UNITED NATIONS

EP

United Nations Environment Programme

Distr.
Limited

UNEP/OzL.Pro/ExCom/33/Inf.2
1 March 2001

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Thirty-third Meeting
Montreal, 28-30 March 2001

DRAFT SECTOR PLAN FOR THE PHASEOUT OF CFC-11 CONSUMPTION IN CHINA FOAM SECTOR

(Submitted by the World Bank)

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I. INTRODUCTION

A. Background

1.1 China joined the Vienna Convention for the Protection of the Ozone Layer in September 1989, and ratified the London Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer (hereafter referred to as the Montreal Protocol or MP) in 1991. Since then, China has been committed to the phaseout of Ozone Depleting Substances (ODS) in accordance with its designation as an Article 5 country as classified under the Montreal Protocol. In January 1993, the Chinese Government (hereafter referred to as the Government) approved the China Country Program for phaseout of Ozone Depleting Substances (hereafter referred to as the Country Program or CP), and started to implement ODS phaseout activities in China with the support of the Multilateral Fund (MLF) of the Montreal Protocol. Since 1999, China ODS phaseout activities have reached a new stage. The CFC production sector phaseout plan was approved in March 1999. An update to the CP was approved by the State Council in November 1999, to provide guidance for future phaseout activities. After having achieved the freeze on production and consumption of CFCs at the 1995-1997 averages, China has now taken measures to regulate the total production and consumption of ODS ahead of schedule of the first phaseout target of the Montreal Protocol.

1.2 In 1992, the Government established a Leading Group for Ozone Layer Protection and its working office to organize phaseout actions. This Leading Group has the overall responsibility for all phaseout activities. The Leading Group has assigned the State Environmental Protection Administration (SEPA) with management of the ODS phaseout programme in China. SEPA has established a Project Management Office (PMO) with administrative responsibility for implementing phaseout programs/projects implemented through the four MLF Implementing Agencies.

1.3 In 1999, there were about 1,100 enterprises in the Polyurethane (PU) foam sector in China. Production in the foam sector has increased continuously to meet the demand for foam products, resulting in increased CFCs consumption in this sector. The total consumption of CFC-11 in the foam sector was 19,162 MT in 1999. By the end of 2000, the phaseout target of CFC-11 through approved projects in foam sector was 10,222 MT; out of this, 3,504 MT had already been phased out by the end of 1999.

1.4 The project-by-project and the umbrella phaseout approach have provided valuable experiences and lessons which helped to achieve the freeze on CFCs consumption in 1999. However, due to the large number of enterprises in foam sector, phaseout of ODS, through a project-by-project approach and umbrella basis is not considered efficient. On the other hand, CFCs production and consumption has been subjected to strict controls in China. The "Sector plan for CFC production phaseout in China" was approved by the Executive Committee of the MLF (ExCom) in March 1999, and the "Solvent Sector Plan for ODS Phaseout in China", and "Tobacco Sector Plan for ODS Phaseout in China" were approved in March 2000. The strategy for future phaseout of CFC production and consumption has therefore been confirmed by China. It is now essential to compile the "Sector Plan for Phaseout of CFC-11 Consumption in China Foam Sector", which will cover the remaining large consumption sector, and will include a phaseout mechanism, a

phaseout strategy, and will determine the demand for incremental costs.

1.5 Along with the progress in implementing ODS phaseout activities in the Halon, Solvent, and Tobacco sectors, ODS phaseout in the Foam sector has become critical to the future of phaseout activities in China. However, the largest consumption of ODS in the foam sector can primarily be ascribed to small companies in China. This poses a major challenge, because of technological and funding limits and the challenges of managing such consumers. The desirable approach, therefore, is to fund incremental costs of ODS phaseout at the national level, and to select feasible operating mechanisms to complete ODS phaseout in foam sector.

1.6 The foam Sector Plan includes phaseout of CFC-11. The detailed phaseout approach will be addressed in a phased action plan. According to the *Sector Plan for CFC Production Phaseout in China*, the production of CFC-11 will be reduced year after year, until it is completely stopped by January 1, 2010. The schedule for consumption phaseout of CFC-11 needs to match the production phaseout of CFC-11.

1.7 The objectives of the Sector Plan are:

(a) To meet the obligations of the Government under the Montreal Protocol by phasing out CFC production and consumption in a coordinated program, by ensuring phaseout of CFC-11 consumption at sector level;

(b) To implement a timely and cost-effective action plan, that can be completed and monitored with indicators at the sector level;

(c) To improve efficiency in the use of MLF resources by reducing management and implementation costs; and, achieving these cost savings on sector scale;

(d) To improve implementation of economic incentives and policies and provide improvements to the project by project approach;

(e) To implement and manage the Sector Plan with an efficient operating mechanism; and

(f) To develop and implement a reporting and auditing mechanism for the sector plan and for fund utilization.

