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

Thirteenth Meeting
Montreal, 25-27 July 1994

COUNTRY PROGRAMME: BRAZIL

This document consists of:

- Comments and recommendations of the Fund Secretariat
- Country Programme Evaluation Sheet (prepared by the Fund Secretariat)
- Transmittal Letter from the Government of Brazil
- Country Programme Cover Sheet
- Country Programme

COMMENTS AND RECOMMENDATIONS OF THE FUND SECRETARIAT

COMMENTS

1. The Country Programme conforms to the format and content of the approved guidelines.

2. In 1993, the total ODS consumption in Brazil was estimated to be 8,918 ODP tonnes. In the same year, Brazil produced 4,010 tonnes of CFC-11 and 7,483 tonnes of CFC-12, and exported 1,444 tonnes of CFC-11 and 2,793 tonnes of CFC-12. Out of 43,970 tonnes of carbon tetrachloride produced in 1993, 18,770 tonnes were used as a feedstock for the production of CFC, 25,154 tonnes were exported and only 46 tonnes were used as a solvent.

3. The Government of Brazil is committed to phase out the consumption of ODS within the shortest period of time, namely 1994 for halons, 2000 for methyl chloroform and 2001 for the other controlled substances.

4. The proposed action plan is a result of the combined efforts of Government, the private sector, the workers, and NGOs, taking into consideration the size and characteristics of the country, its industrial and commercial structure, as well as the availability of alternative technologies and substances. The small and medium size industries, which represent a large portion of the industrial sector in the country, were fully considered in the phase out action plan.

5. The effects of the proposed phase-out strategy on the production sector was also assessed. The CFC manufacturing companies will be able to adjust their production to a level that would meet the market demands. Furthermore, they have already gone through some process modifications which enabled them to produce alternative substances.

6. The Government is presently analysing several regulatory policies and specific actions, to facilitate the implementation of the proposed action plan which, inter alia, include:

- A policy to define, on an annual basis, decreasing ODS production quotas for each CFC manufacturing company, with reference to their 1993 production levels, along with the gradual annual rise of import taxes for the same substances.
- A policy to define increasing federal and/or state taxes applied to ODS.
- A policy to gradually limit or prohibit exports of ODS.
- A policy to prohibit manufacture, imports, exports and commercialization of new final products containing ODS, except for parts and components to be used in the existing systems.
- Tax incentives to encourage consumers to adopt alternative technologies.

RECOMMENDATIONS

The Fund Secretariat recommends as follows:

1. To approve the Brazil Country Programme. Approval of the Country Programme does not denote approval of the projects identified therein or their funding levels.

2. In accordance with the Executive Committee decision on implementation of country programmes (UNEP/OzL.Pro/ExCom/10/40, para 135), to request the Government of Brazil to provide information on the progress of implementation of the country programme within one year of its approval, i.e. on 31 July 1995 and annually on the 31st day of July of each subsequent year.

BRAZIL COUNTRY PROGRAMME EVALUATION SHEET

National Implementing Agency: Interministerial Technical Group (GTO)

Status of ratification of the Vienna Convention and the Montreal Protocol

	Signature	Ratification	Entry Force
Vienna Convention (1985)		19/Mar/90	17/Jun/90
Montreal Protocol (1987)		19/Mar/90	17/Jun/90
London Amendment (1990)		01/Oct/92	30/Dec/92
Copenhagen Amendment (1992)			

Production of controlled substances: 6,748 metric tonnes (mt)

Consumption of controlled substances (1993): 14,291.0 metric tonnes
(excluding methyl bromide) 8,918.2 weighted tonnes (ODP)

Substance	CFC						Halon			Solvents			M-Br
(ton)	11	12	113	114	115	Total	1211	1301	Total	CTC	MCF	Total	
ODS	2,726.0	5,338.0	128.0	20.0	22.0	8,234.0	6.0	5.0	11.0	46.0	6,000.0	6,046.0	
ODP	2,726.0	5,338.0	102.4	20.0	13.2	8,199.6	18.0	50.0	68.0	50.6	600.0	650.6	

Source: Country Programme (1994)

Distribution of ODP by substance:

CFC: 91.9% Halon: 0.8% CTC, MCF: 7.3%

Distribution of ODP by sector:

Sector:	Aerosol	Foam	Halon	Refrig.	Solvent
Consumption (tonnes):	255.0	1,950.0	68.0	5,748.0	897.0
Percent of total:	2.9%	21.9%	0.8%	64.5%	7.3%

Note: In 1993, 4,010 t and 7,483 t of CFC-11 and 12 respectively were produced. In total 4,237 t were exported. Also 43,790 t of CTC were produced, 25,154 t of them were exported and 18,770 were used for the production of CFC

Country Programme

Duration of country programme: 1994-2001

ODS phase-out target:

Phse out of halon by 1994 and MCF by 2000. Complete phase out by 2001

Phase-out priority area:

Foam, refrigeration and solvent sectors

Cost of activities in country programme: $898,774,000

Strategy:

The Govt. is committed to phased-out ODS consumption as fast as possible, namely 2001, taking into account the size and characteristics of the country, it's industrial, commercial and demand structure. The action plan is a result of the combined efforts of Govt. the private sector, the workers, and NGOs. The two CFC manufacturing companies, will adequate their production for the new market demand profile (they have already gone through some process modifications that allow them to produce alternative substances).

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Índice
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Multilateral Fund for the
Implementation of the Montreal
Protocol

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Sir,

I have the honour to submit herewith the Country Programme of Brazil for the Phase-Out of Ozone Depleting Substances under the Montreal Protocol, for the consideration and approval by the XIII Meeting of the Executive Committee, to be held in Montreal next July.

The Brazilian Country Programme was elaborated by the Government in close cooperation with the private sector and academic institutions. I would like to acknowledge the appreciation of the Government of Brazil of the support given by UNDP for the successful conclusion of the Country Programme.

Accept, Sir, the assurance of my highest consideration.

Celso L. N. Amorim
Minister of External Relations of the
Federative Republic of Brazil

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BRAZIL

COUNTRY PROGRAM

FOR THE

PHASE-OUT OF OZONE DEPLETING SUBSTANCES

UNDER THE

MONTREAL PROTOCOL

MINISTRY OF THE ENVIRONMENT AND AMAZON
MINISTRY OF FOREIGN AFFAIRS
MINISTRY OF SCIENCE AND TECHNOLOGY
MINISTRY OF INDUSTRY, COMMERCE AND TOURISM
PRESIDENCY SECRETARIAT FOR PLANNING AND COORDINATION

June, 1994

BRAZIL COUNTRY PROGRAMME

EXECUTIVE SUMMARY

Background

Brazil adhered in June 1990 to the 1985 Vienna Convention for Ozone Layer Protection and the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, having ratified the London Amendments in July 1991. Brazil also signed the Copenhagen amendment, the ratification of which is presently going through Congress. With a per capita consumption of less than 0.3 kg/year, Brazil operates under paragraph 1 of Article 5, qualifying for assistance from the Multilateral Fund for the Implementation of the Montreal Protocol.

The Brazilian Country Programme for the Phase-out of Ozone Depleting Substances under the Montreal Protocol (CP) is the country response to the challenge of reverting the present process of damaging of the Earth's Ozone Layer, and also represents the country's compliance of the obligations to the Montreal Protocol.

To coordinate all actions directed to the Ozone Layer Protection and ODS phase-out, the Brazilian Government has established the Interministerial Ozone Working Group - GTO, attributing the role of Executive Secretariat - SE/GTO to the Ministry of Industry, Commerce and Tourism - MICT. Among SE/GTO responsibilities are included the Country Programme development, design and implementation. The CP development activities have been organized and coordinated by the SE/GTO with strong support by industry associations and, at different phases, of The World Bank and the United Nations Development Programme - UNDP.

Structure of ODS Consumption and Phase-out Schedule

Brazil produces, imports and exports ODS. The total 1993 Brazilian ODS consumption was 14,291 tons, corresponding to 8,918 ODP tons. This total corresponds to a per capita consumption of approximately 0.095 kg/year, considering 150 million inhabitants (as per the latest population census).

In terms of substances brake-down, CFC-12 accounts for 37% of ODS and 60% of ODP total consumption. CFC-11 share is 19% of ODS and 30.5% of ODP. MCF share is respectively 42% and 6.7%. Table 1 shows the overall 1993 Brazilian ODS and ODP consumption.

Table 1 - Total 1993 ODS and ODP Consumption, by substance

	CFC 11	CFC 12	CFC 113	CFC -114	CFC -115	H-1211	H-1301	CTC (*)	MCF	TOTAL
PRODUCTION										
tons	4,010	7,483	-	-	-	-	-	43,970	-	55,463
IMPORTS										
tons	170	648	128	20	22	6	5	-	6,000	6,998
EXPORTS										
tons	1,444	2,793	-	-	-	-	-	25,154	6,000	29,401
TOTAL ODS CONSUMPTION										
tons	2,726	5,338	128	20	22	6	5	46	6000	14,291
%	19	37	0.9	0.1	0.1	0.04	0.03	0.3	42	100
ODP factors										
	1.0	1.0	0.8	1	0.6	3.0	10.0	1.1	0.1	-
TOTAL ODP CONSUMPTION										
tons	2,726	5,338	102	20	13	18	50	50.6	600	8,918
%	30.5	60	1.1	0.2	0.1	0.2	0.6	0.6	6.7	100

In terms of sectoral break-down of the total 1993 ODS consumption, Solvents was the largest user sector, with 44.2% of total consumption. Servicing was the second largest, with its share being 31.8%. Foams was the third, with 13.6%. Refrigeration and Air Condicining accounted for 8.58%.

In terms of total ODP consumption, sectoral break-down shows that Servicing was by far the largest user sector, accounting for 50.8%. Second largest was Foaming, with 21.9%. Refrigeration and Air Conditioning represented 14% while Solvents 10%. Table 2 presents the whole picture.

Table 2 - 1993 ODS and ODP Consumption by sector (tons)

	Dom. Refr.	Ind/Com Refr./ CAC	Mobile AC	Service	Foams	Fire Exting	Solv.	Aeros.	Total
ODS	461	501	254	4,541	1,950	11	6.318	255	14,291
%	3.2	3.5	1.8	31.8	13.6	0.1	44.2	1.8	100
ODP	461	498	254	4,535	1,950	68	897	255	8,918
%	5.6	5.6	2.8	50.8	21.9	0.8	10.0	2.8	100

Source: 1994 CP Survey

Based on 1993 data collected during the preparation of the Country Programme, the 1994 to 2010 calculated cumulative unconstrained consumption of ODS would have been around 365,234 tons, while the constrained consumption until total phase-out is estimated to be 26,421 tons..

The Government of Brazil is committed to the phase-out of ODS in the shortest time possible, considering the size and characteristics of the country, its industrial, commercial and demand structure. The Multilateral Fund resources will play a fundamental role in accelerating phase-out. The availability of alternative technologies will also be of paramount importance. The country will completely phase-out ODS consumption in 2001. Halons have already been phased-out in 1994.

Action Plan

The Action Plan - summarized in the Cover Sheet - presents the combined efforts of Government, Private Sector, Workers and other society representatives, including Non Governmental Organizations - NGOs. The Action Plan, as well as the Country Programme, show the will of the country to enforce its obligations within the Montreal Protocol

Financial Costs

The net incremental costs for phase-out, by sector, are shown in detail in Table 24 of Chapter 4 of the Country Programme, as well as in Chapter 4 of the CP Cover Sheet. An indicative list of phase-out projects, not intended to be all-inclusive, is also presented in Chapter 3 of the CP Cover Sheet.

BRAZIL

COUNTRY PROGRAMME

FOR THE PHASE-OUT OF

OZONE DEPLETING

SUBSTANCES

COVER SHEET

COUNTRY PROGRAMME COVER SHEET

Country	**BRAZIL**
Date Received	**JUNE 1994**
Period Covered	**1994 to 2001**
National Implementing Agencies	**Interministerial Ozone Working Group - GTO formed by:** **Ministry of Foreign Affairs - MRE** **Ministry of Science and Technology - MCT** **Ministry of the Environment and Amazon - MMA** **Ministry of Industry, Commerce and Tourism - MICT (Executive Secretariat)**

1. Phase-out Schedule

Substances	1993 Consumption (ODP tons)	Consumption until Phase-out (ODP tons)	Phase-out Year
CFC-11	2,726	8,942	2001
CFC-12	5,338	15,583	2001
CFC-113	102	149	2001
CFC-114	20	270	2010
CFC-115	13	41	2001
H-1211	18	0	1994
H-1301	50	0	1994
Carbon Tetrachloride	51	148	2001
Methyl Chloroform	600	1,288	2001
TOTAL	8,918	26,421	-

Government Action Plan

YEAR	DESCRIPTION OF ACTION	SECTOR	INTENDED EFFECT
1988	Ban the use of ODS in Aerosols, except for medical use.	Aerosols	Reduce consumption of ODS.
1990	Ratification of Viena Convention and Montreal Protocol	All	Insert Brazil into the International effort to revert the process of Ozone Layer destruction.
1991	Ratification of Montreal Protocol London Ammendments.	All	Insert Brazil into the International effort to revert the process of Ozone Layer destruction.
1991	Creation of the Interministerial Ozone Working Group - GTO	All	Coordinate and harmonize all actions directed to the elimination of ODS production and consumption
1994	Development of Country Programme	All	Produce a Planning instrument to direct both Government and Private Sector actions.
1994	Upgrade the GTO **formally** including representatives of the Ministries of Agriculture and of Finance, the Private Sector, Unions, Environment and Consumer NGOs, Small and Medium Enterprise supporting institutions, Universities and Research Centers, and Quality, Certifications and Standards Institutions.	All	Create a forum where all society agents envolved in the Ozone issue will be represented.
1994	Analize, evaluate, select and detail government legal regulations and/or tax incentives/desincentives, to be enforced in the 1994-1996 period.	All,	Create a Brazilian comprehensive and coherent legal infrastructure for all ozone related issues and government actions.
994-1995	Implement a public awareness programme aimed at the importance of the ozone layer on different forms of life on Planet Earth, and corrective actions being undertaken by the international comunity - including the Montreal Protocol, and Brazil.	All	Mobilize public support for national and international actions concerning the ozone layer issue, and stimulate the use of individual "purchasing power" in favour of non-ODS products.
994-1995	Create new items in the Brazilian Merchandise Classification Table (NBM), discriminating each ODS used in Brazil.	All.	Permit Government to better monitor imports and exports of ODS.

994-1995	Implement yearly or twice a year regular data collection from ODS producers, importers, exporters, and most important users. Establish government action in case of none or incorrect information is suplied.	All.	Create a data bank to allow Government to assess and monitor results of the Country Programme implementation. Detect and correct possible failures.
995-2001	Operate and continuously improve the data bank.	All.	The same as previous item.
994-1995	Implement a time-increasing discrimination factor in the "Industrialized Products Tax - IPI", to have non-ODS consumer products increasingly less taxed than ODS ones.	All, but specially Refrig/AC	Increase ODS free products economically attractiveness - as far as tax contents in products price-list.
994-1995	Implement a time-chart Regulation establishing limit dates for the allowance of manufacture, imports and commercialization of new and final products containing ODS.	All	Create a legal planning horizon for all industry today producing/using ODS products, as a frame for their own strategic planning.
994-1996	Implement awareness and training programmes aimed at the small and medium Refrigeration/AC repair shops spread around the country, informing about the ozone issue, as well as about recovery, recycling and containment procedures.	Domestic Comm. Ind Refrig/AC	Technically capacitate specialized technicians to deal with ODS products minimizing voluntary venting to the atmosphere.
994-1995	Implement regulation prohibiting the voluntary emission/venting to atmosphere of ODS.	All, and specially Refrig/AC	Enforce recovery, recycling and containment procedures.
994-1995	Implement regulations prohibiting the installation of new Halons-based fire extinghishing systems.	Halons	Prevent new demand for Halons.
1995	Create a Halon Bank.	Halons	Optimize the use of Halons existing in the Country by directing it to priority installations..
995-1996	Implement a labeling policy that will identify "Ozone Free Products", as another mean to have public "purchasing power" to act as an economic deterrent for ODS products production.	All, and specially Refrig/AC	Inform public about the Ozone Layer effect of the products they would be buying, maximizing the impact of their "purchasing power".
994-1995	Develop Quality Standards for Recycled Gases.	All	Make the use of recycled ODS technically safe.

Indicative List of Projects (summary)

SECTOR	PERIOD	SECTORAL OR GENERAL PROJECTS DESCRIPTION	COSTS (US$ 1,000)	ODP (MT)
. Foams				
		Automotive Segment		
	1994-1996	Conversion of 14 production lines of molded semi-rigid	3,950	274
		Construction segment		
	1994-1995	Conversion of 3 industries to CFC-free technology in the manufacturing of rigid polyurethane foam (spray) (Note 3)	370	74
	1994-2000	Conversion of insulation panels production lines of 8 companies	2,800	168
		Domestic Refrigerators		
	1994-1996	Conversion of production line of polyurethane insulating panels for non-CFC (CLIMAX) (Note 1)	500	6.4
		Industrial Refrigeration		
		Conversion of insulating material production lines of 8 companies		164
		Furniture		
		Pilot conversion of 3 production lines of semi-riged polyurethane	450	52
		Others		
		Conversion of 7 production lines (Note 2)	1,590	142
	1995-1998	Awareness and Mobilization in the Industry	420	-
	1995-1998	Training Technicians	338	-

SECTOR	PERIOD	SECTORAL OR GENERAL PROJECTS DESCRIPTION	COSTS (US$ 1,000)	ODP (MT)

2. Refrigeration/Air Conditioning

		Domestic Refrigeration		
	1994-1996	Conversion of assembly line of Domestic Refrigerators for non-ODS substances in insulation and in the refrigerating circuit (CONSUL) (Note 1)	6,062	51.1
		Conversion of 1 Domestic Refrigerators circuits production line for the use of HFC-134a (CLIMAX) (Note 1)	4,412	51.9
		1 Projects to convert compressor production lines (EMBRACO) (Note 1)	5,000	-
		Commercial Refrigeration		
	1994-1996	Conversion of Commercial Refrigerators production line to non-CFC-11, CFC-12 and R-502 (METALFRIO) (Note 1)	2,889	119.6
	1994	3 Pilot projectc to retrofit equipment presently using CFC-12, installed in large supermarkets	120	2.4
	1994	3 Pilot project to retrofit equipment presently using R502, installed in large supermarkets	120	2.4
	1995	10 Pilot project to replace equipment presently using CFC-12 installed in small/medium size food stores	10	0.2
	1995	10 Pilot project to replace equipment presently using R502, installed in small/medium size food stores	10	0.2
	1995-1997	5 Retrofit projects for a total of 955 CFC-12 installations, to be executed in the following Brazilian regions: South East (413); South (310); North East (103); Central West (77) and North (52)	955	17.6

	1997-1999	5 Retrofit projects for a total of 1,637 CFC-12 installations, to be executed in the following Brazilian regions: South East (722); South (528); North East (155); Central West (129) and North (103)	1,637	32.7
	1995-1997	5 Replacement projects for a total of 636 CFC-12 installations, to be executed in the following Brazilian regions: South East (275); South (206); North East (69); Central West (52) and North (34)	636	12.7
	1997-1999	5 Replacement projects for a total of 1,092 CFC-12 installations, to be executed in the following Brazilian regions: South East (482); South (352); North East (103); Central West (86) and North (69)	1,092	20.2
	1995-1997	5 Retrofit projects for a total of 155 R-502 installations, to be executed in the following Brazilian regions: South East (67); South (50); North East (17); Central West (13) and North (8)	155	3.1
	1997-1999	5 Retrofit projects for a total of 253 R-502 installations, to be executed in the following Brazilian regions: South East (118); South (72); North East (25); Central West (21) and North (17)	253	5.1
	1995-1997	5 Replacement projects for a total of 104 R-502 installations, to be executed in the following Brazilian regions: South East (45); South (34); North East (11); Central West (8) and North (6)	104	2.1
	1997-1999	5 Replacement projects for a total of 168 R-502 installations, to be executed in the following Brazilian regions: South East (78); South (48); North East (17); Central West (14) and North (11)	168	3.4
		Industrial Refrigeration/CAC		
	1995	Pilot project for industrial recycling of CFC-based refrigerants (ABRAVA) (Note 1)	450	
	1994-1996	Pilot demonstration and training on the use of refrigerant collecting equipment (ATENAS) (Note 1)	160	-
	1994-1995	3 Pilot Projects to retrofit CFC-11 chillers	225	1.5
	1995-1996	3 Pilot Projects to retrofit CFC-11 chillers	225	1.5
	1995-1996	56 Retrofit Projects for CFC-11 installations	7,000	28
	1996-1998	94 Replacement Projects for CFC-11 installations over 25 years old	11,750	47
	1994-1995	3 Pilot Projects to retrofit CFC-12 chillers	225	1.5

	1995-1996	3 Pilot Projects to retrofit CFC-12 chillers	225	1.5
	1995-1996	56 Retrofit Projects for CFC-12 installations	7,000	28
	1996-1998	94 Replacement Projects for CFC-12 installations over 25 years old more	11,750	47
	1995-1997	Conversion/substitution of Industrial Refrigeration equipment used in the steel mill (COMP. SIDERÚRGICA DE TUBARÃO) (Note 1)	400	33.3
		Refrigeration Circuit Parts and Components		
	1994-1996	Treatment and containment of lubricating oil for use in CFC-free compressors (EMBRACO) (Note 1)	281	-
	1994-1996	Modification of evaporators and condensators production line, for HFC-134a use (MIPAL) (Note 1)	50	-
	1994-1996	Modification of the production line of refrigerator circuits parts and components, for non ODS (FLIGOR) (Note 1)	76	-

SECTOR	PERIOD	SECTORAL OR GENERAL PROJECTS	COSTS (US$ 1,000)	ODP (MT)

3. Halons

	1994-2004	Halon Banking and Management (GESPI)	329.5	625
		Alternative Technologies Transfer for Halon 1301 Fire Extinguishing Systems	200	-
		Major Halon Users Phaseout	100	-
		Review of Existing and Drafting of New Standards	120	-
		Workshops, Education, Traning and Technology Transfer	200	-
		Information and Awareness	150	-

4. Solvents

	1995-1999	Public Awareness	250	-
		Distributors Training	250	-
		Users Training	250	-
		Projects Preparation	250	-
		Projects for Existing Equipment Adaptations/retrofit	1,600	66.6
		Projects for Equipment replacement	6,000	249.6
		Recycling Plants	1,000	99.8

SECTOR	PERIOD	SECTORAL OR GENERAL PROJECTS	COSTS (US$ 1,000)	ODP (MT)

. Training and CFC's Recovery, Recycling and Contention

		Training and Certification of Domestic, Industrial and Commercial. Refrig., and AC Mechanics and CFC's Recovery, Recycling and Contention	67,816	-
		Contaminated CFC Recycling Center	914	-

. Methyl Bromide (preliminary)

	1995-2000	Technical Regional Meetings	120	-
	1995-2000	International Consultants	80	-
	1995-2000	Demonstrations Experiments	500	-
	1995-1998	Public Awareness	200	-

e 1: This project has already been submitted to Studies and Projects Financing - FINEP, the Brazilian local financing agent operating as a local implementing agency with The World Bank.

e 2: Bicycle saddles, ornaments, boats, thermoware, portable coolers.

e 3: This project has already been aproved by the Executive Commitee.

