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Ninth Meeting
Montreal, 8–10 March 1993

COUNTRY PROGRAMME : CHINA

国 家 环 境 保 护 局

NATIONAL ENVIRONMENTAL PROTECTION AGENCY

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14 January 1993

Dear Dr. El-Arini,

We are pleased to inform you that the China Country Programme for the Phaseout of Ozone Depleting Substances has been completed and has been approved by all concerned Ministries and by the State Council of the Peoples Republic of China.

We hereby officially submit to you the English version of the Country Programme for presentation to, and approval by, the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, at its Ninth Meeting during 8-10 March 1993 in Montreal. We appreciate the assistance provided by UNDP as lead agency in the preparation of the Country Programme.

There is one specific issue that we would like to draw your attention to and that concerns incremental operational costs. It has not been possible to calculate for each potential project the exact number of years of incremental operational costs. We have therefore taken the following approach. Operational costs have been estimated on both a 4-year basis and a "lifetime" 10-year basis. In order to avoid an unrealistically high estimate of total costs, the basic analysis has used the 4-year time period. However, as each investment project is formulated, we will be in a better position to determine precisely the number of years for which incremental operational costs apply.

NEPA would also like to take this opportunity to thank you for your valuable contributions to the formulation of our Country Programme.

Yours sincerely,

王飞扬祖

Wang Yangzu
Deputy Administrator
NEPA

Dr. Omar El-Arini
Chief Officer
Multilateral Fund Secretariat
Montreal, Canada

C H I N A

COUNTRY PROGRAMME

FOR THE PHASEOUT OF OZONE DEPLETING SUBSTANCES UNDER THE MONTREAL PROTOCOL

Submitted for Consideration at the
Ninth Meeting of the Executive Committee
of the Multilateral Fund of the
Montreal Protocol
(8 - 10 March 1993, Montreal)

NATIONAL ENVIRONMENTAL PROTECTION AGENCY (NEPA)
THE PEOPLES REPUBLIC OF CHINA
BEIJING, CHINA
JANUARY 1993

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I. INTRODUCTION

1.1 OBJECTIVE OF THE COUNTRY PROGRAMME

China 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 September 1989 and the Montreal Protocol on Substances that Deplete the Ozone Layer in June 1991. China has drafted its Country Programme for the Phaseout 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 China to adopt completely and effectively the control measures enumerated under the Protocol and to qualify for technical assistance and funding provided by the Multilateral Fund of the Protocol.

The China CP, which is being presented to the Ninth Meeting of the Executive Committee of the Multilateral Fund, will demonstrate the process of implementation of a basic national policy for environmental protection and the Government's determination to implement provisions of the Protocol despite the difficult and complex economic and technical factors that China will face in programme implementation.

The process adopted by the Government of China for CP development is as follows:

a) first, a detailed statistical compilation and evaluation of ODS production and consumption by sector a well as future trends and consequent ODS consumption implications nationwide was completed;

b) then sectoral appraisals of ODS substitutes and associated technologies, their effectiveness, and their applicability to China were conducted;

c) this was followed by development of a comprehensive and effective action plan for ODS phaseout, with projects specified by sector. Projects have been costed to reflect total costs as well as the incremental cost component that would be requested from the Multilateral Fund.

d) Simultaneously, a set of policies and required institutional framework that the Government considers essential to support, direct and supervise the action plan so as fully operationalize the CP were developed. This framework will support, direct and supervise project and programme implementation as well as evaluate action plan results.

1.2 STATUS OF THE COUNTRY PROGRAMME

The Government has established a Leading Group for Ozone Layer Protection whose responsibilities include CP development, and design and implementation of sectoral work programmes. The Leading Group is headed by the National Environmental Protection Agency (NEPA) and comprises 12 Ministries and Commissions. Reporting to the Leading Group are: (a) the Coordinating Group for

Ozone Layer Protection; (b) the Centre for Environmental Sciences of Peking University which was entrusted with CP preparation and updating by the Leading Group; and (c) eight Sectoral Working Groups covering the areas of aerosols, foams, solvents, halons, chemical substitutes, refrigeration/AC/MAC, refrigerator manufacture, and ODS recycling and recovery.

The CP 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 China's CP. The CP drafting activities have been organized and coordinated by NEPA. The Ministries/Agencies that have participated in and supported CP formulation activities include:

- Ministry of Foreign Affairs (MOFA)
- State Planning Commission (SPC)
- State Science and Technology Commission (SSTC)
- Economic and Trade Office under the State Council
- Ministry of Finance (MOF)
- Ministry of Chemical Industry (MCI)
- Ministry of Light Industry (MLI)
- Ministry of Machinery and Electronics Industry (MMEI)
- Ministry of Public Security (MPS)
- Ministry of Commerce (MOC)
- Ministry of Foreign Economic Relations and Trade (MOFERT)
- Ministry of Aerospace Industry (MAI)
- General Administration of Customs
- State Administration of Taxation
- State Administration for Industry and Commerce.

The first draft CP was prepared during May-June 1992, based on the reports of the eight Sectoral Working Groups which included contributions from 30 national experts. The first national CP workshop was held in Beijing during 1-4 June 1992 at which there were approximately 50 participants including over 20 national experts and several international experts. All Leading Group members were represented and all Sectoral Working Groups made presentations. UNDP (as lead agency), the World Bank and the Fund Secretariat also participated and made presentations at the workshop. Sectoral ODS production and consumption forecasts to year 2005, and in some cases to year 2010, were presented.

The first draft CP relied on the following information:

a) Study on the countermeasures for the control of ODS, internal report, Government of China, 1989.
b) Preliminary report on the status of ODS in China, report of a UNDP mission, December 1989.
c) Report on ODS use in China and a 3-year programme to reduce ODS production and consumption, report of a UNDP mission, May 1990.

d) Preliminary report (February 1992) and final report (June 1992) of the 9-member UNDP mission (with financial assistance from Finland) that during November-December 1991 helped the Government of China formulate investment programme feasibility studies to phaseout ODS in the various sectors.

During June-July 1992, the Sectoral Working Groups refined their analysis and several follow-up meetings were organized by NEPA. At the meeting convened by NEPA during 7-8 July, the Center for Environmental Sciences of Peking University made a presentation on a national policy framework to the Leading Group for Ozone Layer Protection. A result of this meeting was a consensus on the policy framework of the CP.

The second national CP workshop was held during 17-20 August 1992 in Beijing. Sectoral Working Groups made presentations containing more detailed analysis up to the year 2010. An executive summary was discussed. The presented projects were reviewed, their justification and cost-effectiveness analyzed, and financial analysis discussed. The framework for CP presentation to the Executive Committee was also agreed upon.

Since the State Council of China decided on 19 August 1992 that each concerned Ministry/Commission would have to clear the Country Programme prior to its being approved by the State Council, it was agreed that the CP would be presented to the Ninth Meeting of the Executive Committee in March 1993. In order, however, to keep the Executive Committee informed of CP development and to serve as a necessary background to investment project approval, UNDP as lead agency was requested by NEPA to include in its Progress Report to the Eight Executive Meeting of the Executive Committee, an Annex containing the highlights of China's CP. Accordingly, UNDP made the requested presentation during the Eighth Executive Meeting during 19-21 October 1992.

1.3 ASSISTANCE RECEIVED FOR COUNTRY PROGRAMME PREPARATION

The Government of China has estimated the total cost of developing and drafting the country programme at US $400,000 comprising:

a) Sectoral Working Groups and drafting group expenses including the costs of national experts ($250,000)
b) Organizational, administrative and other costs borne by NEPA ($80,000)
c) Costs of international experts ($70,000).

One-half (i.e. $200,000) of the total cost of CP development has been funded by the Multilateral Fund through UNDP (lead agency) which includes all the costs for international experts. The remaining $200,000 equivalent has been provided by the Government of China and other related national entities.

2. ODS SITUATION IN CHINA

2.1 ODS PRODUCTION AND CONSUMPTION IN 1991

There are twenty controlled substances under the amended Protocol of which the following seven are commonly produced and used in China:

Annex A Group I: CFC-11, CFC-12, CFC-113
Annex A Group II: Halon-1211, Halon-1301
Annex B Group II: Carbon tetrachloride (CTC)
Annex B Group III: Methyl chloroform (TCE)

The production and consumption of each of the other 13 controlled substances is either minimal or zero. China produces all seven controlled substances mentioned above. Carbon tetrachloride (CTC) is mainly used as a raw material for CFC production and is transformed into other substances during the production process. As such the CTC figures shown in Table 1 below are only the quantities used as cleaning solvent.

Table 1 shows China's production, consumption and imports of ODS in 1991 as well as their ODP equivalent. China's ODS consumption in 1991 was 48,239 tonnes, of which 62.8% was produced domestically and 37.2% was imported. In ODP terms, total consumption in 1991 was 60,352 tonnes of which 66.9% was produced domestically and 33.1% was imported.

Table 1
ODS/ODP Production, Consumption and Imports in 1991
(Metric tonnes)

ODS	CFC-11	CFC-12	CFC-113	H-1211	H-1301	CTC	TCE	TOTAL
ODS Production	3,100	21,900	800	3,500	10	249	737	30,296
ODS imports	13,130	1,112	2,861	500	40	0	300	17,943
ODS Consumption	16,230	23,012	3,661	4,000	50	249	1,037	48,239
ODS %age share	33.7	47.7	7.6	8.3	0.1	0.5	2.1	
ODP Value	1.0	1.0	1.07	4	16	1.08	0.12	
ODP Production	3,100	21,900	856	14,000	160	269	88	40,373
ODP Consumption	16,230	23,012	3,917	16,000	800	269	124	60,352
ODP %age Share	26.9	38.1	6.5	26.5	1.3	0.4	0.2	100
% Local Production	19.1	95.2	21.9	87.5	20	100	71.1	66.9

Figure 1 shows 1991 ODS production, imports and consumption in China by substance.

FIGURE 1

1991 ODS CONSUMPTION IN CHINA

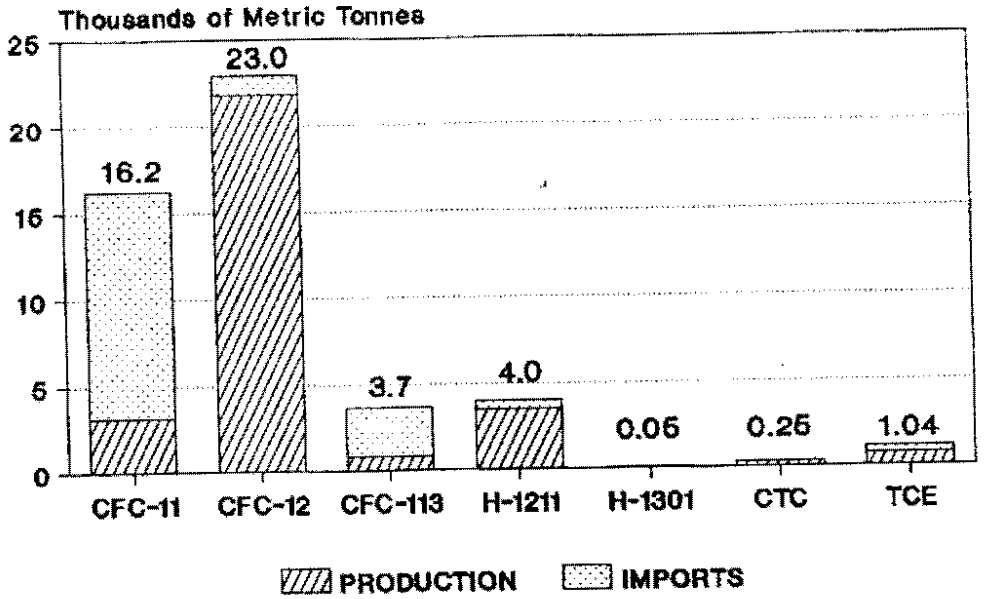


Figure 2 shows ODP consumption shares by substance used in 1991. CFC-12 was the most used substance accounting for 38.1% of the total, followed by CFC-11 in second place with 26.9%. Halon-1211 used for fire-extinguishing purposed accounted for 26.5% which is partly explained by its ODP value of 4.0, while CFC-113 which is used for cleaning purposes was in fourth place with 6.5%. The remaining three substances had very small consumption shares: Halon-1301 at 1.3%, carbon tetrachloride at 0.4% and methyl chloroform at 0.2%.

Table 2 and Figure 3 show 1991 ODS/ODP consumption by sector. In ODP terms, the foams sector is the largest user amounting for 29.5% of total consumption, followed by halons use at 27.8%, then refrigeration at 21.3%, then aerosols at 14.3% and finally solvents at 7.1%.

TABLE 2
ODS AND ODP CONSUMPTION BY SECTOR IN 1991
(Metric tonnes and percent)

	Foams	Refrigeration/AC	Fire Extinguishing	Aerosols	Solvents	Total
ODS	17,773	12,869	4,050	8,600	4,947	48,239
%	(36.8)	(26.7)	(8.4)	(17.8)	(10.3)	(100)
ODP	17,773	12,869	16,800	8,600	4,310	60,352
%	(29.4)	(21.3)	(27.8)	(14.3)	(7.1)	(100)

FIGURE 2

1991 ODP CONSUMPTION IN CHINA

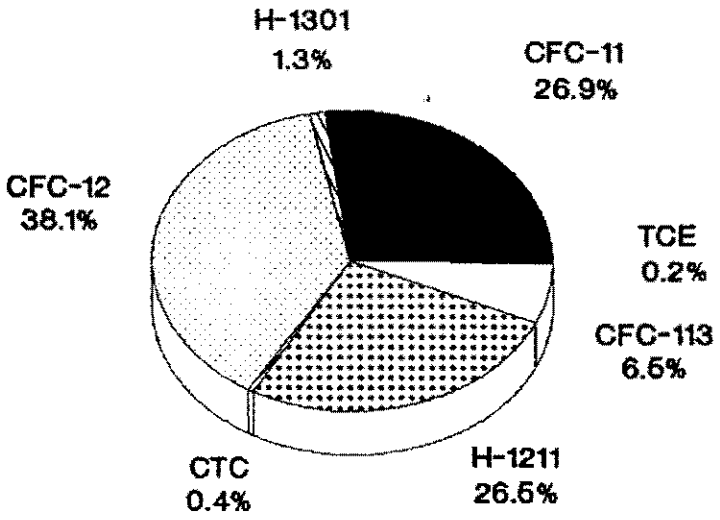


FIGURE 3

1991 CONSUMPTION BY SECTOR

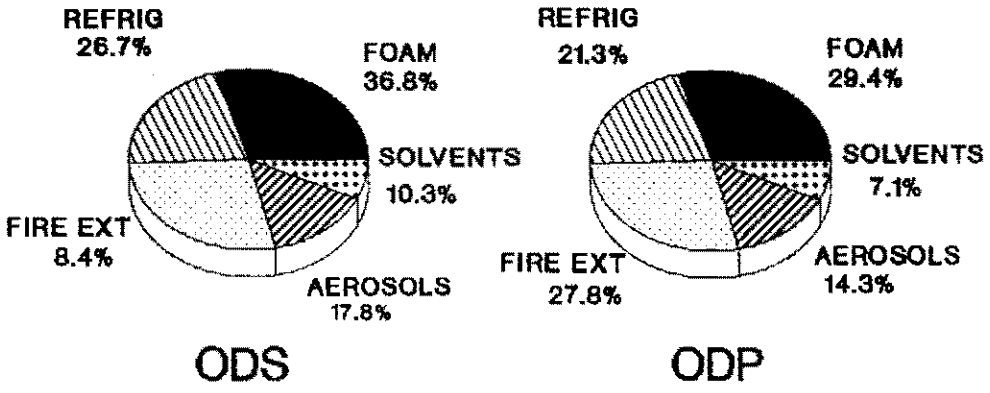


TABLE 3
ODS CONSUMPTION IN 1991 DISAGGREGATED BY SECTORS AND FINAL APPLICATIONS

Sector	Subsector	ODS	Application	ODS Consumption (Tonnes
Foams	Extruded Polyolfins	CFC-12	Fast food containers, etc.	2,173
	Soft Polyurethane	CFC-11	Mattress, sponge, etc.	2,000
	Hard Polyurethane	CFC-11	PU Tubes	600
			Foams and hard insulating boards for refrigerators	13,000
	Subtotal	CFC-11		15,600
		CFC-12		2,173
	Total			17,773
Refrigeration airconditioning	Domestic refrigerators	CFC-12	New products	1,050
		CFC-12	Refilling	448
	Mobile airconditioners	CFC-12	New products	180
		CFC-12	Refilling	360
	Other air	CFC-12	New products	800
	conditioning	CFC-12	Refilling	1,900
	Refrigeration/	CFC-12	New products	1,500
	cold storage	CFC-12	Refilling	5,980
	Refrigerated	CFC-12	New products	1
	Transportation	CFC-12	Refilling	20
	Turbo compressors	CFC-12	New products	150
		CFC-11	Refilling	480
	Subtotal	CFC-11		630
		CFC-12		12,239
	Total			12,869
Fire extinguish-ing	Extinguishing	H-1211	Extinguishers	2,645
			Extinguishing systems	355
			Refilling	600
			Extinguishing usage	400
	Extinguishing	H-1301	Extinguishing systems	45
			Refilling	5
	Subtotal	H-1211		4,000
		H-1301		50
	Total			4,050
Aerosols	Non-medical	CFC-12	Hair spray, etc.	8,360
	medical	CFC-12	Sprayer for asthma and respiratory diseas	240
	Total			8,600

TABLE 3 (contd.)