B. Preparation of Foam Sector Plan

1.8 At the 30th Meeting of the ExCom , resources were approved for China to prepare, with the assistance of the World Bank (WB), a sector plan for phasing out CFC-11 consumption in the (PU component) foam sector in China. Subsequently, the State Environmental Protection Administration (SEPA) and State Light Industry Bureau (SLIB) jointly established a working group for Foam Sector Phaseout. Under the coordination of the working group and WB, a team was set up comprising of experts from Peking University, institutes and industrial associations. Investigations on ODS consumption, and the study of the overall phaseout plan were carried out by this working group.

1.9 The Foam Sector Plan has been developed on the basis of the Government's

obligations under the Montreal Protocol, and China's Country Program update (1999), and also taking into account the principles established in other sector plans approved by the ExCom. The Foam Sector Plan is consistent with the MLF's principles and guidelines, as well as related documents on incremental costs.

1.10 The main principles and guiding determinants of the Foam Sector Plan are:

(a) The Government's obligations under the London Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer;

(b) The principles addressed in the China Country Program (CP) on Phasing Out Ozone Depleting Substances completed in 1993, and the CP Update in December 1999;

(c) The national strategy and planning for economic and social development;

(d) the need to develop a foam sector development plan, which ensures that the development of the foam sector itself must not be jeopardized by ODS phaseout;

(e) The Government's commitment to comply with the agreed overall and annual phaseout targets, assuming that the MLF approves the Sector Plan, disburses funds according to the Annual Programs, and facilitates the transfer of alternative technologies required for ODS phaseout in foam sector; and

(f) phase out of ODS in the foam sector in a cost-effective way.

1.11 The contents of the proposal are:

- Chapter I: Introduction
- Chapter II: Current status of ODS consumption in the foam sector, including progress of ODS phaseout to date
- Chapter III: Phaseout Strategy including: the forecast of ODS consumption without controls, phaseout targets, and phaseout actions
- Chapter IV: Policy actions to be adopted in the foam Sector Plan, and
- Chapter V: Incremental costs.

The following chapters are still under preparation:

- *Chapter VI: Operating mechanism, monitoring, evaluation and reporting*
- *Chapter VII: Action Plan for implementation of Foam Sector Plan*

1.12 The Foam Sector Plan deducts ODS phaseout amount and costs from the baseline for foam projects already approved by the ExCom to avoid double counting. Implementation of the foam Sector Plan will not affect implementation of projects already approved.

1.13 This Sector Plan only addresses PU foam sector in terms of data analysis, broad strategy for phaseout, policy framework, operation mechanism and incremental cost. The

remaining CFC-12 consumption in the PE/PS foam sub-sector will be covered through a strategy/action plan being prepared by China with the assistance of UNIDO, and the phaseout of remaining CFC-11 consumption in the household refrigeration foam sub-sector will be covered under a terminal umbrella project also being prepared by China with UNIDO assistance.

1.14 According to the working programme of foam special working group, one umbrella project (237 tons of CFC-11) under the assistance of UNIDO, will be proposed for consideration to the 34th ExCom meeting. The phaseout amounts attributable to the project will be deducted from the scope of the Foam Sector Plan, in order to arrive at the net amount of CFC-11 to be phased out directly under the Sector Plan.

2.3 The foam sector has been divided into the following components:

a) PU Foam: All remaining PU flexible foam applications, including integral skin; and all remaining PU rigid foam applications, including transport foam applications. All these include small enterprises within the component categories;
b) PE/PS: All remaining PE/PS foam applications, also including small enterprises; and
c) Domestic Refrigeration Foam: All remaining foam applications in household refrigeration industry, again inclusive of all small enterprises.

2.4 The foam sector plan includes CFC-11 phaseout for enterprises which use CFC-11 as foaming agent, including Polyurethane (PU) foam (PU flexible foam applications, integral skin foam and PU rigid foam applications).

2.5 In 1999, the PU foam sector accounted for about 42% of the country's total CFC consumption. With the implementation of Halon Sector Plan, Tobacco Sector Plan and Solvent Sector Plan having commenced, the foam sector becomes the key remaining sector for CFC consumption phaseout, and adoption of the foam sector strategy is the one effective way to control CFC consumption at the national level. Proper monitoring of CFC phaseout and consumption is important, in the next few years.

2.6 Project Management Office (PMO) of SEPA will be responsible for managing the Foam Sector Plan. PMO will be assisted by a special working group that will provide support, including organization of research and development of substitutes and alternative technologies, as well as implementation, enforcement and monitoring of related policies and phaseout actions.