4. Net Total Incremental Cost for ODS Phase-out of Brazil CP

Sector	Total Incremental Cost (USD 1,000)	ODS Reduction (metric tons)	ODP Reduction (metric tons)	Unitary Cost (USD/kg ODS)	Unitary Cost (USD/kg ODP)
FOAMS					
Rigid/Semi-rigid	11,558	22,520	22,520	0.49	0.49
Dom. Refrig.	243,000	25,679	25,679	9.46	9.46
Total	254,558	48,199	48,199	5.27	5.27
REFRIGERATION/ AIR CONDITIONING					
Domestic Refrig.	121,500	11,243	11,243	10.81	10.81
Commercial Refrig.	355,500	93,588	93,472	3.80	3.80
Industrial Refrig./Central Air Conditioning	86,230	292	292	295.30	295.30
Total	563,230	105,123	105,007	5.36	5.36
HALONS	2,670	1,042	6,613	2.56	0.40
SOLVENTS	9,600	162,652	27,108	0.06	0.35
METHYL BROMIDE	900	4,356	3,049	0,21	0.29
GRAND TOTAL	830,958	321,372	189,976	2.58	4.37

Training and CFCs Recovery, Recycling and Contention

Besides the cost of sectoral efforts and projects, which are shown above, there are two initiatives whose results permeate those of all other sectors: these are the Manpower Training, and the Recovery, Recycling and Contention program.

The Training Project costs sum up to an estimated amount of US$ 7,265,000.
The Recovery, Recycling and Containment project estimated cost is US$ 60,551,000.

Total ODS Phase-out cost

With the data and information today available in Brazil, total incremental cost for the phase-out of ODS in the country was calculated to be US$ 898,774,000.

BRAZIL

COUNTRY PROGRAM

FOR THE

PHASE-OUT OF OZONE DEPLETING SUBSTANCES

UNDER THE

MONTREAL PROTOCOL

MINISTRY OF THE ENVIRONMENT AND AMAZON
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MINISTRY OF INDUSTRY, COMMERCE AND TOURISM
PRESIDENCY SECRETARIAT FOR PLANNING AND COORDINATION

June, 1994

BRAZIL COUNTRY PROGRAMME

INDEX

1 - INTRODUCTION

1.1 PURPOSE OF THE COUNTRY PROGRAMME

Brazil qualifies as a Party operating under Paragraph 1 of Article 5 of the amended Montreal Protocol having ratified the Vienna Convention for Ozone Layer Protection in June 1990 and the Montreal Protocol on Substances that Deplete the Ozone Layer in March 1990. Brazil has drafted its Country Programme for the Phase-out of Ozone Depleting Substances (CP) in accordance with Protocol guidelines as contained in paragraph 10 of Appendix II of Annex IV to the Report of the Second Meeting of the Parties. This will enable Brazil to completely and effectively adopt the control measures listed under the Protocol and to qualify for technical assistance and funding provided by the Multilateral Fund of the Montreal Protocol.

Brazil's Country Programme - CP, submitted at the Thirteenth Meeting of the Executive Committee of the Multilateral Fund, reflects the determination of both Government and Private Sector to implement a national policy for the ozone layer protection in accordance with the Montreal Protocol.

The CP has chosen the fastest possible action plan to eliminate production and consumption of ODS, taking into consideration industry and consumers specificities, using the most updated technological and economical data available at the time of the Programme preparation. However, because changes are expected to occur both in availability and pricing of substitute solutions as well as ODS - as they did during the last couple of years, the CP will possibly be updated during the phase-out period, in order to keep pace with the dynamics of the subject.

Furthermore, the CP is mostly dedicated to the elimination of ODS in the industrial sector, not having considered the actions to be undertaken by government to address the occurrence of possible public health effects deriving from increments in ultra-violet light exposure.

Brazil has given absolute priority to the development of CP in a cooperative effort involving all society in some way related to the ozone issue. Partnership was paramount, and the methodology used was the following:

-. the Interministerial Ozone Working Group - GTO, whose composition is explained in paragraph 1.2 , with strong support of industry associations, has set up an outline under which private consultants were contracted to made sectoral surveys in close cooperation with the respective industry associations;

- besides the data collecting on ODS consumption, on alternative substances and technologies and their prices, and the contents, cost and pricing of needed ODS elimination projects, consultants did include suggestions of policies, regulatory legislation and institutional framework required to continually monitor and evaluate the implementation of the programme and its projects;

- it was agreed that each consultant was to produce a document that would reflect not only his technical considerations but - and especially - those of industry associations, consumers and government;

- both a national and an international consultant - the latter an experienced United Nations Development Programme (UNDP) consultant - helped consolidate the sectoral Programmes into a coherent and comprehensive document;

- industries related to ODS production and consumption - mainly represented by Foams, Refrigeration, Halons, Solvents and Sterilants - developed, for each one of these industrial sectors, a "Sectoral Programme for the Phase-out of Ozone Depleting Substances", including a survey containing complete statistical data about the sectors' ODS production and consumption and a report containing future trends, consumption implications, ODS substitutes, alternative technologies, economical analyses, the impact in Brazilian exports and suggestion for the required legislation. For these results each sector received international technical cooperation from UNDP Consultants in Sectoral Workshops.

- these reports were presented in a Workshop for both Government officials as well as representatives of the Private Sector, NGOs, State Environmental Agencies and Universities. The participants comments and suggestions were aggregated in the reports and sent to the GTO Executive Secretariat to be consolidated in a first draft of the CP that was submitted to the GTO for the final approval and sent to the Multilateral Fund Committee.

The support of the Institutional Strengthening Project funds - approved for Brazil in the X Meeting of the Executive Committee of the Multilateral Fund - MF/EXCOM, as well as direct and straightforward and cooperative approach followed by United Nations Development Programme - UNDP were fundamental for the fast and effective development of Brazil's Country Programme.

1.2 STATUS OF THE COUNTRY PROGRAMME

The Government has established, in October 1991, the Interministerial Technical Ozone Group - GTO, which has the responsibility of coordinating Montreal Protocol activities in the country, including the design and implementation of the CP and their sectoral work programmes. GTO has an Executive Secretariat - SE/GTO, represented by the Industrial Policy Secretary of the Ministry of Industry, Commerce and Tourism and comprises 5 Ministries and the Presidency Secretariat of Planning and Coordination, and the Private Sector, State Environmental Agencies and Universities as invited members.

Brazil's Country Programme has been drafted in accordance with the content of the model CP format developed by the Executive Committee of the Multilateral Fund and following the terms of reference for development of Brazil's CP. The CP drafting activities have been organized and coordinated by GTO. The Ministries, State Agencies, NGOs, Universities an Industries Associations that have participated in and supported CP formulation activities include:

Ministry of Foreign Affairs - MRE
Ministry of Industry, Commerce and Tourism - MICT / Industrial Policy Secretariat - SPI
Ministry of Science and Technology - MCT
Studies and Projects Financing Agency - FINEP/MCT
Ministry of the Environment and Amazon - MMA
Brazilian Institute of Environment and Natural Renewable Resources - IBAMA/MMA
Presidency Secretariat for Planning and Coordination - SEPLAN
University of São Paulo / Nuclear Energy National Commission - USP/CNEN

State of São Paulo Environment Agency - CETESB
Brazilian Institute of Cold Technology - IBF
Automotive Manufacturers Association - ANFAVEA
Plastic Industry Association - ABIPLAST
Refrigeration, Air Conditioning and Heating Association - ABRAVA
Electrical and Electronic Industry Association - ABINEE
National Plastic Institute - INP
Brazilian Association of Chemical Industries - ABIQUIM
Brazilian Association of Fire Extinguishing Equipments and High Pressure Cylinders Industries - ABIEX
Brazilian Association of Gas Industries - ABRAPAR
Brazilian Association of Machine and Compressor Industries - ABIMAQ
Brazilian Association of Aerosol Industries - ABA
Agricultural Chemicals Industries Trade Union - SINDAG
Brazilian Association of Cool Transportation - ABTF

The consultants and their respective Sectoral Working Groups collected and analyzed data during April - May 1994. The first consolidated draft CP was prepared in May/June 1994 based on reports of the nine Sectoral Working Groups which included contributions from about 25 national experts. The first National CP Workshop was held in São Paulo in May 20 with approximately 50 participants including national and international experts. All GTO members were represented and all Sectoral Working Groups made presentations. UNDP as supporting Agency, UNIDO and FINEP (Studies and Projects Financing Agency)as a National Agency participated and the results of these activities were presented in the Workshop of May 20.

The first draft CP relied on the following information :
- UNEP/ OZL Pro/ EXCOM / 5/16
- Several Countries Country Programmes
- The Costs to Brazil of Complying with the Montreal Protocol - 1990 (IBAMA - US/EPA - The Brazilian Industry)
- The World Bank - The Brazilian Industry - The Costs to Brazil of Complying with the Montreal Protocol. 1992 - (IBAMA - US/EPA)

All the information presented in this CP were obtained in 1994, during the surveys executed by the industry associations related to each one of the sectors involved.

1.3 ASSISTANCE RECEIVED FOR CP PREPARATION

In 1990, a Case Study was prepared with the important cooperation of the US Environment Protection Agency. The Study was updated in 1992, and a visual Short Form Table was produced out of this last document, providing simple and direct knowledge of consumption of ODS by substance and by sector.

The total and overall cost of the Country Programme preparation is estimated to have been US$ 260,000, most of it at Brazilian Government own expenses.

2 - CURRENT SITUATION

2.1 PRODUCTION AND CONSUMPTION IN 1993.

The following Ozone Depleting Substances (ODS) were identified as being used in Brazil:

- Annex A Group I: CFC-11, CFC-12, CFC113, CFC-114, CFC-115
- Annex A Group II: Halon-1211, Halon 1301
- Annex B Group II: Carbon Tetra Chloride (CTC)
- Annex B Group III: 1,1,1 Trichloroethane, also known as methylchloroform (MCF)

Brazil produces all its consumption needs of CFC-11 and CFC-12; being a part of the total production also exported to other South American countries. In 1993, due to the sometimes lower price of the international market, Brazilian CFC-11 and 12 consumers imported around 10% of the total country's consumption. In respect to CFC-113, 114 and 115, all of the local needs are imported. CTC is locally produced and MCF is totally imported.

Table 1a shows Brazilian consumption of ODS (weighted tons) and its respective total ODP (tons). The table uses calculations procedures as described in Article 3 - Calculation of Control Levels - of the Montreal Protocol, subparagraphs (a) and (b). Production figures include sold volumes and also what was kept as inventory by producers.

Table 1a- Total 1993 ODS and ODP Consumption, by substance (tons)

	CFC 11	CFC 12	CFC 113	CFC -114	CFC -115	H-1211	H-1301	CTC (*)	MCF	TOTAL
PRODUCTION										
Total	4,010	7,483	-	-	-	-	-	43,970	-	55,463
IMPORTS										
Total	170	648	128	20	22	6	5	-	6,000	6,998
EXPORTS										
Total	1,444	2,793	-	-	-	-	-	25,154	6,000	29,401
TOTAL ODS CONSUMPTION										
tons	2,726	5,338	128	20	22	6	5	46	6000	14,291
%	19	37	0.9	0.1	0.1	0.04	0.03	0.3	42	100
ODP factors										
	1.0	1.0	0.8	1	0.6	3.0	10.0	1.1	0.1	-
TOTAL ODP CONSUMPTION										
tons	2,726	5,338	102	20	13	18	50	50.6	600	8,918

(*) Total 1993 Brazilian CTC production was 43,970 tons: however a feedstock of 3,846 tons was formed by both producers, Dow Química (3,747 tons) and Carbocloro (99 tons). As almost all of this feedstock is intended to be used as raw material for CFC-11 and 12 production, it was not included in country's total 1993 ODS consumption.. Also, a total of 162 tons (Dow 109 tons and Carbocloro 53 tons) were sold to be used as dilutants in process formulations (which however are not considered as emissions by the Montreal Protocol). Only about 46 tons (Dow 36 and Carbocloro 10) were sold for use directly as solvent/degreasing agent (where emissions are expected).

Therefore, the total Brazilian ODS consumption is the sum of CFC-11 and 12 consumption (8,064 tons) plus the CFC-113, 114 and 115 imports (170 tons) plus the CTC production directly used as solvent/degreasing agent, (46 tons) plus the MCF imports (6,000 tons) plus halons H-1211 and H-1301 imports (11 tons). This makes a consumption total of 14,291 ODS tons.The total ODP consumption is 8,916 tons.

Table 1b shows the total Brazilian consumption of ODS, per Group and Annexes defined by the Montreal Protocol.

Table 1b - Total 1993 ODS and ODP Consumption tons

	Annex A Group I	Annex A G. II	An. B G. II	An. B G.III	GRAND TOTAL
ODS CONSUMPTION	8,231	11	46	6,000	14,288
ODP CONSUMTION	8,197	68	51	600	8,916t

Figure 1 - 1993 ODS Consumption (Percentage Share)

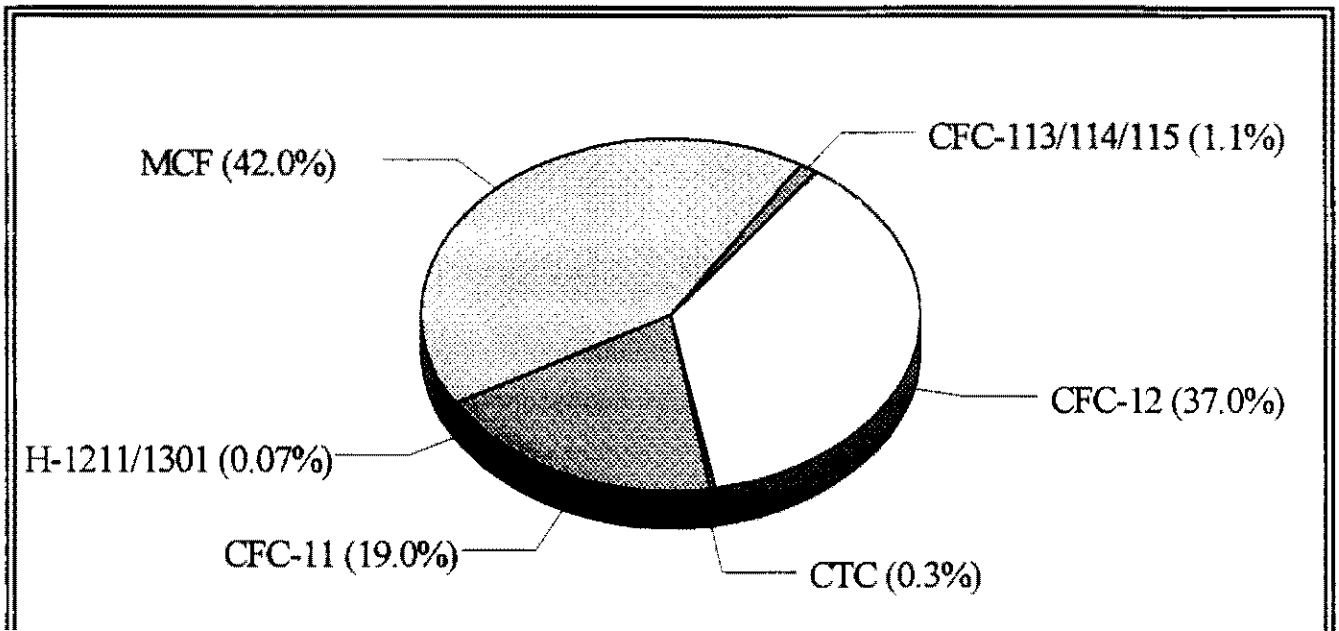


Figure 2 - 1993 ODP Consumption (Percentage Share)

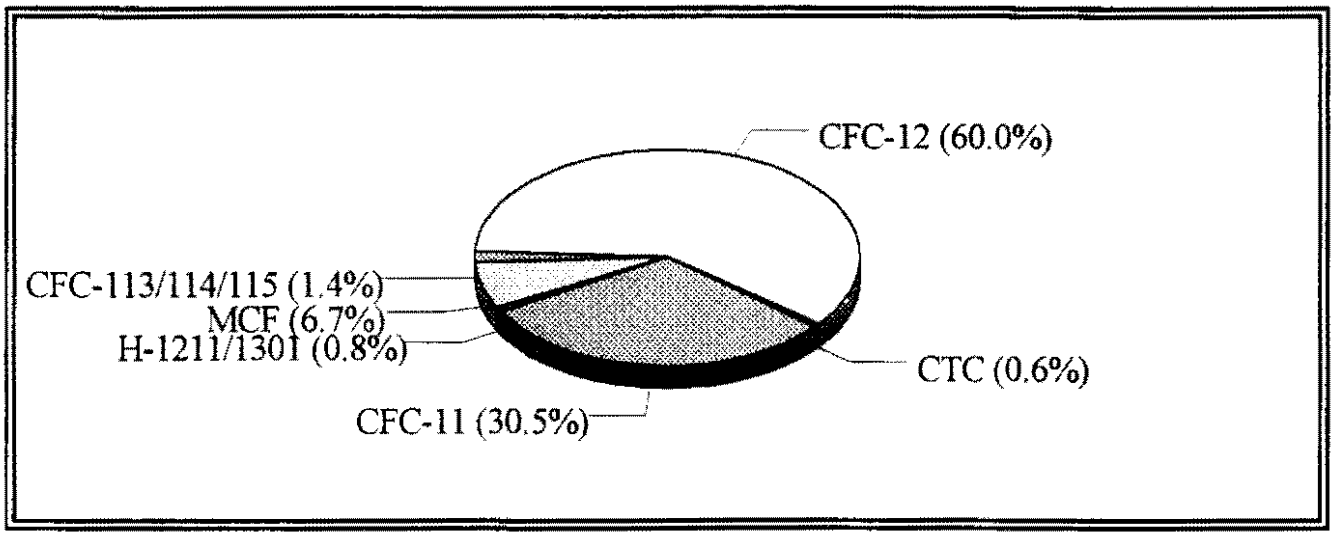


Table 2 shows 1993 ODS and ODP consumption by sector. Consumption of CFCs include 240 tons for aerosols used in the production of pharmaceuticals (CFC-11=70 tons and CFC-12=170). Figures 3a and 3b show ODS/ODP percentage share by sectors.