Sector	Subsector	ODS	Application	ODS Consumption (Tonnes
Cleaning solvents	Communication & Broadcasting equipments	CFC-113	Electronic tuners, SMT, PCB	771
		TCE	Machinery elements & parts	206
		CTC	Electronic elements & parts	51
	Electrovaccum & semi-conductors elements & devices	CFC-11	Electronic gun parts, shadow mask	890
		TCE	Metal parts	237
		CTC	Thin and thick IC	59
	Electronic instruments & apparatus	CFC-113	PCB	623
		TCE	Ceramic filters	166
		CTC	Main leading axle	42
	Computers & peripheral equipment	CFC-113	Control panels, magnetic heads, disks	683
		TCE	PCB, elements and parts	182
		CTC		46
	Other industries	CFC-113	Jewelry, fine elements & parts, operational devices	694
		TCE	Jewelry, fine elements & parts, operational devices	246
		CTC	Dry cleaning	51
	Subtotal	CFC-113		3,661
		TCE		1,037
		CTC		249
	Total			4,947

2.2 FORECAST OF UNCONSTRAINED ODS/ODP DEMAND TO YEAR 2010

China's social economy is being continuously developed and its national economy has been growing steadily since 1978 consequent on its effort to "administer, rectify and deepen the reforms" that started in 1978. China's GNP in 1991 was 7% higher than in 1990, and total industrial production grew at a rapid rate of 14.2% over 1990-1991. It is expected that the economy will speed up in the coming years as the process of "reform and opening to the outside world" gains momentum. It is predicted that a "comfortable society" will be realized by year 2010.

China is a developing country with a diversified industrial structure. Various sectors started using ODS at different times and at different stages of THE production process. The forecast for increased ODS consumption is based on the development plan within each consuming sector. Table 4 presents estimates of unconstrained demand for ODS/ODP over the period 1991-2010, both by substance and by sector. Figure 4 present the estimated unconstrained ODP demand in China by sector over the period 1991-2010.

FIGURE 4

ESTIMATED UNCONSTRAINED ODP DEMAND IN CHINA

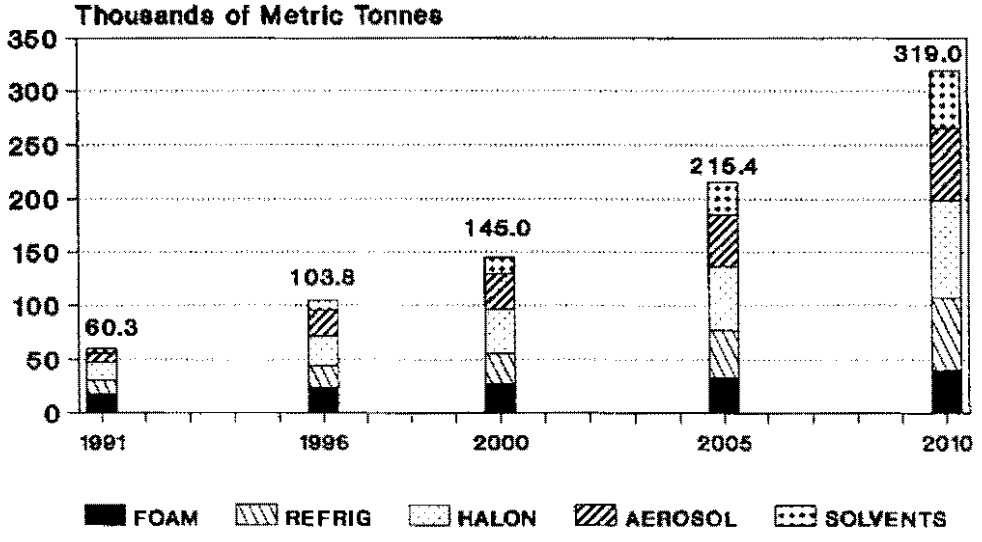


TABLE 4

ESTIMATED UNCONSTRAINED ODS/ODP DEMAND
(IN 1996, 2000, 2005 AND 2010)

(Unit: Metric tonnes)

	1991 Actual		1996		2000		2005		2010	
	ODS	ODP	ODS	ODP	ODS	ODP	ODS	ODP	ODS	ODP
CFC-11	16,230	16,230	20,904	20,904	23,898	23,898	29,278	29,278	35,495	35,495
CFC-12	23,012	23,012	45,910	45,910	65,055	65,055	95,855	95,855	138,492	138,492
CFC-113	3,661	3,917	7,420	7,939	13,794	14,760	25,865	27,676	45,580	48,771
H-1211	4,000	16,000	6,552	26,208	9,055	36,220	13,136	52,544	19,187	76,748
H-1301	50	800	124	1,984	227	3,632	454	7,264	916	14,656
CTC	249	269	532	575	938	1,013	1,757	1,898	3,094	3,342
TCE	1,037	124	2,612	313	3,900	468	7,311	877	12,882	1,546
Total	48,239	60,352	84,054	103,833	116,865	145,044	173,656	215,392	255,646	319,050
Foams	17,773	17,773	22,887	22,887	26,307	26,307	32,341	32,341	39,529	39,529
Refrigeration	12,869	12,869	20,343	20,343	29,263	29,263	44,243	44,243	67,695	67,695
Halons	4,050	16,800	6,676	28,192	9,282	39,852	13,590	59,808	20,103	91,404
Aerosols	8,600	8,600	23,584	23,584	33,381	33,381	48,549	48,549	66,763	66,763
Solvents	4,947	4,310	10,564	8,827	18,632	16,241	34,933	30,451	61,556	53,659
Annex A-I	42,903	43,159	74,234	74,753	102,745	103,711	150,998	152,809	219,567	222,758
Annex A-II	4,050	16,800	6,676	28,192	9,282	39,852	13,590	59,808	20,103	91,404
Annex B-II	249	269	532	575	938	1,013	1,757	1,898	3,094	3,342
Annex B-III	1,037	124	2,612	313	3,900	468	7,311	877	12,882	1,546

This unconstrained ODP demand scenario has the following features and underlying assumptions:

Overall Demand Total ODP unconstrained demand in year 2010 would be 529% higher than actual 1991 ODP consumption. With respect to individual substances, the 2010/1991 percentage increase is as follows: CFC-11 (219%), CFC-12 (602%), CFC-113 (1,245%), Halon-1211 (480%), Halon-1301 (1,832%), carbon tetrachloride (1,242%), and methyl chloroform (1,247%).

Foams (1991: 17,773 tonnes, 2010: 39,529 tonnes) Polyurethane hard foams used in domestic refrigeration will increase at the same rate as the increase in refrigerators, i.e. at 8% p.a. before 1995 and at 3% p.a. after 1995. For other foams including polyolefins, extruded foams, polyurethane soft foams, and hard tubes and boards, the overall demand growth rate is 6% p.a. over the whole period.

Refrigeration/Airconditioning (1991: 12,869 tonnes, 2010: 67,695 tonnes) Industrial refrigeration and airconditioning (excluding MAC) will increase steadily at 8% p.a. over the period. Since most units in the automobile industry would be equipped with airconditioners, for mobile airconditioning (MAC) a much higher growth rate of 20% p.a. before 2000 and 10-12% p.a. after 2000 is forecasted. The market demand for commercial refrigeration equipment is forecasted to grow at 18% p.a. upto year 2000 and at 15% p.a. thereafter. The present production capacity for domestic refrigerators is 12,000,000 units/year and annual production of these refrigerators is expected to grow at 8% p.a. before 1995 and at 3% p.a. thereafter.

Fire-extinguishing (1991: 16,800 tonnes, 2010: 91,404 tonnes) This sector has seen exceedingly rapid growth. Halon-1211 extinguishers demand would grow by 11% p.a. before 1997 and by 7% p.a. after 1997. Halon-1211 extinguishing systems demand would grow by 14% p.a. before 1997 and by 12% p.a. after 1997. Demand for Halon-1301 systems is expected to grow the fastest, i.e. by 20% p.a. before 1997 and by 15% p.a. after 1997.

Aerosols (1991: 8,600 tonnes, 2010: 66,763 tonnes) The market demand for aerosol products has been increasing rapidly in recent years. Demand during 1992-1995 is estimated to increase at 30% p.a., slowing to 9% p.a. during 1996-2000 and slowing further to 6% p.a. during 2001-2010 based on the growth rate of light industry in China's 10-year plan.

Solvents (1991: 4,310 tonnes, 2010: 53,659 tonnes) The electronics industry is developing rapidly in China. While ODS usage in 1991 was a small percentage of total ODS demand, unconstrained demand projections show a growth rate of 11-16% p.a. over the period 1992-2010.

2.3 INDUSTRIAL STRUCTURE FRAMEWORK

China has the largest ODS consumption and production among developing countries. The industrial structure covering both ODS production and consumption is complicated and, therefore, isdescribed in this section so as to present a clear picture on the present status.

A) ODS (excluding Halons) Production Industries

There are about 40 enterprises producing CFCs, with a total production capacity of around 47,000 tonnes in 1991. These enterprises may be divided into two classes, the larger State-owned companies and smaller collectively-owned plants. Technologies used by both types of enterprises have been developed domestically and the same process (liquid-phase catalytic fluorination method) and domestic raw materials come used in their production. Since most production facilities have been locally designed for specific products, the flexibility to switch between different CFCs in the production process does not exist.

There are 12 larger State-owned enterprises, including Shanghai Chloro-alkali Corporation, Jinan Chemical Plant, Changshu Refrigerant Plant, The Yangtze River Chemical Plant (Wuhan), Huiyang Chemical Plant, Sichuan Fujiang Chemical Plant, and Guizhou No.3414 Plant, Guiyang, under the Ministry of Aerospace Industry. Most of these CFC producers are under the administration of the Ministry of Chemical Industry. While the total production capacity of these enterprises was 26,000 tonnes in 1991, actual production was around 16,000 tonnes, accounting for 40% of market demand.

There are many smaller collectively-owned enterprises, but their production is unstable, with an estimated total capacity of 21,000 tonnes. Their actual production in 1991 was around 9,000 tonnes, accounting for 20% of market demand.

Existing CFC production capacity in China cannot completely meet demand. It is obvious, however, that existing capacity has not been fully utilized. At present, CFCs imported from Japan, France, and the USA amount for a large proportion (about 40%) of the market in China. The imported CFCs are estimated at 15,000-20,000 tonnes/year. CFCs produced in China are mainly for the domestic market, with only a small quantity exported. The quantity exported is estimated at 100-200 tonnes/year, mainly for users in the Southeast Asian region.

B) Foam Industry

There are three kinds of products in foam industries which use CFCs as foaming agents, i.e., soft polyurethane foams, extruded polyolefins foams, and hard polyurethane foams.

There are 30-40 major producers of soft polyurethane foam materials. They include State-owned and collectively-owned enterprises, such as the Beijing Foam Plastics Factory, Tianjin Polyurethane Plastic Products Factory, Shanghai No. 6 Plastics Factory, Dalian No. 1 Plastics Factory, Jiangsu Zhejiang No. 5 Plastics Factory, as well as some township and village enterprises (TVEs). The production lines for soft polyurethane foam materials have been imported, mainly from Germany, Norway, U.K., and Italy. In addition to conventional foaming processes, flat-top foaming, vertical foaming, and moud forming processes are used. In 1991, the production of these soft foams in China was about 50,000 tonnes with CFC-11 consumption of about 2,000 tonnes.

There are more than 30 enterprises producing extruded polyolefins foam materials. The major producers are Zhejiang Pilot Plastics Factory, Shanghai No. 18 Plastics Factory, Henan Provincial Foam Plastics Factory, and Suzhou Plastics Institute. Most of the factories are collectively owned, though a few are State-owned. The majority of their products are used as packing materials in the food, domestic appliances, electronics and instrument industries, and as insulating materials for pipelines.

The production lines for extruded polyolefins foam materials were imported, mainly from Japan, U.K. and Italy in the 1980s and consequently represent 1980s technology levels. The major facilities include two extruders in serial, equipment for cooling/pulling/coiling, a high-pressure pump for CFCs injection. In 1991, the production of extruded polyolefins foam sheets was 13,000 tonnes, with CFC-12 consumption of 2,173 tonnes.

There are 10 major enterprises producing hard polyurethane foam materials for pipeline insulation. Most of them are State-owned, such as Shanghai No.6 Plastics Factory, Tianjin Polyurethane Plastics Products Factory, etc., while a few are TVEs. These products are mainly used as insulating materials for heating supply pipelines in the petrochemical industry and for central heating. A total of 600 tonnes of CFC-11 was consumed by all these enterprises in 1991. At present, there are about 100 enterprises producing hard polyurethane foam boards in China, most of which are State-owned together with a few collectively- owned TVEs. Their products are widely used in such sectors as petrochemistry, cold storage, refrigerated cabinets, transport refrigeration, industrial/civil construction, and in the national defense industry. 5,000 tonnes of CFC-11 as foaming agents were consumed in 1991 to produce 5.7 million refrigerators and refrigerated cabinet units. Another 8,000 tons of CFC-11 were used to produce boards for cold storage.

C) Industrial/Commercial Refrigeration Industry

There are around 300 enterprises in the refrigeration and airconditioning industry, with about 250,000 employees. There are about 130 direct users of CFCs, comprising State-owned (70%), collectively-owned and TVEs (29%), and

joint-venture (2%) enterprises. Their consumption of CFCs as refrigerant was 11,371 tonnes in 1991. Major enterprises are as follows:

(1) producers of unit-type airconditioners and associated refrigeration compressors: Beijing Refrigerating Units Factory, Tianjin Tianshan Refrigerating Equipment Company, and Yueyang Refrigerating Equipment Corporation;
(2) producers of turbine-type refrigerating units: Chongqing General Machines Factory;
(3) producers of small-sized semi-closed refrigerating compressors: Nanjing Refrigerating Units Corporation, Zhejiang Refrigerating Equipment Factory, Luoyang Refrigerating Machines Factory (under Ministry of Commerce), Taizhou Commercial Machines Factory, Liaoning Experimental Equipment Factory, Beijing Commercial Machines Factory, Shanghai Refrigerating Equipment Factory, Wuxi Municipal Aircoolers Factory, and Wuhu Xueyuan Refrigerators Factory;
(4) producers of cold storage and medium-sized open-type refrigerating compressors for vessels: Shanghai Aircoolers Factory, Chongqing Refrigerating Units Factory, and Shaoxing Refrigerating Equipment Factory;
(5) producers for large- and medium-sized mobile airconditioners: Yueyang Refrigerating Equipment Corporation and Shanghai Xinjiang Machines Factory;
(6) producers of airconditioners for cars and light-duty vehicles: Shanghai EK CHOR General Machines Corporation, Shanghai Mobile Airconditioners Factory, and Guangzhou Haohua Mobile Airconditioners Corporation.