B. CFC Consumption Status in China

2.7 According the Country Program update of 1999, China's CFC-11 consumption was 25,605 tons, and there were three remaining sectors which consumed CFC-11 in 1999. These were the Tobacco Sector, Refrigeration Sector (foaming agent and refrigerant) and Foam Sector. The CFC-11 for PU foam was 19162 tons, which included CFC-11 consumption by ongoing MLF projects and also the remaining eligible and ineligible enterprises. The historic consumption of CFC-11 in China is shown in table 2, and shows an average annual growth rate of 13% between 1995 and 1999..

Table 2: CFC-11 Consumption in Sectors (tons)

	1996	1997	1998	1999
National consumption of CFC-11	20,823	24,898	27,008[2]	25,605[3]
Consumption for foaming	19,127	23,102	25,355	23,962
Of which by PU foam	12,457	17,192	20,155	19,162
Of which by Refrigeration Sector	6,670	5,910	5,200	4,800
Tobacco Sector	966	1,090	1,003	1,037
Industrial and commercial refrigeration Sector	730	706	650	606

[2] Because production controls were introduced in 1999, CFC producion in 1999 was higher than usual, and the calculated consumption for 1998 – Production + import – export + net stockpile. The stockkpile with dealers and users was also higher than usual in 1998.

[3] Based on updated CP dated which reported to the 33rd ExCom meeting, the CFC-11 production is 22,681 tons, with a net reduction of 1,000 tons from the stockpile with the CFC producers, and 1,924 tons net import.

2.8 CFC-12 was consumed by the Foam Sector, Refrigeration Sector and Aerosol Sector. The consumption of CFC-12 in 1999 for PS/PE was 3,981 tons by ongoing projects and remaining eligible and ineligible enterprises. Historic data of CFC-12 consumption is shown in table 3.

Table 3: CFC-12 Consumption in Sectors (tons)

	1996	1997	1998	1999
National Consumption	22,869	22,238	23,715	16,462
Foam Sector (Extruded Polystyrene foam, PS sheet, PE tubes and sticks)	6,000	6,661	6,663	3,981
Refrigeration Sector and Aerosol Sector	16,869	15,577	17,052	12,481

2.9 Though there were many CFC phaseout projects being implemented prior to 1999, the consumption of CFC was not significantly reduced at the national level. The main reasons for this are the combination of rapid economic growth and relatively few national controls before 1999. In fact, the consumption of CFC would be expected to decrease after 1999, because of national production controls, bans on new installations, and the impacts of project implementation.

C. CFC-11 Consumption of PU Foam at Enterprises' Level

Survey methodology and results

2.10 The Foam Special Working Group (FSWG) started a data survey in April 1999. In April, July and October 1999, FSWG jointly with the industrial associations conducted data surveys by visiting over 600 enterprises in 31 provinces in Mainland China. The field data surveys assimilated the lessons learnt from the solvent sector. FSWG and industrial associations provided a lot of emphasis on public information workshops to facilitate information sharing by the enterprises. As foam enterprises are mainly SMEs, the managers take responsibility for the CFC phaseout directly, communication between FSWG and enterprises was conducted more easily than in the solvent sector surveys. However, the foam SMEs tend to be dispersed widely, making it difficult to survey all of them. Excluding the enterprises which have phased out / are phasing out CFC use using MLF support, over 600 enterprises were reached by FSWG. However, sufficient data could only be obtained from 408 enterprises to justify their classification as identified enterprises. Besides the 408 enterprises, 8 rigid PU foam producers which consumed 237 tons CFC-11 in 1999, would apply for MLF funding as an umbrella project in the 34th ExCom meeting, under UNIDO's assistance.

Table 4: Classification of CFC PU Foam Consumers

Consumption amounts (tons ODP)

	Large-sized enterprises	Medium-sized enterprises	Small-sized enterprises
PU Flexible*	>150	25-150	<25
PU Rigid*	>30	10-30	<10
Integral skin*	>30	10-30	<10

*Size category from UNEP/Ozl.Pro/ExCom/19/54

2.11 Table 4 shows the classification for this sector plan as suggested by theExCom guidelines. However, under this classification no enterprise would qualify to belong to the

large size PU flexible category from amongst the identified enterprises. Taking into account the actual distribution of PU flexible enterprises and the guidelines for CO_2 alternative technology, medium size PU flexible producers were separated into two groups. The medium size I group consumes between 50-150 tons per year, and the medium size II group consumes between 25-50 tons per year.