Table 2 - 1993 ODS and ODP Consumption by sector (tons)

	Dom. Refr.	Ind/Com Refr./ CAC	Mobile AC	Service	Foams	Fire Exting	Solv.	Aeros.	Total
ODS	461	501	254	4,541	1,950	11	6.318	255	14,291
%	3.2	3.5	1.8	31.8	13.6	0.1	44.2	1.8	100
ODP	461	498	254	4,535	1,950	68	897	255	8,918
%	5.6	5.6	2.8	50.8	21.9	0.8	10.0	2.8	100

Source: 1994 CP Survey

Figure 3a - 1993 ODS Percentage Share by Sectors

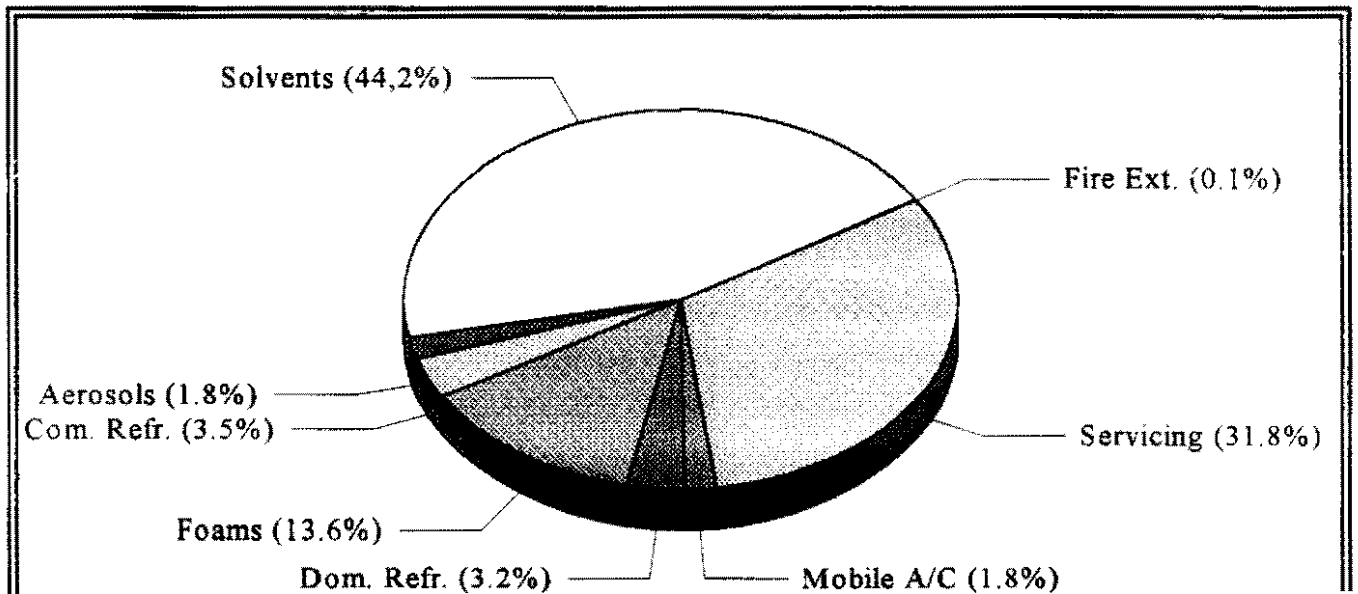
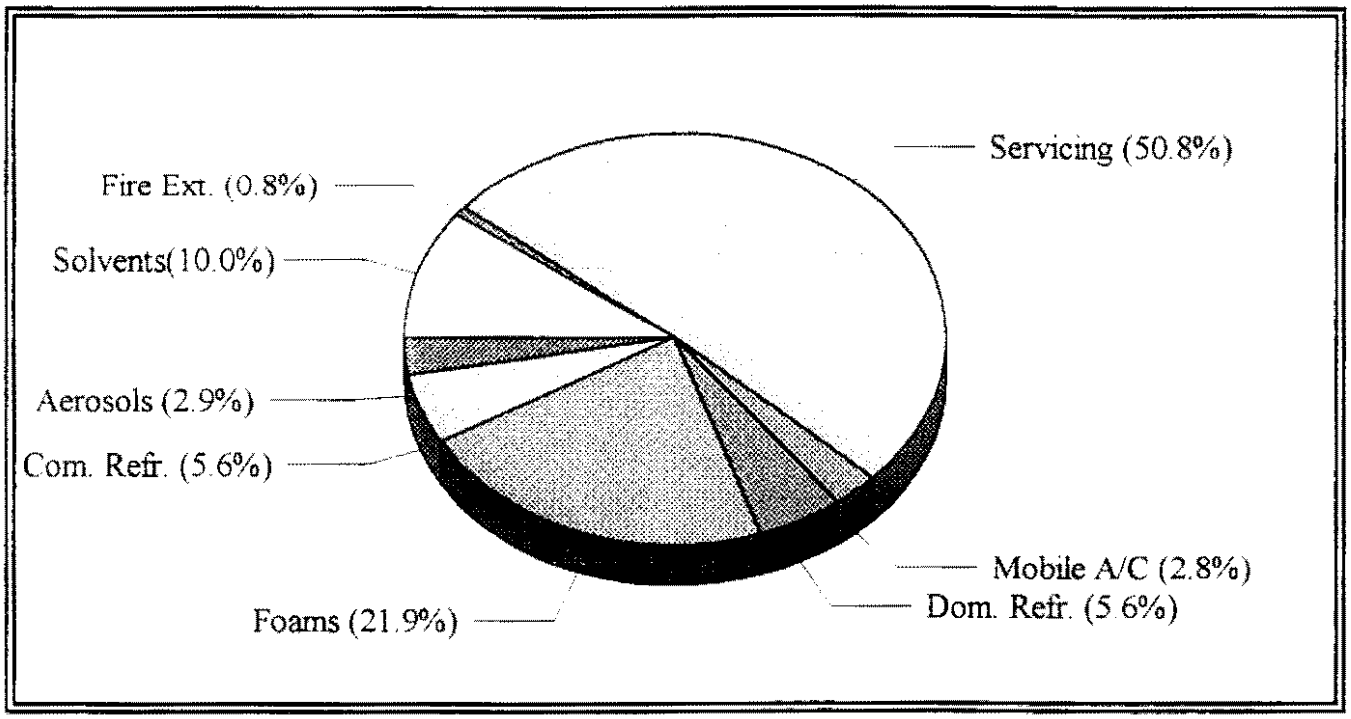


Figure 3b - 1993 ODP Percentage Share by Sectors



2.2 INDUSTRIAL FRAMEWORK

2.2.1 THE SUPPLY SIDE

For decades two companies have been producing CFCs in Brazil: Du Pont do Brasil S/A and Hoescht do Brasil Química e Farmaceutica. Hoechst and Du Pont have a combined CFC-11 and 12 production capacity of respectively of 10,000 and 18,000 tons/year. Both these substances are used mostly in the Foams and Refrigeration markets. Hoechst has started the conversion of its facilities for production of transition alternative substances, and is today able to produce 2,400 tons/year of HCFC-22 and 700 tons/year fo HFC-134a. Since 1991, with the Brazilian economy "overture", CFC-11 and 12 started to be imported. However, even in 1993 90% of Brazilian needs were met by local production, being the rest 10% directly imported by end users or comercial agents. CFC-113 was produced by Hoechst produced till 1992, when it supplied 60% of the local Brazilian market. Today the total demand CFC-113, 114 and 115 is being imported.

MCF, was produced by Dow Química do Brasil S/A until 1992, when it stopped producing it, starting to import and selling it. The company supplies 95% of the Brazilian market, being the remaining 5% met by small imports of other companies (commercial and industrial).

The total 1993 CTC Brazilian production was 43,970 tons. Dow Química produced 40,619 ODS tons and Carbocloro the other 3,351 tons. Dow (11,613) and Carbocloro (3,190) sold a total of 14,803 tons to Du Pont and Hoechst, for their CFC-11 and 12 production. Dow (109) and Carbocloro (53) sold additional 162 tons of CTC for use as raw material or dilutant in chemical formulation processes (this type of aplication is considered intermediate and therefore do not count as emissions by the Montreal Protocol. Dow (36) and Carbocloro (10) sold a total of 46 tons for use generally as solvent/degreasing agents (these aplications are considered

emissions). Dow was planning to shut-down its CTC production facilities during 1994. Carbocloro, former Rhodia, which is presently a 50% Brazilian (Unipar) and 50% American (Occidental) joint venture, has a CTC production capacity of 7,000 tons/year, but its 1993 production was of solely 3,300 tons.

2.2.2 THE DEMAND SIDE

2.2.2.1 FOAMS (not including Domestic Refrigeration uses)

Brazil has already completed conversion to the use of methylene chloride in the flexible foam segment. Thus, the phase-out of 1,300 tons per year is complete, and there are at present no known CFC users among the flexible foam manufacturers. The remaining use of ODS is concentrated in the manufacture of semi-rigid and rigid polyurethane foam. Table 3 shows segments' share of the total sector ODS consumption.

There are about 200 small and medium size enterprises manufacturing foams to supply the industrial refrigeration, automotive , furniture and building construction segments. About 25 medium size enterprises are located in the south and southeast regions and comprise eight percent of ODS consumption, the remaining being small users who are widespread in the country. The industrial refrigeration segment comprises manufacturers of industrial freezers and refrigerators, cool shelves, cold storage rooms and thermally insulated trucks used for the transportation of perishable goods. The furniture segment comprises the manufacture of flexible, semi-rigid molded foams (integral skin) and rigid, structural foams; the automotive industry comprises the manufacturers of flexible, semi-rigid molded foams (integral skin) and rigid, structural foams. The building construction segment comprises rigid blocks, panels, thermally insulated tiles and the spray/ injection process users and manufacturers.

Table 3 - Foams ODS Annual Consumption by End-User

Segment	tons	% share
Automotive	374	41
Buil.&Const	168	19
Furniture	52	6
Refrigeration	164	18
Others	142	16
Total	900	100

source: INP/1994

2.2.2.2 REFRIGERATION/AIR CONDITIONING

Domestic Refrigeration

Brazil has two main compressor manufacturing industries. One is a leading world manufacturer, having produced 9.3 million compressors in 1993, and having exported 70% of its hermetic compressor production (40% of which to developing countries).

There are six major companies involved in the manufacturing or assembly of domestic refrigerators and freezers in Brazil. Even though most produce primarily to supply the domestic needs, the country is the leading exporter of appliances to the Latin American market. Other markets include developed countries such as USA, Canada, France, Spain and Australia.

The current refrigerator manufacturing capacity is around 4 million units. In 1993, total sales were 2 million refrigerators and 750,000 freezers, indicating a slow economy - back to levels experienced in the mid-eighties. Presently, approximately 25 million refrigerators are in use, while there are around 35 million homes. As the Brazilian economy grows, higher demand and production levels are expected. The pent up demand will also improve the market saturation.

The main manufacturers have chains of authorized service stations to provide for the necessary maintenance of the appliances already in use. There is also a large number of independent untrained mechanics servicing the various domestic appliances, and considerable training will be needed to reduce the service based consumption of ODS in this sector.

Central Air Conditioning

Major manufacturers in this sector are either multinational companies or their domestic subsidiaries, mostly American and Japanese. The leading companies in this sector are Carrier, Hitachi, Trane and York. Those companies manufacture components and equipments for their products, such as chillers, and self contained air conditioners. However they do not participate in the market of specific components such as compressors. The percentage of domestically manufactured items is fairly high, especially in reciprocating compressor units. As for centrifugal chillers, recent trends indicate a significant growth of imports of complete units.

The industrial production in this sector during the base year of 1993 can be evaluated by the sales presented in Table 4.

Table 4 - Sales in the Central Air Conditioning sector in the base year of 1993 in Refrigeration tons (TR)

Equipment	Sales, TR
(1) Self Contained	
- Water cooled	13.040
- Air cooled	41.720
(2) Reciprocating compressor chillers	32.060
(3) Fan coils	43.445

Commercial and Industrial Refrigeration and Refrigerated Transportation

This sector is predominantly made up of medium and small companies, operating as contractors and in the assemblage of final products. In general, these companies assemble components and equipments made by other companies. The main equipment is the compressor. There are eight compressor manufacturers operating in the country. Three of them produce reciprocating hermetic compressors, mostly for domestic uses. One of them is a Brazilian capital owned company. The other five companies manufacture open and semi-hermetic reciprocating as well as screw compressors. All of them use foreign technologies, but there is a significant level of domestic technology in the manufacturing process as well as in raw materials.

Table 5 presents sales of compressors domestically manufactured for Commercial Refrigeration uses during the base year of 1993. The production of compressors for Industrial Refrigeration uses for operation with HCFC-22 was 28,080 TR during that year. This value corresponds to approximately 40% of the market in this sector. HCFC-22 shares the market with Ammonia. Centrifugal units for Industrial Refrigeration uses are seldom used, and, in this Program, those units will be accounted for along with those for the Central Air Conditioning sector. It must be noted that during the base year of 1993, there were no sales of compressors for operation with either CFC-12 or CFC/HCFC-502 in the Industrial Refrigeration sector.

Table 5 - Sales of compressors for Commercial and Industrial Refrigeration

Refrigerant	Sales, hp
CFC-12	118,000
HCFC-22	220,000
CFC/HCFC-502	4,100

Source: 1994 Sectoral CP Survey

Other components and equipments for this sector, such as pipes, filters, valves, evaporators, heat exchangers etc. show high levels of domestic manufacturing technologies. Some multinational companies share the market in this sector with those domestically owned. However, it must be emphasized that this sector is made up predominantly of medium and small domestic companies.

The refrigerated transportation market is basically shared by two companies. One is domestic whereas the other is American owned.

Mobile Air Conditioning

Currently, there is only one compressor manufacturer for mobile air conditioning in Brazil. 30% of its production is exported to South America, Central Asia, South Africa and the USA. This company is already producing a compressor model designed for HFC 134a. Its production is marketed both in the domestic as well as in the international market.

Air Conditioning systems are produced by three major transnational companies to meet local

Domestic Air Conditioning

The domestic air conditioning sector is composed of four manufacturers. Product capacity ranges from 5,000 up to 30,000 BTU/h in window room air conditioners and split systems. All of them use HCFC 22 to charge the units.

The segment produces about 500,000 units per year and two companies are responsible for 90% of this production. These two companies are linked with US enterprises and 35% of its production is for export. The main export market is the US and secondly, Latin America.

2.2.2.3 HALONS

The Industrial structure for halons has been rapidly changing due to the strong industry response to the Protocol. The industry has accomplished a sharp decrease in halons consumption, going from 200 ODP tons in 1991 down to zero in 1994. There have been many contributing factors to this rapid decrease; such as high landed price in the past; the availability of alternative technologies and substances for hand held, locally made, extinguishers; and the Protocol signals to the halon producers. Currently, less than 5% of the existing total fire suppression market uses halons in Brazil, essentially limited to only portable extinguishers (10,000 units) and fixed systems (numbers are estimated to vary from 300 to 500 systems and about 760 airplanes). The manufacture of halon-containing hand-held extinguishers has been phased out since 1992. While exact details of Halon use pattern by geographic region are not available, it is estimated that 90% of the users are in the states of São Paulo, Rio de Janeiro and Minas Gerais.

The fire extinguishers with Halon 1211 were produced in the country until 1992, by basically 2 companies. In the last 3 years, 85% of the market was supplied by one of them. Alternative technologies are being used in the current production of extinguishers. There are seven large producing companies, and 5 additional smaller ones. National production of fire extinguishers, without halon, currently satisfies the internal market, and therefore there have been no imports.

Only a few companies produce and supply the fixed systems with Halon 1301, with four manufacturers providing most of the systems to the market. Since the beginning of 1993, there have been no new installations with Halon 1301. The annual growth of the total market of equipment and fire suppression systems in Brazil is estimated to follow the gross national product increase, that is about 5 %, even though the market for new equipment and systems using halons has now been phased out.

Table 6 shows the percentage share of identified end users with current stock of halons in existing equipments and systems. End uses indicated as "Others" were mostly for data processing centers. Virgin stock totals are 3.5 tons of halon 1211 and about 7 tons of halon 1301.

Table 6 - Current Stock in Existing Equipment/Systems by End User

Halon 1211		Halon 1301	
Total= 25 tons		Total= 250 tons	
End User	% Share	End User	% Share
Oil Co. "X"	1	Oil Co. "X"	6.5
Airline "Y"	3	Aviation	4
Bank "Z"	43	Navy	0.5
Others	53	Others	89

Source: ABIEX/1994

2.2.2.4 SOLVENTS AND STERILANTS

There are about 2000 companies using ODS in Brazil, crossing many subsectors. They can be split into 2 (two) major groups according to the predominant technology used by them in the cleaning process:

Hot Cleaning: This group represents close to 20% of the users, but they consume 60% of the demand. They primarily use vapor degreasing technology which ranges from small, simple systems ($10 M) up to very large, complex systems($200M - $400M). As in other countries, a number of the vapor degreasing systems also include ultrasonics or spray to improve effectiveness of soil removal. Many are multinational companies that have already begun some ODS conservation and replacement programs (Ford, IBM, Bosch, VW, etc.) according to their parent companies' strategy.

Cold Cleaning: This group represents close to 80% of the users, and they consume about 40% of the solvent based ODS. They generally do not use sophisticated equipment, and often have manual cold-cleaning operations. These companies are normally dependent upon suppliers' technology and will need special attention during the ODS phase-out and replacement period.

2.2.2.5 *AEROSOLS*

Since 1988, the use of CFCs in Brazil is restricted to the pharmaceutical industry. The total consumption of CFCs in this sector is 255 ons as described below:

- CFC-11: 70 tons
- CFC-12: 170 tons
- CFC-114: 15 tons

The unconstrained scenario for the use of these substances was considered to have a zero grpowth rate.

2.3 UNCONSTRAINED DEMAND SCENARIO

As in many other countries in various regions, the Brazilian economy has not been growing in the past few years which has caused demand for goods and services to fall to mid-eighties levels. There are signs that the economy is about to start a growth period in the near future, with potentially withheld demand coming forth as consumer confidence improves and the recovery progresses. Thus, a range of scenarios was considered, but the chosen principle for all the sectors was to base the growth estimates on conservative projections. Specific conditions for each individual sector were responsible for the different sectoral growth scenarios.

Total Unconstrained ODP tons Demand

Total unconstrained ODP tons demand in the year 2010 would be about 375% of 1993 demand in Brazil, based upon the conservative estimates mentioned above. This is based upon many sectors using GNP, or near GNP growth rates. As mentioned above, as the economy strengthens, it is likely that these growth forecasts will be exceeded. The estimated rise of unconstrained ODP demand can be also seen in Figure 8 of section 3.5.

2.3.1 Foams — 1993 = 900 ODP tons; 2010 = 1,880 ODP tons

With flexible foams virtually phased out, the automotive, integral skin, structural, insulating, and packaging foams are expected to grow at a composite integrated rate of 8%, reflecting the economic recovery and the stored demand for housing. This is expected to continue over the next decade.

2.3.2 Refrigeration and A/C — 1993 = 5,748 ODP tons; 2010 = 15,754 ODP tons

The Refrigeration A/C sector is expecting a rapid growth rate through the year 2010. The unconstrained growth in this sector is anticipated to be at the rate of 10%, as both the economy recovers, and the unsaturated market grows closer to saturation. One of the larger subsectors, domestic refrigeration, is forecast to grow through the year 1996 at the rate of 10%, with growth thereafter through the year 2010 at the rate of 5%. Even though Industrial Refrigeration and Central Air Conditioning sectors do expect to grow at the aforementioned rate, unconstrained forecasts are not adequate since these sectors have already performed the phase-out of ODSs. In the mobile AC market, the consumption of HFC 134a was adjusted in line with each car manufacturer plan with reference to use of non-ODS for their new product line.

2.3.3 Halons — 1993 =50 ODP tons; 2010 =505.3 ODP tons

The halons sector has much of its use in the banking and avionics subsectors. A very conservative growth of just under 5% was forecasted for this sector, starting with the very low

2.3.4 Solvents and Sterilants — 1993 = 897 ODP tons; 2010 = 27,108 ODP tons

Electronics and metal cleaning account for 95% of the use in this market in Brazil. CFC11 growth was taken at 6%, adjusted for the testing being done on compressors in the refrigeration market. The use of CFC113 starting at 128 t/yr. in 1993 is expected to grow at the rate of 8%/yr. unconstrained, related to the electronics and the telecommunication markets. The large use of MCF, is anticipated to grow at the rate of 5%/yr. related to automotive market and metal cleaning uses. CTC was assumed to have no growth. In the mobile AC area, the growth of CFC product consumption has been far larger than the growth of vehicle production. In the unconstrained scenario, the total growth should reach 15%/year over and above 1993 consumption. Such growth can be forecasted for the next coming five years.

For sterilant use of CFC12, a growth of about 9%/yr. is expected for the medical and pharmaceutical markets beginning in 1994, and falling gradually to 5%/yr. after the year 2000.

