissions in Egypt. Economic benefits from recycle/recovery are direct and derive from saving the net cost of ODSs (e.g. CFC-11 and CFC-12) which otherwise would have been imported. Current selling prices for CFC-11 and CFC-12 are $2.64/kg and $3.30/kg, respectively. The net savings to Egypt would be about $2/kg at Port Said.

6.16 Opportunities for ODS substitute savings will also develop from the technology used to recover CFCs. For example, as refrigerators containing HFC-134a penetrate the Egypt market and require service, recovery/recycle savings will derive from reduced HFC-134a imports (with a net value in excess of $10/kg).

6.17 On the financial side, investors may not find recovery/recycle sufficiently attractive under current conditions of high inflation and foreign exchange shortages. Internal Rates of Return (IRR) were estimated at only 8-14% for a typical recycle/recovery project. However, the imposition of an excise on imported CFCs will directly increase the value of the recovered and recycled CFCs. At the proposed excise levels, IRRs are estimated to exceed 50%, provided servicing costs are sustained within reasonable limits.

6.18 Recovery/recycle may also impact the availability of CFCs and indirectly affect the economic cost to Egypt after the year 2000 when supplies of CFCs become short. A basic assumption in this conclusion is that "drop-in" replacements for CFC-12, such as ternary blends, are not widely adopted, and that unserviceable refrigerators are scrapped.

6.19 The two basic strategies ("allowable" and "accelerated") were compared with and without recycling, but with the condition that in the allowable strategy, after 2005, some of the CFC-12 refrigerators which need service are scrapped due to a lack of CFC supplies. The assumption here is that up to one-half of the refrigerators needing service each year would be scrapped and replaced with new units.

6.20 The following economic costs were determined:

	Economic Cost to Egypt (M$)
Allowable (no recovery/recycle program)	$99
Allowable (recovery/recycle starting in 2000)	$92
Accelerated (no recovery/recycle program)	$31
Accelerated (per Optimum strategy)	$27

6.21 The above analysis suggests that the economic value of a recycle/recovery program to Egypt is $5-7M depending on the strategy chosen. Delaying the implementation of recycle/recovery diminishes its total value to the economy.

Chillers

6.22 Technology is available today to convert CFC-11 chillers in hotels and offices to HCFC-123 without a major investment in equipment changes. HCFC-123 is currently produced by DuPont, however, special handling precautions are needed pending completion of toxicity testing in 1994.

Foams

6.23 In addition to the foams used for insulation of refrigerators, ODSs are also used to produce the softer foams needed for furniture, mattresses, and packaging materials. These operations can convert from using CFC-11 to methylene chloride and water and still produce essentially the same product at or below their current cost of manufacture. Some manufacturers have made this transition

and are dealing with the toxicity concerns associated with methylene chloride by using appropriate protective equipment and improving their ventilation of the manufacturing area. A gradual transition to methylene chloride will occur as furniture manufacturers redraw their specifications and adjust their pricing.

Solvents (CFC-113; methyl chloroform; carbon tetrachloride)

6.24 Technology is available today for a wide variety of solvent applications. In general, special solvent systems are needed for each application. The problem in Egypt is that there are many small and diverse uses for ODS solvents, however, the total use is small. The forecasts assume that there will be a gradual transition to other solvents as prices rise and supplies of ODS solvents diminish. Ample technology is available globally to satisfy needs as they emerge.

Halons

6.25 Replacement materials for Halons are traditional CO2, dry powder and water fire extinguishants. Unfortunately, none of these materials are able to protect the high-tech equipment of today nor the people in the vicinity of the fire when the extinguishant is released. Replacements for Halons are being researched but are far from market ready. The forecast is that Halon alternatives will be available around the year 2000. Stockpiling of currently available non-essential stocks could service needs in the interim years.

Other ODS Applications

6.26 CFCs have provided specific advantages to the efficacy of certain medical applications because of their low toxicity, superior solvent characteristics, and other unique physical properties. A replacement for CFC-12 as a propellant for asthma inhalers has not been found. As this use is so small and unique, a special exemption for the application will likely be sought from the Montreal Parties at some time in the future. Use of CFCs in other medicinal applications may also seek exemptions.

Stockpiling

6.27 The collection and storage of reserve stocks of ODSs accumulate during periods of excess supply (e.g. 1991) and provides a mechanism to sustain suppliers of needed materials during periods of short supply such are predicted for the late 1990s. While it would be possible to build large stockpiles of ODSs, there are practical and financial constraints which would limit the scope of this activity (i.e. the financing of the stockpile, the spirit of the Protocol, and the decision process for using the stockpile). A stockpile, however, could be justified for highly specialized applications where suitable substitutes do not exist (e.g. medical applications) and for Halons where recoverable stocks exist is less than critical applications. It is likely that the issue of stockpiling will be considered in future decisions of the Montreal Protocol.

Cost of Substitution

Incremental Cost Issues

6.28 Estimation of incremental costs for ODS substitution has been the subject of several recent World Bank studies.[3] Uncertainties in the process focus on interpretations of Article 10 of the Montreal Protocol which established the Interim Multilateral Fund (IMFMP) and on the "Indicative List of Categories of Incremental Costs" which accompany Article 10 (Annex E of this report). Insofar as has been possible, Annex E guidelines were used to identify incremental costs.

Basic Assumptions

6.29 The following set of basic assumptions have been used in the development the costs analyses in this report:

- All prices and costs are in 1991 US Dollars. Future costs were discounted at 10% to 1991.
- The incremental cost to produce a non-ODS refrigerator in Egypt is $6.80/unit based on an analysis by King in "Financing the Phaseout of ODSs" This includes all incremental unit costs for the compressor, oil, desiccant, refrigerant. The incremental cost for a non-ODS foam system was assumed to be negligible base on mission discussions with foam experts.
- Incremental capital costs for retooling of the Egyptian refrigerator manufacturing capacity will be small and will be recovered through marketing of new models at slightly higher prices.
- Substitution of ODSs in the foam, aerosol, and solvents industries can be accomplished without incurring net incremental capital or operating costs.
- Recycle machines cost (exclusive of duties and taxes) - $2350 for refrigerators and $4000 for mobile air conditioners. Reclamation units will be financially viable and are not considered to be a net incremental cost.
- On average, a new refrigerator costs $320 in Egypt; 7 million units were in service in 1990, all using CFC-12 refrigerant. (avg. 250 g. CFC-12/unit.)
- Refrigerator production is currently 350,000 units per year for domestic use. Approximately 10% of Egypt's refrigerator production is exported.
- Refrigerators require servicing every five years (on average) in Egypt

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[3] King, K. and M. Munasinghe, "Incremental Costs of Phasing Out Ozone Depleting Substances", World Bank Environment Department Paper No. 47, 1991; King, K., "Financing the Phasing out of Ozone Depleting Substances", World Bank Environment Department Internal Paper, August 1991.

- Recovery efficiency of CFC-12 from domestic refrigerators is 90% but is only 27% from mobile air conditioners.

- There are 150,000 air conditioned cars,trucks, and busses in Egypt which require servicing every three years on average.

- All CFC-12 refrigerators in service in 2010 are assumed to become obsolete and are valued based on straight line depreciation discounted at 10% to 1991

ALTERNATIVE STRATEGIES

6.30 The full definition of strategies for analysis requires consideration of protocol ceilings and other constraints, economic activity, market conditions for ODSs, and an objective. In the case of this study, the objective is to identify the strategy which imposes the least economic cost on Egypt and is efficient and equitable to most ODS users. Economic and market descriptions have been described in the assessment of ODS use while protocol constraints are covered in Annex C.

6.31 The magnitude costs incurred by Egypt as a result of continued emissions of CFCs with resultant depletion of the ozone layer, and attendant increases in skin cancers, cataracts, crop damage, and global warming have not been included. The assumption is made that these costs, though difficult to quantify, are much larger than incremental costs determined in this report. This means that any delay in phasing out of ODSs will add to the net incremental cost of ODS phaseout. This further suggests that an accelerated phaseout will be the least costly to Egypt. The basic question is how quickly this can be accomplished given constraints on technology and materials.

Strategies Analyzed

6.32 Two contrasting strategies were chosen to cover a range of options open to Egypt for compliance with the Montreal Protocol.

- Allowable under Montreal Protocol - All transitions to ODS substitutes are delayed until the last possible instance without violating the phaseout requirements under the Montreal Protocol.

- Accelerated - The transition to ODS substitutes is accomplished sector by sector within one or two years of the technology becoming available.

Within each strategy, the effects of three (3) GDP growth rate patterns and two (2) sets of transition rates for ODS substitutes were evaluated.

Growth Assumptions

6.33 GDP growth rates for current (Base) conditions were assumed to be negative 2.3%/year; becoming zero in 1995; and increasing to 3%/year by 1998. In the high growth cases, growth was assumed to reach 6%/year by 1998, while in low growth cases, post-1995 GDP growth remained at zero. While the base case for transition to ODS substitutes was based on estimates from international experts, two cases were examined as optional accelerated strategies:

(1) Fast - An immediate across-the-board adoption of ODS substitutes (completed in 1994), and

(2) Slow - A delay of two years beyond what is considered to be feasible for Egyptian industry for an ODS phaseout.

6.34 While GDP growth rates and population growth are primary variables in forecasting ODS demand, consumer habits are also important considerations in developing sectoral forecasts. For example, domestic refrigerators contribute to quality of life and are one of the first necessity items to be purchased with disposable income. Traditionally, the growth in demand for domestic refrigerators has exceeded GDP growth by several percentage points. Therefore, for Egypt, in all strategies analyzed it was assumed that the refrigerant sector will grow 2% faster than the GDP growth adjusted for population growth.