Most of these enterprises use production processes and equipment dating from the 1960s-1970s while a few enterprises (5%) use modern equipment. Major CFC-consuming products from these enterprises are turbine-type refrigerating units, larger unit-type airconditioners, refrigerating compressors for the food industry, refrigeration and cold storage equipment, refrigerated transportation equipment, and mobile airconditioners. These enterprises are under the Ministry of Machinery and Electronics Industry, The Ministry of Commerce, The Ministry of Aero-Space Industry, The Ministry of Communications, and The Ministry of Railways, respectively.

Most of the refrigeration and airconditioning equipment made in China is for the local market though a few units are exported (mainly to Southeast Asia, Eastern Europe and Africa). All of these enterprises have their own service/repair networks/sites, mainly in areas where their products are sold. These networks are responsible for the service and repair of their products within the guarantee period.

(D) Domestic Refrigeration Industry

The domestic refrigeration industry in China has developed rapidly. At present, there are more than 70 production lines for refrigerators with an annual

capacity of 12 million units and 16 production lines for compressors with an annual capacity of 16 million units. Most of the production lines have been imported from Italy, Japan, France, and Singapore and are equipped with advanced facilities. As a result, the economic cost for renovating these lines would be higher. The production of domestic refrigerators and refrigerated cabinets was 5.7 million units in 1991, with a consumption of CFC refrigerants amounting to 1,050 tonnes. The production rate for domestic refrigerators is still increasing. In addition to meeting domestic demand, these products are increasingly exported to Europe, USA and Southeast Asia.

(E) Halons Industry

The Ministry of Public Security is responsible for the production, import, and consumption of halons in China. There are over 30 enterprises producing halon-1211, most of which are collectively-owned TVEs, with an annual capacity of 6,000 tonnes. At present, 18 enterprises are under regular operations and their production accounts for 87% of total halons production in China. These enterprises are concentrated in Zhejiang Province, such as Zhejiang Provincial Dongyang Chemical Plant, locally-administered and State-owned Zhedong No.1 Chemical Plant, Zhejiang Provincial Extinguishing Chemical Plant, and Xiaoshan Extinguishing Chemical Plant. In addition, there are some halon producers in Guangdong, Sichuan and Liaoning Provinces. The production capacities of each of these enterprises varies from 200-600 tonnes. All their raw materials are produced in China.

The production capacity of halon-1301 is 100 tonnes/year. At present, there is only one producer, the Pilot Plant of the Zhejiang Provincial Chemical Institute, with a production of about 10 tonnes in 1991. During 1991, 540 tonnes of halons (including about 40 tonnes of Halon-1301) were imported because China's actual production of halons could not meet its domestic demand.

The producers of extinguishers and stationary extinguishing systems are major halon users in China. There are more over 80 producers of extinguishers throughout the country, with an annual production capacity of 2.2 million units. The larger producer include: Zhejiang Provincial Extinguishing Equipment Factory, Guangzhou Municipal Extinguishing Equipment Factory, Zhuzhou Extinguishing Equipment Factory (Zhuhai, Guangdong Province), and Jiangling County Extinguishing Equipment Factory (Hubei Province). Most of the producers are collectively-owned and TVEs with a few locally-administered state-owned enterprises. In 1991, the actual production of extinguishers was 1.2 million units with halon consumption of 2,645 tonnes. There are 25 enterprises producing stationary extinguishing systems using halons, such as The Shanghai Zhendan Extinguishing Equipment Corporation, Guangzhou Municipal Extinguishing Equipment Factory and Zhejiang Provincial Extinguishing Equipment Factory; their annual production capacity is over 4,600 units. Around 3,550 tonnes of halons were consumed in 1991.

The service/repair and refilling of halon extinguishers and stationary extinguishing systems are carried out at 900 servicing stations, large and small, throughout the country. In addition, some producers of halon extinguishers and stationary extinguishing systems are also engaged in the service/repair business. It is estimated that 250,000 extinguishers and a certain percentage of stationary systems need to be serviced/repaired or refilled each year and that their annual halon consumption is around 600 tonnes.

(F) Aerosols Industry

In China, over 100 enterprises produce aerosols, most of which are State-owned, whose capacity accounts for around 70% of the total. The rest, excluding 5 joint-ventures, are collectively owned TVEs. All the State-owned enterprises are administered by local governments and they come under the light industry departments or agencies of the provinces/municipalities. About half of the production is administered by industrial agencies at the county level. In 1991, the consumption of CFC-12 and CFC-11 as aerosol propellants was 8,600 tonnes of which CFC-11 accounted for a small portion. Excluding the large filling facilities (>10 million cans per year) in Guangdong Province and the medium-sized facilities (3 million cans per year) in Shanghai and Tianjin, most of the remaining enterprises are small, normally with a capacity of under 500,000 cans per year with some as low as 100,000 cans per year.

Most of the enterprises producing aerosol products are spread along the coastal areas, with Tianjin in the north, Shanghai in the east, and Guangdong in the south as the three major areas.

Most aerosol products are for domestic sale. A few large producers are equipped with continuous and mechanized filling facilities, some of which may easily be transformed provided non-ODS propellants (such as HAPS or DME) are available. At present, partial renovations have been carried out at some enterprises. Others should be further modified so as to meet the requirements of using non-ODS propellants (mainly, in terms of their flammability). The production facilities at most small enterprises are very simple and crude, with manual filling machines and propellant feeding pumps. Some facilities are not equipped with explosion-proof motors. The workshops and their ventilation and lighting facilities are not suitable for filling operations using flammable propellants. It will be quite difficult to cost-effectively transform these enterprises.

(G) Electronic Cleaning Industry

At present, there are over 3,200 electronics enterprises in China, most of which are medium or small-scale, located throughout the country. In addition, there are about 100 State run research institutes. Employees total over 1.7

million. The electronics products manufactured include: electronic materials, electronic elements, semiconductor devices, electro-vacuum devices, assemblies and other specific equipment. Demonstration experiments are to be carried out at Dalian Picture Tube Factory, Dandong Tuner Corporation, Chengdu Qianfeng Radio Instrument Factory, and Nanjing Wired Radio Factory, which are the representative factories selected on the basis of the features of the cleaning processes and their products. Electronic cleaning is only one interim process during the production of electronic products. Two kinds of cleaning processes and facilities are presently used in China, the first was imported together with the production lines and the second was developed locally.

ODS consumption in this industry in 1991 totalled 4,947 tonnes, including 3,661 tonnes of CFC-113, 249 tonnes of CTC, and 1,037 tonnes of TCE (of which 300 tonnes were imported, and 737 tonnes were locally supplied).

(H) ODS Recycling/Recovery Industry

The recycling/recovery of CFCs in China is administered by the Ministry of Commerce. The recovery of CFCs refers to the recovery of CFC refrigerants when the refrigerating units are serviced or repaired. This industry may be roughly divided into the following three aspects:

(1) Service/Repair Networks/Sites for Domestic Refrigerators/Cabinets At least one larger domestic appliance service/repair centres has established by the commercial system under each city. Generally, large and medium-sized domestic appliance shops and refrigerator producers have their own service/repair sites. In addition, there are small private domestic appliance service/repair shops. Over 40,000 service/repair sites for refrigerators/cabinets have been set up nationwide. These sites are administered by the Domestic Appliance Service/Repair Center under the Ministry of Commerce as well as by related authorities under the Ministry of Light Industry, and the Ministry of Machinery and Electronics Industry.

(2) Service/Repair Network/Sites for Mobile Airconditioners The service/repair of mobile airconditioners is undertaken by nationwide service/repair stations established by automobile manufacturers, mobile airconditioner manufacturers, as well as by local automobile service/repair factories. It is estimated that there are over 4,000 such stations throughout the country. Most are administered by National China Automobile Industry Corporation under the Ministry of Machinery and Electronics Industry and the automobile manufacturers.

(3) Service/Repair Networks/Sites for Industrial/Commercial Refrigerating Equipment There are around 8,000 such service/repair stations throughout the country, most of which were set up by the equipment manufacturers or agents. These stations are administered by the equipment manufacturers

under the Ministry of Machinery and Electronics Industry and the Ministry of Commerce, as well as by the China Refrigerating/Air Conditioning Association.

The recycle/recovery of halons in China is administered by the Ministry of Public Security. The recovery of halons refers to the recovery of halon extinguishants when halon using devices are serviced/repaired. There are over 200 recovery sites established by fire-extinguishing authorities in large and medium-sized cities throughout the country. Only about 60% of the residual extinguishants can be recovered from the extinguishers. These sites are administered by provincial and municipal administrations.

2.4 Institutional Framework

The Government of China has established a formal national institutional framework for ozone layer protection and for implementation of the Montreal Protocol. The elements of this institutional framework will now be discussed.

The Government has established a Leading Group for Ozone Layer Protection which is responsible for the implementation of Vienna Convention and Montreal Protocol provisions, the review of various implementation options, and strategic decision-making. The Leading Group comprises the following bodies:

Leader:	National Environmental Protection Agency (NEPA)
Vice-Leaders:	Ministry of Foreign Affairs (MFA)
	State Planning Commission (SPC)
	State Science and Technology Commission (SSTC)
	Ministry of Finance (MOF)
Members:	Ministry of Commerce (MOC)
	Ministry of Light Industry (MLI)
	Ministry of Public Security (MPS)
	Ministry of Aerospace Industry (MAI)
	Ministry of Chemical Industry (MCI)
	Ministry of Machinery and Electronics Industry (MMEI)
	Ministry of Foreign Economic Relations and Trade (MOFERT)
	General Administration of Customs.
	Ministry of Agriculture (proposed)

A Coordination Group for Ozone Layer Protection has been established under the Leading Group and reports to it. The office of the Coordinating Group is located at NEPA which services it and which is responsible for its routine operations. The Coordinating Group has been entrusted with:

a) concrete implementation of the Convention and the Protocol.
b) coordination of the production, import, export and consumption of controlled substances and their products.

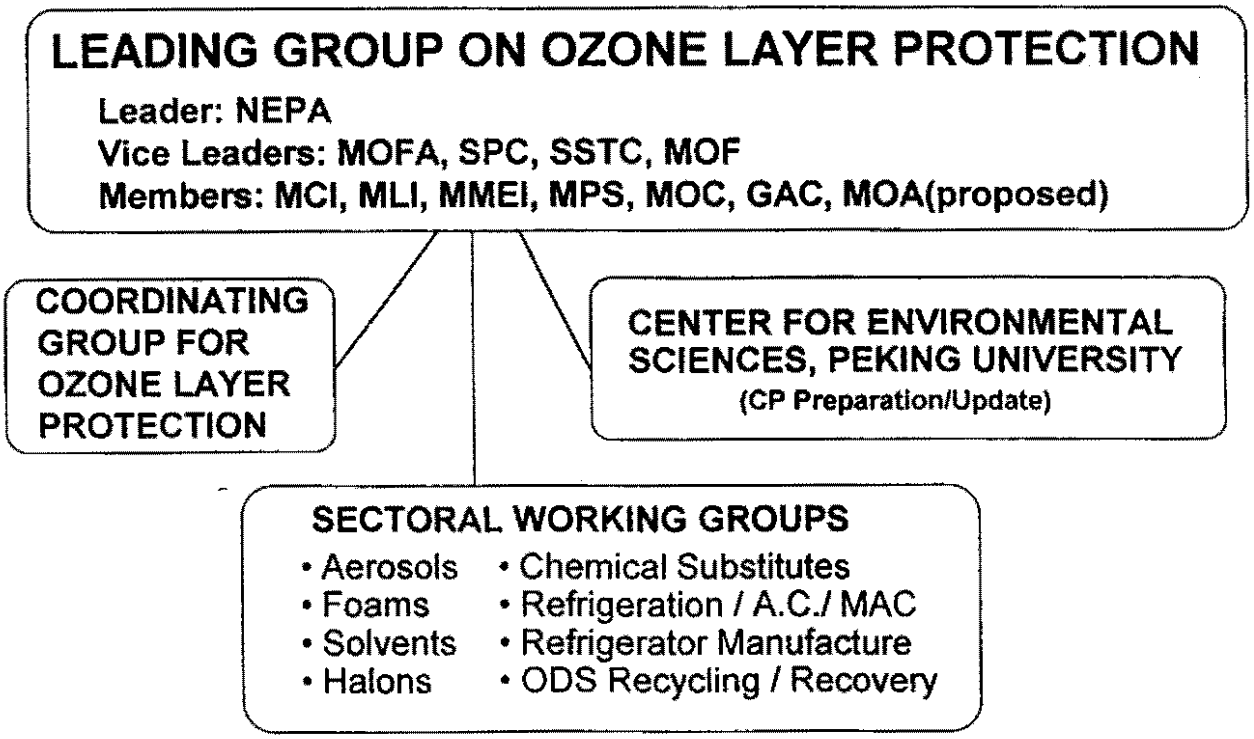
c) financial analysis of the domestic and external funding needed for the implementation of the Protocol.
d) proposing various options to the Leading Group.
e) handling other affairs related to the Convention and the Protocol.

Eight technical Sectoral Working Groups have been formed to formulate sectoral components of the country programme as well as project formulation. They report to the Leading Group. The sectors covered include: aerosols, chemical substitutes, foams, halons, ODS recycling and recovery, refrigeration/airconditioning/MAC, refrigerator manufacture, and solvents. In addition, the Center for Environmental Sciences at Peking University has been entrusted by the Leading Group with responsibility for the drafting and updating of the Country Programme.

A summary of the division of responsibility for ozone layer protection in China is presented in Figure 5.

FIGURE 5

INSTITUTIONAL FRAMEWORK FOR OZONE LAYER PROTECTION IN CHINA



The division of responsibilities is as follows:

National Environmental Protection Agency (NEPA) is responsible for the supervision of Convention/Protocol and Country Programme implementation. This includes elaborating international cooperation projects, establishment of related regulations, evaluation of ODS production, import, export and consumption, and supervision of the collection and reporting of data on ODS production and consumption.

Ministry of Foreign Affairs (MOFA) is responsible for international affairs related to the Convention and Protocol, as well as policies and laws that have external implications.

State Planning Commission (SPC) and the Economic and Trade Office under the State Council are responsible for macro-level programming and planning for the production, import, export and consumption of ODS and their products.

State Science and Technology Commission (SSTC) is responsible for the elaboration of the research plan for ozone layer protection, as well as the organization and management of projects with special emphasis on technology-related issues and aspects.

Ministry of Finance (MOF) is responsible for the financial management of external funds granted for ozone layer protection in China.

Ministry of Commerce (MOC) manages the production and utilization of small-size commercial refrigerators and cold storage machines that are manufactured using ODS. It is also responsible for coordinating the recovery and management of CFCs in these uses.

Ministry of Light Industry (MLI) manages the production and utilization of domestic refrigerators (including domestic cold cabinets) and single-phase room airconditioners and related compressors, aerosol products, soft and hard polyurethane foam plastics, and polystyrene and polyethylene extruded foam materials manufactured using ODS.