2.4 INSTITUTIONAL FRAMEWORK

The Government of Brazil established, back in 1991, a formal national framework: the Ozone Interministerial Working Group - GTO. The GTO was declared responsible for establishing policies, for the coordination of all actions related to the ozone layer protection, and for the implementation of the Montreal Protocol, including the Country Programme. The GTO is formed by the following official agencies:

Ministry of Environment and Amazon, through the Brazilian Institute of Environment and Renewable Resources - IBAMA

Ministry of Foreign Affairs

Ministry of Science and Technology

Ministry of Industry, Commerce and Tourism

Presidency Secretariat for Planning and Coordination - SEPLAN

The Executive Secretariat of GTO - SE/GTO - is exerted by the Industrial Policy Secretariat of the Ministry of Industry, Commerce, and Tourism. The SE/GTO usually invites representatives of the private sector, namely of industry associations related to ODS consuming industry sectors, to all GTO's meetings.

After the development of Brazil's CP, the GTO will be replaced by a similar agency, which will be responsible for the implementation and continuous assessment of the Programme. Government Action Plan and the role of the agencies involved in it can be seen respectively in sections 3.2 and 3.3.

2.5 POLICY FRAMEWORK

Brazil signed the Vienna Convention and the Montreal Protocol in June 1990, and adhered to the London amendments in July 1991. The Copenhagen amendments were signed and are in the process of ratification by the Congress.

Since 1988 however, the country had already prohibited the use of CFCs as propellant agent in aerosols. Additionally, in 1991 the Interministerial Ozone Working Group was created, with the responsibility to coordinate all actions intended to protect the ozone layer, including those necessary to comply with the commitments assumed under the Montreal Protocol, among which is the development of a Country Programme for the Phase-out of Ozone Depleting Substances - CP.

The development of the CP actually started with development, with support of the US/Environment Protection Agency, of a Study Case "The Cost for Brazil to Comply with the Montreal Protocol". This document was updated in 1992. From that date two alternatives of CP development were tried by the GTO, both with scarce and insufficient results: contracting consultants and firms. Eventually, the production of the CP was made through a strong partnership between Government and the Private Sector, making use also of resources allocated for Institutional Strengthening.

In March 1993 IBAMA started to collect ODS production and consumption data in order to comply with the MP.

2.6 GOVERNMENT AND INDUSTRY RESPONSE

In June 6th, 1990, Brazil became a signatory to both the Montreal Protocol and the Vienna Convention. Brazil has been very active both in the worldwide and in the Country effort to phase-out ODS. Individual experts are actively contributing to (some co-chairing) Montreal Protocol UNEP's Assessment Panels and Technical Options Committees.

Except for essential medical needs, Aerosol use of CFCs was banned in 1988, with one year given to convert the industry. The phase-out was completed in 1989, on schedule. The Brazilian ODS producers, all 100% multinational (foreign owned capital) companies that have almost all already implemented phase-out in their home countries, have also started modifications in their Brazilian plants, to to allow its production of alternative and sometimes transitional substances. The rate of their process modification has been determined by market demand. These companies are willing to make fast and complete phase-out, accordingly to the pace of implementation of the Brazilian Country Programme. The multinational corporations are actually contributing for the reduction of ODS across all sectors in Brazil. For example Coca-Cola Corp. has informed its supplyers of refrigerated balconies and similar Coca-Cola labeled equipments that it will only buy CFC-free products from january 1996 on.

The phase-out of CFC in Flexible Foam manufacturing - continuous process (injection machines) or manual process (boxes) - has already been described and was completed in the late 1980s: this activity would consume approximately 1,300 tons of CFC today, if not phased-out.. The phase-out of ODS used in polystyrene for the manufacturing of packaging products and thermal insulation was completed in the late 80's through substitution of ODS for H2O

CFC-11 in their insulating foams for most of their plants, on their own initiative and at their own expense. The phase-out of halons began in 1991. Portable extinguishers exports stopped in 1992. Brazilian demand also dropped during the same period. No new fixed halon systems have been installed since 1993.

Three local manufacturers have begun production of recycling machines. A local compressor manufacturer has completed its own research and has begun production of HFC 134a compressors for both local consumption and for export to several countries.

Among industry associations, the ozone issue has been an important part of their agendas since 1987, and they have been active contributors in the international industry efforts to define technology paths and standards needed for successful use of the alternative technologies. Their initiative and leadership has been praised by the Government as the basis for the currently successful model of the government /industry working partnership needed to phase-out ODS in Brazil.

In 1992, the Government developed the organizational plan and formed the GTO (Ozone Working Group) under the Ministry of Industry, Commerce and Tourism, and at the same time formed the Interministerial Working Group for the implementation of the Montreal Protocol.

3. ODS PHASE-OUT IMPLEMENTATION

3.1 GOVERNMENT STRATEGY STATEMENT

In 1993, Brazil consumed approximately 0.095 kg/capita/year, or about one fourth of the maximum level set by the Montreal Protocol to allow a party country to apply for a grace period of 10 years after the phase-out year scheduled by the Montreal Protocol and its amendments. Nevertheless, the Government of Brazil is committed to the phase-out of ODS in the fastest possible way and is willing to undertake all actions needed to accomplish this. However, it is clear that the phase-out pace must make a compromise between the environmental urgency and the hability of both Brazilian industry and consumers to shift to alternative substances and processes.

The Brazilian Government is therefore fully aware of the importance and urgency for the ozone layer protection, and ther is the same awareness of the importance of the availability of both financial as well as technological resources for the country's ODS phase-out to be accomplished in the least time. Thus, ODS phase-out progress in Brazil will be partially determined by the desired availability of assistance from the Multilateral Fund - MF. In this respect, it is the Government's strategy to fully cooperate with all four international implementing agencies of the Multilateral Fund, each in the role indicated by the same MF. Presently, negotiations between The Worl Bank and one of the country's national Financing Agency - FINEP are very much advanced. The effort of both agencies to reduce the time presently needed for project analysis and approval is going to accelerate the rate of results of the resources that have already been allocated. In addition, The United Nations Development Programme - UNDP and The United Nations Industrial Development Organization - UNIDO have up to know contributed a lot for the identification and preparation of industry conversion projects. Brazil has not yet developed stronger tyes with The United Nations Environment Programme - UNEP. However, as the CP has identified an urgent need for manpower training - with priority for thousands of Refrigeration and Air Conditioning mechanics spread all over the country, Government feels there is a large oportunity for productive and extremely usefull cooperation in this field.

In short, Brazil will be able to accelerate its ODS phase-out once it has obtained cost-effective substitute technologies and sufficient financial and training assistance corresponding to the implementation of the various technologies.

Concerning the various strategic approaches for the more advisable speed for Brazilian ODS phase-out, three were considered: a delayed one, an accelerated one, and a moderate third. Regarding the effects of each one among the producing companies, it was verified that all of them would relatively easily adequate themselves for the new market demand profile, whatever it would be. Du Pont and Hoechst, local producers of CFC-11 and 12 have already gone through some process modifications that allow them to already produce alternative substances. Furthermore, the enforcement of some periodically increasing differentiation federal and/or state taxes can easily encourage consumer's choice in favour of ODS-free equipments. The creation of an "Ozone-Free" label or certification could very well go along for the acceleration of industry's switching to ODS-free technologies.

The possibility of using hidrocarbons - maybe a must for those industries directing their export

choices. Hidrocarbons - wether locally produced or imported - woul be marketed by the Brazilian oil monopoly, Petrobrás, who is presently analising economic profitability of iso butane and ciclo pentane. Technologically wise, there seams to arise for the modifications needed within Petrobras refineries to make them able to produce the said substances. The dedicated company's Research Center - CENPES, is more than qualified to design all necessary changes, and Brazilian contractors are expected to be prepared to timely implement the necessary modifications.

Of the three strategy options considered, a **delayed strategy** was considered neither appropriate nor cost effective for the long term. Since Brazil has a number of multinational corporations and joint ventures that are already engaged in the phase-out process, the mid-sized and smaller scale industries would be at a commercial disadvantage if delays in their conversions should occur. Also, a major consideration must be the cost of early obsolescence in general, but especially in the Refrigeration sector, which is a dominant sector in Brazil. Along with these considerations, a **delayed strategy** causes unnecessary consumer disruption (due to later shortages, etc. of available ODS), a loss of international industrial competitiveness, and a later, higher cost of industrial retrofiting.

A more attractive and **moderate strategy**, and the one chosen by Brazil, is to adopt a phase-out strategy that moves the country away from ODS as fast as possible, with due considerations, and timing adjustments given, for the unique elements that are applicable to the Brazilian situation, and are essential to the successful completion of the plan. The strategy chosen is to integrate and balance these elements, and on the basis of both technical and economic feasibility, to complete the phase-out as early as possible.

The mid-sized and small scale industries are one of the considerations that affect the timing of the phase-out, since adequate time and effort must be made to reach out to this population and, while still providing some ODS materials to allow an orderly transition, do the necessary communications, training, and technology transfer needed to achieve a complete phase-out. For this reason an **accelerated strategy** would not be adequate to the country.

Also, the availability of servicing for existing and earlier products to meet the demands of local consumers should not be affected by the reduction of ODS. This would meet the criterion that local consumers should not be penalized during the replacement of relevant durable goods such as refrigerators and cold storage units. It will require close coordination of production, imports, and recycled materials. A smooth transition from ODS to their substitutes should be carried out in a time frame that is consistent with available, demonstrated technologies.

Brazilian demand for ODS substitutes, the substitute technologies for ODS consumption, and related equipment and raw materials will be based on both the development of local consumer markets and the participation of Brazil in the growing export markets. The latter basis will have some offsetting impact on the need for a smooth transition to the new technologies, since the developed country destination markets will be demanding that the products arriving are supplied with non-ODS based technologies.

In addition to the strategic choices, the strategy must utilize several elements to ensure success. A national campaign will have to be identified which increases public awareness of the importance of ozone layer protection, prepares them for the changes that are going to be seen, and enlists their support to provide the commercial incentives needed to maintain industrial conversion momentum. To assist the mid-sized and the small scale industries, and the industry

information, data bases, and operational mechanisms for implementation. The Government capacity to manage and implement the complexities of the phase-out will have to be increased and maintained at a high level throughout the phase-out period. Involvement of the industry associations will have to be formally instituted in assuring that technology transfer is deployed throughout each industrial subsector, and that training programmes and other industrial phase-out activities are implemented successfully.

At this point, it is important to inform that the whole Brazilian Country Programme was written with all the above considerations in mind, and based in all technical and economical informations available in mid 1994. It is felt that during the CP implementation, need will arise for adjustments to be made, considering the fast and continuous development of both internal and foreign new alternatives, and their respective variations in price. The Government however will keep the Multilateral Fund updated to any changed deemed necessary.

3.2 GOVERNMENT ACTION PLAN

Because Brazil is a producer nation, the major CFCs consumed (CFC 11 and CFC 12) are anticipated to remain available to meet near future demands, which in turn will be continuously decreasing accordingly to the planned phase-out schedule and government regulations. After production is discontinued, and recycled substances are the sole supply, a set of criteria will be set up to define priority of access to the use of the diminishing available supply. This shrinking availability of supply of ODS, possibly coupled with differentiating taxes and regulatory actions, are expected to assure a fast transition to ODS-free technology.

The Brazilian Government is presently analyzing a list of possible regulatory policies and actions, which are described below. Additional policies may be necessary as more experience is gained during the phase-out process.

a. A public awareness policy aimed at the importance of the ozone layer issue and its effects in life on the Planet - particularly human - and the current national and international Government and Industry actions to address the problem, as well as reporting the overall contribution of the country to the Montreal Protocol.;

b. A policy to define annually decreasing ODS production quotas for every local producing company, with reference to its own 1993 production level, along with the gradual annual rise of import taxes for the same substances.

c. A policy to define increasing federal and/or State taxes aplied on ODS.

d. A policy to gradually limit - through quotas - or prohibit exports of ODS.

e. A policy to prohibit manufacturing, imports, exports and national commercialization of new final products which contain ODS, except for repair parts and components to be used in the existing systems and equipments. The dates chosen will be in phase with the completion of appropriate sectoral phase-outs.

f. Investment policies which encourage the use of ODS substitutes and discourage the use of ODS by the various industry sectors.

h Tax incentives to encourage consumers adoption of alternative technologies, i.e. differentiating federal and/or State sales/Industrial Products Taxes aplied to ODS-free productsas, from those aplied to products using ODS.

i. A labeling policy, which provides for the labeling of substances that are friendly to the Ozone Layer. This will have to be combined with a public awareness programme that assures economic driving force in favor of ODS free technology.

j The evaluation of a policy which provides a favorable interest credit line for enterprises who engage in activities and projects which are complementary to, but not funded by, the Multilateral Fund.

k. A regulatory policy which provides a phase-out schedule for production and imports, using a base year, but controlling based upon overall ODP so that specific product manufacturing and import flexibility can be maintained.

l. A regulatory programme which prevents the unauthorized alteration of ODS free systems, in order to prevent the return to ODS.

m. A policy which provides for the training and the certification of technicians who are involved in the installation and repair of refrigeration equipment, as well as those who will be engaged in the recycling and recovery programmes of the country.

n Specific awareness programmes aimed at reaching out to the small size industries and service companies, therefore creating the economic climate which will allow labeling to have an economical incentive impact, and reporting on overall contribution of the country to the Montreal Protocol.

o. In order to promote recovery/ recycling, a policy which prohibits venting or other voluntary emissions during operation or maintenance of ODS containing equipment, except for essential uses as established by law.

p A programme to develop quality standards for alternatives as well as recycled gases and recycling equipment, so that phase-out momentum is maintained.

3.3 ROLES IN IMPLEMENTING THE STRATEGY

The Interministerial Ozone Working Group will act as the national central coordinator for all actions related to the ozone layer protection. These include the definition of national policies, regulatory legislation and programmes, the evaluation of the implementation of regulations, programmmes and projects (including industry conversion ones), as well as the national coordination with the Montreal Protocol.

The GTO will also be responsible for the implementation of awareness programmes bringing to the public updated information about the ozone layer issue and the national and international actions being designed and/or implemented to solve the problem. Among its actions, is the monitoring of the Country Programme goals and results, and the compliance to the Montreal Protocol agreement. The role of Executive Secretariat of the GTO will be performed by one of

elected by the GTO. Until the accomplishment of the preparation of the Country Programme, this role was performed by the Ministry of Industry, Commerce and Tourism.

The Official Agencies and their roles are as follows:

Ministry of Agriculture responsible for interfacing with agriculture and agro-business, and for the design of awareness and training programmes for the metil bromide users.

Ministry of Environment and Legal Amazon, and IBAMA (Brazilian Institute of Environment and Renewable Resources) responsible for the policy implementation related to control of production, imports, exports and consumption, and supervision of the collection and reporting of data on ODS production and consumption.

Ministry of Industry, Commerce, and Tourism, responsible for the interfacing with industry, and also for collecting import and export data and defining import tariffs for items entering the country.

Ministry of Finance will be responsible, through Customs, for ensuring that ODS is not imported after the regulated dates, either alone or contained in other materials. It is also responsible, through the Tax Bureau, for tax collection and will enforce any tax related incentives, if and when these are created.

Ministry of Science and Technology will be responsible for developing policy on technology transfer related to ODS, in cooperation with GTO. This Ministry has within its organization Studies and Projects Financing Agency - FINEP, which is already playing an important role as national executing agency for investment projects forwarded to the MF through the World Bank.

Presidency Secretariat of Planning and Coordination will evaluate impact of proposed policy recommendations relating to control of ODS and the overall phase-out plan.

In addition to the above, representatives of other segments of society will be called in to participate in the GTO:

Private Sector Representatives will provide input from the industries involved in the phase-out programme. A possible format for Private Sector participation is through an Advisory Board formed by representatives from industry associations. The Board will bring feedback related to the implementation of policies, regulatory legislation actions, projects and technology transfer, evaluating them and suggest additions or modifications to existing phase-out policies.

Working Class Representatives will bring fundamental contribution to the design and implementation of training and public awareness programmes, helping to monitor and assess the results of the implementation of the CP.

Environmental and Consumers Non-Governmental Organizations (NGOs) inputs will help monitor and assess the results of the implementation of the CP from the environmental and from the consumer's view-point.

Universities, Research and Development Institutes, Technical and Professional Training Institutes can contribute both in testing the performance of different alternate substances,

ODS. The Government is expecting that existing training infrastructure - like Industrial National Training Service and Commercial National Training Service, respectively SENAI and SENAC, will play an important role in providing specialized training. The two mentioned institutions manage taxes collected by Government for this specific purpose.

Small and Medium Enterprise Fostering Organizations like the Micro and Small Enterprise Support Service - SEBRAE and the Syndicate of Small Industries - SIMPI can help disseminate ozone issue awareness and training demand among their target public and associates as well as themselves provide training courses..

Quality Certification Technical Standards Associations/Institutes will be responsible for defining "Good Servicing Practices" - GSP, i.e. for Refrigeration and Air Conditioning mechanics. The rules for application and the issuing of GSP and "Non ODS Products" certificates will be provided by these organizations, both public and private. The Brazilian Association of Technical Standards - ABNT will be among these..

3.4 TECHNICAL CONSIDERATIONS FOR ODS PHASE-OUT

3.4.1 THE SUPPLY SIDE

As previously related, no problems are anticipated that could bring delays to the conversion of industries presently producing ODS. Because most of them - Du Pont, Hoechst and Dow Química - are 100% foreign capital owned, with their headquarters locared in non-Article 5 countries, their conversion almost already happened in their home countries, being their policy to have the rate of conversion of their Brazilian facilities defined by the requirements of the local market. These companies will therefore easily adapt their production facilities to the speed of implementation of the Country Programme. It has also been said that the modifications needed to switch their CFC-11 and 12 production capability to HCFC-22 are of low complexity and cost, and so all of them have already modified their plants to extent they needed to adapt themselves for the changing market profile. However, the switch from CFC-12 to HFC-134a is made either through conversion of the existing plant or through investment in new facilities, depending on the caracteristics of the previuosly existing plant . Carbocloro (CTC 7,000 tons/year production capacity) has not yet defined the future of its plant. Being 50% Brazilian owned capital, it could be eligible for MF support in its conversion incremental costs.

Concerning the hipothesis of hidrocarbon based alternate substances, the sole possible supplier is Petrobras, the Brazilian State oil monopoly. This company has begun feasibility analysis for the modifications needed to produce - and distribute - iso butanoe and cyclo pentane, or similar substances.

3.4.2 THE DEMAND SIDE

The rapid development of ODS phase-out technologies and the different rate of development between the various sectors has required that each sector carry out a survey of the present status and potential substitution technologies. As a result, each sector has proposed its own technical approach as the basis for the development of the sectoral phase-out scenarios in Brazil.

While some of the alternative technologies are commercially available, there are others that are in the emerging stage, and are expected to be available within the next few years. The commercially available technologies are those which have already been successfully employed elsewhere and are available in the international community.

The use of HCFCs in Brazil will be related to the country's needs during the transitional period when CFCs are being phased out, and therefore, the phase-out of HCFCs has not been considered in the Country Programme. One of the principles employed was to minimize their use by ensuring that, whenever there is a definite, proven, cost effective alternative available, the use of HCFCs will be strongly discouraged.

In each of the sectors where ODS elimination will happen, the availability of training courses will be fundamental for the overall results of the CP. The use of existing training institutions and infrastructure like the above mentioned SENAI and SENAC will be extremely helpful in accelerating the training programme implementation as well as deeply reducing its costs.

3.4.2.1 FOAMS

The technical and economic evaluation of the rigid and semirigid foam industry defines the alternative substances in accordance with table 7:

Table 7 - Alternative Substances for Foams

Current Substances	Transition Substances	Definitive Substances
CFC 11	HCFC 141b	Cyclopentane and Pentane Water or CO2
CFC 12	HCFC 22 BLEND 142b/22	HFC 134a

Transitional substances are considered important for the sector because they allow the industry to search for better solutions, while, in the meantime, progressing with CFC phase-out. This is especially true for the technologies that use HCFCs. Here, emphasis will be given to HCFC 141b, due to the ease of the chemical substitution and the demand of less sophisticated equipment. The implementation of such technologies should be done in a way that a future permanent solution will not require additional capital investments. In the case of the substitution by technologies employing definite substances, it is estimated that, in an initial phase, only 10% of the industry will introduce them. High costs and the non-availability of local production of the substances are the main reasons for this strategy.

The small and mid-sized enterprises should be oriented to find the proper technological solution through workshops, seminars and training while the large companies are making their choices with their knowledge of the local and international markets.

3.4.2.2 REFRIGERATION/AIR CONDITIONING

Domestic Refrigeration

The domestic refrigeration sector is aware of a range of technical options for ODS replacement. The Brazilian refrigeration industry will base its selection from these options on the following criteria:

- acceptable performance;
- proven technology;
- commercial availability;
- safety in production and use;
- environmental acceptability;
- economic viability.

Not all replacement technologies meet all of the previous criteria, especially in respect of environmental acceptability. Such technologies, nevertheless, can provide an important interim function, allowing the industry time to search for better, and mature, non-ODS solutions. Table 8 presents the potential ODS replacement technologies for domestic refrigeration sector.