Table 5: Identified CFC-11 Consumption for PU Rigid Foam (not Funded)

	Number of enterprises	Number of equipment	Number of eligible equipment	Consumption (tons)					Eligibility rate in 1999	Average size (tons)
				1995	1996	1997	1998	1999		
All enterprises	*179*	*586*	*461*	*3235*	*3941*	*4258*	*5066*	***5160***	92.3%	28.8
Large-sized enterprises	*59*	*227*	*175*	*1689*	*2341*	*2719*	*3266*	*3420*	95.5%	58.0
Medium-sized enterprises	*84*	*290*	*239*	*1253*	*1318*	*1288*	*1575*	*1561*	88.0%	18.6
Small-sized enterprises	*36*	*69*	*47*	*294*	*281*	*251*	*224*	*179*	68.6%	5.0
Eligible enterprise	*152*	*550*	*459*	*3116*	*3761*	*4038*	*4698*	*4762*		31.3
Large-sized enterprises	*55*	*221*	*175*	*1689*	*2263*	*2689*	*3171*	*3266*		59.4
Medium-sized enterprises	*72*	*272*	*237*	*1162*	*1261*	*1142*	*1363*	*1374*		19.1
Small-sized enterprises	*25*	*57*	*47*	*265*	*236*	*208*	*164*	*123*		4.9
Ineligible enterprises	*27*	*36*	*0*	*120*	*180*	*220*	*367*	*398*		14.7
Large-sized enterprises	*4*	*6*		*0*	*78*	*30*	*95*	*154*		38.5
Medium-sized enterprises	*12*	*18*		*90*	*57*	*147*	*212*	*187*		15.6
Small-sized enterprises	*11*	*12*		*29*	*45*	*43*	*61*	*56*		5.1

Table 6 : Identified CFC-11 Consumption for PU Flexible Foam (not funded)

Type of enterprises		Number of enterprises	Number of equipment	Number of eligible equipment	Consumption (tons)					Eligibility rate in 1999	Average size(tons)
					1995	1996	1997	1998	1999		
Total	**All enterprises**	**225**	**250**	**214**	**3952**	**4758**	**5292**	**5892**	**6,222**	**92.5%**	**27.7**
	Large-sized (=>150 tons)	**0**									
	Medium-sized–I (50=<, <150)	*62*	*75*	*68*	**1820**	**2463**	**2741**	**3844**	**4316**	97.4%	**69.6**
	Medium-sized–II (25=<, <50)	*36*	*43*	*31*	**1226**	**1600**	**1922**	**1457**	**1333**	81.2%	**37.0**
	Small-sized (<25)	*127*	*132*	*115*	**906**	**695**	**629**	**591**	**573**	81.8%	**4.5**
	Eligible enterprise	200	224	214	**3789**	**4482**	**4930**	**5495**	**5753**		**28.8**
	Medium-sized–I (50=<, <150)	*60*	*73*	*68*	**1820**	**2463**	**2741**	**3844**	**4202**		**70.0**
	Medium-sized–II (25=<, <50)	*28*	*34*	*31*	**1226**	**1440**	**1667**	**1177**	**1082**		**38.6**
	Small-sized (<25)	*112*	*117*	*115*	**743**	**579**	**522**	**474**	**469**		**4.2**
	Ineligible enterprise	25	26	0	**163**	**276**	**362**	**397**	**469**		**18.8**
	Medium-sized–I (50=<, <150)	*2*	*2*		**0**	**0**	**0**	**0**	**114**		**56.8**
	Medium-sized–II (25=<, <50)	*8*	*9*		**0**	**160**	**255**	**280**	**251**		**31.4**
	Small-sized (<25)	*15*	*15*		**163**	**116**	**107**	**117**	**104**		**6.9**
Continuous	Continuous Foam	106	131	104	**3770**	**4659**	**5186**	**5780**	**6120**	92.5%	57.7
Foam	Large-sized (<150)	*0*	*0*	*0*							
	Medium-sized–I (50=<, <150)	*62*	*75*	*68*	**1820**	**2463**	**2741**	**3844**	**4316**	97.4%	69.6
	Medium-sized–II (25=<, <50)	*36*	*43*	*31*	**1226**	**1600**	**1922**	**1457**	**1333**	81.2%	37.0
	Small-sized (<25)	*27*	*32*	*24*	**724**	**596**	**523**	**479**	**471**	79.4%	17.4
	Eligible users	109	133	123	**3609**	**4384**	**4826**	**5389**	**5658**		51.9
	Medium-sized–I (50=<, <150)	*60*	*73*	*68*	**1820**	**2463**	**2741**	**3844**	**4202**		70.0
	Medium-sized–II (25=<, <50)	*28*	*34*	*31*	**1226**	**1440**	**1667**	**1177**	**1082**		38.6
	Small-sized (<25)	*21*	*26*	*24*	**563**	**481**	**418**	**368**	**374**		17.8
	Ineligible users	16	17	0	**161**	**275**	**359**	**391**	**462**		28.9
	Medium-sized–I (50=<, <150)	*2*	*2*		**0**	**0**	**0**	**0**	**114**		56.8
	Medium-sized–II (25=<, <50)	*8*	*9*		**0**	**160**	**255**	**280**	**251**		31.4
	Small-sized (<25)	*6*	*6*		**161**	**115**	**104**	**111**	**97**		16.2
Box Foam	All box foam users	100	100	91	**182**	**99**	**106**	**112**	**102**		1
	Medium-sized–I (50=<, <150)	*0*	*0*	*0*							
	Medium-sized–II	*0*	*0*	*0*							