6.35 In the foam and aerosol sectors, exclusive of refrigerant foams, many items are considered to be luxuries. Growth was therefore assumed to be at the GDP growth rate adjusted for population growth.

6.36 Industrial items such as solvents and Halons were assumed to grow at the GDP rate.

Results

6.37 A total of eight model runs were made to illustrate the identification of an optimum strategy.

- Allowable strategies under high, low and base GDP growth rate assumptions.
- Accelerated strategies under high, low and base GDP growth rate assumptions with examination of fast and slow transition to alternatives.

	Accelerated Phaseout (1992-2000) US$M	Optimum Phaseout (1994-1998) US$M	Allowable Phaseout (2000-2010) US$M
Net Incremental Capital Costs	2.6	2.6	1.2
Net Incremental Operational & Administrative Costs	17 - 27	19.5	3 - 10
Early Replacement Costs for Refrigerators	5.2 - 5.8	5.3	88 - 117
Total	24 - 35	27	92 - 129

Conclusions

6.38 The estimated economic costs to Egypt range from $26M to $129M in current US dollars depending on the rate at which the phaseout develops, and economic growth conditions thru 2010.

6.39 While the results of this analysis appear definitive and lead to the conclusion that a prompt and orderly phaseout will minimize the economic cost to Egypt, it should be borne in mind that the IMFMP does not provide for reimbursement of all of the economic costs included in this analysis.

6.40 Other conclusions from the analysis are:

(a) The economic cost associated with the forced early replacement of domestic refrigerators is a dominant element in the analysis. This stems from the fact that there will be approximately 10 million refrigerators in service in Egypt in 2010 and the replacement costs only apply to those continuing to use CFC-12. Obviously, an early transition to HFC-134a will reduce the population of CFC-12 refrigerators in 2010, and hence reduce replacement costs. Average age of the CFC-12 refrigerator population in 2010 was also a factor. In the accelerated cases, the average CFC-12 refrigerator was within two or three yrs of replacement while in the delayed case CFC-12 refrigerators had eight to ten years of remaining life.

(b) Project requirements and administrative costs were essentially the same in all cases analyzed, however, the timing of these investments had a small impact on economic cost ($2-3M)

(c) Operational costs ranged from $16M to $27M, and were primarily reflective of the net incremental costs for non-ODS domestic refrigerators. Again the timing of the introduction of these refrigerators was a factor in the magnitude of operational costs.

(d) The incorporation of recycle/recovery into the accelerated phaseout cases had the effect of reducing ODS consumption and reducing protocol limits. Its primary benefit was assure local supplies CFC-12 at a cost approximately $2/kg below import costs. This savings (up to $0.7M/yr) reduced net operational costs. Additional savings (not included) should be expected from applying this technology to the conservation of HFC-134a.

7.0 RECOMMENDED STRATEGY

7.1 It is recommended that the government of Egypt adopt a National Ozone Policy (NOP) integrated with a series of projects that support a phaseout of ODS consumption as soon as is technically feasible in order to accomplish the phaseout at the least economic cost to Egypt. Funding of the projects is to be financed in the context of the overall NOP.

7.2 National Ozone Policy is a set of government policy instruments directed specifically at the phasing out of ODSs. Four broad approaches--coordination, market-based, command and control, and voluntary--are blended into the NOP for Egypt in a pragmatic way.

7.3 For each stage of the Action Plan, policy instruments are required to support the existing investments and prepare for the next stage. The primary emphasis is on **effectiveness** (i.e., to encourage rapidity of phase out) and the secondary emphasis on **efficiency** (i.e., to control costs as much as possible without seriously compromising rapidity). The trade-off is a matter of judgment, taking into account consideration of uncertainty, and institutional constraints/policy traditions.

7.4 Each policy option is based on various assumptions and parameters.

Technology availability. Assumptions were made about when the alternate chemicals will be "technically available", in accordance with technical progress in industrialized countries. In the Egyptian situation, there are five key technologies that will affect the use of ODS in the major user sector (refrigeration and air conditioning): refrigerant fluid, compatible lubricating oils, compressors, insulation, and servicing techniques. In the foam industry technology is available now. Many solvents have replacements, but solvents are not a major ODS requirement in Egypt. Halon replacements are not currently available, but stockpiling to service essential users is an interim solution.

Phase out targets. These are taken as given (although in principle the Protocol could be revised by the Parties). These targets provide an envelope of maximum consumption within which planned consumption must fall.

Demand. The future demand for ODS (or suitable substitutes) is rather uncertain and can only be treated on a strategy basis. High, Base Case, and Low contrasting strategies were developed in order to test the impact of alternative phaseout speeds on ODS consumption and cost.

Future costs. Perhaps the least known parameters are the future costs of the alternate chemicals and substitute technologies. Industry "best" estimates were used.

7.5 The recommended policies are those which are compatible with the existing institutional and policy framework of Egypt and fully utilize market forces and negotiated agreements with industry to accomplish phaseout goals in a cost effective and equitable manner.

7.6 Public acceptance of the inconveniences accompanying the ODS phaseout is an essential ingredient in achieving a prompt and effective ODS phaseout. It is recommended that the government of Egypt actively support programs directed at elevating public awareness, in particular recycle/recovery activities, and provide early announcement of its intentions to both the public and to industry to encourage appropriate dialogue.

7.7 The following National Ozone Policy (NOP) will be adopted by the Government of Egypt to facilitate a prompt enad effective phaseout of ODS use in compliance with the Montreal Protocol:

- O Create an "Ozone Panel" within the Federation of Egyptian Industries (FEI) to provide a consultive role in the formulation and promulgation of specific policies forming the NOP. The "Ozone Panel" will also function to develop voluntary agreements within industry to establish specific end-use bans consistent with the overall objectives of the ODS phaseout program. The FEI will study all appropriate policy instruments for accomplishing the phaseout promptly and effectively and will recommend adoption of those which are most necessary.

- O Through the FEI Ozone Panel, monitor ODS phaseout progress and evaluate the need to increase prices of ODSs to levels at or below which substitutes become financially attractive in order to provide incentives where the phaseout may be lagging. The recommended policy instrument is an import tax on CFCs at a level which encourages the use of the substitutes.

- O Strengthen the Egyptian Environmental Affairs Agency by increasing technical and financial resources to a level consistent with growing environmental needs within Egypt.

- O Establish a licensing system for ODS users which encourages environmentally responsible handling practices and restricts distribution to users qualified through approved training programs.

- O Establish ODS import monitoring procedures which account for all ODSs as required under the Montreal Protocol, and from which progress in reducing ODS consumption can be tracked to make appropriate adjustments in programs and policies.

- O Expedite implementation of specific projects directed at reduction of ODS use and adoption of substitute chemicals and technologies. All imported equipment and technologies are to be exempted from customs duties , sales taxes, etc.

- O Public awareness of the "ozone issue" will be enhanced through media attention to programs and projects included in a Demonstration Program for ODS reduction technologies. Emphasis will be placed initially on the conservation aspects of the projects and subsequently on demonstration of cost savings upon project completion.

ACTION PLAN SUMMARY
EGYPT

Item	1992-1993	1994-1995	1996-2010
"Ozone Panel"	Establish joint industry-gov't. panel within the FEI to encourage dialogue on key issues and to broker agreements on bans and other policies	. Continue functions as outlined.	Continue functions as outlined
Monitoring	Develop a monitoring system for ODS imports within the Customs Dept. which meets the following objectives: - complies with reporting requirements of the Montreal Protocol - tracks progress of ODS phase - supports excise collection	Monitor progress and issue proper reports to UNEP and others. Monitor effectiveness of excise.	. Continue monitoring to assure phaseout completion.
Licensing	Conduct workshops for refrigeration service personnel featuring recovery/recycle	Establish a licensing system for refrigerator service personnel	Extend licensing to all ODS users
Public and Industry Awareness	Direct media attention to demonstration projects on recycle/recovery of CFCs and to the necessity to conserve precious CFC supplies. Communicate features of National Ozone Policy to the public and to industry.	Continue to enhance awareness and outreach activities with workshops and seminars. Announce new policies well in advance of introduction.	Continue to develop support for phaseout activities

ACTION PLAN SUMMARY
EGYPT
(continued)

Item	1992-1993	1994-1995	1996-2010
Recycle/Recovery	. Develop and implement project to demonstrate recycle/recovery for domestic refrigerators, mobile air conditioners and large chillers to encourage public awareness and to secure basic data for replication of similar projects in Egypt. Make feasibility study of regional reclamation facility for CFCs.	. Evaluate initial results and expand application of recycle/recovery to about 15% of the service jobs on domestic refrigerators and to 60% for mobile air conditioners Est. cost - $500,000	. Continue to expand the application of recycle/recovery to cover entire market opportunity. Est. cost: $3,000,000
Excise on CFCs	FEI to consider pro and con of excise on CFCs with goal of discouraging continued use of CFCs where adequate substitutes are available.	Apply excise tax to CFCs if considered necessary to accelerate rate of CFC phaseout. Est. (CFC-11) 20-40 LE/kg (CFC-12) 30-50 LE/kg	. Sustain excise at feasible levels.
Bans	Enforce ministerial decree banning use of CFCs in aerosols. "Ozone Panel" to consider additional bans on select end-users and recommend new bans as needed, e.g. - carbon tetrachloride - CFC-113 solvents - etc.	Prepare to ban servicing of refrigeration devices without using proper recycle/recovery techniques Implementation based on FEI review of recycle/recovery program results	Prepare bans for all CFCs (to take effect in 2000)

RECOMMENDED GOVERNMENT ACTIONS

8.5 The following is a summary of actions recommended for the various ministries and agencies with active roles in the implementation of an ODS phaseout in accordance with the Montreal Protocol.