For CFC-12 refrigerant used in domestic refrigeration, suitable substitution technology are not available from Brazil or from foreign countries. There are emerging solutions such as hydrocarbons, and the international scenarios are not well defined. When HFC-134a is used as the substitute refrigerant specific compressor should be used with an associated lubricant and desiccant, all having a higher price which will result in a higher industrial product cost (operational cost). Moreover the manufacturing process should be well controlled to avoid problems of lubricant contamination by residues and/or moist air. So in the short-term (1994 - 1996), domestic refrigeration sector in Brazil will perform a deep analysis of both alternatives, HFC-134a and hydrocarbons, through demonstration projects. Afterwards, in the medium-term (1996 - 2000), the applicable substitution technical approach will be determined and popularized within the whole industry by the year 2000.

For CFC-11 used as blowing agent in the polyurethane foam applied in the domestic refrigerators and freezers cabinets, a suitable substitution technology are not available currently. In this particular case the technology that employ HCFC-141b may be used in a short and/or medium term. There are emerging solutions such as hydrocarbons that could be considered as an option to be evaluated in the short-term (1994 - 1996) and possible implementation in the medium-term (1996 - 2000).

Table 8 - Potential ODS Replacement Technologies

Use	Existing ODS Technology	Reduced ODS Technology	Non-ODS Technology
Refrigerant	CFC-12		HFC-134a Hydrocarbons
Insulation	CFC-11	HCFC-141b	Hydrocarbons

Commercial and Industrial Refrigeration and Central Air Conditioning

Commercial and Industrial Refrigeration/Central Air Conditioning constitute industrial activities covering a wide spectrum of uses. The ODS using profile presents significant differences among them. Whereas Industrial Refrigeration is not an ODS intensive user in this country, the other two fields are CFCs users in different ways. In fact, most of the industrial plants operate with ammonia which is not an ODS. A small percentage operate with HCFC-22, scheduled for late phase-out, and very special ones operate with other refrigerants, including CFCs. In addition most of the plants under construction in this field are already scheduled for ammonia operation. On the other hand, Commercial Refrigeration might face some difficulties during phase-out, due to the characteristics of the consumers, suppliers, and contractors. Consumers are made up of small business and supermarkets whereas suppliers and contractors cover a wide range of small and medium size companies. Both have limited access to information on recent developments on phase-out technologies. This industry is also major ODS consumer, especially CFC-12 and CFC/HCFC-502. The Central Air Conditioning sector in this country may be divided in two different fields of uses. The large capacity chillers, operated by centrifugal compressors, and the medium capacity chillers and self contained equipment, mostly operating with reciprocating compressors. The former field is an exclusive CFC user: either CFC-11 or, in a lesser extent, CFC-12. The second field uses almost exclusively HCFC-22. Most Central Air Conditioning suppliers in this country are either multinational companies or licensees. In the case of centrifugal machines, the transfer of technologies from developed countries might be accelerated, depending upon the country strategy and market opportunities. Reciprocating machines will not face an early phase-out strategy due to the intensive use of HCFC-22 in this field.

A smooth and accelerated phase-out of CFCs for the Commercial and Industrial Refrigeration/Central Air Conditioning fields will depend upon the availability of reliable technologies, the cost of implementation, and, above all, that those technologies are environmentally safer. Table 9 presents a list of presently used refrigerants, and transition and long term replacements.

Table 9 - Summary of Technology Alternatives for Commercial and Industrial Refrigeration/Central Air Conditioning sectors.

Sector	Present	Replacement/ Transition	Replacement/ long term
Industrial Refrigeration	Ammonia, HCFC-22, CFC-12, others (minor)	HCFC-22	Ammonia, 134a, Hydrocarbons
Commercial Refrigeration	CFC-12, 502, HCFC-22	HCFC-22, HFC/HCFC Blends	HFC-134a, Ammonia
Central Air Conditioning	CFC-12, CFC-11, HCFC-22	HCFC-123	HFC-134a, Ammonia
Mobile Air Conditioning	CFC-12	No transition product	HFC-134a

Industrial Refrigeration

As noted above, phase-out in the Industrial Refrigeration industry is already under way through a consistent and long term commitment to the use of ammonia as refrigerant. Ammonia uses in this field present a current expansion trend, and presently it seems that this will be the long term refrigerant for the field in this country, with few exceptions for specific uses, such as in the petroleum industry, where hydrocarbons have been used for some time. Few cases that presently use CFCs, especially CFC-12, might be retrofitted to HCFC-22, where appropriate. The use of either HCFC-22 or HFC-134a could be a good alternative for ammonia in new plants.

Commercial Refrigeration

Refrigerants CFC-12 and CFC/HCFC-502 are by far the most used refrigerants in the Commercial Refrigeration field. In very few instances HCFC-22 is used. Given the late phase-out of this refrigerant and its excellent thermodynamic performance, it seems adequate to use it as a replacement during the transition period either in retrofitting, where appropriate, or in new machines. It should be pointed out that HCFC-22 used to be the refrigerant for low temperature uses before the introduction of CFC/HCFC-502 in this country. An alternative to the HCFC-22 are the binary and ternary blends (HFC/HCFC) introduced by the manufacturers to replace CFCs without causing major drawbacks in used installations.

Long term replacements in this field must be considered separately, depending upon the range of evaporating temperatures. For medium to high temperature uses, HFC-134a is still one of the best candidates despite its reduced but not negligible greenhouse effect. This refrigerant is a natural choice as a long term replacement due to refrigerant manufacturers commitment to it, guaranteeing its future continuous supply. In addition compressor manufacturers in the country as well as overseas suppliers are also committed to this refrigerant.

There is no apparent replacement for HCFC/CFC-502 for low temperature uses. HFC binary and ternary blends are being considered as potential replacements by the international community. However, those blends are still under development. The country will make the option for the appropriate technology as soon as it is available. In the mean time, as indicated above, the use of HCFC-22 is recommended.

In some cases, where effective spillage control could be provided, ammonia should be seriously considered as a long term replacement. However, due to its toxicity, ammonia uses in Commercial Refrigeration must be limited to indirect refrigeration. In such a case the excellent thermodynamic characteristics of ammonia can compensate for the reduced thermodynamic performance associated to indirect refrigeration.

Central Air Conditioning

As pointed out before, phase-out in the Central Air Conditioning field will be limited to centrifugal compressor chillers operating either with CFC-11 or CFC-12. Reciprocating compressor uses will not be affected due to the extensive use of HCFC-22 in this sector.

Centrifugal machines operating with CFC-11 might be retrofitted with HCFC-123, which can also be used in new machines. In fact this is the current trend in this country, where HFC-134a is being considered as the replacement for CFC-12.

Several multipurpose plants are currently using ammonia in this country. This refrigerant could be a long term solution in specific uses associated to either reciprocating or, preferably, screw compressors. The same comments made for Commercial Refrigeration hold true in this case.

As an Article 5 country, Brazil has an extended 10 years period for ODSs phase-out. An adequate strategy for the transition to an ODS free society would be one that takes into account this prolonged period for phase-out, and preserves CFCs inventory, allowing for normal obsolescence of equipments. On the other hand HCFC-22 presents extensive use in the Refrigeration and Air Conditioning sector in this country. This refrigerant combines excellent thermodynamic performance and a wide range of potential uses with a relatively reduced effect over the ozone layer. In addition, HCFC-22 is scheduled for a delayed phase-out. This makes it an excellent and natural alternative during the transition period, especially in the Commercial Refrigeration sector.

New technologies for refrigerants must be complemented by the introduction of technologies for the recovery, recycling, and reclamation of refrigerants as well as guidelines and technologies for emissions prevention. On the other hand, new refrigeration plants must be operated with long term replacements wherever possible. Technologies must be introduced to make refrigeration plants compact in order to reduce refrigerant inventory. This will potentially have two main effects: limiting emissions and reducing costs. The use of non-ODS will require new materials and new technologies for Mobile Air Conditioning. Consequently, it is not foreseen the widespread use of transition substances nor to provide economically viable retrofit system services.

3.4.2.3 HALONS

Halon 1301 is mainly used for Fire Extinguishing Systems. Alternatives to halons depend on the type of hazard protected with the halons. For Halon 1301 for Fixed Installations, the alternatives are:

* Gaseous Fire Extinguishing Systems, e.g.
  - CO_2 Fire Extinguishing Systems,
  - Nitrogen based Fire Extinguishing Systems (Inergen, Argonite)
* Water Based Fire Extinguishing Systems, e.g.
  - Automatic Sprinkler Systems and Pre Action Sprinkler Systems
  - Low and High Pressure Water Mist and Water Fog Systems
* Foam Based Fire Extinguishing Systems, e.g.
  - Low and High Expansion Foam, AFFF type foams
* Powder based Fire Extinguishing Systems
* Halon like Chemical Replacements (1)
  - FC-3-1-10 trade name: PFC-410 (3M, USA)
  - HFC-227 e.g. trade name: FM - 200 (Great Lakes, USA)
  - HFC-23 trade name FE - 13 (DuPONT, USA)
  - HFC-125 trade name: FE - 25 (DuPONT, USA)

- Blend of HCFCs NAF3(North American Fire Guard)

Halon 1211 is mainly used in Portable Extinguishers, the alternatives being Water, CO_2, Powder, Foam and Halon like chemical replacements (HCFCs). It is also used for fixed fire extinguishing systems for some application in aviation and military equipment and installations.

Table 10 can be used as guideline for the selection of alternative fire protection systems for new installations and for replacement of existing. ones. Table 10 include present experience and will be adjusted in accordance with new development and experience gained world wide. The activities necessary to permit transition to new technologies include, among other:

- Establishment of technical background for utilizing new fire protection systems, evaluation of performance, standards and guidelines, education and training
- Licensing agreements with foreign companies
- Manufacturing and installation

TABLE 10 - Alternative Technologies to Halons

TYPE OF RISK	ALTERNATIVES TO HALONS
COMPUTER ROOMS	CO2 FIRE EXTINGUISHING SYSTEMS NITROGEN BASED FIRE EXT. SYSTEMS SPRINKLER SYSTEMS
CONTROL ROOMS	NITROGEN BASED FIRE EXT. SYSTEMS SPRINKLER SYSTEMS
TELECOMMUNICATION INSTALLATIONS TELEPHONE EXCHANGE CENTERS	NITROGEN BASED FIRE EXT. SYSTEMS WATER MIST SYSTEMS PRE ACTION SPRINKLER SYSTEMS CO_2 FIRE EXTINGUISHING SYSTEMS
GENERATOR ROOMS AND ELECTRICAL INSTALLATIONS	CO_2 FIRE EXTINGUISHING SYSTEMS NITROGEN BASED FIRE EXT. SYSTEMS WATER MIST SYSTEMS
MACHINE ROOMS ENGINE ROOMS	CO_2 FIRE EXTINGUISHING SYSTEMS WATER MIST SYSTEMS
FLAMMABLE LIQUID STORAGE FACILITIES	CO_2 FIRE EXTINGUISHING SYSTEMS FOAM FIRE EXTINGUISHING SYSTEMS NITROGEN BASED FIRE EXT. SYSTEMS (WATER MIST SYSTEMS)
FLOATING ROOF TANKS	FOAM FIRE EXTINGUISHING SYSTEMS
AIRPLANES, ENGINE PROTECTION	NO ALTERNATIVES AVAILABLE YET
DEFENSE EQUIPMENT AND INSTALLATIONS	NO ALTERNATIVES AVAILABLE YET

Source: Erik Pedersen, DIFT, Denmark

Whichever alternative is selected the important thing to keep in mind is that the same degree of

3.4.2.4 ***SOLVENTS AND STERILANTS***

There are many alternatives offered by the major suppliers to replace the ODSs for other products less dangerous to the environment. Since there is no single alternative to ODSs in the aforesaid markets, the introduction of alternative products and technologies will require careful evaluation by users and suppliers, as well as financial resources that make the conversion feasible.

Among all major difficulties to choose the adequate alternative, the presently used cleaning technology is by far the most restrictive. It is estimated that:

- there is little restrictions to replace 40% of the present ODSs market (volume) by other chlorinated solvents without ODP. In that case the same equipment could be used (Vapor Degreaser) with minor adjustments to operate with Perchloroetilene and Trichloroetilene.

- The remaining 60% of the market will not be able to use the above mentioned chlorinated solvents as alternatives. Many are the reasons to believe that a large portion of this market will have difficulty to do the conversion and will need special attention and treatment. Generally it is possible to point the following reasons:
- little or no technology presently used (cold cleaning, decentralized, etc.)
- specific characteristics of dirty to be cleaned
- work environment hazards. etc.

Currently, ethylene oxide (EO) is widely used for gas sterilization of medical equipments and devices. Though being specially useful for sterilizing heat sensitive tools and equipments, EO is toxic, mutagenic, a suspect carcinogen, besides being flammable and explosive. In order to reduce flammability and explosion risks, EO is diluted with CFC-12. A commonly used mixture, known as "12/88" consists of 12% of EO and 88% of CFC-12 (by weight). Most users of "12/88" could switch to pure EO.

Recycling is an attractive alternative for sterilization, but the necessary safety precautions will be needed. The use of pre-sterilized disposable products is another alternative. The most promising future alternative for the sterilization sector probably is an HCFC based blend (22,124,152) that can serve as a virtual drop-in for existing "12/88" equipment. It can also be used in "10/90" equipment (10% EO and 90% CO2).

Ahead, in Table 11, the major alternatives choices for each sector are indicated. This table, as explained before, is just indicative but believed to be the best choices available for the Brazilian market nowadays:

Table 11 - ALTERNATIVES FOR SOLVENTS AND STERILANTS

TECHNOLOGY	PREFERRED	ACCEPTABLE	EMERGENT
SOLVENTS	no clean fluxes	chlorinated	no clean pastes
	aqueous cleaning	perfluorocarbons	
	non-halogenated, organic solvents		
FORMULATIONS	non-halogenated, organic solvents	chlorinated	
STERILANTS	Hidrofluorcarbons (HFC) Blends	Hidroclorofluorcarbons (HFC) Blends	Pre-sterilization
	Pure Ethylene Oxide (EO)	HCFC 124	Disposable Products
	EO/CO2 Blends	EO/HCFC Blends	

3.5 ODS RECOVERY, RECYCLING AND CONTAINMENT

According to existing surveys it is known that 4,541 tons of CFCs were released in Brazil during 1993, by refrigeration and air conditioning sectors, either voluntarily or involuntarily, which are the major contribution of these substances released to the atmosphere.

Contributing for this emission, that is responsible for 55 % of the replacement of CFCs in the domestic market, are leakages mainly in industrial and commercial refrigeration, especially because of precarious installation, and the quality of maintenance services. Another important point worth mentioning is voluntary discharges that occurs when gas is not collected during equipment repair because of labor scarcity, lack of proper tools and devices, for gas collecting and reuse, as well as, unawareness of environmental issues.

Although not being aware of CFC recycling possibility, the sector knows that it is necessary to take actions to minimize the problems caused by product scarcity, and it is sympathetic with a recycling program, through connecting the success of this enterprise to the development of a comprehensive training program.

This being the case, any program related to this issue, that aims to reduce the amount of CFCs released to the atmosphere, should consider an extensive training project, that shows clear and specific targets, including not only the technical aspects, but also aims to outreach the community as for the importance of environmental protection.

Thus, in such a wide ranging program, training is only one step, but a very important one in the case of Brazil. Training effort must be focused not only in good recovery practices, but also in environmental education, standardization, regulation, inspection and certification. Additionally, the availability of recovery equipment for demonstrations will be necessary, as well as a plan to

According to existing data, approximately 35,000 mechanics are working in the Brazilian market, in the refrigeration sector, mainly in domestic and small equipment commercial sectors. The majority of these mechanics render low quality services, because of difficulties to participate in any kind of training and, in most cases, cannot afford the appropriate tools. Out of this total 6,000 mechanics that work for licensed authorized official shops are able to render a better quality of services, due to technical training and working conditions. Annex 2 shows the consolidated numbers for the ODS Recovery, Recycling and Contention Program, including the cost of its implementation.

3.5.1 TRAINING

The size of the Brazilian territory along with its specific features e.g. climate, social, economical and cultural conditions, and different levels of knowledge about the problem pose an intense challenge to any large scale training initiative. The logistic necessary to implement a recycling program strongly recommends the design of an objective training programme, with permanent monitoring, evaluation and necessary adjustments, and considering a timetable of priorities to be developed in 2 years (1995 and 1996).

The Training and Certification Program for Refrigeration Mechanics will have 1,461 courses, divided em 4 phases. It will probably begin in the 1st Quarter of 1995, and will possibly be finished in December of 1996. In its implementation the regions will be prioritized according to the amount of installed equipments and/or ODP, therefore trying to optimize the resources allocated for this project. Courses will be offered in fixed locations and in mobile vans/trucks.

FIXED COURSES will reach a total of 581, which will be responsible for the training of 17,430 mechanics selected from big Metropolitan Regions, other Capitals and also, from important cities of the States of Sao Paulo and Rio de Janeiro. Each course will be given for groups of 30 mechanics, previously selected and registered.

MOBILE COURSES will be developed through 20 Mobile Units traveling the main cities in which will be concentrated the mechanics coming from small towns in its surrounding. Considering that in some regions it will be difficult to have groups of 30 mechanics, it was estimated, as average, 20 mechanics for each mobile course. Each mobile unit will be responsible for 1 course per week during 11 months of 1996, that will result in the total of 880 courses and 17,600 mechanics trained.

The total and break-down cost of the Training Program is shown in Annex 2.

3.5.2 DOMESTIC REFRIGERATION (RRC)

In 1993 Domestic Refrigeration was responsible for the emission of about 681 tons of refrigerant gas to the atmosphere, representing about 15% out of the total CFCs 4,541 tons for replacement/after-market emissions occurred in the Refrigeration and Air Conditioning sectors .

The current amount of domestic refrigerating equipments (refrigerators and freezers) is estimated to be 25 million units, with a gas inventory of 5,000 tons of CFC 12. Hence the annual emissions derived from equipments in use today represent around 13.5% out of the total

The estimate is that 1 million compressors were replaced in 1993, meaning that, at least 200 tons of CFCs were released in the atmosphere. If we consider that 20% of repairs have been made without changing of compressors, that 20% of the total charge was released and also that it is reasonable to consider that 20% of gas loss happens during the reloading of the system after the change of compressors, we would reach a total annual consumption of 288 tons/year of CFCs.

The reduction of CFC emissions during system charge, as well as the recovery of the CFC used for cleaning the refrigerating circuit, would allow the reduction of about 600 ODS tons/year consumption.

3.5.3 COMMERCIAL REFRIGERATION (RRC)

Commercial refrigeration in the food retailing sector is an important consumer of CFCs. The CFCs in this sector are usually used in balconies and refrigerated gondolas, and freezers, and usually are the 12, 22 and 502 kind.

In Brazil there are currently 33,000 food retailing shops, with food self-service sales concept. The major 300 supermarket networks operate 3,430 stores all over Brazil, and are therefore responsible for about 67% in the sector.

Data collected in medium and large size food storage and food selling shops in São Paulo, showed that the medium load of CFC-12 and R-502 per store is of 240 kg, and that the average annual release corresponds to 80% of load in the system. It is important to emphasize that HCFC 22 is currently the most employed substance in this sector, and that CFC-12 correspond to about 15% out of the total.

Based on the above data, total load of the systems in Brazil in the already mentioned 3,430 stores would be of 823,200 kg, while their emission would reach 658,560 kg/year. In small stores, the total ODS load would reach 271,656 kg and their total emission would be 217,324 kg/year. Thus, total annual emission in the sector could reach 875,884 kg/year.

An optimization programme for the systems in use would disseminate "good servicing practices" which would include preventive maintenance programmes with gas recovery both during the system servicing and at the end of the equipment life span, could reduce the current ODS emission up to a total of 750 tons/year.

Therefore, the total quantity of gas that could be recycled/reclaimed is estimated to be 200 tons/year.

3.5.4 AIR CONDITIONING/INDUSTRIAL REFRIGERATION (RRC)

The total capacity of central air conditioning/industrial refrigeration systems in use in Brazil is estimated to be 2,150,000 TR (Tons of Refrigeration). Out of this total, 28% is estimated to be chiller type using CFC11 or CFC12. The average capacity of central systems using CFC11 or CFC12 is 334TR/system, with the average amount of 326 kg of CFC in the system:

With the above data the number of systems in use in Brazil is estimated to reach a total of 1,802 units. The total gas load in all those units is estimated to be 587,452 kg. The total annual emissions would then be 176,235 kg of CFC.

In these systems, the average amount of CFC consumption is around 30% of their CFC capacity, per year, being emissions caused by leakages and bad service practices. Gas recovery and recycling are not usual practices at this time. There is also need for recovering the amount of CFC11 used for refrigeration circuit cleaning.

It is necessary to improve the systems in use today in order to minimize leakages and gas contamination, as well as to offer some kind of incentives for preventive maintenance and for the collection of gas during servicing, and also for gas recovery or reclaiming. The emission reduction in these type of systems, including the recovery of gas at the end of the equipment life span, is estimated to reach 200 tons/year. Furthermore, gas recovery at the end of the systems life span will enable the collection of a significant quantity of gas, that could be reused. The amount of ODS to be collected is estimated to be about 100 tons/year.