Table 6 : Identified CFC-11 Consumption for PU Flexible Foam (not funded)

Type of enterprises		Number of enterprises	Number of equipment	Number of eligible equipment	Consumption (tons)					Eligibility rate in 1999	Average size(tons)
					1995	1996	1997	1998	1999		
Total	**All enterprises**	**225**	**250**	**214**	**3952**	**4758**	**5292**	**5892**	**6,222**	**92.5%**	**27.7**
	Large-sized (=>150 tons)	**0**									
	Medium-sized–I (50=<, <150)	*62*	*75*	*68*	**1820**	**2463**	**2741**	**3844**	**4316**	97.4%	**69.6**
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	Small-sized (<25)	*127*	*132*	*115*	**906**	**695**	**629**	**591**	**573**	81.8%	**4.5**
	Eligible enterprise	200	224	214	**3789**	**4482**	**4930**	**5495**	**5753**		**28.8**
	Medium-sized–I (50=<, <150)	*60*	*73*	*68*	**1820**	**2463**	**2741**	**3844**	**4202**		**70.0**
	Medium-sized–II (25=<, <50)	*28*	*34*	*31*	**1226**	**1440**	**1667**	**1177**	**1082**		**38.6**
	Small-sized (<25)	*112*	*117*	*115*	**743**	**579**	**522**	**474**	**469**		**4.2**
	Ineligible enterprise	25	26	0	**163**	**276**	**362**	**397**	**469**		**18.8**
	Medium-sized–I (50=<, <150)	*2*	*2*		**0**	**0**	**0**	**0**	**114**		**56.8**
	Medium-sized–II (25=<, <50)	*8*	*9*		**0**	**160**	**255**	**280**	**251**		**31.4**
	Small-sized (<25)	*15*	*15*		**163**	**116**	**107**	**117**	**104**		**6.9**
Continuous	Continuous Foam	106	131	104	**3770**	**4659**	**5186**	**5780**	**6120**	92.5%	57.7
Foam	Large-sized (<150)	*0*	*0*	*0*							
	Medium-sized–I (50=<, <150)	*62*	*75*	*68*	**1820**	**2463**	**2741**	**3844**	**4316**	97.4%	69.6
	Medium-sized–II (25=<, <50)	*36*	*43*	*31*	**1226**	**1600**	**1922**	**1457**	**1333**	81.2%	37.0
	Small-sized (<25)	*27*	*32*	*24*	**724**	**596**	**523**	**479**	**471**	79.4%	17.4
	Eligible users	109	133	123	**3609**	**4384**	**4826**	**5389**	**5658**		51.9
	Medium-sized–I (50=<, <150)	*60*	*73*	*68*	**1820**	**2463**	**2741**	**3844**	**4202**		70.0
	Medium-sized–II (25=<, <50)	*28*	*34*	*31*	**1226**	**1440**	**1667**	**1177**	**1082**		38.6
	Small-sized (<25)	*21*	*26*	*24*	**563**	**481**	**418**	**368**	**374**		17.8
	Ineligible users	16	17	0	**161**	**275**	**359**	**391**	**462**		28.9
	Medium-sized–I (50=<, <150)	*2*	*2*		**0**	**0**	**0**	**0**	**114**		56.8
	Medium-sized–II (25=<, <50)	*8*	*9*		**0**	**160**	**255**	**280**	**251**		31.4
	Small-sized (<25)	*6*	*6*		**161**	**115**	**104**	**111**	**97**		16.2
Box Foam	All box foam users	100	100	91	**182**	**99**	**106**	**112**	**102**		1
	Medium-sized–I (50=<, <150)	*0*	*0*	*0*							
	Medium-sized–II	*0*	*0*	*0*							

	(25=<<50)										
	Small-sized (<25)	*100*	*100*	*91*	**182**	**99**	**106**	**112**	**102**		
	Eligible box foam users	91	91	91	**180**	**98**	**103**	**106**	**95**	**93.00%**	1
	Ineligible box foam users	9	9		**3**	**1**	**3**	**6**	**7**		0.8