Ministry of Public Security (MPS) manages the research, production, use and recovery of halon extinguishants, fire extinguishers, and stationary extinguishing systems as well as halon substitutes and substitute technologies.

Ministry of Chemical Industry (MCI) manages the production of ODS (excluding halons) and the research, development and management of production of substitutes.

Ministry of Machinery and Electronics Industry (MMEI) manages the production and use of boards for cold storage and combined cold storage, 3-phase airconditioning equipment, refrigerant compressors (excluding those used in domestic refrigerators and cabinets), refrigerant and cold storage equipment (excluding domestic and small-size commercial refrigerators), and mobile airconditioners which are manufactured using ODS. MMEI is also responsible for managing the production and operation of ODS recovery facilities and leakage monitoring instruments, as well as the development and use of cleaning reagents manufactured using ODS.

Ministry of Foreign Economic Relations and Trade (MOFERT), with the concurrence of the Ministry of Commerce, is responsible for the management of the import and export of controlled substances and their products.

General Administration of Customs is responsible for the control and statistics on the import and export of controlled substances and their products.

State Administration of Commodity Prices manages the prices of controlled substances and substitute technologies.

Local environmental protection agencies are, at the local level, responsible for the implementation of regulations and ordinances for environmental protection, and the supervision of local production and consumption of ODS. They ensure that ODS reduction regulations are followed and that new and technically innovative projects are supported.

2.5 POLICY FRAMEWORK

China's policy framework to phaseout ODS has been developed in the context of national enviromental protection policies currently being implemented in coordination with economic reform activities currently underway. Nine specific policies have been developed to phaseout ODS use and to encourage the introduction and use of substitute technologies. A summary of their key features follows:

a) Policy for Production Management The permit and quota system would be used for ODS production with enterprises requiring Government permission for ODS manufacture. Environmental impact assessments would be used to strictly control requests for new projects or expand existing projects that would produce or use ODS. Those enterprises producing products using ODS will have to follow the phaseout schedule in the country programme, failing which those enterprises would either be penalized or shut down.

b) Import Policy The import of controlled substances and their products would be restricted when needed by appropriate measures so as to promote local development and production of ODS substitutes.

c) Price Policy The prices of controlled substances and their substitutes and substitute technologies will be adjusted when necessary and appropriate so as to ensure a smooth transition process.

d) Sales Policy The Government will become the exclusive supplier for sales of ODS and will manage this sales programme based on the national ODS phaseout plan in the country programme taking due account of essential ODS uses.

e) Taxation Policy Tax reductions/exemptions on controlled substances and their products will be strictly controlled and applicable tax rates will be increased when appropriate. Preferential tax rates will apply to products manufactured using ODS substitutes. Tax reduction and/or exemption would apply for ODS recovery since the Government will establish recovery networks and filling centres to encourage the re-use of ODS.

f) Investment Policy The Government will encourage investment policies that help ozone layer protection so as to positively influence domestic and external funding of projects away from ODS use and towards use of ODS substitutes. Industrial sectors would be responsible for the elaboration of sector investment policies that promote ozone layer protection.

g) Incentive Policy The Government supports and encourages universities, scientific research laboratories, industries and institutions to develop technologies for ozone layer protection applicable to China. A special fund will be established to encourage organizations and individuals who have made or could make outstanding contributions to the phaseout of controlled substances.

h) Public Awareness Policy Public awareness on the importance of ozone layer protection will be raised through extensive use of the public media (television, radio, newspapers, magazines). Technical training courses will be designed to increase the skills of technicians and managers involved in the production, use and management of controlled substances and their substitutes.

i) Green Label Policy The Government will design a system to issue "green labels" for products manufactured using either ODS substitutes or that are completely free of ODS.

j) Legal Policy Laws and regulations for the management of controlled substances and their substitutes will be enhanced and finalized.

2.6 GOVERNMENT AND INDUSTRY RESPONSES TO THE PROTOCOL

Since 1987, the Government of China has actively taken part in activities related to the Protocol. It has carried out a series of international and domestic activities to implement the Convention and the Protocol especially since 1989 when it formally joined the Vienna Convention and since June 1991 when it ratified the amended Montreal Protocol respectively.

The state-level organization and administrative institutional framework for ozone layer protection in China has been established, and Ministry-level administrative institutions for ozone layer protection have been also set up by relevant industrial administrative authorities.

Industrial management systems have been elaborated, such as:

- The Ministry of Light Industry, concurrent with NEPA, issued the "Notice on Controlling the Development of Aerosol Products Using CFCs" in April, 1991. According to this Notice, no new CFC-based manufacturing installations are permitted and CFC substitution technologies must be used for any new or expanded aerosols production plant.

- The permit system for production of halon extinguishants and extinguishing devices has been implemented by the Ministry of Public Security.

- In September 1990, the Ministry of Public Security concurrent with the Ministry of Machinery and Electronics Industry and the State Administration for Industry and Commerce, issued the "Notice of Suspending the Construction of New Plants for Fire Trucks and Extinguishing Devices", so as to control halon consumption.

Research activities have been undertaken for the development of substitution technologies and substitutes. China is proud to announce that results in the following fields have been achieved:

- The synthesis of HFC-134a has been completed and tested in refrigerators;

- Rigid foams insulating material of CFC-11 has been successfully developed and tested in refrigerators;

- Experiments on HFC-152a and binary operating media of HCFC-22/HCFC 142b and HCFC-22/HCFC-152a blends for use in refrigerators have been carried out;

- A dry powder KC1 extinguishant and water-based extinguishants have been developed;

- Water cleaning and substitute cleaning methods have been tested on parts of electronic guns and PCBs.

The Government has arranged the associated domestic funds for technical renovation of major enterprises within the refrigeration and airconditioning industry. For example, specific loan funds have been mobilized for the substitution of compressors presently in use by the Nanjing and Beijing Refrigerating Units Factories, and these loans will be made in 1992. Specific loans are planned for the enlargement of the NH3 refrigerating equipment in Yantai Refrigerating Unit Factory, and loans will be also initiated this year. Technical reform funds have been arranged for making smaller NH3 refrigerating equipment in Luoyang Refrigerating Machines Factory, and the loan will be initiated in 1993. These actions have resulted in adequate preparations being made for obtaining assistance under the Multilateral Fund and carrying out all needed renovation activities for technical substitution.

An assessment centre for CFC substitution (for use in refrigerators) has been established at the Beijing Household Electrical Appliance Institution under the Ministry of Light Industry. This centre, together with various refrigerator manufacturers and related research organizations and universities, has carried out significant substitution research and assessment activities.

Various international and domestic activities for exchange of technical, policy and related information and technologies have been organized, such as:

- "International Halon Extinguishants and Substitutes Workshop/Exhibition", held in Hangzhou, Zhejiang Province, September 10-14, 1990;

- "China-Sweden Workshop for Ozone Layer Protection", held in Beijing, May 19-27, 1991;

- "China-America Workshop on Appraisal Projects for CFC Substitution in Refrigeration", held in Shanghai, October 1991;

- "National Academic Exchange Meeting on Refrigerating CFC Substitution Technologies", held in Shanghai, October 1991;

- "China-Japan Workshop for Ozone Layer Protection", held in Beijing, December 18-19, 1991; and

- At meetings held by various industries, papers and information on ozone layer protection have been issued and exchanged.

A series of papers have been issued in various academic journals as well as general magazines and newspapers so as to raise public understanding of the importance of ozone layer protection and ODS control.

3. ODS PHASEOUT IMPLEMENTATION

3.1 GOVERNMENT STRATEGY

The Government of China will strictly adhere to the provisions under the revised Protocol and undertake the needed obligations for the phaseout of ODS production and consumption in China, provided sufficient funds are made available and needed technologies are transferred in accordance with the provisions of the Protocol. China is fully aware of the importance and urgency for ozone layer protection, but China is short of the funds and technologies necessary for ODS phaseout. So ODS phaseout progress in China will be determined by the availability of assistance from the Multilateral Fund. China will speed up its ODS phaseout once cost-effective substitute technologies and sufficient financial assistance corresponding to the implementation of technical changeover are obtained.

The demand for products manufactured using ODS (or ODS containing substances) will be far from saturated in China before the year 2010. The availability of servicing for these products to meet the normal demands of local consumers should not be affected by the reduction of ODS production and consumption. So a smooth transition from ODS to their substitutes, i.e., starting from high ODP to low then to zero ODP substances, should be carried out. Local consumers should not be penalized during the replacement of the relevant durable consumables such as refrigerators.

Chinese demand for ODS substitutes, the substitute technologies for ODS products, and the related equipment and raw materials will be based mainly on the development of local production. Thus, on the basis of technical and economic feasibility, the complete phaseout of ODS will be carried out as early as possible.

The complete phaseout of ODS in the aerosols industry (excluding medical applications will be attained in 1997. The complete phaseout of ODS in the foams industry (excluding the portion used in refrigerators and hard polyurethane boards) is expected in year 2000.

The Government will organize the necessary technical and economic appraisals on projects listed in the Country Programme for ODS Phaseout so as to ensure the effective use of grants obtained from the Multilateral Fund. The Country Programme will be adjusted as needed during its implementation based on continuing development of domestic and foreign ODS substitution technologies.

The ODS phaseout in China will be closely linked to the economic reforms and the adjustment of the industrial structures and product configurations using ODS. Relevant laws and regulations and technical policies for industries will be established so that management of and guidance to ODS phaseout activities will be enhanced.

3.2 TECHNICAL APPROACH FOR ODS PHASEOUT IN CHINA

Due to the rapid development of ODS phaseout technologies and the varying rates of development between different sectors, each sector has completed a comprehensive survey of the development status and prospect on domestic and foreign substitution technologies in the sector, taking into account the economic, technical, and managerial feasibilities for implementing the phaseout programme in China. Based on the above, each sector has proposed its phaseout technical approach as the technical basis for the elaboration of sectoral ODS phaseout scenarios.

Early obsolescence of equipment containing or using ODS will be a major cost of the CFC phaseout process in China, and extraordinary measures will be needed to minimize this early equipment retirement cost. China will reduce this cost significantly by following the principle of using transitional substances such as HCFCs to phase out CFCs, thereby extending the life of installed equipment across the country while simultaneously reducing ODP. This principle will include the conversion of manufacturing facilities away from CFC production to HCFCs in order to satisfy the demand created by the loss of CFC availability.

The Country Programme has not, for instance, considered the phaseout of HCFC-22 as the related technologies have not been clarified so far. In the future, with the development of related technologies, the revised Country Programme will cover these issues.

3.3 CHEMICAL SUBSTITUTES (OTHER THAN HALONS)

Under MCI coordination, the overall plan is to reduce CFC imports and production in conjunction with CFC consumption, while increasing production of fluorinated substitutes to meet the constantly growing total demand (see figure 12). The industry structure will be gradually adjusted as CFC manufacturing is phased out or converted to production of alternatives. Since the demand for HCFC-22 will be greater than current supply, the plan calls for conversion of CFC-12 plants to HCFC-22 manufacture. AS the plan is executed, 70% of CFC-11/12 manufacturing will be eliminated by 2005, with a 100% phaseout by the year 2010.

The ODS production industry will reduce production and, at the same time, will carry out research in and development of substitute production processes and construct industrial production plants based on the demand for substitutes. The technical approach for chemical substitutes has two main components, first an adjustment of the CFC production structure and, second, the construction of production systems for substitutes. The adjustment of the CFC production structure is aimed at the gradual concentration (reduction) of plants without increasing total CFC production capacity so as to create the necessary conditions to facilitate transformation of the production process in the future.

The existing ODS (for example, CFC-113 and TCE) are used as feedstocks for many of the mature substitute technologies currently used in foreign countries. Pilot production is necessary in order to develop and select the most economic and effective technologies which are suitable for Chinese conditions which and can use raw materials produced in large quantities in China (eg. ethylene chloride).

In the short- and medium-term (1992-2000), a few large-scale CFC-using plants will be transformed to produce HCFC-22, which is the most convenient and effective approach for rapid CFC reduction in China. In the medium-term (1996-2000), a substitute plant with the capacity of 10,000 tonnes/year will be constructed, and some CTC plants will be reconstructed so as to produce methylene dichloride and chloroform. In the long-term (2001-2010), when additional commercial-scale plants with a capacity of 11,000 tonnes/year have been constructed based on substitutes, the production of CFCs will be completely stopped.

3.4 FOAMS INDUSTRY

Two substitutes, i.e., butane/pentane and a mixture of CO2 and HCFC-22 can be used for the production of extruded polyolefins foam materials. The use of ODS in the production of soft polyurethane foam materials may be reduced through a change of processes, the use of methylene dichloride, and the addition of softeners and polyols. CO_2 may be used instead of CFCs in the production of rigid foams.

China will introduce the above substitute technologies in the near future, complete the necessary demonstration projects by 1996, and popularize them within the whole industry. The complete phaseout will be implemented by year 2000.

For the hard polyurethane materials and boards used in refrigerators, the foaming technology for 50% reduction of CFC-11 is mature. China will initiate some demonstration projects for refrigerator production in during 1992-1996. These will include the combined polyether technology for 50% reduction of CFC-11 foaming agent, and the polyol technology using CO^2/CFC-11 for 50% reduction of CFC-11 in the production of hard polyurethane boards. It is estimated that, starting from 1997, foaming technology for 50% reduction of CFC-11 will be popularized throughout the whole industry.

In order to phaseout completely CFC-11 foaming agent, China will develop (and import) some transitional substitute technologies in the medium-term (1997-2000), such as technologies using HCFC-123/HCFC-141b, HCFC-123/HCFC-141b/CO2, HFC-134a, HCFC-22, HCFC-22/HCFC-142b, and pentane, and will set up several demonstration projects. Following the results of the demonstration projects, replication can occur rapidly. The technical approach to be followed for 100% CFC reduction will be determined by year 2000, and will be popularized through the whole industry before year 2005.

3.5 INDUSTRIAL/COMMERCIAL REFRIGERATION

The substitution technologies which have been proved through international commercial applications will be adopted by the Chinese industrial/commercial refrigeration industry.

a) For larger unit-type airconditioners with larger refrigerating output, HCFC-22 will be used instead of CFC-12;

b) For refrigeration and cold storage facilities with output less than 5KW, HCFC-22 will be used instead of CFC-12;

c) For food freezers and cold storage facilities with an output between 2.5 and 72 KW, NH3 and HCFC-22 will be used instead of CFC-12;

d) For mobile airconditioners, HFC-134a will be used instead of CFC-12;

e) For turbine-type refrigeration units, HCFC-123 or HFC-134a will be used instead of CFC-11; and

f) For refrigerated transportation facilities (including refrigerated trucks, trains, and bulk containers), HCFC-22 will be used instead of CFC-12.

In the short-term (1992-1996), China will introduce and master the above technologies through the establishment of demonstration projects. It is estimated that, starting from 1997, these technologies will be gradually popularized through the whole industry and industry-wide technical transformation will be completed by year 2005.

3.6 DOMESTIC REFRIGERATION

For CFC-12 refrigerant used in domestic refrigeration, perfected substitution technologies are not available from China or from foreign countries. When HFC-134a is used as the substitute refrigerant, HFC-134a specific compressors have to be imported or manufactured and associated lubricant and desiccant should be developed so as not to increase the original energy consumption of the units. Other problems have to be resolved, such as the compatibility with the washers and valves, coppering of the valves, the toxicity test, etc. When HFC-152a or other binary operating media are used as the refrigerant, it is not necessary to change the original refrigeration system, lubricant, and desiccant, and the energy consumption would not increase.

Other problems, however, may be associated with use of HFC-152a. So in the short-term (1992-1996), China will construct small-scale demonstration production lines using both HFC-134a and HFC-152a technologies. Based on this approach, construction of enlarged demonstration production lines and corresponding development of non-fluor absorption refrigerators will be carried in the medium term (1996-2000). The applicable substitution technical approach for will be determined and popularized within the whole industry by the year 2000.