Ministry of Cabinet Affairs and Ministry of State for Administrative Development

Develop a long range plan, based on this report, which establishes a concensus for activities to institutionalize a National Ozone Policy (NOP) predicated on a prompt phaseout of ODS consumption in Egypt. Allocate appropriate resources within the government to assure effective implementation of the NOP.

Coordinate the efforts of all ministries involved with the NOP at all stages of its development and implementation.

Egyptian Environmental Affairs Agency (EEAA)

Support the International Coordination Unit (ICU) within the EEAA to manage the implementation of World Bank and UNDP projects and programs focused on the environment and to coordinate the ODS reduction project preparation activities.

Continue participation in all International conferences on the Montreal Protocol and related issues, and feed back information and data to interested ministries, particularly with regard to timing matters and proposed revisions to the Protocol.

Suggest needed legislation to the Ministry of Cabinet Affairs for consideration in the development of long range plans for the ODS phaseout.

Establish liaison with the Federation of Egyptian Industries (FEI) through the FEI "Ozone Panel"

Ministry of Finance

Develop an import monitoring system for ODSs which provides data to meet full UNEP Montreal Protocol reporting requirements and which can be used to monitor progress in phasing out all ODSs.

Assure exemption from customs duties and sales taxes of all equipment and technologies receiving grant assistance from the Interim Multilateral Fund of the Montreal Protocol (IMFMP)

Ministry of Interior

In cooperation with EEAA develop enforcement policies for new laws, regulations and decrees adopted under the NOP to accomplish the ODS phaseout.

Ministry of Industry

Coordinate activities of the FEI and EOS in facilitating efforts to support the NOP and accomplish the ODS phaseout.

Support establishment of the "Ozone Panel" within the FEI.

Encourage EOS development of necessary engineering standards for the technologies needed for ODS phaseout so that project activies are not impeded.

Provide coordination as necessary for public sector industrial acitivites, particularly in cases impacted by privitization.

Federation of Egyptian Industries (FEI)

Establish a consultive "Ozone Panel" including representatives of ODS industries and advisors from the government to assis development of coordinated government–industry policies under the NOP.

Facilitate liaison with all key ministries, industry leaders and other public interests to assure appropriate dialog during the development and implementation of the NOP.

Establish a licensing system for ODS users based on appropriate training requirements and demonstrated performance.

Organization for Standardization and Quality Control (EOS)

Develop engineering standards for ODS substitute chemicals and technologies based on international standards.

Ministry of State for International Cooperation (MSIC)

Sign and obtain ratification for grant agreements from the IMFMP. Receive designated funds from the IMFMP and dispense to designated Banks for use in implementing approved project activities.

INVESTMENT

8.7 The external constraint (uncertainty about future costs and availability of technology), the differing business states of ODS users and the objective of minimizing costs introduce a time element into the Action Plan.

8.8 A first tranche of investment under the plan will be focused on the most cost effective projects by companies with active interest in the ODS phaseout who have participated with UNDP and the World Bank in project development. The second tranch will focus on projects and programs needed to meet the institutional and policy objectives of the Country Program. The third tranche will be initiated in parallel with the secon tranche and will concentrate in major ODS users who need special assistance in organizing and completing their project activities. A fourth tranche would follow to complete the ODS phaseout program.

8.9 The following projects are proposed for tranche one submission:

a. Conversion of CFC-12 refrigerator compressor manufacturing plant to one capable of producing HFC-134a compressors. (Misr Compressor Manufacturing Co)

b. Replacement of CFC-12 with HCFC-22 in water coolers (Koldair)

c. Hi-Pressure foaming equipment for non-CFC rigid and semi-rigid foam manufacture. (Taki Foam and Technopol)

d. Improved ventilation to permit safe use of methylene chloride for flexible foam manufacture.(Misr Foam)

e. Conversion of polystyrene/polyethylene sheet manufacture to hydrocarbons. (Al Sharif)

f. Pilot plant for Domestic Refrigerators (IDEAL)

8.10 A umbrella project to meet country wide training programs and facilities will be submitted in tranch two along with a project improve institutional capacity for implementation of the country program and to upgrade reporting and continued monitoring of ODS use throughout Egypt.

8.11 Tranche three will consist mainly of projects in the refrigeration sector to convert domestic refrigerator manufacturers to non-CFC designs and to recover and recycle CFCs commonly vented during the servicing of refrigerators and air conditioners. The fourth tranche will focus on a variety of small ODS users in all sectors and would be designed to complete the ODS phase out by 1998.

PROJECT SUMMARY

8.12 Annex A summarizes all projects believed to be necessary for a complete phaseout of ODS in Egypt.

Annex A.1
ODS PHASEOUT PROJECT SUMMARY
EGYPT

No	#	Sector	Company	Title	Implementing Agency	Budget($)	ODS Tons/yr	Unit Abatement Cost ($/kg)
1	1	Refrigeration	MCMC	Manufacture of HFC-134a Compressors	World Bank-IFC	2,800,000	325	0.67
2		Refrigeration	Koldair	Replacement of CFC-12 with HCFC-22	UNDP	272,000 + 141,000/yr	18	23.96
3		Foams- Rigid	TAKI-VITA	Hi-Pressure Foaming	UNDP	490,000 + 90,000/yr	34	3.39
4		Foams-Rigid	Technopol	Hi-Pressure Foaming	UNDP	645,000 + 45,000/yr	55	2.73
5		Foams - Flexible	Misr Foam	Ventilation for safe MeCl Use	UNDP	415,000 + 22,000/yr	100	0.45
6		Foams-PS Sheet	Al Sharif	Butane-Safe Use	UNDP	1,715,000 + 15,000/yr	75	2.40
7	2	All	Government of Egypt	Technician Management Seminars	UNDP	500,000 + 20,000/yr	NA	NA
8		All	Government of Egypt	Institutional Capacity Building	TBD	1,000,000 + 50,000/yr	NA	NA
9		All	Government of Egypt	Monitoring of ODS Imports	TBD	1,500,000 + 500,000/yr	NA	NA
10		Refrigeration	TBD	Training & Recovery/ Recycle of CFCs	UNDP UNIDO	3,000,000	200	1.50
11		Refrigeration	Kiriazi	Improved service & 50% CFC in Refrig foam	TBD	1,225,000	50	2.50
12		Refrigeration	Electrostar	Conversion to non-CFCs in Domestic Refrigerators	TBD	500,000	50	1.00
13		Refrigeration	IDEAL	Pilot Plant for Domestic Refrigerators	UNDP	3,134,000 + 334,000/yr	10	high

Annex A.2
ODS PHASEOUT PROJECT SUMMARY (cont)
EGYPT

No	#	Sector	Company	Title	Implementing Agency	Budget ($)	ODS Tons/yr	Unit Abatement Cost ($/kg)
14	3	Refrigeration	Alaska	Conversion to non-CFCs in Domestic Refrigerators	TBD	1,650,000	42	3.30
15		Refrigeration	Iberna	Conversion to non-CFCs in Domestic Refrigerators	TBD	790,000	13	6.00
16		Refrigeration	Kiriazi	Convert to HFC-134a Refrigerant	TBD	534,000 + 400,000/yr	30	2.60
17		Refrigeration	Kiriazi	Convert to non-CFC foam	TBD	6,450,000	40	16.10
18		Foams-PS Sheet	Interfood	Butane-Safe Use	TBD	1,400,000	240	0.58
19		Foams-PS Insulation	Advechems	Replacementof CFCs with HCFCs	TBD	450,000 + 415,000/yr	196	
20		Foams- Rigid Board	Military	50% CFC Reduction	TBD	1,830,000	40	4.60
21		Aerosols	ElNasr	Replace CFC with LPG	TBD	3,000,000	450	0.75
22		Aerosols	Beleidy	Replace CFC with LPG & other	TBD	1,500,000	450	0.35
23		Aerosols	SIPEC	Replace CFC with LPG	TBD	200,000	60	0.33
24		Aerosols	KZ	Replace CFC with LPG	TBD	2,000,000	?	?
25		Aerosols	Dexan	Replace CFC with LPG	TBD	675,000	85	0.79
26	4	All	TBD	ODS Reclam ation Center	TBD	5,000,000	?	?
27		Halon	TBD	Recovery & Halon Bank	TBD	$1,000,000	?	?
28		Refrigeration	Balance of Users	Complete Refrigerator Conversion	TBD	$5,000,000	?	?
29		Foams	Balance of Users	Complete Conversion to non-CFCs	TBD	$2,000,000	?	?

ANNEX A.3
ODS PHASEOUT PROJECT SUMMARY (cont.)
EGYPT

TRANCHE		BUDGET $	ODS (TONS/YEAR)
1		6,337,000 + 213,000	607
2		10,859,000 + 434,000	310
3		20,479,000 + 815,000	1651
4		13,000,000	?
TOTAL		51,675,000 + 1,462,000	2568+

ANNEX B

ODS PHASE-OUT ALTERNATIVES

Refrigeration and Air Conditioning

B.1 Chlorofluorocarbon refrigerants were developed in the early 1930s. They provided a safe alternative to ammonia, sulfur dioxide and isobutane, which at the time were the cooling fluids commonly used in home refrigerators and air conditioners for public buildings. While other applications have resulted from CFC development, cooling applications grew most rapidly. Today, the fluorocarbon family of compounds account for nearly all cooling fluids used by the refrigeration and air conditioning industry in the vapor compression systems which have become the industry standard.

B.2 For satisfactory performance in the vapor compression common to most units, a refrigerant must not only have favorable thermophysical properties but also be non-flammable, basically non-toxic, and inert to materials of construction. Fluorocarbons have achieved their prominence because they posses the unique combination of properties which best satisfies these sometimes conflicting requirements.