Table 7: Identified CFC-11 Consumption for Integral Skin Producers

	Number of enterprises	No. of equipment	No. of eligible equipment	Consumption tons					Eligibility rate in 1999	Average size(tons)
				1995	1996	1997	1998	1999		
All enterprises	4	4	4	19	24	50	25	34	100%	8.6

Table 8 : Distribution of CFC-11 Consumption for PU (R) Foam (not funded) (tons)

Order	Province	Number of users	1995	1996	1997	1998	1999	Percentage of total consumption in 1999
1	Zhejiang	14	268	403	449	544	723	14.0%
2	Sandong	25	472	532	635	725	705	13.7%
3	Helongjiang	15	336	510	445	504	543	10.5%
4	Ganshu	16	327	329	381	431	457	8.9%
5	Guangdong	10	264	261	301	418	388	7.5%
6	Jiangshu	12	244	243	277	288	300	5.8%
7	Xinjiang	7	220	275	282	301	296	5.7%
8	Beijing	8	146	204	239	302	279	5.4%
9	Hubei	8	178	160	187	240	204	4.0%
10	Liaoning	9	117	90	192	257	192	3.7%
11	Shanghai	4	170	180	157	182	178	3.4%
12	Henan	8	86	183	179	164	153	3.0%
13	Hebei	5	48	128	97	114	122	2.4%
14	Shanxi	9	87	103	103	123	117	2.3%
15	Ningxia	8	77	101	102	107	105	2.0%
16	Jilin	5	47	37	23	77	81	1.6%
17	Sichuan	1	40	55	52	76	76	1.5%
18	Shanxi	3	7	12	7	29	55	1.1%
19	Yunnan	2	25	40	31	51	53	1.0%
20	Qinghai	1	23	24	32	33	36	0.7%
21	Hainan	1	15	25	28	30	30	0.6%
22	Chonqin	2	17	17	17	21	20	0.4%
23	Fujiang	1	10	12	14	16	18	0.3%
24	Tianjing	1	5	8	13	15	12	0.2%
25	Xizhang	1	5	5	6	8	10	0.2%
26	Hunan	2	1	4	3	5	6	0.1%
27	Guangxi	1	1	2	4	5	1	0.0%
28	Neimeng							
29	Jiangxi							
30	Anhui							
31	Guizhou							
total		179	3235	3941	4258	5066	5160	100.0%

Table 9 : Distribution of CFC-11 Consumption for PU Flexible Foam (not funded)

Order	Province	Number of Pipelining enterprise	Consumption of pipelining users in 1999 (tons)	Number of box foam user	Consumption of box foam users in 1999(tons)	Total consumption in 1999 (tons)	Percentage of total consumption in 1999
1	Sichuan	12	1067	42	47	1113	17.9%
2	Henan	13	979			979	15.7%
3	Hebei	15	809			809	13.0%
4	Jiangshu	21	800	1	1	801	12.9%
5	Zhejiang	14	548	8	7	555	8.9%
6	Shandong	6	328	2	2	329	5.3%
7	Guangdong	7	316	7	8	324	5.2%
8	Shanghai	7	224			224	3.6%
9	Anhui	4	198			198	3.2%
10	Yunnan	5	149	12	9	158	2.5%
11	Liaoning	2	140			140	2.3%
12	Shanxi	3	114			114	1.8%
13	Guizhou	3	89	24	25	114	1.8%
14	Fujiang	2	106			106	1.7%
15	Shanxi	3	61	1	0	61	1.0%
16	Hubei	2	61			61	1.0%
17	Xinjiang	1	60			60	1.0%
18	Helongjiang	3	33	3	3	36	0.6%
19	Neimeng	1	20			20	0.3%
20	Ningxia	1	20			20	0.3%
21	Chonqin	0	0			0	0.0%
Total		125	6119	100	102	6222	100.0%

Table 10: Distribution of CFC-11 Consumption for Integral Skin Foam (not funded)

Order	Province	Number of users	1995	1996	1997	1998	1999	Percentage of total consumption in 1999
1	Jiangshu	3	14.7	20.8	44.3	22.8	31.2	91.0%
2	Shandong	1	4.5	2.9	5.7	2.2	3.0	9.0%
Total		4	19.2	23.7	50.0	25.0	34.2	100.0%

2.12 By the standards in Table 4, the average size foam producers in China would all be categorized as 'small', reflecting the difficulty and cost of transporting foam products over long distances in China. As a result, foam producers have generally been sized to serve local and regional rather than national markets. Tables 5-10 present summaries of the data on enterprises obtained from enterprise surveys conducted during the preparation of the Foam Sector Plan. Enterprises which were included in the umbrella project to be submitted to 34th ExCom meeting are excluded from above tables. The following data analysis excludes the proposed umbrella project, and assumes its approval.