3.7 HALONS

So far, mature halon substitutes are not available on the international market. The major technical approaches for China to reduce its halons consumption are as follows:

a) Stop the use of halon extinguishing devices in non-essential uses. Dry powder extinguishers, foam extinguishers, water-based extinguishants, rapid response and cyclical open-and-close automatic spraying systems, low-pressure CO_2 systems, high foaming systems, dry powder extinguishing systems, and N2 systems will be used instead of halon extinguishing systems used in different cases;

b) Reduce the leakage of halons during production, service, storage, and transportation;

c) Import production technologies for dry powder extinguishants and extinguishers;

d) Improve the recovery, storage, and recycling of halons so as to ensure the use of halons in essential applications after the year 2010.

e) Initiate studies of new non-halon extinguishants and mixtures of halons and other gases such as CO2, so as to reduce the dependence of extinguishing devices on halons; and

f) Develop halon substitutes and destruction technologies.

According to the above technical approaches, activities on the substitution of halons in non-essential uses, production of non-halon extinguishants and extinguishing devices, development of leakage-proof technologies, demonstration of halon recovery facilities, and evaluation of halon destruction technologies and halon substitutes and substitution systems will be carried out in the short-term (1992-1996). Halon extinguishing systems in non-essential uses will be gradually replaced, production of halon extinguishants and extinguishing devices will be stopped, and halon recovery, storage, and recycling activities will be reinforced in the medium-term (1996-2000), so as to store adequate halons for essential uses beyond the year 2010.

3.8 AEROSOLS

For aerosol products, other than those for medical purposes, various commercial ODS substitutes are available on the world market. China has decided to adopt the most commonly refined LPG (HAPS), and has further decided to use oil-field LPG refined through the absorption process. In addition, due to the problems associated with the supply of LPG, dimethyl ether (DME) is also considered as the second alternative propellant.

Over 90% of Chinese aerosol producers, most of which have recently set up operations are not equipped with the facilities and workshops suitable for using flammable propellant. An investment of about RMB 300 million (around $55

million) will be needed to complete the technical transformation of these producers. China has decided to establish three filling centres in the areas where aerosol product enterprises are concentrated, i.e., one each in the Tianjin, Shanghai, and Guangdong areas. These centres will supply the non-ODS propellant, provide a filling service for numerous small enterprises, and supply qualified propellant to those enterprises which are capable of filling the flammable non-ODS propellant. The use of CFC-11 as a propellant will be banned by 1997.

3.9 SOLVENTS

The Chinese electronics industry has decided to import advanced and mature cleaning technologies so as to phaseout the use of ODS. Four demonstration cleaning lines, one each for: a) telecommunications and broadcasting; b) electrovaccum and semi-conductors; c) elements and instruments; and d) computers and peripherals will be constructed. These demonstration lines will use aqueous cleaning, other non-ODS substitute cleaning, and "no-clean" processes. Cleaning process and recovery labs will be established and production lines for cleaning facilities will be constructed.

The above technologies (facilities) will be imported in 1993. In 1994 construction of the demonstration production lines will be completed and these cleaning facilities will be popularized among those 800 enterprises with good replication possibilities. On this basis, promotion of the technologies through the whole industry will be started in 1996. These activities, however, will be complicated and difficult due to the varieties of the cleaning processes employed and the large differences in technical levels among the various enterprises.

3.10 ODS RECOVERY AND RECYCLING

Based on the international development of mature ODS recovery and reclamation technologies, China has decided to adopt two technical approaches:

a) Recovery only -- centralized reclamation - use simple recovery devices to extract CFCs from the facilities being serviced. The recovered CFCs are compressed and condensed and pumped into containers for temporary storage. The contained CFCs are then sent to the reclamation centres for purification through distillation. After testing, the purified CFCs are bottled and then returned to the recovery sites for reuse. This model is suitable for areas with a high density of service networks/sites. Its main advantage is that the quality of the regenerated refrigerant can be ensured.

b) Simultaneous recovery and reclamation. The recovery devices are equipped with oil separators, dewatering units, acid removers, and filters. Recovery and purification may be carried out at the same time.

Based on the present status and the development trend of the use and servicing of airconditioning and refrigeration facilities, China has decided to establish 1,200 recovery sites in the short-term (1992-1995), and 1,600 recovery sites and a reclamation centre in Beijing in the medium-term (1996-2000). A further 2,800 recovery sites and a reclamation center will be established in the Shanghai area. The construction of the recovery/recycle networks/sites will be completed by year 2005.

Unserviceable refrigerators and cabinets will be recovered through a compensatory programme and, when the ODS is extracted, they will be disposed of. Recovery/purification of CFCs during the production of refrigerators and cabinets will be carried out by specific recovery facilities installed at the State-assigned manufacturers of refrigerators and cabinets.

3.11 ODS PHASEOUT SCENARIO TO YEAR 2010 AND IMPLICATIONS FOR PRODUCTION OF ODS SUBSTITUTES

As stated in Dection 3.1 on Government Strategy, the phaseout scenarios being implemented should be cost-effective and should take into account the interests of local ODS product customers. Scenario implementation costs have been used as the only measure for appraisal of the cost-effectiveness of the scenarios since the calculation of other net benefits, if any, cannot be estimated apriori and can only be calculated on a project-by-project basis.

All the costs of implementing the scenarios refer to those under the "Indicative List of Categories of Incremental Costs" adopted by the Second Meeting of the Parties. The cost-effectiveness of the scenarios can be determined by comparing the incremental costs of scenarios with the total costs that include the funding provided by China.

The incremental costs of implementing the scenarios have been estimated at the enterprise level and follow closely the related definitions adopted by the Multilateral Fund. In addition:

a) Double-counting of cost items has been carefully eliminated;
b) Capital costs are carefully separated from operational costs;
c) Operational costs have been calculated on both a 4-year basis and on a "lifetime" basis not to exceed 10 years. However, in order to avoid an unrealistically high estimate of total incremental costs, the basic analysis has used the 4-year operational cost period. However, as each project is formulated, it will be easier to determine precisely the number of years for which incremental operational costs apply.
d) Savings or benefits gained from implementing the scenarios as deducted from a project by project analysis are deducted.

It should be noted that incremental costs at the state level, such as the costs incurred for the implementation of the permit systems for ODS production and consumption as required by the policies and measures adopted by the Government for ozone layer protection, are not included in the costs of implementing the scenarios. China has developed an optimal scenario for complete ODS phaseout by year 2010 that meets the provisions and requirements of the Montreal Protocol. The tables and figures that follow show the following:

a) Figures 6 - 10 are line diagrams comparing the trends of unconstrained demand and year 2010 phaseout scenario targets for Annex A Group I, Annex A Group II, Annex B Group II, Annex B Group III, and all controlled substances, respectively.

b) Table 5 presents estimated ODS/ODP consumption under year 2010 phaseout with intermediate figures for years 1996, 2000 and 2005. It covers the seven controlled substances, the five major sectors plus recovery/recycling, and categorization by Protocol Annex/Group definitions.

TABLE 5

ESTIMATED ODS/ODP CONSUMPTION UNDER YEAR 2010 PHASEOUT
(IN 1996, 2000, 2005 AND 2010)
(Unit: Metric tonnes)

	1991 Actual		1996		2000		2005		2010	
	ODS	ODP	ODS	ODP	ODS	ODP	ODS	ODP	ODS	ODP
CFC-11	16,230	16,230	12,434	12,434	4,700	4,700	21,800	21,800	0	0
CFC-12	23,012	23,012	24,391	24,391	11,094	11,094	6,647	6,647	0	0
CFC-113	3,661	3,917	5,320	5,692	3,700	3,959	1,087	1,163	0	0
H-1211	4,000	16,000	2,380	9,520	900	3,600	500	2,000	0	0
H-1301	50	800	50	800	30	480	20	320	0	0
CTC	249	269	353	381	190	205	60	65	0	0
TCE	1,037	124	1,373	165	1,005	121	500	60	0	0
Total	48,239	60,352	46,301	53,383	21,619	24,159	11,614	13,055	0	0
Foams	17,773	17,773	13,997	13,997	4,200	4,200	2,500	2,500	0	0
Refrigeration	12,869	12,869	17,071	17,071	10,914	10,914	6,947	6,947	0	0
Halons	4,050	16,800	2,430	10,320	930	4,080	520	2,320	0	0
Aerosols	8,600	8,600	5,757	5,757	680	680	0	0	0	0
Solvents	4,947	4,310	7,046	6,238	4,895	4,285	1,647	1,288	0	0
Annex A-I	42,903	43,159	42,145	42,517	19,494	19,753	10,534	10,610	0	0
Annex A-II	4,050	16,800	2,430	10,320	930	4,080	520	2,320	0	0
Annex B-II	249	269	353	381	190	205	60	65	0	0
Annex B-III	1,037	124	1,373	165	1,005	121	500	60	0	0
Recycling CFC-12			1,054	1,054	1,666	1,666	2,040	2,040	2,040	2,040