B.3 Refrigeration systems using fluorocarbons as the cooling fluid are common in all sectors of modern society. The most common units are the domestic refrigerators and freezers found in nearly all developed countries' homes and in a growing number of households in developing countries. At retail stores, food display cases are refrigerated to extend shelf life and prevent spoilage. At the wholesale level, large warehouses and transport vehicles (trucks, trains, and ships) are refrigerated to expand the market areas for their products. Industrial plants use refrigeration to sustain desired operating conditions and to prevent loss of volatile substances. Finally, air conditioning utilizes fluorocarbon refrigerants to cool air in a variety of environments, including most mechanical forms of human transportation, in many homes and most modern office buildings and hotels. Air conditioning is particularly important in the hotter regions of the world.

Market Segmentation

B.4 Due to the wide range of applications for fluorocarbon refrigerants, the industry ordinarily segments users as follows:

By the type of device utilizing fluorocarbons

By the end-use served by the device

By the servicing of the device.

B.5 Within each segment there are usually only one or two fluorcarbons with physical properties best suited to the application. These fluorocarbons naturally serve most of the users within the segment.

Commonly Used CFCs for Retrigerators and Air Conditioners

Refrigeration	
Commercial Units	
Food Storage	CFC-12; R-502
Industrial Machines	CFC-12
Transport Units	CFC-12; R-502
Home Refrig/Freezers	CFC-12
Vending Machines	CFC-12
Air Conditioning	
Large Buildings	CFC-11; CFC-12; HCFC-22
Mobile Units	CFC-12
Room and Package Unit	HCFC-22
Heat Pumps	HCFC-22

Alternatives to Chlorofluorocarbon Refrigerants

B.6 There are several options for replacing CFCs in the vapor compression systems commonly used in refrigeration and air conditioning equipment. The Technical Options Report prepared in May 1989 under the auspices of the United Nations Environmental Programme identified the following options described below for replacement of CFC cooling fluids:

Use HFC-134a.

B.7 This appears to be one of the best long term alternative refrigerants. Most equipment manufactures have based their long term plans on using HFC-134a to replace CFC-12 in new refrigeration systems. Compression equipment must be redesigned to optimize energy efficiency. More importantly, the standard lubricant used in CFC-12 systems must be replaced with one which is compatible with HFC-134a. Such lubricants are commercially available but are significantly more costly the CFC-12 lubricants. Alternative lubricants are polyester and polyalkaneglycol (PAG) oils. The polyester oils are the most stable as well as the most expensive. They are the lubricant of choice for long-service equipment such as domestic refrigerators. PAGs are the lubricant of choice for automotive air conditioners which have an average service life of only 5-7 years in the developed world.

Replace CFC-11 with HCFC-123.

B.8 Low pressure water chiller systems used for air conditioning in most large office buildings, hotels, and similar structures commonly employ CFC-11 as the refrigerant. These systems form an integral part of each building structure and represent a major investment component. Replacing such systems is not feasible. Retrofitting existing water chiller units to use an alternative refrigerant such as HCFC-123 is the most developed option for eliminating CFC-11 use at this time. Field testing of such retrofits has been underway by major

manufacturers for several years. The technology for accomplishing the retrofit is readily available. Equipment modifications include minor changes in elastomeric and motor components; however, system capacity is reduced by up to 10 percent. Toxicity testing of HCFC-123 must be completed before this technology can be widely applied. Preliminary tests have indicated that exposure of workers to HCFC-123 vapors must be limited. An interim ALV of 10 ppm has been set as a precautionary measure pending completion of the tests.

Use "drop-in" ternary blends.

B.9 A series of ternary fluorocarbon mixtures (HCFC-22; HFC-152a; HCFC-124), referred to as "blends", have been designed as "drop-in" replacements for CFC-1B. The primary feature of these "blends" is that they simulate quite closely the thermodynamic properties of CFC-1B. They are also compatible with the same lubricant as is used with CFC-1B. The "blends" have the potential to satisfy the long-term service requirements for equipment, such as domestic refrigerators and auto air conditioners currently using CFC-1B. "Blends" are also considered to have potential as an interim substitute for HFC-134a in cases where equipment designs are retrofit for "blends" rather than redesigned for HFC-134a.

B.10 From the perspective of a developing country with limited technological resources, the primary disadvantages of "blends" include the following items.

- Most "blends" are proprietary mixtures patented by DuPont and are therefore not available from multiple sources.
- "Blends" tend to lose one component more rapidly than the others. Hence, there is a composition and performance drift with time. Restoring the system to an original composition can require chemical analysis and special metering of components.
- The "blends" require two components which although available are in short supply on the world market (HCFC-124 and HFC-152a).
- Life testing of equipment retrofitted with "blends" is at a relatively early stage. Such testing must be satisfactorily completed prior to global acceptance of this technology.

B.11 On balance, the economic advantages of "blends" outweigh the disadvantages primarily because of the large installed base of equipment (e.g. refrigerators) which can complete their useful life without requiring CFC-12 for servicing. "Blends" would offset this potential economic cost.

B.12 The future for "blends" in developing countries is one of gradual growth commencing about 1995 as supplies of CFC-12 become scarce. Growth, however, will be constrained by supply of technology and materials from the United States.

Conserve available CFC resources.

B.13 Significant quantities of CFC-12 are wasted during servicing of defective refrigeration equipment. Some of the wastage is the result of diagnostic procedures which use CFC-12 as a test gas. Additional wastage occurs when improper recharging equipment is used

by inexperienced service personnel. Proper service procedures for devices such as domestic refrigerators have the potential to reduce CFC-12 imports in some countries by over 50 percent. While conservation practices which reduce wastage of CFCs are cost effective, traditional CFC prices will need to increase significantly to support the required changes within the equipment service community.

Retrofit Existing Equipment for HCFC-22

B.14 Specialty equipment, such as water coolers, use small CFC-12 refrigerant units which can be replaced with similar HCFC-22 units. Equipment redesign efforts are small, while the HCFC-22 technology is well proven in devices such as window air conditioners. The obvious advantage for such redesign is that HCFC-22 has an ODP of only 0.05. The added cost of the HCFC-22 compression system, and the added cost of the redesign are disadvantages which will be overcome as supplies of CFC-12 become short, and prices for CFC-12 escalate.

Use Ammonia.

B.15 This option is only a viable consideration for new installations, as ammonia will not function in existing equipment. Ammonia has good thermodynamic properties and good heat and mass transfer properties and is the lowest-priced refrigerant available today. Under specific operating conditions it has a high coefficient of performance. Ammonia is toxic and flammable, characteristics which are important safety concerns when public exposure to leakage is possible.

B.16 Application of ammonia as a significant replacement for CFC-11 or CFC-12 refrigerant is unlikely.

Recovery - Recycle - Reclamation of CFCs

B.17 Opportunities to conserve existing supplies of CFC by recapturing and reusing CFCs from existing facilities exist primarily in the refrigerant sector. Refrigerants are usually contained in a sealed systems and are amenable to recapture during routine repair or maintenance. Flexible foams release their contained CFCs during the first few days following manufacture. Closed-cell rigid foams slowly release their CFCs over a period of several years. Aerosol products release their CFCs immediately upon use.

B.18 Refrigeration and air conditioning equipment (e.g. home refrigerators, auto air conditioners, etc.) require periodic repair or maintenance during which it is usually necessary to remove the CFC refrigerant before the appropriate service procedure can be performed. A common repair is to locate and seal a leak thru which CFC escaped. Another common repair is to replace of the hermetically sealed compressor-motor unit because the motor is burned-out. Both repairs require discharging any residual refrigerant in the system before commencing the mechanical phase of the repair procedure. Large commercial and industrial system users employ periodic preventative maintenance to protect their investments. A common component of maintenance procedures is replacement of used CFC refrigerant with virgin material to remove contaminants (water, air, degraded oils, metal particles) from the system. The used CFCs are often discharged to the atmosphere.

B.19 Different types of equipment use different refrigerants; they must not be mixed. A refrigeration device must not be recharged with a refrigerant other than that for which it was originally designed without consultation with the manufacturer of the original equipment.

B.20 Conservation of refrigerants used in existing facilities requires: 1) isolation of the refrigerant within the system; 2) coupling the system to an external container; 3) conveying the refrigerant from the system to the external container; 4) purification of the recovered refrigerant, and 5) recharging equipment with pure refrigerant. There are three terms which best define the various phases of these activities in the refrigeration and air conditioning sector - recovery, recycle, reclaim.

> **Recovery:** To remove refrigerant in any condition from a system and store it in an external container without testing or processing.
>
> **Recycle:** To purify refrigerant for reuse by oil separation, filtration, drying, and/or chemical treatment. This procedure is usually (but not necessarily) performed on a job site or in a service shop and the purified CFC is returned to the equipment from which it was originally recovered.
>
> **Reclaim:** To reprocess recovered refrigerant by distillation and other means so that it meets new product specifications. Reclamation is usually performed in a large scale centrally located facility with extensive analytical capabilities.

B.21 Recovery is the essential first step that must be taken before the refrigeration system is opened to the atmosphere. By definition the quantity of refrigerant recovered will not exceed its initial charge (e.g. 150-300 grams for a home refrigerator). Recovery of small quantities of refrigerant is possible but is generally not cost effective at current CFC prices. One system uses evacuated bags into which the refrigerant is vented. The bags are then sent to a central facility where their contents are pumped into a storage tank for reclamation.

B.22 To recycle refrigerants, specially designed machines are directly coupled to the refrigerant system charging line; refrigerant is processed through a variety of purification devices in the machine; the system is evacuated of all residual gases; virgin refrigerant is added to replace system losses, and the recycled refrigerant is returned to the system. The recycle procedure can be interrupted prior to the evacuation step in order to inspect or repair system defects.