2.13 The total identified CFC-11 consumed was 11,416 tons in 1999. The CFC-11 consumed by PU rigid and PU flexible enterprises was 45.2% (5,160 tons) and 54.5%

(6,222 tons) respectively, of the total identified CFC-11 used by enterprises that have no phaseout projects. The remaining 0.3% (34 tons) of this CFC-11 was consumed by 4 integral skin producers. The CFC-11 consumption by large-size enterprises is 66% (3,420 tons) of the total identified consumption in PU rigid sub-sector. There are no large-size enterprises in PU flexible sub-sector. The total consumption of CFC-11 by continue-foaming enterprises is 98% (6,120 tons) of total identified consumption in PU flexible sub-sector. The box foam only shares 2% (102 tons) accordingly. The eligibility rates are 92.3% and 92.5% for PU rigid and PU flexible identified enterprise respectively.

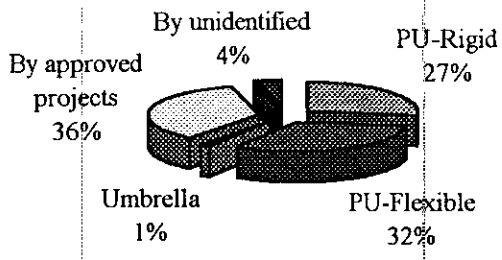
2.14 Based on the data survey, only two identified enterprises are foreign-owned. Also, the main reason for the ineligibility for MLF funding is because companies were set up after July 1995.

Table 11: Identified and Residual Consumption of PU Foam in 1999 (tons)

Total PU foam	By identified Rigid	By identified Flexible	By identified Integral Skin	Consumption by ongoing projects*	Total identified consumption		Consumption by unidentified users	Total consumption will be phased out under this sector plan	Identified rate of total consumption
					The umbrella project	Need approval under this sector plan			
19,162	5,160	6,222	34	6,718	237	11,416	791	12,207	93.5%

* Total phaseout target for CFC-11 in the foam sector is 10,222 tons by the end of 2000 and the total completed phaseout is 3,504 tons by end of 1999. For details on consumption of approved and ongoing projects, see paragraph 2.20 and 2.21.

Fig 2: Consumption Share of CFC-11 in PU Foam Sector



2.15 By the end of 1999, ongoing projects consumed 6,718 tons CFC-11 in the PU foam sector, including consumption by enterprises who had projects approved in 2000. The residual consumption of CFC-11 in the PU foam sector was 12,207 tons. The consumption by 408 identified enterprises was 11,416 tons in 1999. Although the number of identified enterprises is about 50% of the total enterprises, the total consumption of these enterprises was about 90% of the total consumption in 1999.

2.16 As demonstrated by Table 10, the total unidentified CFC-11 consumption was 791

tons. According to survey data presented in Tables 5-10, the eligibility rate for small rigid foam producers and flexible foam producers are 69% and 82% respectively, assuming that the eligibility rate for unidentified CFC-11 consumption is 70%. Therefore, the eligible consumption by unidentified users is 554 tons. The eligible rate for consumption to be phased out under this sector plan is 91%.

Table 12 Consumption to be phased out under the sector plan (tons)

Total consumption		By identified rigid and integral skin foam		By identified flexible		Consumption by unidentified enterprises	
12,207		5,194		6,222		791	
Eligible	Ineligible	Eligible	Ineligible	Eligible	Ineligible	Eligible	Ineligible
11,103	1,104	4,796	398	5,753	469	554	237

Estimate of total number of enterprises

2.17 It is assumed that all unidentified consumption is by small size enterprises. Based on survey information shown in tables 5 to 7, the number of unidentified enterprises are estimated in the following table.

Table 13: Estimated for number of unidentified enterprises

	Rigid PU foam	Flexible PU foam
Assuming that the size of unidentified users are 30% of the average size for identified small users (tons)		
Unidentified consumption in 1999 (tons)	791	
assumed consumption by sub-sector (tons)	45%	55%
	356	435
Estimated unidentified users	237	322
Total number of unidentified users	560	

2.18 The current number of PU foam enterprises which consume CFC-11 is shown in table 14. Based on estimates in table 13, it is assumed that there are about 1,100 PU foam producing enterprises. .