FIGURE 6
UNCONSTRAINED GROWTH VS C.P. PLAN

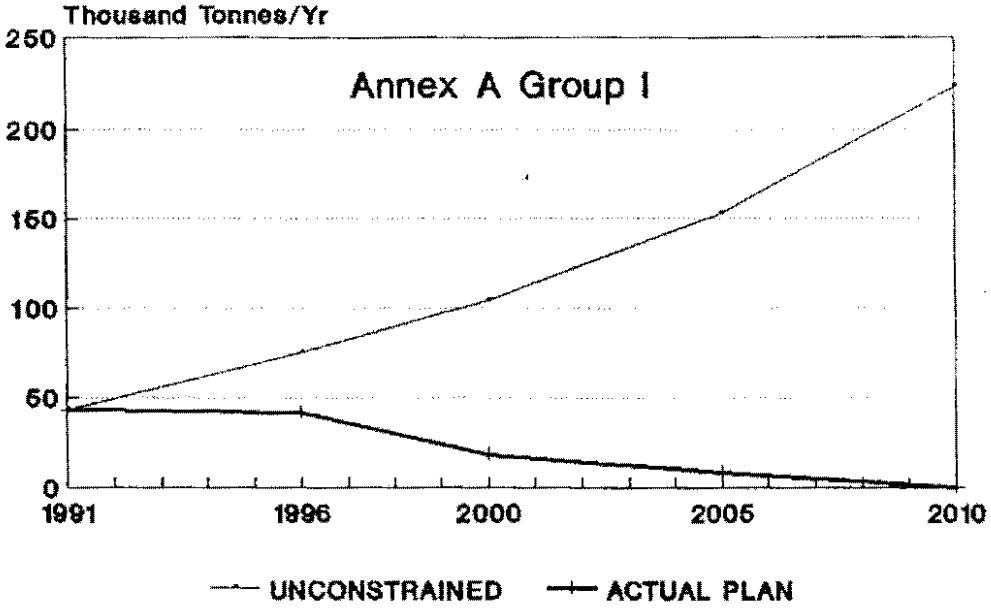


FIGURE 7
UNCONSTRAINED GROWTH VS C.P. PLAN

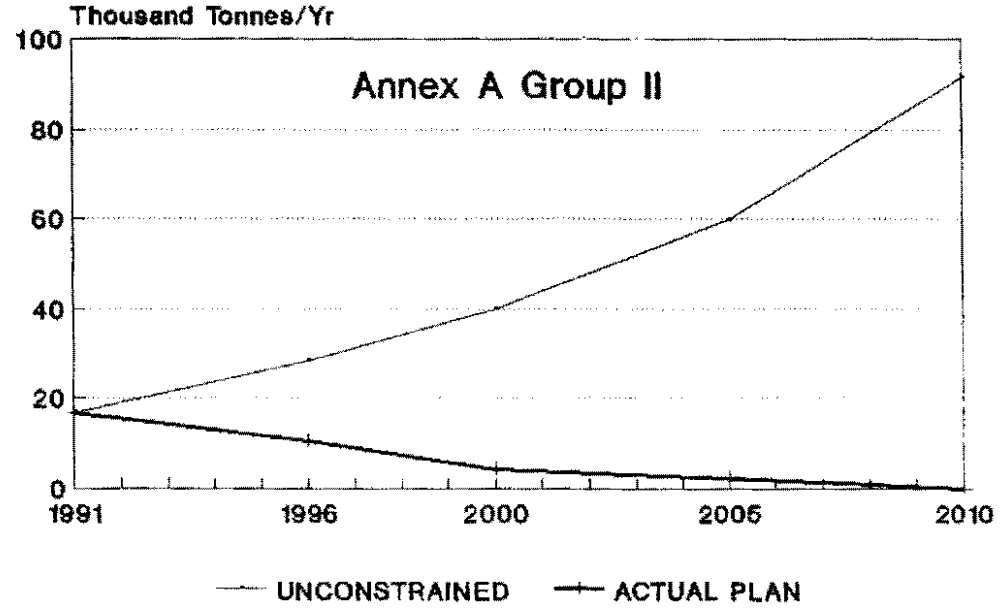


FIGURE 8
UNCONSTRAINED GROWTH VS C.P. PLAN

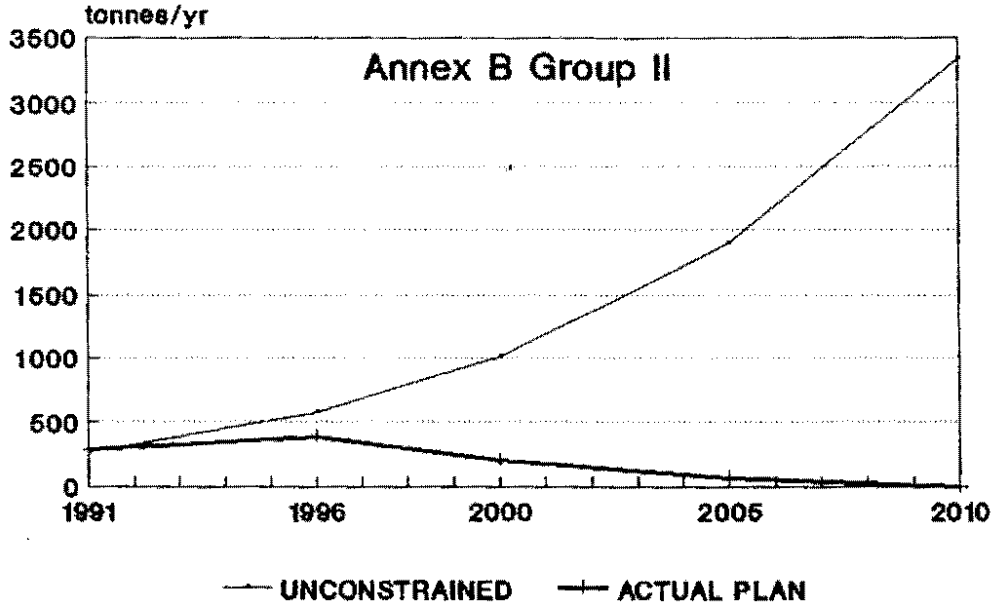


FIGURE 9
UNCONSTRAINED GROWTH VS C.P. PLAN

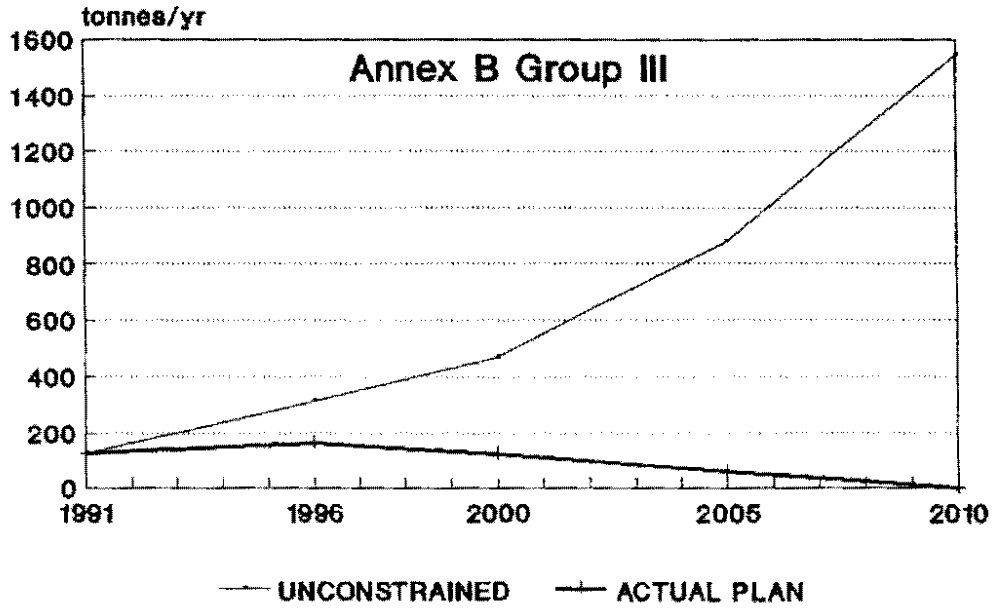


FIGURE 11

ESTIMATED ODP REDUCTION RATE IN CHINA

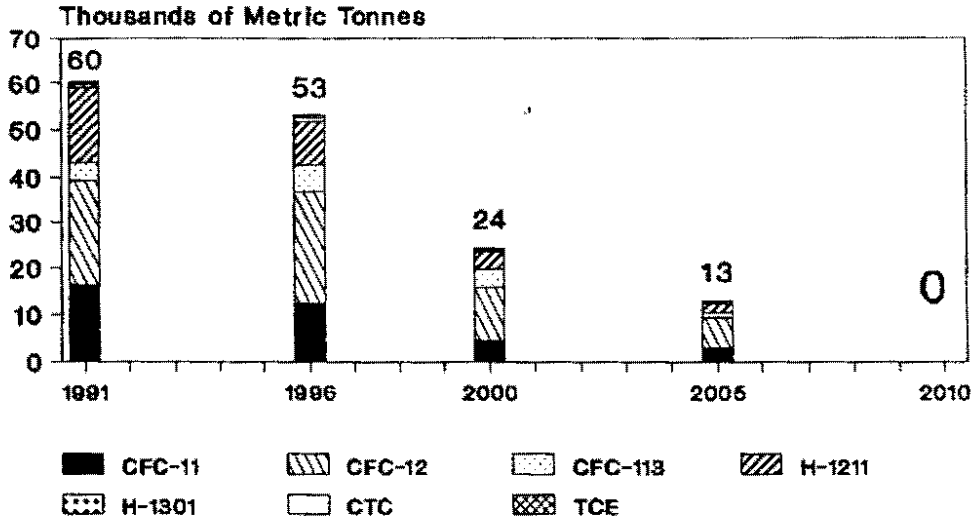
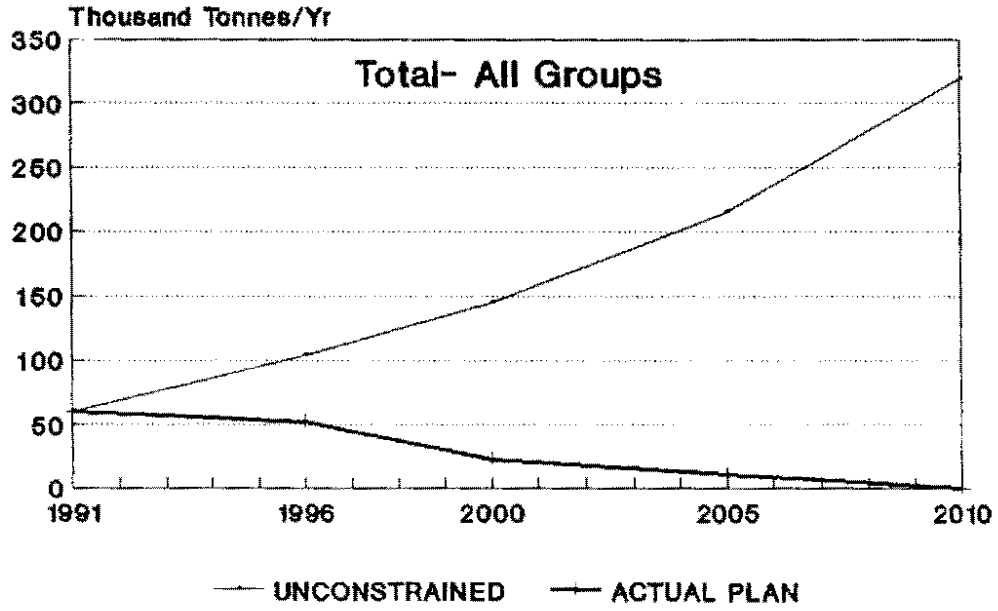


FIGURE 10

UNCONSTRAINED GROWTH VS C.P. PLAN



c) Table 6 presents the estimated reduction in ODS/ODP under year 2010 phaseout with intermediate figures for years 1996, 2000 and 2005 respectively. It has the same group categorization as Table 5. Figure 11 presents the same scenario in bar charts.

d) Table 7 shows expected ODS production by controlled substance to year 2010.

e) Table 8 presents the forecasted demand for ODS substitutes to year 2010 covering HCFC-22, HFC-134a, HFC-152a, HCFC-141b/142b, and HCFC-123.

f) Table 9 and Figure 12 present the plan for development of ODS substitute production capacities to year 2010 covering HCFC-22, HFC-134a, HFC-152a, HCFC-141b/142b, and HCFC-123.

The direct net incremental costs for ODS phaseout in China by year 2010 are as follows:

	(US $million)
Chemical Industry	$ 320.34
Foams	344.30
Industrial/Commercial Refrigeration	242.76
Domestic refrigeration	224.49
Halons	195.14
Aerosols	8.40
Solvents	65.78
Recycling & Recovery	30.62
Total	$1,431.83

The following are the assumptions underlying the above figures:

a) All costs are in current US dollars.

b) The above figures include direct investment costs and project operational costs for the first four years only. When individual projects are fully specified, they would cover "lifetime" operational costs not to exceed 10 years.

c) No incremental costs are included for solvent cleaning lines built after 1996 and using non-ODS cleaning agents.

d) No incremental costs are included for new production plants for foam plastics that use non-ODS foaming techniques.

e) For recycle/recovery networks, while incremental capital costs are included, operational costs and any net benefits are excluded.

f) No incremental costs are considered for mobile airconditioner plants built after 1996 and using HFC-134a as refrigerant.

TABLE 6

ESTIMATED REDUCTION IN ODS/ODP POTENTIAL UNDER YEAR 2010 PHASEOUT (IN 1996, 2000, 2005 AND 2010)

(Unit: Metric tonnes)

	1996		2000		2005		2010	
	ODS	ODP	ODS	ODP	ODS	ODP	ODS	ODP
CFC-11	8,470	8,470	19,196	19,1956	26,478	26,478	35,495	35,495
CFC-12	21,519	21,519	53,961	53,961	89,208	89,208	138,492	138,492
CFC-113	2,100	2,247	10,094	10,801	24,778	26,512	45,580	48,771
H-1211	4,172	16,688	8,155	32,620	12,636	50,544	19,187	76,748
H-1301	74	1,184	197	3,152	434	6,944	916	14,656
CTC	179	193	748	808	1,697	1,833	3,094	3,342
TCE	1,239	149	2,895	347	6,811	817	12,882	1,546
Total	37,753	50,450	92,246	120,885	162,042	202,336	255,646	319,050
Foams	8,890	8,890	22,107	22,107	29,841	29,841	39,529	39,529
Refrigeration	3,272	3,272	18,349	18,349	37,296	37,296	67,695	67,695
Halons	4,246	17,872	8,352	35,772	13,070	57,488	20,103	91,404
Aerosols	17,827	17,827	32,701	32,701	48,549	48,549	66,763	66,763
Solvents	3,518	2,589	13,737	11,956	33,286	29,162	61,556	53,659
Annex A-I	32,089	32,236	83,251	83,958	140,464	142,198	219,567	222,758
Annex A-II	4,246	17,872	8,352	35,772	13,079	57,488	20,103	91,404
Annex B-II	179	193	748	808	1,697	1,833	3,094	3,342
Annex B-III	1,239	149	2,895	347	6,811	817	12,882	1,546
Recycling CFC-12	1,054	1,054	612	612	374	374	0	0

TABLE 7
EXPECTED PRODUCTION OF CONTROLLED SUBSTANCES TO YEAR 2010
(Unit Metric Tonnes)

	1991	1996	2000	2005	2010
CFC-11	3,100	12,000	4,000	2,500	0
CFC-12	21,900	20,000	8,000	6,500	0
H-1211	3,500	2,380	900	500	0
H-1301	10	50	30	20	0
CFC-113	800	800	400	100	0
CTC	249	350	150	50	0
TCE	737	700	350	200	0
Total ODS Production	40,373	43,638	16,712	11,005	0

TABLE 8

FORECASTED FOR ODS SUBSTITUTES
TO YEAR 2010

(Unit: '000 metric tons)

	1996	2000	2005	2010
HCFC-2	-	5.5	22.0	35.4
HFC-134a/152a	1.0	2.9	7.7	14.6
HCFC-123/141b/142b	0.23	0.6	1.3	2.5

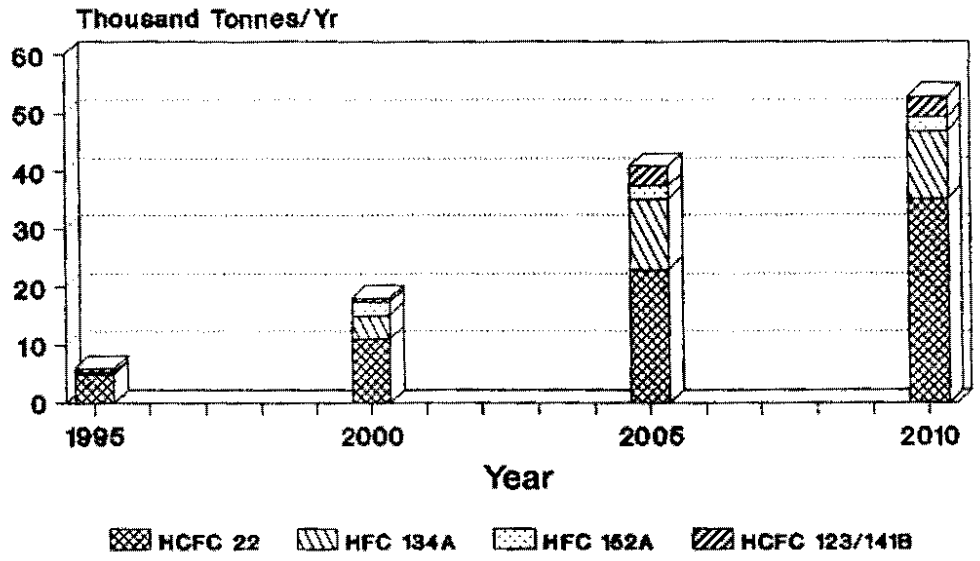
TABLE 9

PLAN FOR DEVELOPMENT OF ODS SUBSTITUTE PRODUCTION CAPACITIES
TO YEAR 2010

(Unit: '000 metric tonnes)

	1996	2000	2005	2010
HCFC-2	5.0	11.0	23.0	35.0
HFC-134a	-	4.0	12.0	12.0
HFC-152a	0.3	2.4	2.4	2.4
HCFC-123/141b/142b	0.6	0.6	3.5	3.5

FIGURE 12
Projected Capacity of ODS Alternatives in China



g) Only the incremental costs of capital investment in enterprises producing ODS substitute chemicals are included. Their operational costs are excluded since they will roughly equal the loss of profits and taxes and the premature retirement of CFC production.

h) No incremental costs have been included for the obsolescence of plants producing: (1) carbon tetrachloride (CTC) with CFCs as feedstock; (2) carbon tetrachloride and methyl chloroform (non-chemical feedstocks); and (3) industrial refrigeration equipment using CFCs

The direct net incremental cost figure of $1.43 billion for a year 2010 ODS phaseout in China is considered the least-cost option at the present time given the provisions of the revised Protocol, the stage of development of ODS substitute technologies, the availability of funding from the Multilateral Fund and the specific conditions of Chinese industry. These estimates would be adjusted if and when significant changes occur in the potential and availability of substitute technologies.

In addition to the above costs, there are the incremental costs for the premature retirement of domestic refrigerators and refrigeration and airconditioning equipment, the transformation of commercial refrigeration equipment, and the recovery and disposal of the shells of refrigerators and cold cabinets. These costs have not been included in the Country Programme at the present time since it is difficult to calculate these costs accurately due to unclear technical and financial guidelines available at present. These estimates will be refined during the implementation of the Country Programme.

3.12 GOVERNMENT ACTION PLAN TO IMPLEMENT THE ODS PHASEOUT STRATEGY

The Government Action Plan to implement the proposed ODS phaseout strategy is based on the Government Strategy as specified in Section 3.1 of this Country Programme. The Action Plan reflects the thrust of China's ozone layer protection policy and includes the administrative arrangements for the implementation of the ODS phaseout scenario in the short (1992-1996), medium (1997-2000) and longer (2001-2010) terms.

Table 10 presents the Government Action Plan to implement the proposed ODS phaseout strategy.

The administrative and management costs for implementing the Government Action Plan are part of the incremental costs which should be financed by the Multilateral Fund. The costs of those administrative activities that would be carried out had the Protocol not existed have been deducted. The net administrative/management costs for implementation of the Action Plan would amount to US $500,000 per year.

3.13 OVERVIEW OF THE PROJECTS PROPOSED TO IMPLEMENT THE ODS PHASEOUT STRATEGY

A detailed list of projects is specified in Annex 1. These include institutional support, technical assistance, technology development, demonstration/ promotion, industrial process transformation and recovery/recycle projects proposed by China for the implementation of the year 2010 ODS phaseout strategy. Due to their technical continuities, these projects comprise an inseparable integral package of actions and activities. The implementation of these projects as scheduled and the achievement of their predicted results are of vital importance to the timely phaseout of ODS in China.