As 83% of the present building systems are maintained by external contractors, and only 17% have their own maintenance service, the present number of maintenance service contractors in Brazil is estimated to be around 200.

3.5.5 RECYCLING CENTERS

The ODS Recovery, Recycling and Contention Program has the goal of reducing the CFC consumption and to collect it for further recycling or reclaiming. The implementation of previous projects will result in an estimated amount of 700 tons/year of gases to be recycled or reclaimed, an activity that could be made by the present day CFC producers.

An alternative to that is the utilization of centralized recycling or reclaiming centers, which are believed to be more economical i.e. in the case of small users. Highly populated areas would be the best places for the installation of these centers. Areas as the Metropolitan Regions of Sao Paulo, Rio de Janeiro and Belo Horizonte are good example of appropriated places for that. The use of the current gas distribution network would also allow the use of empty returning tanks to convey the contaminated collected gases to the centers. It has been proposed that the first center be placed in the Sao Paulo Metropolitan Region, as a performance test. The investments and budget for this center is shown in Annex 2. However, before such an investment is made, experience from other countries will be gathered and the program design will reflect the findings.

3.6 ODS PHASE-OUT SCENARIO TO YEAR 2010

3.6.1 The Supply Side

The ODSs phase-out scenario herein presented is based on 1993 consumption data shown in Chapter 2. The CFCs and other ODS production industries instaled in Brazil are all 100% foreign capital owned, except for Carbocloro (a CTC producer) which is . All thes companies are willing to phase-out ODS production as fast as possible, but according to the country's

Phase-out Programme. Actually, both Du Pont and Hoechst, the sole Brazilian producers of CFC-11 and CFC-12 have already made modifications in a portion of their process plants, which allows them to produce HCFC-22, in substitution of the priorly mentioned CFCs. According to these same companies, only relatively minor changes will be needed to have the whole 100% of their present day CFC production capacity switched over to produce HCFC-22. However, to be able to produce HFC-134a, new plants will have to be installed. On the whole, the said process modifications and new installations are currently being made at the exact pace necessary to accomodate the phase-out changes in the market demand profile. In the case of CTC, Dow Química has already planned for its plant shut-down during 1994, which will turn Carbocloro into the only one Brazilian local producer.

As per the introduction of hidrocarbons, both as foaming and refrigerant agents will help turn broader the alternatives available to present day ODS users. However, the availability of hidrocarbons depends on the state oil monopoly - Petrobrás, which will have to be made aware of its role and mobilized to also produce these substances. It is known however that this late company has already begun a Technical and Economical Assessment Process to determine the conditions under which it would be feasible - and profitable - for them to produce - or import - iso-butane and ciclo pentane, or similar hidrocarbons.

Therefore, the total phase-out scenario has been composed superposing the estimated consumption needs of every and all present day ODS using sectors. Figures 4, 5, 6 and 7 show the Unconstrained forecast versus the estimated Phase-out consumption respectively for Annex A Group I, Annex A Group II, Annex B Group II, and Annex B Group III substances. Figure 8 includes the total ODS unconstrained forecast consumption versus Total Country Program Phase-out predictions for Brazil.

Figure 4 - Annex A Group 1 - CP versus Unconstrained Forecast (ODS Tons/Years)

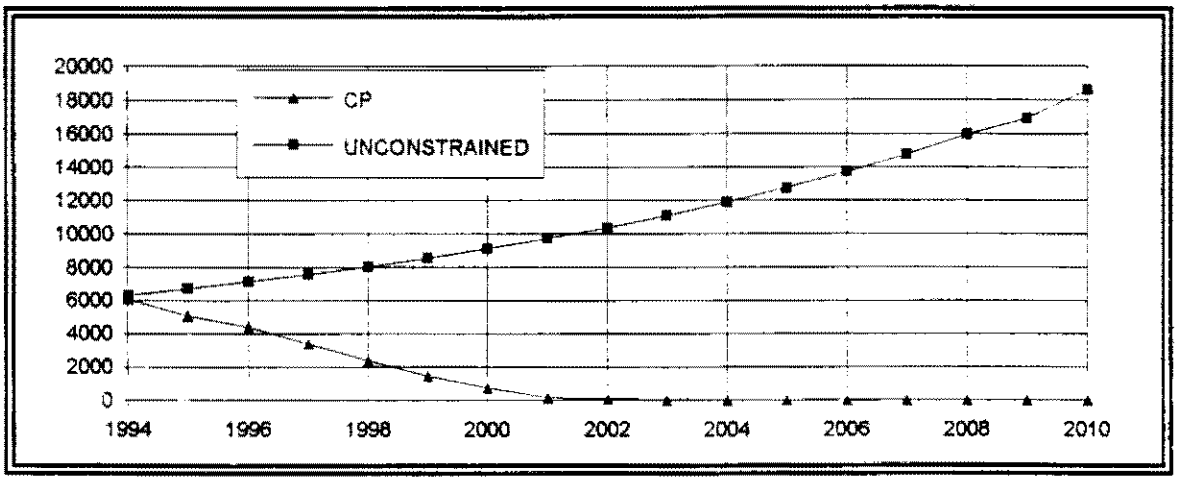


Figure 5 - Annex A Group 2 - CP versus Unconstrained Forecasts (ODS Tons/Years)

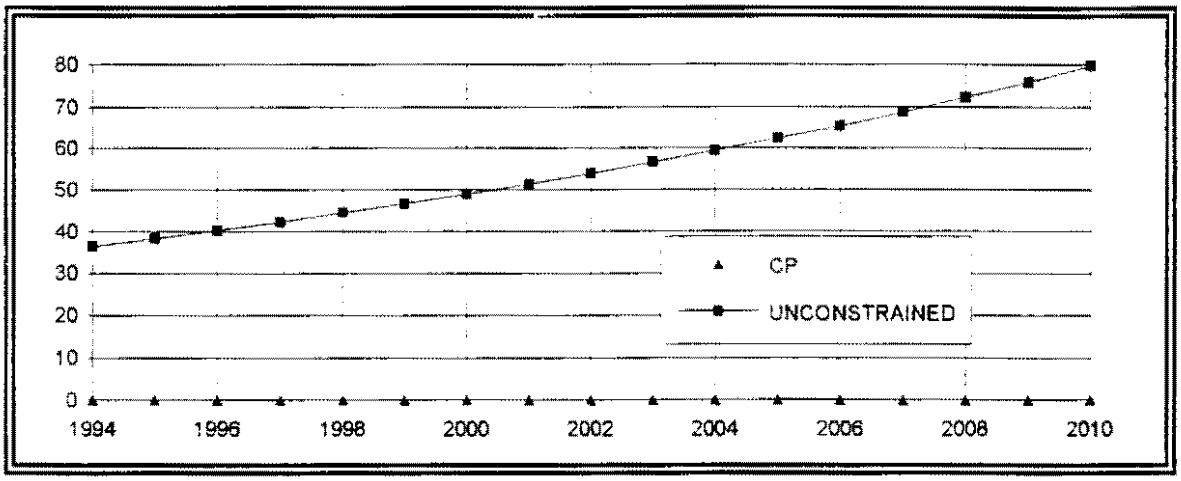


Figure 6 - Annex B Group 2 - CP versus Unconstrained Forecasts (ODS Tons/Years)

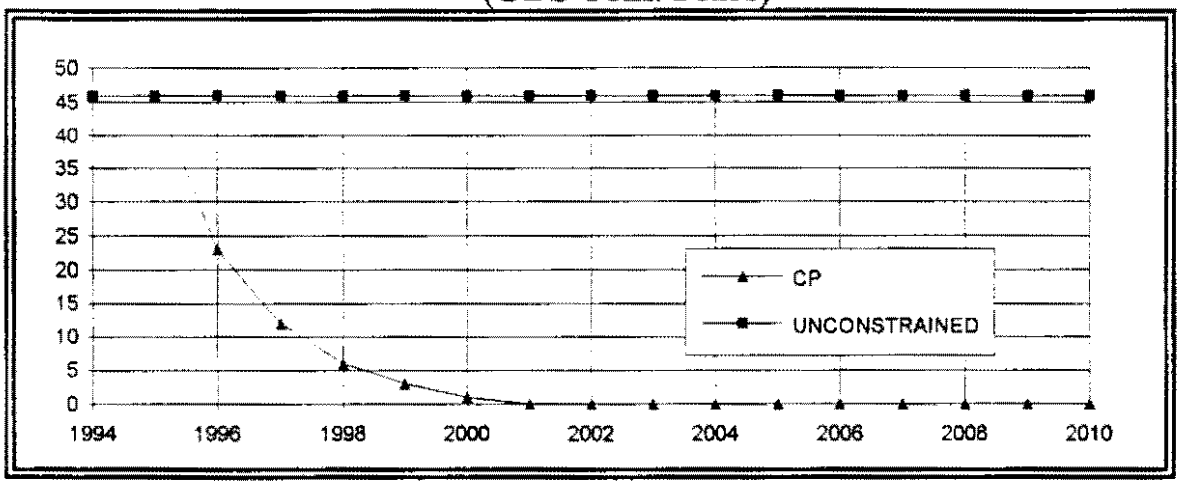


Figure 7 - Annex B Group 3 - CP versus Unconstrained Forecasts (ODS Tons/Years)

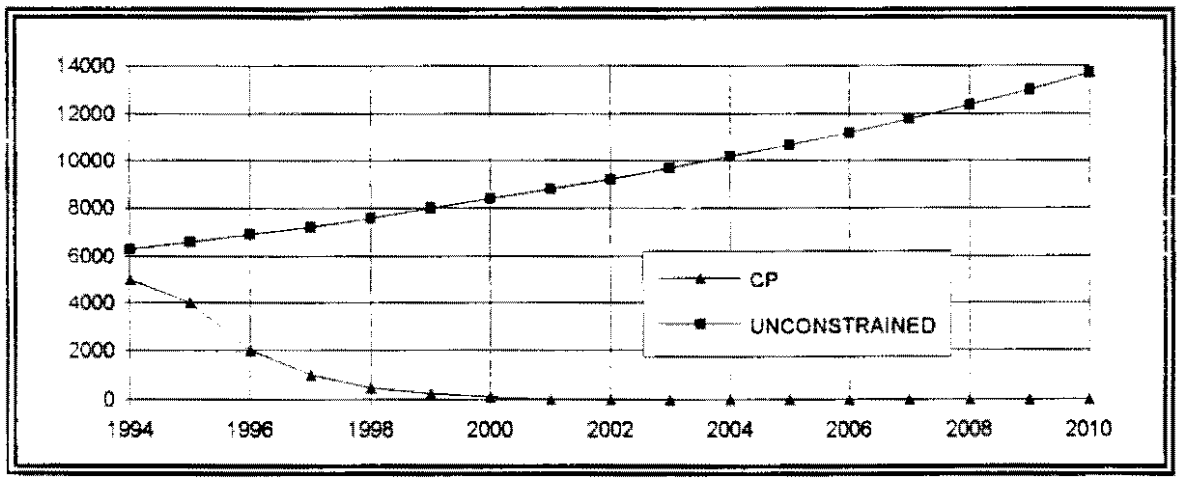
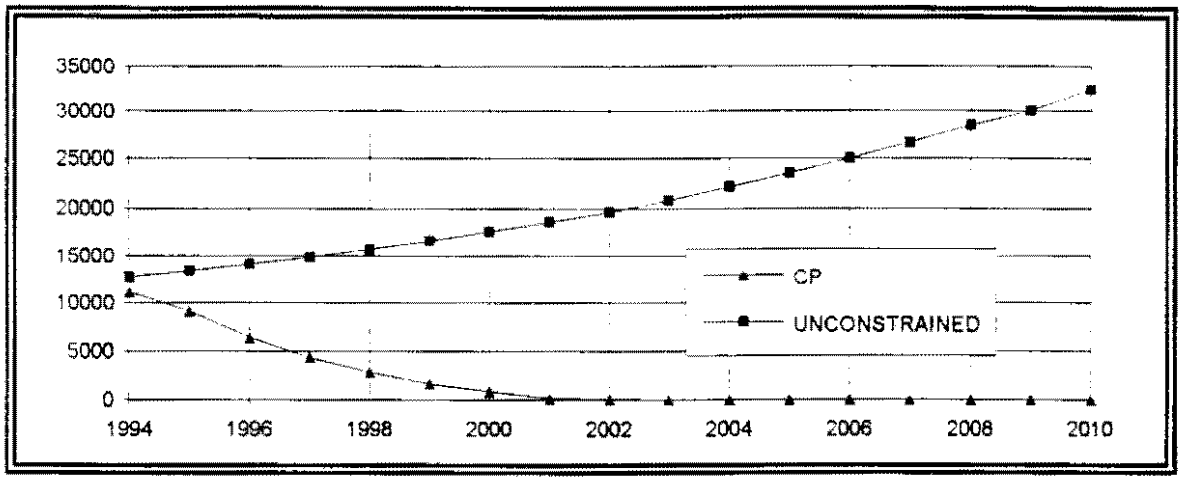


Figure 8 - CP versus Unconstrained Forecasts
All Groups (ODS tons/Years)



3.6.2 The Demand Side

3.6.2.1 *FOAMS*

An inquiry made with manufacturers and consumers of CFCs in the rigid and semirigid foam industry has disclosed that it is altogether feasible for CFCs to be phased out by the year 2000. Such a phase-out strategy, however, is subject to the putting up of resources from the Multilateral Fund, as well as a number of other steps to ensure the competitiveness of manufacturers in the domestic and international markets.

Since the raw materials and alternative items of equipment are imported, measures by the government will also be required for the feasibility of the CFC substitution program.

Table 12 - Forecast of CFCs Substitution for Foams (tons)

Substances/Years	1994	1995	1996	2000	2010
CFCs	800	500	300	0	0
HCFC 141b	0	320	550	1,140	1,540
HCFC 22	20	40	40	15	0
BLEND 142b/22	0	5	20	15	0
CYCLOPENTANE	0	10	25	70	100
HFC 134a	2	10	25	40	80
T O T A L	822	885	960	1,280	1,720

It is important to note that in 1994 there are signs of reduction in the consumption of CFCs as a result of alternative formulations using H_2O (CO2) in larger amounts as a substitute for the CFCs.

The use of other substitute materials, besides H_2O (CO2), will also cause a reduction in the volume of CFCs used in the formulations.

3.6.2.2 REFRIGERATION/AIR CONDITIONING

Forecasts for the Refrigeration/Air Conditioning sector were based on consumption estimations during the base year of 1993. Data for this year were obtained from manufacturers of assembled units and equipment such as compressors. These estimations were observed to be within the range of 15% (in the lower side) from estimations provided by ODSs producers. The estimated uncertainty of consumption estimations by sector was in the same range of the observed differences between the two sources of data. This result indicates that both sources are quite adequate and compatible. However, it is acknowledged the need and importance of better consumption estimations as a mean to adequately apply and monitor phase out policies.

Domestic Refrigeration

The CFC-12 phase-out in the domestic refrigeration sector is feasible by the end of 2000 by using alternative substances, such as HFC-134a and/or Hydrocarbons. This replacement is expected to be a gradual process as presented in the table 13.

Table 13 - CFC 12 Constrained and Unconstrained Consumption (1994/2001)

Year	Unconstrained (tons)	Constrained (tons)	% Reduction
1994	506	506	0
1995	557	557	0
1996	612	612	0
1997	643	514	20
1998	675	405	40
1999	709	284	60
2000	744	149	80
2001	781	0	100
2002	820	0	100
2003	861	0	100
2004	904	0	100
2005	949	0	100
2006	997	0	100
2007	1,047	0	100
2008	1,099	0	100
2009	1,154	0	100
2010	1,212	0	100

The previous scenario (Table 13) does not account for CFC-12 required for servicing of domestic refrigeration products.

Table 14 - CFC 11 Constrained and Unconstrained Consumption (1994/2001)

Year	Unconstrained (tons)	Constrained (tons)	% Reduction
1994	1,155	1,155	0
1995	1,270	1,270	0
1996	1,398	1,398	0
1997	1,468	1,174	20
1998	1,541	924	40
1999	1,618	647	60
2000	1,699	340	80
2001	1,784	0	100
2002	1,873	0	100
2003	1,967	0	100
2004	2,065	0	100
2005	2,168	0	100
2006	2,277	0	100
2007	2,391	0	100
2008	2,510	0	100
2009	2,636	0	100
2010	2,767	0	100

In the domestic refrigeration sector, CFC-11 phase-out in the cabinet insulation is possible by the end of 2000 if the newly emerging replacement technology matures quickly and there is early availability of funding for both trial of the new technology and the incremental costs associated with full scale conversion of the product plants. Table 14 presents the estimated CFC-11 consumption from 1994 until 2001, as a comparison between unconstrained and constrained consumption. In this estimation is considered a gradual reduction of CFC-11 consumption which will start in 1997.

Commercial and Industrial Refrigeration/ Central Air Conditioning

Central Air Conditioning and Industrial Refrigeration sectors have been following a spontaneous phase-out policy in recent years. The result of this strategic option taken by these sectors is that all new units installed in the base year of 1993 carried only alternative refrigerants. The only problem faced by these sectors is the one related to the installed centrifugal units, operating with CFC-11 and CFC-12.

The phase-out scenario for the Industrial Refrigeration and Central Air Conditioning sectors must be completely different from the one for Commercial Refrigeration, where no action has been taken so far. Commercial Refrigeration sector requires a consistent and realistic phase-out. Phase-out in this sector must take into account the particular characteristics of the market and its difficulties either in transferring of technology or in its economy. It must also be seriously

Industrial Refrigeration and Central Air Conditioning

ODSs consumption in these sectors is related to the installed centrifugal units operating with CFC-11 and CFC-12. Predictions of ODSs consumption can be obtained from data shown in Table 15. This table was set up from data obtained from vendors and contractors operating in both sectors.

Table 15 - Annual sales of centrifugal units, in TR

Year	CFC-11	CFC-12	Total
1970/1979	121,500	93,550	215,050
1980/1989	46,600	71,950	118,550
1990	1,300	4,270	5,570
1991		3,000	3,000
1992	250	1,500	1,750
1993		1,000	1,000
Total	**169,650**	**175,270**	**344,920**

UNCONSTRAINED FORECAST (for Industrial Refrigeration and CAC)

In Table 15 it is clearly shown the aforementioned trend in the Industrial Refrigeration and Central Air Conditioning sectors of drastically reducing the ODSs consumption. This policy has lead to the point where no new units carrying ODSs were installed during the base year of 1993. Unconstrained forecasts of ODSs consumption in those sectors must take into account this fact. Summary of the assumptions made for the unconstrained forecast

(1) ODSs consumption is related to leaks from installed units. 10% of the ODSs inventory is lost every year through leaks.

(2) Centrifugal units are retired with 30 years of operation.

(3) It is assumed that the ODSs inventory per TR is 1 kg.

Table 16 presents the unconstrained forecast of ODSs consumption up to year 2010. The forecast is plotted in Figure 5.

ODS PHASE-OUT PROGRAMME (for Industrial Refrigeration and CAC)

The phase-out program for Industrial Refrigeration and Central Air Conditioning sectors predicts actions in RETROFITTING and RETIREMENT. CONTAINMENT actions are also predicted, but given the estimated low level of leaks in those sectors, predictions were not made regarding reductions in the current average leak level.

SUMMARY OF THE PROGRAMME (for Industrial Refrigeration and CAC)

(1) Units with less than 15 years of operation were considered potentially eligible for retrofitting. The retrofitting program will be developed in a four year period, starting in 1995.

(2) Early Retirement program of old units was also considered sound for these sectors. The main motivation behind this program is that units with more than 25 years of operation could be retired in favor of new ones operating with alternative refrigerants. The retirement of units might face difficulties due to the high cost of capital in the country. In addition, it is a common belief in this country that centrifugal units can operate more than 35 years without major problems. Thus early retirement (25 years of operation) might be induced by direct financial incentives and by the fact that new units are more efficient from the stand point of energy consumption. The early retirement program is predicted to take place in a 10 year period, starting in 1995. Extending the life can reduce thge cost in this sector, but the total Brazilian situation must be before there is the final decision on the correct equipments life-time.

Table 16 presents the unconstrained and estimated consumption for the Industrial Refrigeration and Central Air Conditioning sectors. It can be noted that, according to the proposed phase-out scenario, by the year 2004 the ODSs consumption will be brought down to zero in all these sectors.

Table 16 - Unconstrained forecast and estimated ODS consumption in the Industrial Refrigeration and Central Air Conditioning sectors.

Year	Unconstrained Forecast Consumption (Tons)	Estimated Consumption (Tons)	ODS Reduction %
1994	34.5	34.5	0
1995	34.5	29.1	14.7
1996	34.5	23.7	29.4
1997	34.5	18.3	47.0
1998	34.5	12.9	61.2
1999	34.5	10.8	67.6
2000	32.3	8.6	71.9
2001	30.2	6.5	80.0
2002	28.0	4.3	85.7
2003	25.9	2.2	92.3
2004	23.7	0	100
2005	21.6	0	100
2006	19.4	0	100
2007	17.3	0	100
2008	15.1	0	100
2009	13.0	0	100

Commercial Refrigeration

Sales of compressors for Commercial Refrigeration uses since 1970 is presented in Table 17. Data were obtained from compressor manufacturers.