B.23 The recycle procedure is particularly useful for large systems which are pre-equipped with the necessary valves and recovery tanks (e.g. large centrifugal chillers). Special recycle machines are available for minimizing refrigerant loss during periodic maintenance. Owners of large systems are often reluctant to use recycle procedures because they believe the risk of inadequate purification is excessive. In such instances, it is feasible to recover the used refrigerant for reclamation and reuse in other facilities.

B.24 Reclamation of used refrigerant is a complex task requiring precise identification of all materials being handled to avoid cross contamination with other refrigerants and/or acceptance of dangerous substances in combination with the refrigerants. Purification generally requires large distillation facilities similar to those used during CFC manufacture.

FOAMS

B.25 CFCs are used in the foam sector for processes which expand plastic materials to create insulation, cushioning, packaging products, floatation devices, and shoe soles. Foams compete with fiberglass, paper, polyester fiberfill, and natural fibers for application in end-products. CFCs are used as blowing agents because they have suitable volatility and low toxicity, are non-reactive and non-flammable, and are cost effective. When retained in the foam cell structure, their low thermal conductivity imparts excellent insulation characteristics to the foam. CFCs in combination with other agents are also used to decrease foam density and increase softness of flexible foams. CFCs cool the exothermic reaction in the production process and protect the product against overheating and burning.

Market Segmentation and Alternatives

B.26 The primary plastic types and their respective CFC blowing agents are:

Polyurethane	CFC-11
Polystyrene	CFC-12
Polyolefins	CFC-11/12/114
Phenolic	CFC-11/113

Polyurethane

B.27 Polyurethane foam is produced by in-situ catalytic polymerization of a polyol and a reactive isocyanate [toluene diisocyanate (TDI) or diisocyanate-diphenylmethane (MDI)] in the presence of a blowing agent (CFC-11, methylene chloride, or CO2). The specific ingredients used depend on the foam characteristics desired. Flame retardants are added to meet end user specifications. Since the process is catalytic, exothermic, and initiates at ambient conditions, ingredients are mixed in their proper proportions at the point of their introduction into the process.

B.28 Polyol/blowing agent/catalyst systems are frequently premixed by suppliers so that reaction can be initiated simply by adding the isocyanate. Premixing reduces the need for storage and mixing facilities at the user's plant and usually improves quality control. Large manufacturers, however, prefer to mix their ingredients on site.

B.29 Foam products are classified as:

Flexible--Open cell structure--flexible and elastic foams for cushioning in home and office furniture, bedding, carpet underlay, and car seats.

Semi-Rigid--Open cell structure--moderate elasticity for safety padding in vehicle interiors (instrument panels, arm rests, door panels, etc).

Rigid--Closed cell structure for acoustic and thermal insulation--panels in housing and for insulation of home refrigerators.

Integral Skin--Compact outer skin with a gradual change over to a fine cellular core; high rigidity and surface hardness, low weight--desks, windows, electronic parts, and shoe soles.

B.30 CFC-11 requirements vary with the type of foam being produced. As an ingredient, CFC-11 accounts for 10-30 percent of the finished foam weight. Methylene chloride can be used to replace CFC-11 in most flexible foam applications on an equimolar basis; however, methylene chloride toxicity (suspect carcinogen) is a concern which must be delt with in the process environment by use of protective equipment to avoid worker exposure to fumes released during foam formation.

B.31 Polyurethane foams can also be expanded by carbon dioxide (CO2) which is generated in-situ by a reaction between water and isocyanate. These so-called "water blown" foams are not as soft as "CFC blown" foams and must be specially formulated to achieve acceptable product quality. Partial water substitution for CFC-11 has been demonstrated to reduce CFC requirements without significant loss of performance in rigid foams.

B.32 Home refrigerators contain significant quantities of rigid foam which is formed in place at the point of manufacture to insulate the interior compartment and to add stability to the external shell. Refrigerator manufactures usually mix their ingredients on site. CFC-11 requirements have been reduced at several locations by up to 50 percent by employing a combination of "water blown" and CFC-11 expansion methods with special polyols.

B.33 HCFC-22 has shown promise as a direct replacement for CFC-11 without major formulation adjustment. Although HCFC-22 is a gas (boiling point -40.8C) at ambient conditions, its extremely good solubility in polyols and polyurethane systems allows it to be used with only minor equipment modifications. On a weight basis, approximately 60-65% of the amount of CFC-11 is needed to reach CFC-11 equilibrium free rise densities thereby reducing net cost of manufacture. HCFC-22 blown foam cell structures tend to be somewhat finer and may require formulation adjustment to stabilize the foam. However, the finer structure improves insulation value and partially offsets the higher thermal conductivity of HCFC-22 as compared to CFC-11.

B.34 HCFC-123 (ODP=0.02) and HCFC-141b (ODP=0.15) are also potential blowing agents for polyurethane foams. HCFC-141b must be handled as a flammable liquid. HCFC-123 has been assigned a 100 ppm AEL (Acceptable Exposure Level) and will require special handling. Both materials are being extensively tested for toxicity as part of the Program for Alternative Fluorocarbon Toxicity Testing (PAFT), sponsored by major global fluorocarbon manufacturers. Scheduled dates for reporting results of the PAFT two-year chronic inhalation exposure tests are:

PAFT Reporting Dates - Two-Year Tests	
HCFC-123	mid-1992
HCFC-141b	mid-1993

B.35 Application of HCFC-123 and HCFC-141b as commercial blowing agents, even on a small scale, prior to completion of the PAFT tests is unlikely. Early tests have indicated a

need to establish an ALV of 10 ppm as a precaution. Also, world capacity for production of these materials will be limited until it is clear that toxicity is acceptably low and that there will be sufficient demand and justification for the required capital investment.

B.36 In summary, it is technically possible to reduce CFC consumption in the polyurethane foam industry by at least 80 percent using a combination of process modifications and currently available blowing agent/polyol systems. Complete elimination of CFCs will require development of new blowing agent systems, probably HCFC-based, or changes in design of the end-products as new technologies (e.g. vacuum panels) emerge.

Polystyrene

B.37 There are two types of polystyrene foam: rigid boardstock for insulation, and rigid sheet for disposable food service and packaging products. Both types of foam are produced by an extrusion process in which CFC-12 is dispersed in molten polystyrene under high pressure. As the mixture leaves the extruder, the CFC-12 vaporizes and causes the plastic to expand uniformly. The high moisture resistance of polystyrene makes it practical and cost effective for applications where water is present. Since polystyrene is thermoplastic, sheets can be molded into special shapes for packaging foods, meats and eggs. These applications are of environmental concern because they contribute to solid waste and are not biodegradable.

B.38 HCFC-22, in combination with hydrocarbons, can be substituted for CFC-12 in the manufacture of most extruded polystyrene sheet products. HCFC-22 has FDA approval in the U.S. for food packaging, provided HCFC-22 concentration is <5ppm at the time of food contact. Other HCFCs and HFCs are being considered as CFC-12 replacements. All must await completion of toxicity tests and all will need special approval for use in contact with foods. In the mean time, natural products and plastic sheets can and will displace most applications for polystyrene sheet.

B.39 HFC-152a is gaining acceptance as a blowing agent for polystyrene in facilities equipped for handling flammable gases, such as propane.

Other Foams

B.40 Polyolefin foams account for only five percent of all foams and include products made from polyethylene and polypropylene resins which occasionally include other resins as modifiers. The process technology for polyolefins is essentially the same as that used for polystyrene except that the blowing agent is usually a mixture of CFC-114, CFC-12, and/or CFC-11. Specific properties of polyolefin foams meet the requirements for packaging of high value goods such as furniture and electronic devices where the package must be designed to provide a high degree of product protection. Substitute packaging materials and systems do not usually meet the high performance requirements of these products.

B.41 Hydrocarbons, and HCFC-22/HCFC-142b mixtures are used today to replace CFC-12 in polyolefin foam manufacture.

Cosmetics

B.47 Major applications of CFCs in cosmetics include hair sprays, antiperspirants, perfumes and colognes, skin care products, shaving creams, and other personal products. These applications account for 30-50 percent of all aerosol production in most countries. Active ingredients can vary widely. Propellants must meet special requirements of compatibility with all components in the system.

B.48 Propellants must be non-toxic, inert, odorless, and preferably non-flammable. CFC-12 and CFC-114 are commonly used in combination with various alcohols and water. Alternative non-CFC delivery systems such as pumps and sticks have satisfied half of the cosmetic market needs, but most consumers still prefer aerosols. Propellants such as deodorized liquid petroleum gas mixtures (LPG) are one CFC substitute but are often flammable during use. Dimethyl ether (DME) is also flammable but is used because of its compatibility with water based formulations. There is no universal alternative for cosmetic applications, as each has its own specific requirements and preferences.

Household Products

B.49 Household products account for approximately 30-40 percent of the demand for aerosol propellants. These products include laundry aids, furniture polishes and cleaners, oven cleaners, air fresheners, insecticides, and insect repellants. They usually compete with similar non-aerosol products but are preferred based on the performance of their delivery system. The most commonly used CFCs are CFC-11 and CFC-1B. Replacement with LPG has been satisfactory. One company, Johnson Wax, converted all of their CFC aerosols to LPG propellant in 1975 and has had satisfactory performance opposite competitive products ever since.

Other Aerosols

B.50 Miscellaneous aerosol propellant applications account for the balance of demand and include paints, coatings and finishes, lubrication products, automotive products, speciality insulation systems, food products, and medicines. CFC-11 and CFC-12 are commonly used. Replacement with LPG and inert gases such as CO_2, N_2O and N_2 have been effective in most cases with the exception of medical applications, where the special characteristics of CFCs have made them essential and irreplaceable.

SOLVENTS

Background

B.51 The unique solvent characteristics of chlorinated hydrocarbons and fluorocarbons has led to a wide range of solvent applications where cleaning efficiency and product quality are enhanced significantly as a direct result of using the solvent.