TABLE 10
ACTION PLAN SUMMARY

CHINA

Item	1992 - 1996	1997 - 2000	2001 - 2010
Country Programme	Complete elaboration and commene to implement	Reassess and adjust, then continue	Reassess, continue and complete
Legal System	Establish legal system for ODS management, and implement	Improve related regulations and system, and continue	Continue
Bans	Ban to build new enterprises producing refrigerators refrigerant and air conditioning equipment, & foam materials using ODS Ban on increase halon extinguishers (special cases excluded)	Ban on producing aerosols using ODS Ban to build, enlarge or reform cleaning lines using ODS Ban on building new plants to produce ODS	Ban to import ODS or products using or containing ODS Ban uncontrolled release of ODS during servicing
Investment control	Strict control of investments in new, enlarged, or technically reformed enterprises producing or consuming ODS	Ban to invest in building plants producing ODS Ban to invest in building plants using ODS Plants producing ODS substitutes or using non-ODS enjoy preferential investment policies.	Continue
Management of ODS and their products and substitutes	Study and revise the process specifications and standards related to ODS and their products and substitutes	Establish quality inspection and control centre of ODS and their products and substitutes and operate the centre.	Continue
Taxation	Feasibility study on related tax policies, practice inclined tax policies on the use of CFCs	Inclined policies on the production and sale of ODS and their substitutes, ODS products and their substitutes	Continue

Item	1992 - 1996	1997 - 2000	2001 - 2010
Permit	Permit system for ODS production	Permit system for ODS consumption	Continue
Awareness, education and and technical information exchange	Carry out awareness and education on ozone layer protection through public media, such as newspapers, broadcasting, and TV programmes, so as to upgrade the environmental awareness of the public Communicate key points of National Ozone Policy to the public Issue special bulletins on ozone layer protection in China	Continue the awareness and education, hold technical workshops and public meetings Announce new policies in advance of of their introduction Inform the consumers about the premature retirement of refrigerators and refrigerant and air conditioning equipment	Continue
Reward funds for ozone layer protection	Establish the reward funds for ozone layer protection Ensure financial resources Establish management institution for the funds and elaborate their management methods	Operate the funds	Continue
Exclusive sales of ODS	Investigate thoroughly ODS consumption status and their input channels, straighten out ODS sales networks, and establish ODS exclusive sales systems	Define consumption quotas to users, control the quotas and supply according to the quotas	Continue
Green label policy	Elaborate and implement methods for issuing green labels to qualified products	Establish quality control institution for green products approval. Qualified products are allowed to use the green labels	
Technical substitution	Define and implement technical demonstration of substitute projects for phaseout of ODS production and consumption	Assess substitute technologies and further define the technical approach for ODS phaseout	Continue the activities unfinished during the last period and finally reduce ODS production and consumption to zero

Item	1992 - 1996	1997 - 2000	2001 - 2010
	Develop substitutes for halons and halon extinguishing systems	Promote mature production technologies for ODS phaseout	
	Develop CFC-12 substitutes for refrigerators	Define and implement technical specifications/substitute projects phaseout of ODS production and consumption	
	Develop substitute foaming technologies for hard polyurethane boards	Continue the technical development activities unfinished during the last period	
	Develop processes for pilot production of CFC substitutes	"	
	Develop cleaning processes	"	
Recycle/ recovery of ODS	Establish networks and sites for recycle/recovery and operate them	Continue the activities during the last period	Continue activities during the last period
		Establish networks and sites for halon recovery and storage, recover the halons in extinguishing devices in non-essential cases and use them in the devices in essential cases	
Monitoring	Develop a monitoring system for ODS imports within General Administration of Customs	Continue the activities during the last period	Continue activities during the last period
	Define and divide responsibilities for supervision and management of the technical substitute projects among environmental protection agencies and various sectors and industries, and commence monitoring activities		
	Determine the phaseout plan, start the reward and punishment strategy		
	Report regularly on the progress of ODS phaseout		

The technical assistance and investment projects specified in Annex 1 have been proposed by the responsible sectoral plants/organizations based on the phaseout targets in the Country Programme. These have been amended where needed and then approved by the respective Ministries utilizing the advice of both UNDP and World Bank international experts in several cases. Following this approval, each project has been reviewed by NEPA for consistency of objectives. These technical assistance and investment projects and their priorities have been reviewed and evaluated based on:

- cost-effectiveness;
- substitutes based on different technologies;
- potential for recycle/recovery, improvement of operation, and reduction of ODS leakage and emissions;
- availability of substitute technologies with zero ODP value;
- priority for substitutes with low GWPs or low energy consumption;
- substitute technologies with low ODP values for use mainly in airconditioning and refrigeration during the interim period; and
- interconnections and priorities of the investment projects in the phaseout plans of the implementing sectors.

For the implementation of these projects, all costs which should be borne and can be afforded by the Government, local administrations and the enterprises themselves will be budgeted under the national funding component. Only the incremental costs of these projects qualify for assistance by the Multilateral Fund which is essential to implement these projects as scheduled and achieve their predicted results.

The net incremental costs of these projects have been estimated based on the "Indicative List of Categories of Incremental Cost" adopted by the Second Meeting of the Parties to the Protocol as well as the guidelines issued by the Executive Committee of the Multilateral Fund. It should be noted that:

- The first batch of projects have had their feasibility studies completed and some of these projects have already been approved by the Executive Committee of the Fund;

- The second batch of projects will be initiated in 1993; and

- The third batch of projects comprise mainly medium and long-term projects to be initiated after 1993.

These projects have been proposed on the basis of existing state-of-the-art substitute technologies. Some of the projects, especially the medium-term and long-term ones, might have to be adjusted with progress in the development of substitute technologies.

3.14 FINANCIAL COSTS OF THE COUNTRY PROGRAMME INCLUDING NET INCREMENTAL COSTS FOR ODS PHASEOUT BY YEAR 2010

The net incremental costs by sector to implement the projects specified in Annex I of the Country Programme are presented in Table 11. These net incremental costs are specified on an annual basis for the years 1992 through 2010 respectively. Figure 13 presents the total ODS phaseout costs by sector while Figure 14 presents the unit phaseout cost by sector. A summary of the net incremental costs by sector is as follows:

Sector	Total Phaseout Cost ($ Millions)	ODS Phaseout Tonnes	Unit Phaseout Cost (US$/kg)
Chemical Industry	320.34	-	-
Foams	344.30	39,529	8.71
Ind./Com.Refrig.	242.76	63,270	3.84
Domestic Refrig.	224.49	4,425	50.73
Halons	195.14	91,404	2.13
Aerosols	8.40	66,763	0.13
Solvents	65.78	53,659	1.23
Recycle/Recovery	30.62	2,040	15.01
Total	1,431.83	321,090	4.46

Table 12 shows the projected percentage of Multilateral Fund assistance by sector. The total cost and net incremental cost estimates are based on the following additional assumptions:

a) Operational costs/savings have been calculated on a 4-year basis only. As each project is formulated, it will be possible to determine the "lifetime" operational costs/savings and to evaluate the component qualifying as net incremental costs.

b) Potential incremental benefits have been deducted from the project costs for the aerosols projects.

c) All Multilateral Fund assistance necessary for chemical industry use as feedstock are termed incremental investment costs, and are reflected in the sectoral costs for industry end-users.

d) A significant portion of the Multilateral Fund assistance necessary for the foams industry will be used as incremental operational costs, which can be divided into two parts. The first part is for the promotion of technology covering 50% reduction of CFC-11 during the production of hard polyurethane boards and materials for refrigerators; the second part is the loss to users due to the increase in weight per unit volume of the insulating material foamed using the water-based process.

TABLE 11

NET INCREMENTAL PROJECT COSTS BY SECTOR FOR ODS PHASEOUT UNDER SCENARIO 2010
(US Thousands)

Year	Chemical Industry	Foams	Industrial Commercial Refrig.	Domestic Refrig.	Halons	Aerosols	Solvents	Recycle/ Recovery	TOTAL
1992		3,300		200	950	1,700	1,790	360	8,300
1993	5,470	6,710	12,260	11,860	8,380	5,160	5,150	2,970	57,960
1994	29,180	23,420	31,970	2,300	9,000	1,440	10,560	3,160	111,030
1995	28,190	39,920	15,200	4,900	7,790	100	5,000	3,180	104,280
1996	28,950	44,800	32,950	6,000	27,140		3,450	3,510	146,800
1997	30,850	48,250	29,390	3,800	26,000		15,000	2,580	155,870
1998	26,400	42,050	35,410	21,700	19,000		10,000	2,160	156,720
1999	13,100	23,850	23,240	28,930	14,400		5,000	2,160	110,680
2000	2,400	22,000	26,380	16,100	14,400		4,000	2,740	88,020
2001	12,250	20,000	23,680	31,300	13,080		4,000	1,860	106,170
2002	23,150	20,000	6,140	26,000	9,100		1,000	1,860	87,250
2003	44,000	25,000	6,140	14,000	8,400		830	1,260	99,630
2004	40,000	15,000		14,000	8,400			1,260	78,660
2005	23,400	10,000		17,500	8,400			1,260	60,560
2006	9,000			20,500	8,400			60	37,960
2007	4,000			2,200	6,300			60	12,560
2008				1,600	3,000			60	4,660
2009				1,600	3,000			60	4,660
2010								60	60
TOTAL	320,340	344,300	242,760	224,490	195,140	8,400	65,780	30,620	1,431,830
ODP Phase-out(Tonnes)		39,529	63,270	4,425	91,404	66,763	53,659	2,040	321,090
Phaseout cost (USD/KG)		8.71	3.84	50.73	2.13	0.13	1.23	15.01	4.46

FIGURE 13
Total Phaseout Costs by Sector In China
(Year 2010)

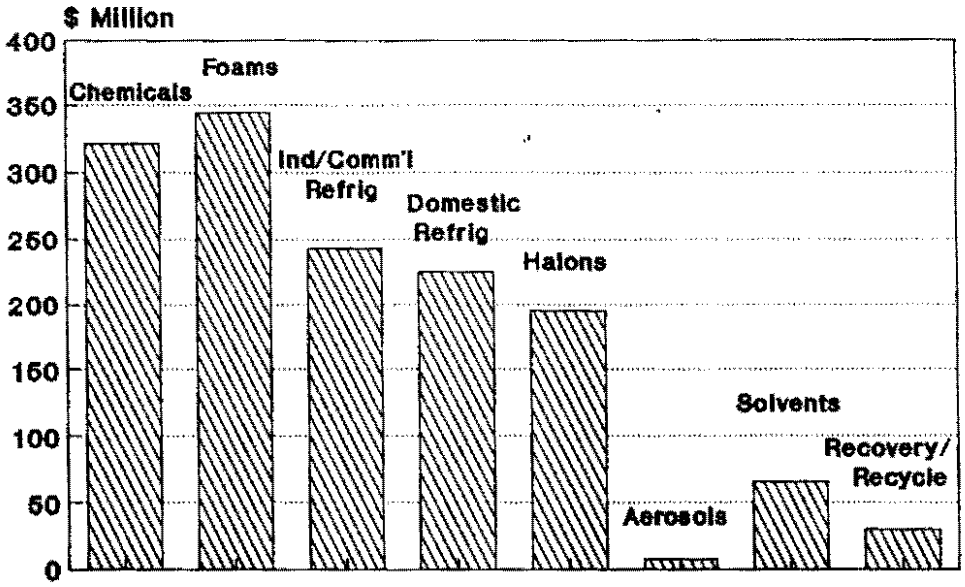


FIGURE 14
Unit Phaseout Costs by Sector In China
(Year 2010)

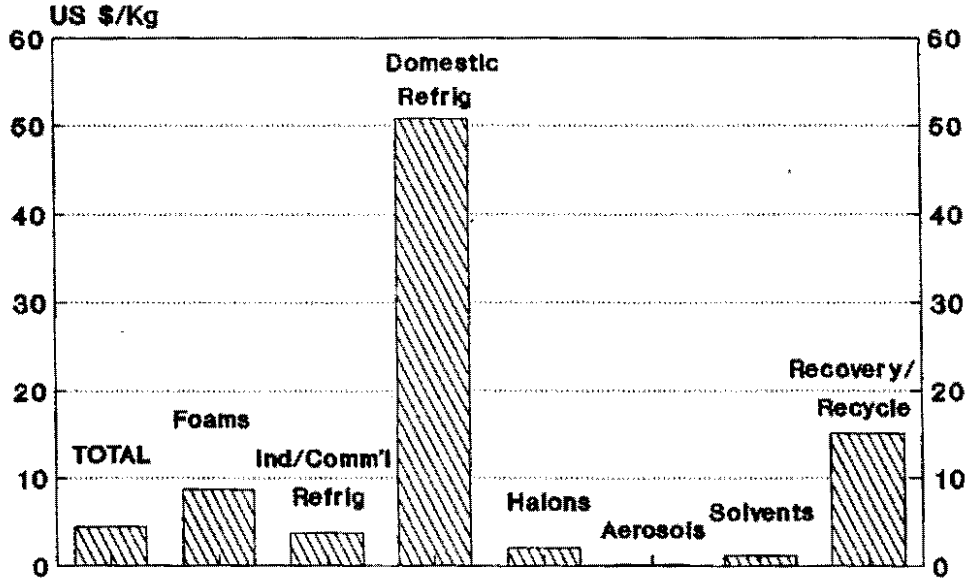


TABLE 16

USES OF MULTILATERAL FUND ASSISTANCE BY SECTORS
(percent)

Sector	Technical Transfer Investment in Facilities Training	Operational Costs and Profits and Gain/Loss in Savings	Total
Chemical Industry	100	-	100
Foams	56.4	43.6	100
Industrial/Commercial Refrigerators	40.1	59.9	100
Domestic Refrigerators	74	26	100
Halons	100	-	100
Aerosols	100	-	100
Solvents	100	-	100
Recycle/Recovery	100	-	100
Total	71	29	100

e) Multilateral Fund assistance necessary for the industrial/commercial refrigeration sector and the domestic refrigeration sector combined will be divided about equally, between incremental investment costs and operational costs. The incremental operational costs include the costs of raw materials, disposable new refrigerants, and the replacement of lubricants.

f) In addition to the capital investment in the halons, aerosols, solvents, and recycle/recovery sectors, Multilateral Fund assistance would also go to technical support costs including the restructuring of over 3,000 enterprises in the solvents sector and the establishment of the recovery networks and sites. No incremental operational costs have been included for these four sectors since these costs would be borne by China.

g) Two kinds of costs are not included in the above calculations, namely, the net incremental costs due to the interest costs of bank loans (both domestic and external), and the costs associated with the premature retirement of ODS-using appliances at the later stage of the phaseout process.

h) The costs to users to service and refill the refrigerants will also increase when the substitute refrigerants are used. The incremental costs due to the use of HFC-134a, HFC-152a, and HFC-123 are estimated in Table 17 and amount to US $661.8 million. These incremental costs for users are calculated starting from 1996. The demands for refrigerant refilling are estimated based on the averages during each period. The price difference between HFC-134a and CFC-12 is $110/tonne; the price difference between HFC-152a and CFC-12 is $3,000/tonne; the price difference between HFC-123 and CFC-11 is $400/tonne; and the incremental costs for HCFC-22 users are not counted.

TABLE 17

ESTIMATED NET INCREMENTAL COST FOR END USERS IN THE REFRIGERATION SECTOR USING ODS SUBSTITUTES

(US $ Million)

Period	HFC-134a	HFC-152a	HFC-123	Total
1996-2000	26.8	2.0	8.3	37.1
2001-2005	117.1	3.0	20.0	140.1
2006-2010	441.0	3.7	39.9	484.6
Total	584.9	8.7	68.2	661.8

Thus the total net incremental costs for China to completely phaseout ODS by year 2010 are as follows:

		($ Million)
a)	Project implementation	1,431.83
b)	Incremental costs for substitute refrigerant end-users	661.80
c)	State administrative costs	9.50
	Total	2,103.13

The above figure of $2.103 billion is the total net incremental cost that China will seek from the Multilateral Fund so as to phaseout a potential unconstrained demand of around 320,000 tonnes of ODP by year 2010. It is expected that the Government of China, provincial and local governments as well as the concerned enterprises will have to expend a significant level of internal funds for the implementation of the Country Programme phaseout plan. These internal costs have not yet been estimated and are thus not included in the total ODS phaseout budget costs. The Government will estimate these internal costs when the Country Programme is next updated.

3.15 SUPERVISION ARRANGEMENTS

NEPA is responsible for the overall supervision and management of the production, import, export, and consumption of ODS in China. Domestic CFC production data are collected and reported by the Ministry of Chemical Industry. Production data on halons are gathered and reported by the Ministry of Public Security. Quantities of ODS (including CFCs and Halons) imported and exported are managed by the Ministry of Foreign Economic Relations and Trade, and the statistical data on their categories, quantities, and applications are reported by the General Administration of Customs.

Specified quotas for ODS consumption will be established by the State Planning Commission and the Office of Economy and Trade under the State Council, jointly with other related authorities and will be based on the phaseout plan in the Country Programme.