Table 17 - Annual sales of compressors for the Commercial Refrigeration sector since 1970, in hp.

Year	CFC-12	HCFC-22	CFC/HCFC-502
1970/1979	1,015,000	464,000	330,000
1980/1989	990,000	649,000	273,000
1990	102,000	115,000	7,000
1991	109,000	157,000	4,000
1992	113,000	189,000	3,500
1993	118,000	220,000	4,100
Total	**2,447,000**	**1,794,000**	**621,000**

***UNCONSTRAINED FORECAST* (for Commercial Refrigeration)**

Refrigerant inventory in Commercial Refrigeration plants varies significantly. In general it is relatively large due to the liquid receiver. It has been assumed an average inventory of 4 kg/compressor hp. Summary of the assumptions for the unconstrained forecast:

(1) An average growth of the market of 10% a year up to 2010.
(2) The main source of ODSs consumption in this sector is due to either accidental or maintenance related leaks. It has been estimated that 45% of the current inventory is lost every year through leaks.
(3) The retirement age of a unit in this sector has been estimated to be about 15 years.

During the last decade applications of Refrigerant CFC/HFCF-502 in the Commercial Refrigeration sector have presented a trend toward a voluntary phase out. This trend has been prompted by high prices of this refrigerant in the Brazilian market. Part of this voluntary phase out has been performed through retrofitting of units to HCFC-22. Sales of new units for operation with CFC/HFCF-502 have droped significantly in the 90's, as observed in Table 15, confirming the afore mentioned trend toward a voluntary phase out of this refrigerant.
Unconstrained forecasts of consumption of CFC/HFCF-502 must take into account the afore mentioned trend. Thus, it is expected that, from 1994 on, sales of new units will drop to zero. Consumption will be related to servicing of the units still operating with this refrigerant. The unconstrained forecast scenario will consider a gradual retirement of units until 2010, when the units installed in the 90's will be obsolete.

Tables 19 and 20 present the unconstrained forecast of ODSs consumption in the Commercial Refrigeration sector.

ODS PHASE-OUT PROGRAMME (for Commercial Refrigeration)

(a) New units

Given the difficulties of the Commercial Refrigeration market to quickly adapt to the new situation, it is predicted a gradual change from ODSs to alternative refrigerants in the new units market. The program predicts that the transition will take about five years, starting in 1995. As a result, in 2000 all new units introduced in the Commercial Refrigeration sector will operate with alternative refrigerants.

(b) Retrofitting

It is assumed that units with less than 7 years of operation are potentially eligible for retrofitting. It must be reminded that the retirement age in this sector is 15 years. The retrofitting program is summarized in Table 18 for CFC-12. As for CFC/HCFC-502 it is predicted that 8890 equivalent hp will be retrofitted. Experience of other countries will be considered and applied to this program.

Table 18 - Retrofitting program for units operating with CFC-12 in the Commercial Refrigeration sector.

Start of Operation	Retrofitting Period	Retrofitted Units, hp
1988 a 1994	1995 a 1999	769,800
1995 a 1999	2000 a 2004	296,813

(c) Early Retirement

There is a consensus in the Commercial Refrigeration sector that, after a certain number of years in operation, and depending on their models and designs, units could be retired if financial incentives were provided to the owners. In that case, units that started operation between 1981 and 1987 could be eligible for early retirement from 1995 on. Under these circumstances, about 700,000 equivalent hp units operating with CFC-12, and 8890 equivalent hp operating with CFC/HCFC-502 could be prematurely retired by 2001.

(d) Containment

The leak rate in the Commercial Refrigeration sector is fairly high, running at a current level of about 45% of the actual inventory per year. Actions to reduce this level must be taken, including education and units inspection as well as normalization. According to the present plan, it is expected that, as a result of these actions, the level of leaks will be progressively reduced from the current 45% to 15% by the year 2003.

The estimated consumption of ODSs according to the above scenario is presented along with the unconstrained forecast in Tables 19 and 20, for both CFC-12 and CFC/HCFC-502.

Table 19 - Unconstrained forecast and estimated consumption of CFC-12 in the Commercial Refrigeration sector (tons).

Year	Unconstrained Forecast	Estimated Consumption	ODS Reduction %
1994	3,330	3,330	0
1995	3,461	2,559	26
1996	3,623	1,979	45
1997	3,818	1,423	63
1998	4,051	902	78
1999	4,325	426	90
2000	4,645	256	94
2001	5,014	171	97
2002	5,438	100	98
2003	5,922	43	99
2004	6,472	0	100
2005	7,090	0	100
2006	7,775	0	100
2007	8,541	0	100
2008	9,395	0	100
2009	10,334	0	100
2010	11,368	0	100

Table 20 - CFC/HCFC-502 in the Commercial Refrigeration sector (tons).

Year	Unconstrained Forecast	Estimated Consumption	ODS reduction %
1994	30	27	11
1995	28	21	24
1996	26	16	39
1997	24	11	56
1998	23	5	76
1999	21	0	100
2000	19	0	100
2001	17	0	100
2002	15	0	100
2003	13	0	100
2004	11	0	100
2005	9	0	100
2006	8	0	100
2007	6	0	100
2008	4	0	100
2009	2	0	100
2010	0	0	100

DOMESTIC AIR CONDITIONING

This segment does not have a short term phase-out program because HCFC 22 is considered as a transitional substance with low Ozone Depleting Potential. On the other hand, it must be said that some companies have already started testing chlorine free substances and have programs to collect and recycle HCFC 22. 381 tons of HCFC 22 were consumed in 1993.

MOBILE AIR CONDITIONING

Brazilian car manufacturers are shifting the use of CFC-12 to HFC-134a in the occasion of designing new models. Therefore, according to their estimates, in 1997 all new vehicle models in production will be with non-ODS. However, the carry over models will continue to use CFC-12 up to year 2000, when CFC-12 will be completely phased out.

Table 21 - Mobile Air Conditioning Estimated Consumption of CFC-12 and its trend to HFC-134a

YEAR	Unconstrained Consumption Forecast (tons)	Estimated Consumption (tons)	ODS reduction (%)
1994	420	271	35.5
1995	489	293	40.0
1996	560	224	60.0
1997	710	142	80.0
1998	880	88	90.0
1999	1,044	0	100.
2000	1,220	0	100.0

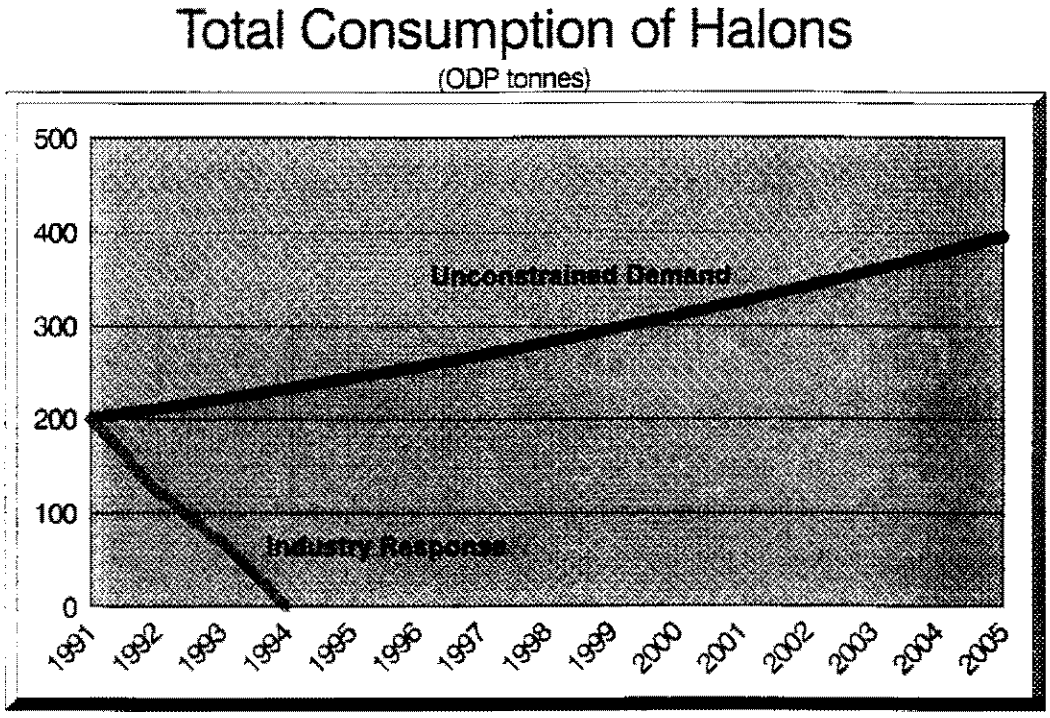
Note:Service consumption not included. For the brazilian market, the following position must be considered:

a. The work life of a vehicle is approximately of 10 years
b. Every two years the air conditioning has to be recharged with new or recycled refrigerant.

3.6.2.3 HALONS

Brazil has assumed a leading position as far as the industry response to implementing the Protocol. The past difficulties in the overall imports, the high cost of Halons and the availability of alternative technologies, led to the absence of growth in the Halon equipment and systems market and to the production halt in 1992 of hand held extinguishers. The same difficulties hit the Halon 1301 users, other than the aviation segment. Large users, among others the Oil Company that belongs to the government, had it as a company policy to avoid imports. This caused a rapid decision to move towards alternative solutions. The industry response to all the above considerations is shown in Figure 5. Total consumption of Halon 1211 and 1301 in

were estimated based on an annual growth of 5%, following the Gross National Product of Brazil.



ODP tonnes = (Halon 1211 tonnes x 3) + (Halon 1301 tonnes x 10).
Source: ABIEX/1994

The description of the current scenario of the Halon utilization in the country indicates a clear trend towards an expected market driven phase-out in the sector without any other legal measure being taken to accelerate it. As a matter of fact, imports and production of equipment and systems using Halons were null in 1993 and 1994. This scenario calls for an strategy made as to guarantee servicing quantities of Halons to supply existing equipment and installation and to avoid unnecessary costs due to early retirement of equipment that can efficiently suppress fire and save lives. The guarantee that good fire protection practices are undertaken is the key issue for the sector that also believes that improved fire protection engineering is the best Halon replacement. The sector intends to direct its efforts based on this.

Even though the tendency of the market is to move toward a gradual phase-out of existing equipment and systems, it is advisable to have a regulation prohibiting the use of Halons in new equipment or installations, to be an important legal support necessary to help the Associations to advise and orient especially the small users. This is also important to assure continuity in the country of the actual scenario of zero consumption as of beginning of 1994, following developed world production halt schedule. A summary of the strategy by the sector is:

- To prohibit imports of Halons for new units and systems by regulatory action. Imports have been avoided by the sector already.

- To accelerate, with the support of a program, the replacement of existing stock of Halon 1211 hand held extinguishers for non critical uses by alternatives, already existing in the market.

- To keep the existing Halon 1301 systems in service for as long as it is technically

- To recover Halon 1301 and 1211 through management of a Halon Banking System to be established, in order to meet the servicing needs of existing systems and equipment.

- To maintain or improve the degree of safety in fire protection engineering and practices.

3.6.2.4 ***SOLVENTS AND STERILANTS***

The suppliers responsible for more than 90% of local demand of these ODSs are companies with multinational ties well established in Brazil, producing and commercializing a large portfolio of products. Beyond that, those companies have global responsibility for ODSs phase-out and replacement. This has driven them to look for alternative solutions to ODSs supply in Brazil, anticipating the phase-in of alternatives and the phase-out of ODSs.

The strategies adopted by these companies is to follow the phase-out dates estimated for the high-consuming countries for the imported products (1,1,1 TRI and CFC 113) and supply accordingly to the Country Program for the local produced ODSs (CFCs 11 and 12), as indicated ahead:

Table 22 - SUPPLIERS ODS PHASE-OUT SCHEDULE

PRODUCT	CFC 11		CFC 12		CFC 113		CTC		1,1,1 TRI	
SUPPLIER	Phase -out	Alter nativ.	Phase -out	Alter nativ.	Phase -out	Alter nativ.	Phase -out	Alter nativ.	Phase -out	Alter nativ.
DOW QUÍMICA							CP	no	1996	yes
DuPont	CP	yes	CP	yes	1995	yes			NA	yes
Hoechst	CP	yes	CP	yes	1996	yes				
W Martins			1996	yes						
Oxigênio			1996	yes						

In addition to these companies listed before, there are others that are also well established in the market and that have potential alternatives to the presently used ODSs. Its is expected that suppliers' competition will increase in these markets.
Almost 60% of ODSs volume is consumed by companies with access to technology and that had already begun usage reduction programs. Beyond that, the suppliers had begun by themselves information, training, replacement and recycling programs with their clients.
Therefore, the consumption of ODSs had already dropped some 50% from 1989 to 1993 (from 13,200 ton/y to 6500 ton/y).

This consumption reduction can be related to many reasons:

- better product usage due to prudent handling and environmental awareness
- recycling processes optimization
- phase-in of alternative products

These consumption reductions were also highly motivated by cost/benefit advantages, but, nowadays, its believed that no more gains can be accomplished without significant investment in technology and product conversions.

Beside the fact that almost all suppliers and distributors of ODSs had already begun an anticipated phase-out of these ODSs (Table 21), it was not yet considered the hypothesis of an early "phase-out" of those products for the Solvents and Sterilants Markets different from the scheduled indicated by the Montreal Protocol for countries operating under Paragraph 1 of Article 5. This position is due to the assumption that the largest universe of users (80%) are small companies represented in many different associations, with diverse access to the alternatives technology. Furthermore, these products can be freely imported and there is no official regulations (law) to limit it.

On the other hand, it is important to highlight that the market forces will, most probably, establish an early phase-out schedule very close to the local suppliers phase-out for over 90% of present consumption, due to the availability of competitive alternatives.

Therefore, it is now considered the possibility to transform the industry individual actions into a more aggressive Country Program with the adequate support of government and international entities.

Thus, it is proposed an early "phase-out" of these ODSs by year 2000, initially freezing the 1995 consumption at the same volume of 1994 and thereafter - from 1996 on - establishing step reductions of 20% every subsequent year, taking as reference 1994/1995 consumption. The agressive elimination of TCA use will be the key to success of this plan.

Table 23 - Country Programme Yearly ODS Consumption (% with respect to 1994 Consumption)

1995	1996	1997	1998	1999	2000
100	80	60	40	20	0

It should be stressed that no production or consumption of ODSs is expected in the year 2000.

3.7 MONITORING ARRANGEMENTS

The Ministry of the Environment and Amazon, through all the State agencies of the Institute of Environment and Renewable Resources - IBAMA, will play its constitutional role of monitoring and enforcing all legislation to be issued.

IBAMA and its agencies will regularly inform the GTO about its monitoring, so the GTO could take measures to correct unwanted tendencies or to reaffirm positive ones.

4 - FINANCIAL IMPLICATIONS OF THE COUNTRY PROGRAMME

4.1 INTRODUCTION TO PROJECTS PROPOSED BY SECTOR

A summary of the proposed projects, by sector, while only an indicative list that is not all-inclusive, is presented in Annex 5. Projects cover a wide range of uses, activities, and services essential for the implementation of the proposed strategy of phase-out, including institutional support, technical assistance, technology development, training, pilot and demonstration projects, industrial processes and recovery/recycling projects. Those projects will be implemented in such a way to allow for a phase-out according to the proposed schedule of the Country Programme.

All projects presented in Annex 5 are in accordance with the phase-out guide lines and strategies proposed by each sector. Basic premises in project preparation and proposition were taken into account such as:

- compatibility with sector proposed strategy for phase-out;
- cost effectiveness;
- priority for usage of alternative refrigerants;
- potential for recovery/recycling as well as containment;
- introduction of new technologies with priority for those that are effective from the point of view of energy conservation;
- stress the use of low ODP substances (such as HCFCs) during the transition period in such cases where either new technologies are not available or are under development ; this is particularly important for the Refrigeration/Air Conditioning sectors;

Incremental costs qualify for assistance by the Multilateral Fund. Such an assistance is transcendental for the Brazilian industry compliance with the proposed Country Program for ODSs phase-out. The financial implications have been evaluated separately by each sector as indicated in the following section. Procedures and guidelines for such an evaluation varied from sector to sector and were based on the "Indicative List of Categories of Incremental Costs" adopted by the Second Meeting of Parties to the Protocol as well as the guidelines issued by the Executive Committee of the Multilateral Fund. In some instances, individual incremental costs of projects were considered in the estimation of the total incremental cost, whereas in others unitary incremental costs of proposed actions were adopted. This is the case of Refrigeration/Air Conditioning sectors, where the unitary incremental costs were based on current labor, components, and material costs referred to one kg of ODS.

4.2 FINANCIAL COSTS BY SECTOR

Table 24 indicates the total estimated incremental costs for phase-out in Brazil. Total reduction of ODS/ODP are included with the correspondent unitary incremental costs.

Table 24 - Incremental costs for phase-out, the reduction of ODS/ODP, and the unitary costs for phase-out in Brazil.

Sector	Total Incremental Cost (USD 1,000)	ODS Reduction (tons)	ODP Reduction (tons)	Unitary Cost (USD/kg ODS)	Unitary Cost (USD/kg ODP)
FOAMS					
Rigid/Semi-rigid	11,140	22,520	22,520	0.49	0.49
Dom. Refrig.	243,000	25,679	25,679	9.46	9.46
Total	254,140	48,199	48,199	5.27	5.27
REFRIGERATION/ AIR CONDITIONING					
Domestic Refrig.	121,500	11,243	11,243	10.81	10.81
Commercial Refrig.	355,500	93,558	94,472	3.80	3.80
Industrial Refrig,/Central Air Conditioning	86,230	292	292	295.30	295.30
Total	563,230	105,123	105,007	5.36	5.36
HALONS	2,670	1,042	6,613	2.56	0.40
SOLVENTS	9,600	162,652	27,108	0.06	0.35
METHYL BROMIDE	900	4,356	3,049	0,21	0.29
GRAND TOTAL	830,958	321,372	189,976	2.58	4.37

The estimated costs for Methyl Bromide phase-out considered unconstrained demand for this product only until the year 2000.

Besides the cost of sectoral efforts and projects, which were shown in Table 24, there are two initiatives whose results permeate those of all other sectors: these are the already described - Manpower Training, and the Recovery, Recycling and Containment projects.

Annex 2 contains detailed information about the Training Project costs, which will sum up to an amount of estimated US$ 7,265,000. The Recovery, Recycling and Containment project is also detailed in the same Annex 2, and its cost is US$ 60,551,000.

Total ODS Phase-out cost

With the data and information today available in Brazil, total incremental cost for the phase-out

BRAZIL

COUNTRY PROGRAMME

FOR THE PHASE-OUT OF

OZONE DEPLETING

SUBSTANCES

ANNEXES

ANNEX 1

THE USE OF METHYL BROMIDE IN BRAZIL AS RELATED TO THE MONTREAL PROTOCOL

HISTORICAL CONSIDERATIONS

Methyl Bromide (MB) has been used in Brazil for more than half a century, mainly for controlling ants in agriculture and range lands as well as for disinfestation of storage rooms and other storage and transportation facilities for tobacco and food grains.

Later it started to be used also for soil fumigation as an effective chemical for controlling root nematodes as the root infection became a serious problem for fruit crops and in forest plantation for pulp industry.

As a soil sterilizer, it is used primarily in greenhouses and plant nurseries to prevent the spreading of the desease when the plants are taken to the fields where the soil treatments are either too expensive and time consuming or uneconomical in most of the cases.

It has also been used for the same purpose in tobacco nurseries were consumption has been growing steadily and today it accounts for more than 60% of the Brazilian import to sustain a production that is second only to the USA, the first world producer.

Other minor uses of this chemical is in quarantine facilities for biological cleaning of plant materials introduced in the country, mainly for research purposes, disinfestation of grain processing facilities, such as cereal mill plants and other space room facilities that store or process food subjected to insect infestation and where substitutes can be damaging to the equipments (induce rust formation), contaminate the processed materials or their products.

More recently, as Brazil increased its share in the international market of fruit "in natura", a new area was opened for MB use as a fumigant for fruit and packaging sanitary cleaning, although alternative methods have already imparted a decreasing trend in such applications.