B.52 Three industries rely on solvents for sustaining product integrity.

Electronics - where residues must be removed from components (electronic chips, circuit boards, etc.) without damaging the substrate or the primary parts.

Metal Parts Manufacture - where heavy residues of oils, greases , and cuttings must be effectively removed before assembly, painting, or packaging.

Dry Cleaning (clothing) - often included in the scope of the solvent business because of the large volume used, but not included in this study because ODSs are not ordinarily used as solvents.

B.53 Major ODS solvents classified as controlled substances under the Montreal Protocol are trichlorotrifluoroethane (CFC-113), Carbon Tetrachloride (CTC), and 1,1,1 trichloroethane (methyl chloroform).

CFC-113

B.54 This chlorofluorocarbon solvent has been the solvent of choice for high-end electronics applications and has participated strongly in the growth of the computer business during the 1980s. It is also preferred for the cleaning of precision parts, machine tools, and other metal components. In these applications, the solvents often contain about 2% CFC-11.

Carbon Tetrachloride

B.55 While CTC has been widely used in the past as a solvent for general cleaning, its toxic properties have mitigated against it use. Today, it is only used as a solvent where low-cost is the only consideration and there is no human exposure. Other applications for CTC are as the primary raw material for CFC-11/12 manufacture, and as an ingredient for certain pesticides and pharmaceuticals

Methyl Chloroform

B.56 First used as a solvent to replace carbon tetrachloride in cold cleaning, methyl chloroform is now used for both cold cleaning and vapor degreasing and is highly effective whether used hot or cold and the method is dip, spray, wipe, flush or ultrasonic. Additives are frequently used to enhance corrosion protection and solvent stability.

Alternative Solvents

B.57 With few exceptions, the "ozone issue" and the Montreal Protocol restrictions have prompted solvent users to seek and apply alternative non-ODS solvents to their operations. These efforts have been largely successful without sacrificing cleaning effectiveness. The attention directed at solvent containment and reclamation has paid cost dividends. One measurable result of the transformation to non-ODS solvents has been an 80% reduction in CFC-113 use in the United States since 1986. Methyl chloroform has displaced some of the CFC-113; in time, these applications will move to 1,1,1 trichlorethylene. Every application usually has one or more options that can be adopted. These include use of terpenes, organic and alcohol-based solvents, and longer range HCFC solvent blends if toxicity testing is completed with satisfactory results. In other instances, process changes which eliminate the need for solvent cleaning (e.g. no clean fluxes) are proving satisfactory.

HALONS

B.58 Halons are used extensively as effective fire extinguishants in hand-held units (Halon 1211) and in central systems (Halon 1301). Commercial aircraft and modern military equipment (tanks, aircraft, and ships) have all adopted Halon systems for fire protection.

B.59 Except for Halon consumed in equipment testing or during a fire event, all Halon is still contained in its original container. Because of its effectiveness in extinguishing fires without damaging electronic or other equipment or without toxic or other impacts on humans, Halons are strongly preferred over other extinguishants. There are other obvious fire extinguishants that users can adopt in place of Halons (water, dry chemical, CO_2) at the expense of effectiveness. A chemical substitute with all of the unique properties of Halons has not been identified; however, by using alternatives in applications where use of Halons is non-essential, the reduction in the consumption will be appreciable.

ANNEX C

PHASEOUT SCHEDULE FOR CONSUMPTION OF CHEMICALS REGULATED BY MONTREAL PROTOCOL

	Starting date for implementation	Developed countries	7/1/89	1/1/92	1/1/93	1/1/95	1/1/97	1/1/00	1/1/05
		Developing countries (Article V)	1/1/99	1/1/02	1/1/03	1/1/05	1/1/07	1/1/10	1/1/15
	Controlled substances	Base year [1/]	Consumption limit (as % of base year)						
ANNEX A	CFCs (11, 12, 113, 114, 115)	1986	100%	100%	100%	50%	15%	0%	0%
	Halons (1211, 1301, 2402)	1986		100%	100%	50%	50%	0%	0%
ANNEX B	All other CFCs	1989			80%	80%	15%	0%	0%
	Carbon tetrachloride	1989				15%	15%	0%	0%
	Methyl chloroform	1989			100%	70%	70%	30%	0%

Note: 1) For Article V countries, base consumption rate is average annual consumption of controlled substances for period or maximum, whichever is lower.

	Period	Maximum
ANNEX A	1995-1997	equivalent to 0.3 kg/capita
ANNEX B	1998-2000	equivalent to 0.2 kg/capita

2) Allowable production is 10% greater than consumption (but no less than 15% of base year consumption).

3) Production means actual amount produced minus amount destroyed (subject to approval) minus amount consumed as feedstock. Recycled substances are not considered to be production or consumption.

Annex D

MISSION CONTACTS
Country Program Preparation Mission
August 28 to September 6, 1992

Dr. Salah Hafez	Chairman	Egyptian Environmental Affairs Agency
Eng. Salwa El Tayeb	Consultant Eng.	"
Abd Ellatief M. Hafez	Consultant-Enviromental Officer	"
Dr. Ahmed El Darsh	First Undersecretary-International Finance	Ministry for International Cooperation
Abdel-Monem Mahmoud Eljammal	Director General - International Finance	"
Samir Abbass	Technical Officer	"
Dr. Eng. Yusef K. Mazhur	First Undersecretary	Ministry of Industry
Eng. Mohamed Ebrahim	Factory Gen Mgr	United Investments Corp
Eng. Maher Mansour	Production Mgr.	"
Abdel El Mati Sayed		Chamber of Chemical Ind.
Eng. Niazy El Sheshai	Technical Consultant	GMC Group
Fouad Latif		Iberna Co.
Ali Fahmy	General Manager	Fed. of Egy. Industries
Adel Schoeib	Director General	Chamber of Eng. Industries
Amer Afifi	Chairman	Misr Chemicals and Coatings
Mohamed El Nawawy	Head of Filling and Pack	SIPEC
Fathy Abdel Salam		Power - Egypt Co.
Kamel Wadie Dawoud	Production Manager	Kiriazi
Dr. Mohamed Nabil Daif	Chief of R&D Branch	Armed Forces Armament
Maj Gen. Dr. Sayed Meshaal	Chairman	ElNasrCo.
Dr. Ali Sabry	Planning Dept.	"
Eng. Mohamed Aly Abdellatif		Mirco-York
Mohamed Hasan Younis	Q.C. Manager	KZ Pesticides
Dr. Mohamed Azouz	Vice President - Technical	Beleidy Group
Salah M. Dewedar	Consulting Engr.	
Gen. Isam Al Rimaly	Vice President	Konvekta
Fayez Ismail	Projects Director	AlSharif Projects Co.
Mohamed Atef A.K. Ibrahim		"
Dr. Eng. Salah El-Deeb	Chairman	Misr Compressor Mfg.
Kunio D.Kikuchi	Sr. Investment Officer	World Bank - IFC
Samir Aref	Planning Manager	Advechems
Abu Bakr El Sanady	Production Manager	"
Farouk Hosni Moursi	General Manager	Electrostar
Ossama Sayed Sleid	Gen Factories Mgr.	Misr Foam
Ali Amin Khalil	Executive Director	Misr Foam
Mahmoud Hassan	General Manager	Technocom
Samia Guirguis	Programme Officer	UNDP

ANNEX D

Mission Contacts - World Bank Mission to Egypt - 7/14 to 8/2/91

M.CabAff	Dr. Atef Abeid	- Minister
EEAA	Dr. Hussein Ramzy Hussain	- Act'g Ch'man of EEAA
	Eng.M. Farouk Bedewi	- Deputy Chairman
	Eng. Salwa El Tayeb	- Chemical Engineer
	Dr. Ahmed Ahim Ibrahim	- Consultant
GOFI	Eng. Farouk Mohsen	- Director,Chemical Dept.
	Eng. Hazem Abd El Whaab	- GM of Dev. & Tech Res
	Mrs Sehan Aly Younis	- Chemical Engineer
	Eng. Mohamed A. Eweiss	- Consultant Emgineer
Zanussi	Farouk Hosni Moursi	- General Manager
	Gouda El Menoufi	- Vice President
El-Ard	Eng. Mahdouh Kamel	- Accountant
Kiriazi	Kiriaco Stepho Kiriazi	- Chairman
	Kamel Wadi Dawoud	- Production Manager
	Sanir Nagib Hanin	- Financial&Commerce Mgr
	Eng. Nagi N. A. El Masih	- Maintenance Division
Ideal	Eng. Badr El Din Attia	- Technical Director
	Eng. Gamel El Kady	- Sector Director (Boss)
	Eng. Fahmy M. Aly	- Production General Manager
	Eng. Manal Rashty	- Production Engineer
Koldair	Eng. Salah Eldin Soliman	- Head of AC Sector
	Eng. Sadek M. Bushra	- General Manager R&D
	Abd El-Gawad Amer	- Financial Sector Chief
Misr Foam	Eng. Ossama Sleet	- Factory Manager
Miraco	Eng. A. Barakat	- Chairman
	Eng. Alaa Aly	- Head Central AC Dept
	Eng. Samy Shalaby	- Gen Mgr Production
	Eng. M. Labib Attiah	- Gen Mgr Service & Install
	Eng. Sayed Abdel Atti	- Head, Central Serv. Div.
Amer Univ	Dr. Amr N. Abdel-Hamid	- Professor of Mech Eng.
MCMC	Dr. Eng. Salah El Deeb	- Chairman and Mang Dir.
	Eng. Sayed Anwar Shokeir	- General Manager
	Eng. Hazem Khedr	- Financial Dept
	Eng. Hussein Mitkees	- Plant Technical Mgr.
Semiramis	Alla El Husseini	- Asst. Chief Engineer
FPME	George Josephides	- General Manager
FreonMisr	Magdi Amin Attallah	- Manager
Reftruck	Youssef A. Moussallem	- General Manager
IESC	Gordon E. Swaney	- Regional Dir - Cairo
M.Indust	Dr. Eng. Yusef K. Mazhar	- First Undersecretary
EOS	Prof. Dr. M. Hilal	- President
US AID	Dr. William H. Smith	- Director of Engineering
	Ken Lu Phang	- Environmental Officer
	Dr. Richard Rhoda	- Director, Science & Tech
Technocom	Mahmoud M. Hassan	- General Manager
KPMG	Dr. Darwin G. Johnson	- Chief of Party
Am CofC	Hisham A. Fahmy	- General Manager
	Maria Day	- Adm Assistant
FEI	Dr. Eng. Adel I Gazzarin	- Chairman
	Mousa Khalaf Negm	- Deputy Chariman
	Ali Fahmy Abdel Razek	- Director General Engr
HCEngr.	Abdel Wahaa Habbak	- Chairman
Sabbour	Hussein Sabbour	- Chairman