NEPA is responsible for reporting the data on ODS production and consumption in China to the Protocol's Ozone Secretariat in Nairobi. NEPA, jointly with other related authorities under the State Council, will establish a unified system for reporting ODS data, so as to report the data according to the requirements under the Protocol. NEPA will periodically gather ODS data through a survey of ODS producing and consuming enterprises throughout the country and will assist the local authorities establish an identical data collection and reporting system.

An inspection and measurement centre for ODS and their substitutes will be established, which will be responsible for the inspection and measurement of ODS and their substitutes. It will evaluate the predicted targets and results obtained using substitute technologies, and the applicability of the planned phaseout dates.

Enterprises producing and consuming ODS will collect and report the detailed data on their ODS production and consumption. The producing enterprises will provide the following detailed data: raw materials, categories and quantities of ODS products, detailed records of supplies and sales, as well as the conditions for ODS substitutes production and quantities produced. ODS consuming enterprises will provide the following detailed data: categories and quantities of ODS consumed per product unit, sources of ODS, production and growth rates of ODS-containing products, market demand and development trends, and the status of products manufactured using ODS substitute technologies. The administrative authorities of concerned enterprises are responsible for the management of ODS data reporting systems for the corresponding enterprises.

Local environmental protection bureaux, directed by NEPA, will supervise the data reporting systems of local enterprises producing and consuming ODS so that Government provisions on ODS phaseout are followed.

The Leading Group for Ozone Layer Protection will carry out regular inspections and assessments on the status of ODS production and consumption in China according to the phaseout plan under the Country Programme, so as to revise the phaseout plan when needed and implement it effectively.

The Government of China has empowered the related authorities and NEPA to supervise project implementation in China. NEPA will submit regular reports on the use of Multilateral Fund assistance and the progress of the projects to the Executive Committee of the Fund.

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Annex 1 Summary of ODS Phaseout Projects in China

I. First Batch of Projects: 1992

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
1.	Aerosols: Shanghai and Tianjin, Replacement of CFC with LPG	680	13,000 CFC-12
2.	Foams: Polyurethane foam with 50% CFC reduction	459.1 489 (price subsidies)	2,481 CFC-12
3.	Foams: Zhijing, Replacement of CFC with Butane,, polyethylene, and polystyrene foams	96	400 CFC-12
4.	Halons: Production of ABC dry powders	90	400 H-1211 (Potential)
5.	Halons: AFFF foams and ABC dry powders extinguishers	72	400 H-1211
6.	Solvents: Dalian, Demonstrative cleaning line for electron gun without the use of ODS	49.5	86 CFC-113
7.	Solvents: Dandong, Demonstrative automatic cleaning line for electronic tuners using non-ODS	49.5	27.5 CFC-113

II. The Second Batch of Projects: 1993

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
Chemical Substitutes			
1.	Replacement of CFC-12 production plans with HCFC-22	915	5,350
2.	Survey of CFC production plants and assessment of their replacement	15	
3.	Development of HFC-152a process	300	300
4.	Development of HCFC-123/124/ HFC-125 process	387	98
5.	Development of HCFC-141b/142b process	45	89
6.	Inspection and measurement center for the quality of CFC substitutes	49	
7.	Pilot production of lubricant suitable for HFC-134a	170	
8.	Feasibility study on the development of process for the lubricant suitable for HFC-134a	1.6	

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
Foams			
1.	Hard PU tubes Shanghai, replacement of CFC with CO2	50	200 CFC-11
2.	Soft PU foams Tianjin, PU Product Factory	65	90 CFC-11
3.	Extruded PS.PE foams Shanghai, Replacement of CFC with CO2 and HCFC-22	120	200 CFC-12
4.	Establishment of 4 technical promotion centers	105	
5.	Survey of the social status of foam industry (including VTEs)	15	
6.	Enlarged demonstration for foaming with 50% water Wanbo, hangtian, and Huayi Refrigerator Factories and Guangdong Business Machine Factories	70	320
7.	Replacement of boards for commercial refrigeration & isolating CFC-11 Assessment Center, MOC	35	
8.	Demonstration for foaming with 100% substitute No. 510 Institute, Kezhao, Wushi, Xiangxuehai Factory	47	50
9.	Feasibility study on the application of vacuum isolating, material in refrigerators	3	
10.	Technical development for 100% replacement of CFC-11 (water-only foaming for for PUR) Liming Chemical Engineering Institute, MOCI	65	
11.	Technical development for 100% replacement of CFC-11 (HCFC substitute for hard PU) Liming Chemical Engineering Institute, MOCI	45	

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
12.	Inspection & measurement center for the quality of polyols for the replacement the replacement of 50% - 100% CFC-11 Liming Chemical Engineering Institute, MOCI	35	
13.	In-situ spray coating of PUR for cold storages, for 50% reduction of CFC-11 Tianjin Commercial College & Lanzhou No. 510 Institute	30	300
14.	Study on the reclamation & reuse of waste & bad-quality PU plastics,Guangdong Business Machine Factory & Tianjing Refenerated Resource Institute	45	8
15.	Import of substitutes Guangdong Chemical Raw Material Co.	20	
Industrial/Commercial Refrigeration			
1.	Production of medium-sized semi-closed refrigerating compressor, Beijing Refrigerating factory	287.4	250
2.	Production of refrigerating compressors using ammonia Yantai Refrigerator Factory Refrigerator Factory	247.5	200
3.	Production of small semi-closed refrigerating compressors Nanjing Refrigerator Factory	194	300
4.	Production of small open-type refrigerating compressors,Anhui Refrigerator Factory	170	150
5.	Production of small compressors using ammonia Luoyang Refrigerating Factory	670	697.5
6.	Production of mobile air conditioners Shanghai EK CHOR General Machine Co. & Shanghai Mobile Air Conditioners Factory	1,352 1,824 (Price subsidies)	480

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
7.	Production of semi-closed refrigerating compressors Shanghai Cold Air Machine Factory	275	300
8.	Production of medium-sized open-type refrigerating compressors Shanghai Cold Air Machine Factory	200	200
9.	Production of air conditioners for large passenger coaches Yueyang Refrigerating Equipment Factory	630 514 (price subsidies)	155
10.	China Technical Center for CFC substitution in Refrigerating/Air Conditioning Industry	220	
11.	Technical Information Center for Substitution of CFC-12 in Mobile Air Conditioners	60	
12.	Assessment Center for Substitution of CFC-12 in Commercial Refrigerating	112	
13.	Production of turbo refrigerators Chongqing General Machine Factory	120	180
14.	Production of valves for refrigerators using ammonia Lushun Refrigerator Factory	80	
15.	Production of Throttle and temperature controller for refrigerators using ammonia Shanghai Termostatic Controller Factory	120	
16.	Promotion Center for the use of Substitutes in Commercial Refrigerating Industry	45	
17.	Demonstration of the innovation of CFC-12 refrigerating systems for cold storages	80	12
18.	Demonstration of the innovation of CFC-12 refrigerating systems for large food	50	4
19.	Innovation of air conditioning/refrigerating facilities for star-level restaurants	65	5
20.	Revision of construction standards for cold storages and large and medium stores	20	

	Projects Domestic Refrigeration	Cost (10,000 USD)	Annual ODS Reduction (Ton)
1.	Replacement of CFC with 134a(compresors and refrigerators), Shanghai Refrigerator Compressor Factory	140 200 (subsidies)	45
2.	Replacement of CFC with 152a, Wanbao Refrigerator Factory	90 200 (price subsidies)	165
3.	China coordination office for the application of substitutional technologies	45	
4.	Development of national standards for the subsitutional technologies in domestic refrigeration	30	
5.	Technical assessment & quality measurement center for CFC-12 substitutes	48.5	
6.	Replacement of the refrigerant with 134a Beijing Snowflake Refrigerator Factory	135.6 352 (price subsidies)	80
7.	Demonstrative Production line for refrigerators using 134a as operating medium Huayi Electric Appliance Corporation	145 352 (price subsidies)	80
8.	Demonstrative line for use of 152a, Hangtian Refrigerator Factory	100 36 (price subsidies)	30
9.	Use of mixed operating medium, Zhongyi Refrigerator Factory	169.5 (price subsidies)	80
10.	Use of mixed operating medium, Shanzi Refrigerator Factory	120 48 (price subsidies)	80
11.	Use of mixed operating medium, Shuanglu Refrigerator Factory	49.5	80

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
12.	Use of mixed operating medium, Kenai Refrigerator Factory	49.5	80
Halons			
1.	Demonstration for production shutdown at halon-1211 manufacturers	200	200
2.	Production line for water-based extinguishants and extinguishers at Jinan	40	300
3.	Demonstration for transformation of production of portable halon extinguishers	80	100
4.	Quality control, information and consultation center for halon products	30	
5.	Production of halon recovery devices (1000 ton/year)	240	10
6.	Ten sites of halon recovery/recycle	200	
7.	Introduction of CO2, N2 rapid response, cyclic open/close sprinkling systems	60	500
8.	Development of substitutional system for halon	47	
9.	Elaboration and revision of regulations and standards, education and training	90	
10.	Determination of essential cases for use of halons	40	
Aerosols			
The South Filling Center of China Aerosol Industry, Zhongshan Fine Chemical Ltd.		160	5,127

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
Solvents			
1.	Implementation of the plan for ODS phaseout in electronic cleaning and other	54.5	
2.	Options for non-ODS in electronic cleaning and other cleaning	20	
3.	Lab for electronic cleaning & recovery engineering	125	
4.	Construction of production line for water-cleaning equipment electronic Process Process and Technology Institute, Ministry of Machinery and Electronics Industry	236	
5.	Demonstrative line for abolishment of ODS-Cleaning, Chengdu Qianfeng Radio Instrument Factory	49.5	8
6.	Demoonstrative line for abolishment of ODS-cleaning, Nanjing Wired Radio Factory	49.5	10
Recovery/Recycle			
1.	Institutional support for the standing institution under the leading group of CFC recovery	114	
2.	Study tour abroad and survey of site selection in the Country	12.6	
3.	Construction of 1200 recovery/recycle stations	720	850
4.	Production of recovery equipment, Qingdao Refrigerator Corporation	80	
5.	Establishment of Beijing Reclamation Center	75	
6.	Production of video tapes and elaboration of operation manuals for the training training of technician in the recovery field, Tianjin Commercial College	65	

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
NEPA			
1.	Propaganda of and education on ozone layer protection	35	
2.	Establishment of laws and regulations for ODS control	20	
3.	Establishment of operation costs for technical clearing house	45	
4.	Establishment of reward fund for ozone layer protection	30	
5.	Establishment of environmental monitoring and supervision networks	30	
6.	Administrative Office for the Ozone Project	20	

III. The Third Batch of Projects

	Projects	Cost (10,000 USD)	Initiated From
Chemical Substitutes:			
1.	Production plant for HFC-134a, 4000 ton/year	5,500	1994
2.	Production plant for HFC-152a/141b/142b,2000 ton/year	3,500	1996
3.	Production plant for HCFC-123, 3000 ton/year	3,500	2001
4.	Development of process for HFC-23, 100 ton/year	100	1996
5.	Development of process for HFC-23, 100 ton/year	100	1996
6.	Innovation and transformation of CTC production plant with the capacity of 10,000 ton/year	1,500	1997
7.	CTC destruction equipment with the capacity of 1,000 ton/year	150	1997
8.	Production plant for synthetic polyster lubricant (10,000 ton/year)	2,500	1996
9.	Production plant for new electronic cleaners (terpines), 800 ton/year	200	1997
10.	Production transformation from CFC-12 into HCFC-22, 6000 ton/year	1,020	1998
11.	Production plant for HFC-134a/32, 8000 ton/year	8,000	2003
12.	Transformation from CFC-12 into HCFC-22, 1200 ton/year	2,040	2002
13.	Transformation from CFC-12 into HCFC-22, 1200 ton/year	2,040	2005

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
Foams			
1.	Promotion for transformation of extruded PS and PE foams, 28 projects	1,540	3,170
2.	Transformation of CFC for hard PU tubes, 8 projects	1,660	815
3.	Promotion of soft PU foams, 50 projects	850	3,289 CFC-11
4.	Promotion of the production technologies for polyether polyols to reduce the use use of CFC-11	300	
5.	Promotion for 50% CFC-11 reduction	1,242.5 2,800(price subsidies)	6,500
6.	Demonstrative production line for 100% CFC-11 reduction	1,500	200
7.	Demonstrative project of polyether production for 100% CFC-11 reduction (including innovation of MDI)	163	
8.	Production of polyether for 100% CFC-11 reduction	600	
9.	Promotion among the whole industry for 100% CFC-11 reduction	22,000	16,000
Industrial/Commercial Refrigeration			
1.	Production of compressors for refrigerated trains, Shijiazhuang Carriage Works Ministry of Railways	120	50
2.	Promotion of the production of medium-sized semi-enclosed compressors, Tianshan	484.8	500
3.	Nation-wide promotion of the production of small semi-enclosed compressors	2,145.5	2,134
4.	Promotion of the production of small open-type compressors, Ningbo Refrigerator	280	300

	Projects	Cost (10,000 USD)	Annual ODS Reduction (ton)
5.	Promotion of medium-sized open-type compressors,Chongqing Refrigerator Factory Shaozing Refrigeratory Factory	400	400
6.	Production of air conditioners for passengers coaches, Shanghai Xinjiang Machine Machine Factory	604 514 (price subsidies)	155
7.	Promotion of the production of mobil air conditioners, 6 plants	3,645 5,472 (price subsidies)	1,440
8.	Production of totally enclosed compressors Xinji Municipal Refrigerating Factory, Wuhan Commercial Machine Factory	2,330 880 (price subsidies)	400
9.	Promotion center for use NH3 compressors in commercial system	45	
Domestic Refrigerators			
1.	Promotion among the whole industry of CFC-12 substitute technology	7,600 12,440 (price subsidies)	2,000
2.	Development of non-F absorption refrigerators, Qinhuangdao and Maanshan Refrigerator Factories	50	
Halons			
1.	Control of halon emissions during the production of halon-1211 extinguishants	20	15
2.	Control of halon emissions during the production of halon-1211 extinguishers	45	8

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
3.	Reduction of halon emissions from extinguishing systems	45	0.2
4.	Improvement of pressure meter to reduce leakage	91	5
5.	Reduction of the use of halon through the mixture of halon and other gases	48	500
6.	Destruction of halons	50	7
7.	Demonstration project for halon recovery tanks	30	
8.	Dvelopment of halon substitutes for measurement and training purpose	25	100
9.	Production transformation for halon-1211 extinguishers, 79 enterprises	2,552	2,420
10.	Complete shutdown of H-1211 and H-1301 production	3,416	3,300
11.	Recovery, storage, and recycle of halons, storage capacity: 10,000 ton	2,416	
12.	Study on halon substitutes	50	
13.	Demonstration of replacement of halon systems with non-halon stationary extinguishing systems	480	
14.	Replacement of stationary halon extinguishing systems	6,664	3,000
15.	Premature retirement of halon extinguishers	2,400	960
Solvents			
1.	Promotion of non-ODS cleaning technologies among medium and small enterprises (more than 800 enterprises)	1,760	3,518
2.	ODS reduction in non-electronic clening (10 enterprises)	200	100

	Projects	Cost (10,000 USD)	Annual ODS Reduction (Ton)
3.	Further promotion of non-ODS cleaning technologies (about 2000 enterprises)	3,983	
Recovery/Recycle			
1.	Construction of 1600 recovery/recycle station from 1996 to 2000	960	960
2.	Establishment of shanghai Reclamation Center	65	
3.	Construction of 1200 recovery/recycle stations from 2000 to 2005	720	440
4.	Construction of 100 CFC recovery sites for refrigerator/cabinet production lines	150	300
5.	Study on recovery and disposal technologies for refrigerators/cabinets	100	