CONSUMPTION OF METHYL BROMIDE

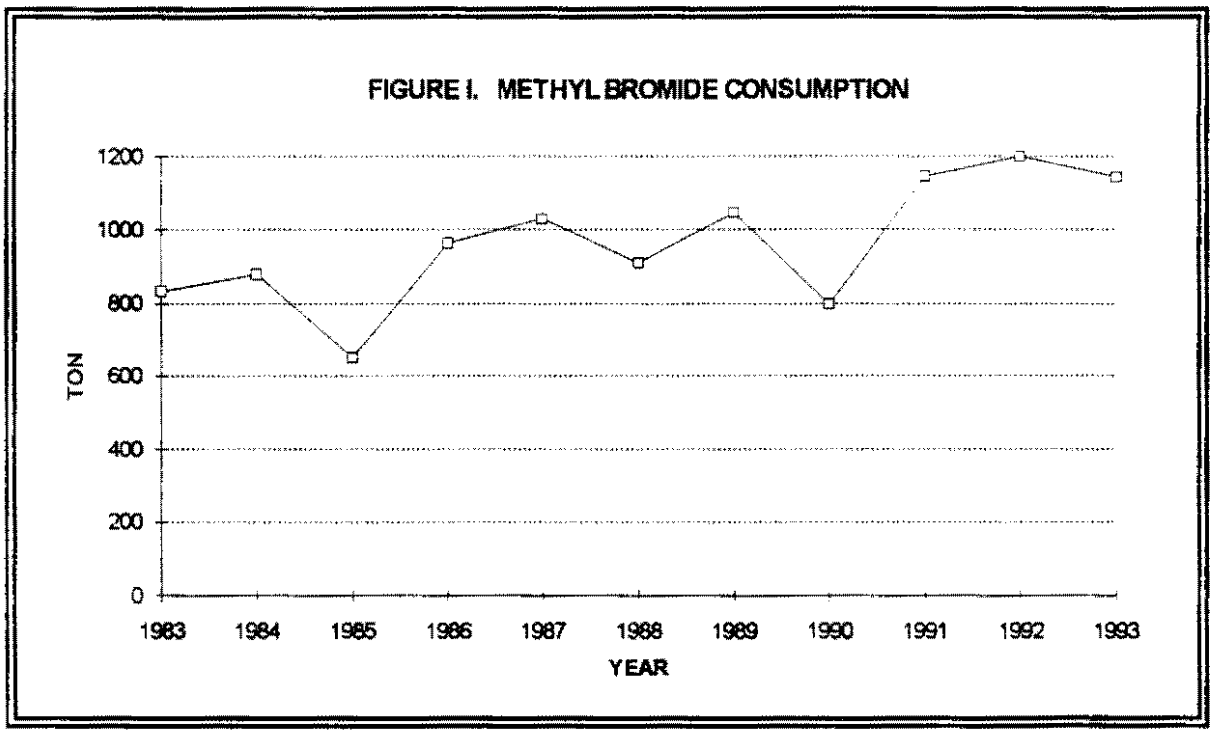
The time series for consumption of MB in Brazil as shown in TABLE I, is based on data

Environment and Renewable Resources) from the main importer of this compound and on data from SINDAG (Syndicate of producers Traders and Distributors of Plant Protection Chemicals), handled to GTO by an Agricultural Chemical Trader that covers the peridod from 1989 to 1993.

The distribution of uses of MB as percent of the total consumption for the year 1992 was as follows: tobacco leaf production = 64%; forest plantation = 4%; ship sterilization = 4%; soil treatment = 11%; space fumigation = 18%.

TABLE I - METHYL BROMIDE CONSUMPTION (TONS/YEAR)

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
QUANT.	834	880	652	963	1030	910	1046	798	1147	1200	1144



ALTERNATIVE TECHNOLOGIES

Despite the excellent properties of methyl bromide as a plant and crop protection agent due to its fast action and practically no residue left after the treatment, as well as its insecticide, nematocide and herbicide actions, there have been some relevant successes in the development of alternatives that can accomplish similar results even with some advantages in many cases.

The available alternatives for the phase out of MB are listed in TABLE II.

Some of these alternatives are already proven efficient options and have been used for long time as is the case of phosphine as a BM substitute. Its use has been increasing since

limitation for its uses has been the time factor whenever a short time for pre-shipment sanitation is required.

TABLE II - AVAILABLE ALTERNATIVES FOR THE "PHASE OUT" OF MB

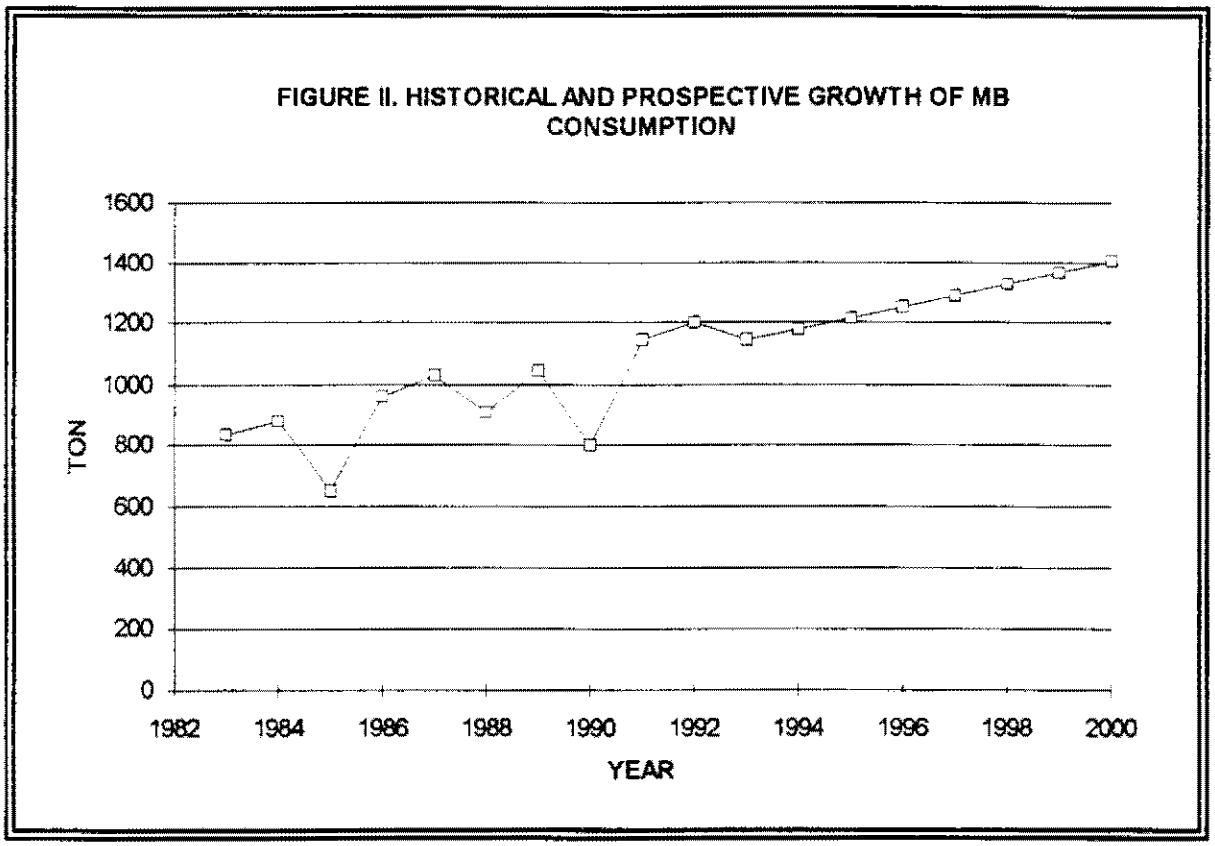
COMMON USES	ALTERNATIVES
NEMATODE CONTROL (SOIL FUMIGATION)	
TOBACCO	BASAMID, FLOATING TRAYS
HORTICULTURE AND AND FRUIT PLANTS NURSERIES	BASAMID, "SOLARIZAÇÃO" (SUN HEATING)
FLOWER NURSERIES	VAPOR TREATMENT
FOREST TREES NURSERIES	ALTERNATIVE SUBSTRATES (VERMICULITE IN PLASTIC TUBES)
ANTS CONTROL FOREST AND PASTURES	MIREX, MIREX-S
STORAGE AND TRANSPORT SPACES	
GRAINS	PHOSPHINE
FRUITS	THERMAL WATER TREATMENT
OTHER SPACES (ROOMS, HOUSES,ETC.)	PHOSPINE, COMMON SANITARY CLEANING AGENTS

The remaining users of BM in all different sub-segments will need some demonstration work and motivation that must be provided by the teaching methods normally used in agricultural extension services with the engagement of the government through its research and extension agencies.

PROSPECTIVE CONSUMPTION OF METHYL BROMIDE

The prospective consumption of MB until the year 2000 was calculated on the basis of the tendency curve shown in Figure I and taking into account the historical evolution of this market in Brazil.

The expected annual consumption in the absence of the Montreal Protocol was estimated to follow a net increase rate of 3,0% as a result of the expected increase of tobacco production and a less marked increase in consumption of the other sub-segments that have been affected by environmental pressures not specifically related to the Protocol



PROPOSED PHASE OUT SCHEDULE FOR MB

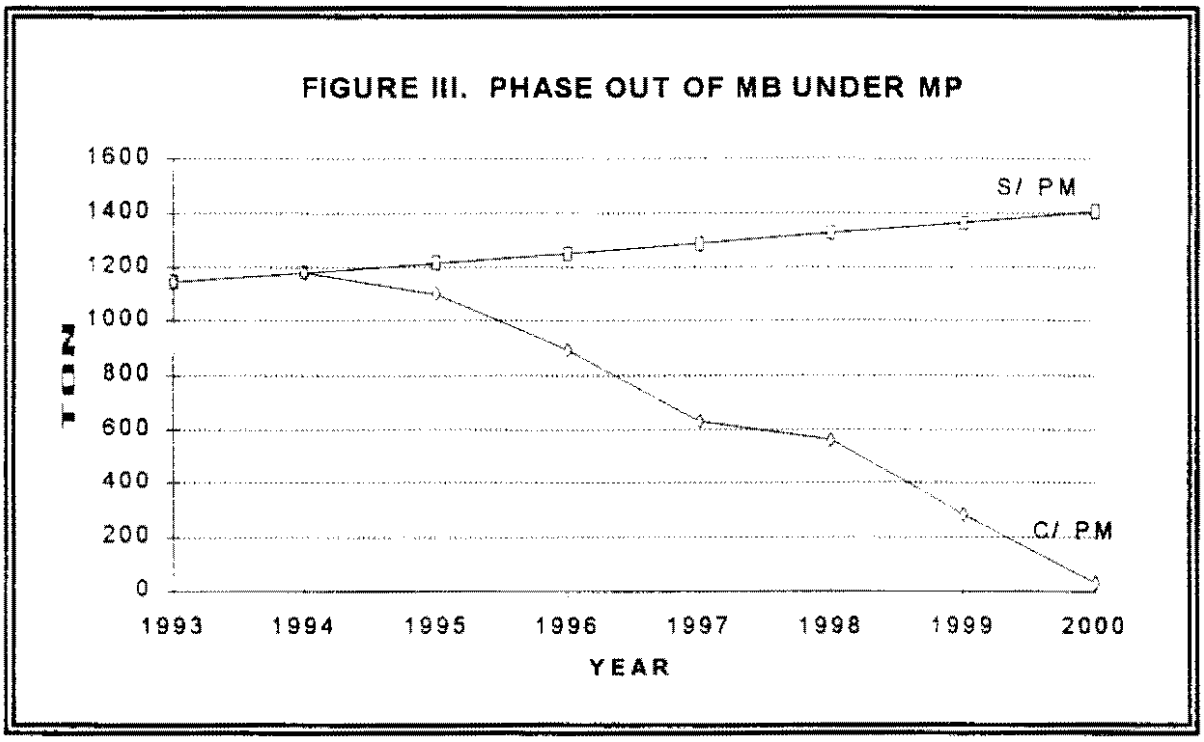
A proposed phase out schedule for MB was calculated on the basis of information collected from different sources, including official research institutions, individuals (scientists, experts and dealers), importers and distributors as well their class associations, users of MB as represented by farm commodities exporters and respective associations, flower cooperative association, tree nurseries for either pulp production or forestation purposes, and finally the main tobacco processor company that was most helpful in providing data and other information about the expected phasing out of the largest fraction of the imported gas.

The expected situation for the phasing out of MB is presented in TABLE II in which is shown the percentage decrease that could be achieved if the Protocol's Fund is available for the accelerated process.

TABLE III - PHASE OUT OF MB UNDER THE MONTREAL PROTOCOL

YEAR	1993	1994	1995	1996	1997	1998	1999	2000
UNCONSTRAINED	1144	1178	1214	1250	1288	1326	1366	1407
CONSTRAINED	1144	1178	1097	893	630	562	282	31

According to the above phase out schedule a minor amount of about 31 tons will still be allowed to be imported for special cases in which the complete substitution can not yet be made as is the case of research experiments or any other not detected at this moment.



COSTS INVOLVED

The practical actions to be taken, mostly represented by demonstration experiments and technical advising regional meetings and use of the media whenever convenient for public awareness of the benefits brought about by the proposed change in technology and banishment of a deleterious substance has a calculated value hat amounts to about US$ 900,00.00.

This does not involve direct costs of substitution as represented by investment needed to accomplish the required change at the producer level, since most of the alternatives represent an improved technology that would otherwise be adopted. In many cases the substitution will involve simpler procedures at lower cost.

The breakdown of the above total cost is is as follows:

TECHNICAL REGIONAL MEETINGS 95(4), 96(2), FROM 97 TO 2000 1 PER YEAR (2 DAYS EACH)	US$120,000
INTERNATIONAL CONSULTANTS 95(2), FROM 96 TO 2000(1 PER YEAR) .(5 DAYS EACH)	US$ 80,000
DEMONSTRATION EXPERIMENTS (INCLUDING TECHNICAL ASSISTANCE)	US$ 500,000
PUBLIC AWARENESS (TECHNICAL PAPERS, MEETINGS, NEWS MEDIA)	US$ 200,000

In addition most of the technical support for improving agricultural technology is provided by government agencies and research institutions and are offered either free of charge or at subsidized costs.

PRELIMINARY GOVERNMENT ACTIONS PROPOSAL

Although cost advantages in some cases, environmentally improved image, and removal of market barriers can be the driving forces behind the move toward the use of alternatives to the MB, there will be always some need of government endorsement and legal pressure to hasten the process if the proposed phase out schedule is to be met.

Such actions can be identified as:

1 - To establish a legal deadline beyond which no more MB can be imported unless for uses of essential nature.

2 - To establish the banishment of the MB for the cases when alternatives with already proven efficacy are available at economical costs.

3 - To impose as a punishment for the faulty users the losing of the subsidies or tax reductions allowed for the agricultural and related activities.

4 - To provide means for intensifying research and extension activities in universities and other government institutions to improve the knowledge of the alternatives for MB uses.

5 - Improve and simplify the procedures for registration of MB substitutes when already registered in the more restrictive markets of the industrialized countries with no pending further limitations.

ANNEX - 2

DETAILS ON SECTORAL SELECTED PHASE-OUT PROJECTS

CFC's Recovery, Recycling and Contention project

ITEM	DOMESTIC REFRIG.	COMM. REFRIG.	AC/ INDUS. REFRIG.	TOTAL
TOTAL GAS LOAD IN THE SYSTEMS (MT)	5,000	1,095	587	6,682
CFC CONSUMPTION (MT/YEAR)	671	876	176	1,723
EMISSION REDUCTION (MT/YEAR)	578	737	178	1,493
NUMBER OF RECOVERING MACHINES	11,667	1,144	753	13,564
AMOUNT OF GAS TO RECYCLE (MT/YEAR)	387	177	99	663
INVESTMENT FOR RECOVERY (1000US$)	5,833	4,576	6,400	16,810
INVESTMENT FOR SYSTEM OPTIMIZATION AND CONSULTING (1000US$)	25	28,025	14,531	42,581
(PAYMENT FOR THE COLLECTED GAS 1000US$/YEAR)	677	309	173	1,160
INVESTMENT IN TRAINING (1000US$)	5,812	1,453	-	7,265
TOTAL INVESTMENTS (1000US$)	12,347	34,363	21,104	67,816
COST-EFECTIVENESS (US$/kg of CFC)	4.27	9.33	23.71	9.08

NOTE 1: 80% of the investment in training were allocated in the domestical refrigeration and 20% in commercial refrigeration sector.
NOTE 2: 10% of all finantial values are for administration and contingency.

TRAINING AND CERTIFICATION OF MECHANICS

1. Duration of the training programme (months): 24

2. Number of mechanics to be trained and certified:

   2.1. In courses given in fixed locations: 17,430
   Total cost: US$ 2,560,894
   Individual training cost: US$ 147/mechanic

   2.2. In courses given in mobile units: 17,600
   Total cost: US$ 4,580,120
   Individual training cost: US$ 260/mechanic

   2.3. Total number of mechanics to be trained: 35,030

3. Total number of instructors: 62

4. Number of courses to be teached:
   courses given in fixed locations: 581
   course given in mobile units: 880

5. Total Cost: US$ 7,265,000
   Average Unitary Cost: US$ 207.39/mechanic

CONTAMINATED CFC RECYCLING CENTER PROJECT

Amount of CFC to be recuperated:	150 MT/year
Recycling/Reclaiming efficiency:	70 (%)
Net amount of CFC for reuse:	105 MT/year
Payment for the contaminated gas	25% of new gas
Total investments -18 months period:	US$ 914,323
Credits:	US$ 787,500
Balance (US$):	US$ 126,823
Amount of CFC recuperated (18 months period):	157,500 kg

Cost-Effectiveness (18 months period) US$ 0.80/ kg CFC

HALON PROJECTS

1. Halon Banking and Management Program

A halon banking and management program will be established in cooperation between authorities, users of halons and the fire protection industry. It will include a clearinghouse activity and recovering and recycling programmes for both halon 1211 and 1301. Programme will be to recover sufficient halon 1301 to cover the need for refilling existing and priority installations. The aim of the 1211 program will be to replace 1211 by other extinguishing agents. Servicing and maintenace companies handling halons wil be part of this programme.

The activities will include and overall coordination, and one or moreprojects. Bilateral coorporation with USA and Canada may also be desirable.

Total ODS Savings: 56 ton
Total Project Cost: US$ 1,500,000

2. Review of existing standards and drafting of new standards required for the implementation of the phase out program

The Brazilian Association of Technical Standards (ABNT) will coordinate a review pocess on existing standards, codes and other documents which migth influence the future use of halons. The activity will also include adoption and translation of internationally accepted standards on alternative technologies, recycling equipment and quality of recovered/recycled halons.

Phase-out = 100 ODS tons (base year 1991)
Total project cost = US$ 120,000

3. Transfer of alternative technologies for halon 1301 fire extinguishing systems.

In order to make technologies on alternative Fire Systems available to the Brazilian market for new fire extinguishing systems and eventual replacement of existing halon fire extinguishing systems a programme will be established to facilitate transfer of technology and know how. The programme migth include demonstration and training. A bilateral coorporation with Canada is foresceen as part of this activity.

Phase-out: 200 ODS tons (base year 1991)
Total project cost = US$ 200,000

4. Major Halon Users Phase-out Programs

In order to provide the necessary technical assistance to some of the the major users of halons in Brazil, e. g. Oil Industry, Telecomunication, Aviation and Defence, tecnical ssistance will be required to assist such organizations to establish a cost effective phase-out schedule. Project will include both techinical assistance and the cost of replacing halon fire extinguishing systems to the extent necessary to ensure supply of halons for more critical uses and/or costly instalations.

Phase-out: 100 ODS tons
Total project cost = US$=500,000

5. Workshops, Education, Training and Technology Transfer

Dissemination of information, education and training are important parts of the overall phase-out activities for the halon sector. Due to the overall requirement to maintain the same degree of safety and due to the high cost of replacing existing systems, education and training within the fire protection sector is required. As spill and unwanted discharge of the halons account for a major part of the halons emmision, training of servicing and maintenance personell will have a high priority in the programme. A technology transfer programme with information exchange will be carried out in the extent necessary to ensure the implementation of the halon phase-out programme and that tecnologies and knowlegde are made available to establish the most cost effective programmes. Bilateral cooperation with Canada is forseen for this programme.

Phase-out: 200 ODS tons
Total project cost = US$ 200,000

6. Information and Awareness

Information and awareness campaigns will be carried out as part of especific programs and will be coordinated with the overall information activities on ozone layor protection.

Estimated phase-out: 200 ODS tons
Project Cost = US$ 150,000

7. TOTAL HALONS PHASE-OUT COST = US$ 2.670.000

REFRIGERATION / AIR CONDITIONING

Domestic Refrigeration

The segment has 5 projects at different stages of analysis by the implementing agency. One of them has already been submitted to the Executive Committee of the Multilateral Fund. These projects involve substitution of CFCs in the cooling and foaming systems . Others projects are expected from the various companies of the segment, as well as the projects for the following phases of the 5 initial projects.

Central Air Conditioning / Industrial Refrigeration / Commercial Refrigeration

Projects coming out of Central Air Conditioning and Industrial Refrigeration include retrofits and substitution of equipments. During the elaboration of the Country Programme, an universe of 300 potential projects was identified .The segment of Commercial Refrigeration, composed of the largest range of users, will extend the number of projects of the whole sector to 5,000. These projects will include small, medium size and large companies spreading all over the country. For the small size enterprizes, it is forseen the formation of groups of companies with similar characteristics. The actual identification of these companies will be carried out by the sectoral associations that participated in the elaboration of the Country Programme.