EEAA	Egyptian Environmental Affairs Agency 11-A Hassan Sabry St Zamalek, Cairo	Tel. 341-6546	FAX	342-0768
GOFI	General Organization for Industrialization 6 Khalil Agha St Garden City, Cairo	Tel. 354-0677 354-0678 355-0669(Farouk) 355-2076(Hazem)	FAX TLX	354-4984 23389 TANFIZ UN
Zanussi	Electrostar for Refrigeration 6 El Sabah St Giza, Cairo	Tel. 854-614 622-716	FAX TLX	622-716 21734 ESTAR UN
Kiriazi	Kiriazi Refrigerators Manufacturing Co. (factory) 10th of Ramadan City - Area B2 (service) Misr & Sudan St, Lots (4&5) M Cairo	Tel. (015)363-312 (015)363-488 (015)363-412/512	FAX TLX	(015)364-200 23776 KRZI UN
El-Ard	El-Ard Co for Import and Export 5 El Ahrar St Monandeseen, Cairo	Tel. 360-6302	FAX TLX	360-6302 21380 ALABD UN
Ideal	The Delta Industrial Co. (IDEAL) 18 Emad El Din St Cairo, Egypt	FAX Tel. 284-6087	TLX	92218 DTC UN
Koldair	Koldair Co (Air Conditioners) PO Box 431 Cairo	Tel. 724-397 620-944 620-949	FAX TLX	733-322 22513 KLDR UN 21209 KLDR UN
Misr Foam	Misr Foam Co (Flexible Foam Mfg) 6th of October	Tel. (011)230-441 (011)230-883		
Miraco	Misr Air Conditioning Mfg. Co (YORK) (office) 48 El Batal Ahmed Abdel Aziz St Giza, Egypt (factory) Km 28, Cairo/Alex Rd	FAX Tel. 348-3369 360-6507(Barakat) 539-425 (factory)	349-8124 TLX	93100 MIRACO UN
Amer Univ	The American University of Cairo 113 Sharia Kasr El-Aini Cairo	Tel. 354-2964 ext 5324(Amr)		
MCMC	Misr Compressor Manufacturing Co PO Box 170 Dokky, Cairo	Tel. 711-829 360-4853	FAX TLX	360-4325 21465 MCMC UN
FPME	Freon Products Middle East (same as Freon Misr)			

FreonMisr	Freon Misr (DUPONT) 12 Degla St Mohandessen, Cairo	Tel. 349-5035 361-6182	FAX TLX	349-5003 20363 FREON
Reftruck	Reftruck Co. Transport Refrigeration & Insulation 10th of Ramadan City A-2	Tel. (015)363-089 258-1950 661-247/258-2251	FAX TLX	392-5700 93220 MHFOZUN
IESC	International Executive Service Corps Nile Hilton Center Cairo	Tel. 767-444 765-666 Ext 22/23	FAX TLX	760-874 92222 HILTLS UN
M.Indus	Ministry of Industry 2 Latin America St Garden City,Cairo	Tel. 355-3442 TLX	FAX 93112 MIDUS UN	354-8362
EOS	Egyptian Organization for Standardization & Quality Ctl 2 Latin American St Garden City, Cairo	Tel. 355-7841	FAX TLX 93296 EOS UN	
US AID	United States Agency for International Development Cairo Center Garden City, Cairo	Tel. 354-8211		
Technocom	Technocom 14 Gheziret El Arab St Mohandessin, Cairo	Tel. 345-0634 TLX	FAX 22409	344-2782
FEI	Federation of Egyptian Industries 26A Sherif St Immobilia Bldg, Cairo	Tel. 392-8075 392-8319	FAX	
Am CofC	American Chamber of Commerce in Egypt Cairo Marriott Hotel Zamelek, Cairo	Tel. 340-8888 ext 1541	TLX FAX	20870 AMCHE UN 340-8888 ext 1543
M. CabAff	Ministry of Cabinet Affairs & State for Admin. Dev. 1 Magles El Shaab St Lazoghli Square, Cairo	Tel. 355-8026		
EngrHC	Holding Company for Engineering Cairo	Tel. 393-0133/5787		
Sabbour	Sabbour Associates 20 Lotfi Hassona Cairo	Tel. 716-656/712-018		

ANNEX E

MONTREAL PROTOCOL REVISIONS

"Multilateral.Fund"

Second Meeting of the Parties
London, U.K. - June 27-29, 1990

Article 10: Financial mechanism

1. The Parties shall establish a mechanism for the purposes of providing financial and technical cooperation, including the transfer of technologies, to Parties operating under paragraph 1 of Article 5 of this Protocol to enable their compliance with the control measures set out in Articles 2A to 2E of the Protocol. The mechanism, contributions to which shall be additional to other financial transfers to Parties operating under that paragraph, shall meet all agreed incremental costs of such Parties in order to enable their compliance with the control measures of the Protocol. An indicative list of the categories of incremental costs shall be decided by the meeting of the Parties.

2. The mechanism established under paragraph 1 shall include a Multilateral Fund. It may also include other means of multilateral, regional and bilateral cooperation.

3. The Multilateral Fund shall:

(a) Meet, on a grant or concessional basis as appropriate, and according to criteria to be decided upon by the Parties, the agreed incremental costs;

(b) Finance clearing-house functions to:

(i) Assist Parties operating under paragraph 1 of Article 5, through country specific studies and other technical cooperation, to identify their needs for cooperation;

(ii) Facilitate technical cooperation to meet these identified needs;

(iii) Distribute, as provided for in Article 9, information and relevant materials, and hold workshops, training sessions, and other related activities, for the benefit of Parties that are developing countries; and

(iv) Facilitate and monitor other multilateral, regional and bilateral cooperation available to Parties that are developing countries;

(c) Finance the secretarial services of the Multilateral Fund and related support costs.

4. The Multilateral Fund shall operate under the authority of the Parties who shall decide on its overall policies.

5. The Parties shall establish an Executive Committee to develop and monitor the implementation of specific operational policies, guidelines and administrative arrangements, including the disbursement of resources, for the purpose of achieving the objectives of the Multilateral Fund. The Executive Committee shall discharge its tasks and responsibilities, specified in its terms of reference as agreed by the Parties, with the cooperation and assistance of the International Bank for Reconstruction and Development (World Bank), the United Nations Environment Programme, the United Nations Development Programme or other appropriate agencies depending on their respective areas of expertise. The members of the Executive Committee, which shall be selected on the basis of a balanced representation of the Parties operating under paragraph 1 of Article 5 and of the Parties not so operating, shall be endorsed by the Parties.

6. The Multilateral Fund shall be financed by contributions from Parties not operating under paragraph 1 of Article 5 in convertible currency or, in certain circumstances, in kind and/or in national currency, on the basis of the United Nations scale of assessments. Contributions by other Parties shall be encouraged. Bilateral and, in particular cases agreed by a decision of the Parties, regional cooperation may, up to a percentage and consistent with any criteria to be specified by decision of the Parties, be considered as a contribution to the Multilateral Fund, provided that such cooperation, as a minimum:

(a) Strictly relates to compliance with the provisions of this Protocol;

(b) Provides additional resources; and

(c) Meets agreed incremental costs.

7. The Parties shall decide upon the programme budget of the Multilateral Fund for each fiscal period and upon the percentage of contributions of the individual Parties thereto.

8. Resources under the Multilateral Fund shall be disbursed with the concurrence of the beneficiary Party.

9. Decisions by the Parties under this Article shall be taken by consensus whenever possible. If all efforts at consensus have been exhausted and no agreement reached, decisions shall be adopted by a two-thirds majority vote of the Parties present and voting, representing a majority of the Parties operating under paragraph 1 of Article 5 present and voting and a majority of the Parties not so operating present and voting.

10. The financial mechanism set out in this Article is without prejudice to any future arrangements that may be developed with respect to other environmental issues.

Article 10A: Transfer of Technology

The following Article shall be added to the Protocol as Article 10A:

Article 10A: Transfer of Technology

Each Party shall take every practicable step, consistent with the programmes supported by the financial mechanism, to ensure:

(a) That the best available, environmentally safe substitutes and related technologies are expeditiously transferred to Parties operating under paragraph 1 of Article 5; and

(b) That the transfers referred to in subparagraph (a) occur under fair and most favorable conditions

Annex IV

APPENDICES TO DECISION II/8 ("FINANCIAL MECHANISM")
ADOPTED BY THE SECOND MEETING OF THE PARTIES

Appendix I

INDICATIVE LIST OF CATEGORIES OF INCREMENTAL COSTS

1. The evaluation of requests for financing incremental costs of a given project shall take into account the following general principles:

(a) The most cost-effective and efficient option should be chosen, taking into account the national industrial strategy of the recipient party. It should be considered carefully to what extent the infrastructure at present used for production of the controlled substances could be put to alternative uses, thus resulting in decreased capital abandonment, and how to avoid deindustrialization and loss of export revenues;

(b) Consideration of project proposals for funding should involve the careful scrutiny of cost items listed in an effort to ensure that there is no double-counting;

(c) Savings or benefits that will be gained at both the strategic and project levels during the transition process should be taken into account on a case-by-case basis, according to criteria decided by the Parties and as elaborated in the guidelines of the Executive Committee;

(d) The funding of incremental costs is intended as an incentive for early adoption of ozone protecting technologies. In this respect the Executive Committee shall agree which time scales for payment of incremental costs ar appropriate in each sector.

2. Incremental costs that once agreed are to be met by the financial mechanism include those listed below. If incremental costs other than those mentioned below are identified and quantified, a decision as to whether they are to be met by the financial mechanism shall be taken by the Executive Committee consistent with any criteria decided by the Parties and elaborated in the guidelines of the Executive Committee. The incremental recurring costs apply only for a transition period to be defined. The following list is indicative:

(a) Supply of substitutes

(i) Cost of conversion of existing production facilities:

- cost of patents and designs and incremental cost of royalties;
- capital cost of conversion;
- cost of retraining of personnel, as well as the cost of research to adapt technology to local circumstances;

(ii) Costs arising from premature retirement or enforced idleness, taking into account any guidance of the Executive Committee on appropriate cut-off dates:

- of productive capacity previously used to produce substances controlled by existing and/or amended or adjusted Protocol provisions; and
- where such capacity is not replaced by converted or new capacity to produce alternatives;

(iii) Cost of establishing new production facilities for substitutes of capacity equivalent to capacity lost when plants are converted or scrapped, including:

- cost of patents and designs and incremental cost of royalties;
- capital cost;
- cost of training, as well as the cost of research to adapt technology to local circumstances;

(iv) Net operational cost, including the cost of raw materials;

(v) Cost of import of substitutes;

(b) Use in manufacturing as an intermediate good

(i) Cost of conversion of existing equipment and product manufacturing facilities;

(ii) Cost of patents and designs and incremental cost of royalties;

(iii) Capital cost;

(iv) Cost of retraining;

(v) Cost of research and development;

(vi) Operational cost, including the cost of raw materials except where otherwise provided for;

(c) End use

(i) Cost of premature modification or replacement of user equipment;

(ii) Cost of collection, management, recycling, and, if cost effective, destruction of ozone-depleting substances;

(iii) Cost of providing technical assistance to reduce consumption and unintended emission of ozone-depleting substances.

Appendix II

TERMS OF REFERENCE OF THE EXECUTIVE COMMITTEE

1. The Executive Committee of the Parties is established to develop and monitor the implementation of specific operational policies, guidelines and administrative arrangements including the disbursement of resources, for the purpose of achieving the objectives of the Multilateral Fund under the Financial Mechanism.

2. The Executive Committee shall consist of seven Parties from the group of Parties operating under paragraph 1 of Article 5 of the Protocol and seven Parties from the group of Parties not so operating. Each group shall select its Executive Committee members. The members of the Executive Committee shall be formally endorsed by the Meeting of the Parties.

3. The Chairman and Vice-Chairman shall be selected from the fourteen Executive Committee members. The office of Chairman is subject to rotation, on an annual basis, between the Parties operating under paragraph 1 of Article 5, and the Parties not so operating. The group of Parties entitled to the chairmanship shall select the Chairman from among their members of the Executive Committee. The Vice-Chairman shall be selected by the other group from within their number.

4. Decisions by the Executive Committee shall be taken by consensus whenever possible. If all efforts at consensus have been exhausted by no agreement reached, decisions shall be taken by a two-thirds majority of the Parties present and voting, representing a majority of the Parties operating under paragraph 1 of Article 5 and a majority of the Parties not so operating present and voting.

5. The meetings of the Executive Committee shall be conducted in those official languages of the United Nations required by members of the Executive Committee. Nevertheless the Executive Committee may agree to conduct its business in one of the United Nations official languages.

6. Costs of Executive Committee meetings, including travel and subsistence of Committee participants from Parties operating under paragraph 1 of Article 5, shall be disbursed from the Multilateral Fund as necessary.

7. The Executive Committee shall ensure that the expertise required to perform its functions is available to it.

8. The Executive Committee shall meet at least twice a year.

9. The Executive Committee shall adopt other rules of procedure on a provisional basis and in accordance with paragraphs 1 to 8 of these terms of reference. Such provisional rules of procedure shall be submitted to the next annual meeting of the Parties for endorsement. This procedure shall also be followed when such rules of procedure are amended.

10. The functions of the Executive Committee shall include:

(a) To develop and monitor the implementation of specific operational policies, guidelines and administrative arrangements, including the disbursement of resources;

(b) To develop the three-year plan and budget for the Multilateral Fund, including allocation of Multilateral Fund resources among the agencies identified in paragraph 6 of decision II/8;

(c) To supervise and guide the administration of the Multilateral Fund;

(d) To develop the criteria for project eligibility and guidelines for the implementation of activities supported by the Multilateral Fund;

(e) To review regularly the performance reports on the implementation of activities supported by the Multilateral Fund;

(f) To monitor and evaluate expenditure incurred under the Multilateral Fund;

(g) To consider and, where appropriate, approve country programmes for compliance with the Protocol and, in the context of those country programmes, assess and, where applicable, approve all project proposals or groups of project proposals where the agreed incremental costs exceed $500,000;

(h) To review any disagreement by a Party operating under paragraph 1 of Article 5 with any decision taken with regard to a request for financing by that Party of a project or projects where the agreed incremental costs are less than $500,000;

(i) To assess annually whether the contributions through bilateral cooperation, including particular regional cases, comply with the criteria set out by the Parties for consideration as part of the contributions to the Multilateral Fund;

(j) To report annually to the meeting of the Parties on the activities exercised under the functions outlined above, and to make recommendations as appropriate;

(k) To nominate, for appointment by the Executive Director of UNEP, the Chief Officer of the Fund Secretariat, who shall work under the Executive Committee and report to it; and

(l) To perform such other functions as may be assigned to it by the Meeting of the Parties.

E.8

IMPLEMENTATION GUIDELINES[1]

SECTION II

FRAMEWORK FOR ACTIVITIES SUPPORTED BY THE FUND

II.1 COUNTRY PROGRAMMES

1. The Executive Committee shall invite each Party operating under paragraph 1 of Article 5 and wishing to receive support from the Multilateral Fund to develop a country programme and projects in accordance with paragraph 10(g) of the Terms of Reference of the Executive Committee.

2. The country programme is expected to contain inter alia:

(a) a review of recent production, imports, applications and use of controlled substances by the main producers, users, and consumers. Where information is available it would be useful to indicate links to multinational producers or users;

(b) a description of the institutional framework governing controlled substances - (Government agencies, collaborating NGOs, consumer groups, industry associations);

(c) a description of policy framework, regulatory and incentive systems;

(d) a description of government and industry activities in response to the Protocol;

(e) a statement of strategy for implementation of the Protocol, indicating the respective roles of Government, supporting multilateral and bilateral agencies;

(f) an action plan encompassing investment and technical assistance projects, pre-investment studies, and any additional policy analysis required;

(g) a timetable for each activity, and for action plan review;

(h) a budget and financing programme for the above activities.

3. In developing its country programme and/or individual project, a Party may request technical assistance, other services and support from the implementing agencies within their respective areas of expertise and within the context of work programmes approved by the Executive Committee.

4. A Party operating under paragraph 1 of Article 5 shall submit its country programme to the Executive Committee for its consideration and approval in accordance with paragraph 10(g) of Appendix II of Annex IV to the Report of the Second Meeting of the Parties.

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[1] UNEP/OzL.Pro/ExCom/3/18, Annex III, pg. 29.

5. A country programme approved by the Executive Committee shall serve as a basis for project preparation and further cooperation between the Party and the implementing agencies. However, individual projects prepared prior to the completion of a country programme shall also qualify for funding if consistent with project eligibility criteria (see section III) approved by the Executive Committee.

II.2 WORK PROGRAMS

1. The Executive Committee shall invite implementing agencies and other appropriate agencies depending on their expertise, to develop work programmes in cooperation with recipient countries in order to receive support from the Multilateral Fund.

2. Work programmes should specify:

(a) types of activities and projects on which agreement has been reached between the implementing agency and the concerned Party;

(b) types of activities and projects which must be sufficiently defined to allow the Executive Committee to review and monitor these activities;

(c) means of coordinating with other implementing agencies;

(d) time frame for action;

(e) expected outcomes; and

(f) estimated budget by major categories and fiscal quarters.

3. The Executive Committee shall approve work programmes based on project eligibility criteria, on an annual basis and review progress under these programmes semi-annually.

4. The implementation of any aspect of the Work Programme shall be subject to the availability of funds. In the event of a shortage of available funds the Executive Committee shall provide guidance to the implementing agencies concerning priorities for implementation (see section IV).

5. Each implementing agency is responsible for implementation and supervision of projects within its work programme. The agency shall report to the Executive Committee annually on the progress of the work programmes.

II.3 PROJECT APPROVALS

1. Project proposals where the agreed incremental costs exceed $500,000 shall be considered and approved by the Executive Committee.

2. Project proposals where the agreed incremental costs are less than $500,000 shall be approved by the implementign agencies within the context of an approved work programme and after confirmation by the Fund Secretariat on the availability of funds and contributions in-kind.

3. Project proposals not developed in cooperation with implementing agencies shall be submitted to the Secretariat for transmittal to the appropriate implementing agencies for inclusion in their next work programme.