Table 14: Distribution of CFC-11 PU foam users

	Number
Enterprises that have projects from MLF	169
Identified enterprises by survey	
Of which covered under propose UNIDO umbrella project	8
Of which under this sector plan	408
Estimated unidentified producers	560
Total number of producers	~1,100

D. Previous Phaseout Activities in the Foam Sector

2.19 China has introduced a range of measures relating to CFC phaseout. These measures to date include:

- In 1997, SEPA, State Development and Planning Committee, State Economic and Trade Committee, and State Industrial and Commercial Administration jointly issued a

Circular on Bans of Establishment of New Production Sites for Production and Consumption of ODS;

- In 1997, SEPA issued a Circular on Enforcement of Declaration and Registration of Pollutants;
- Several seminars were held with international support, on CFC alternative technologies for foam sector for enterprises ;
- Many activities promoting awareness were carried out via conferences, TV, newspapers, and other media;
- In March 1999, the ExCom approved the CFC Production Sector Plan and China started phaseout of CFCs production. Future CFC production would be limited under that sector plan;
- Domestic research institutes and enterprises have started to develop substitutes and alternative technologies, and have made progress to lay the foundations for CFC phaseout in foam sector.

2.20 **Financing from MLF:** By the end of 2000, there were a total of 163 approved projects (covering 169 enterprises) in the foam sector. Of these, 61 are PU rigid projects, 41 are PU flexible foam investment projects , and 10 were integral skin projects. The total phaseout amount for CFC-11 through these projects is 10,222 tons ODP.

2.21 The information for approved projects in the foam sector (PU foam and Extruded Polystyrene foam) are summarized in table 14.

Table 15 Approved fund and phaseout targets in Foam Sector at end 2000 (tons)

Subsector	No. Projects	Investment Projects (US$)	Non-Investment Projects (US$)	ODP to be Phased out (tons)	ODP Phased out (tons)
Flexible	41	16,820,849		3,876	1,832
Integral skin	10	1,914,095		180	20
Multiple-subsectors	2	852,600		77	77
Polystyrene/polyethylene	27	20,054,867		5,102	3,259
Rigid	61	41,398,156		5,904	1,758
Polyol Production	3	1,005,000			
TA	5		880,019		
Project Preparation (PRP)	14		1,030,000		
Total	**163**	**82,045,567**	**1,910,019**	**15,139**	**6,946**
Total Approved (US$)	**83,976,780**				

2.22 **ODS phased out through MLF support**. A total of 10,222 tons ODP of CFC-11 will be phased out by approved projects. The approved CFC-11 projects and their annual status are shown below in table 17. Since the annual amount of CFC phased out cannot be directly estimated from the current MLF and China's database, sampling data of projects is used, to setup assumptions to estimate the consumption phased out by approved projects. The project implementation in the years after project approval are shown in the following table 16. According to the assumption demonstrated in table 16, if a project with 100 tons phaseout target was approved in 1997, the phaseout impact will be 50 tons in 1999, 30 tons in 2000 and the remaining 20 tons in 2001.

Table 16 Percentage project implementation in years after project approval (cumulative distribution for the distributed time lag)

Project Implementation after approval	Schedule (cumulative values)
Within 1 year	0%
Within 2 years	0%
Within 3 years	50%
Within 4 years	80%
Within 5 years	100%
Within 6 years	-

* We assume that the implementation speed for this sector plan will be quicker than the individual projects, details are in Section C. Model Assumptions, Chapter V. Incremental cost Analysis

2.23 By the end of 1999, ongoing projects consumed 5,498 tons; also, projects accounting for 1,220 tons CFC-11 were approved in 2000. The remaining consumption of CFC-11 at the 1999 baseline is 12,444 tons. Excluding the 237 tons of CFC-11 for the UNIDO umbrella project, the remaining 12,207 tons of CFC-11 will be phased out under this sector plan.

Table 17 Phaseout Status of Approved CFC-11 Projects in Foam Sector

Approved in the Subsector (tons)	1993	1994	1995	1996	1997	1998	1999	2000	Total
Rigid	430	235	190	272	837	946	2103	891	5904
Flexible	180	443	620	562	0	379	1364	329	3876
Integral skin		20	39				121		180
Multiple subsector			77						77
PS/PE		130	55						185
Total approved in the year	610	828	981	834	837	1325	3588	1220	10222
Completed amount in the year	0	0	305	597	861	877	865	1080	4584
Consumption by ongoing projects	610	1438	2114	2351	2326	2775	5498	5637	

E. Issues

2.24 Phaseout activities in foam sector are a challenge, as it is the largest CFC consuming sector. The main issues for CFC phaseout in foam sector include:

- **Need for an efficient phaseout approach**. Most foam enterprises are very small, privately owned and widely distributed. Phaseout of CFCs through a project by project approach is too time consuming to meet the Montreal Protocol requirements. Also, China's economic system is changing from a planned system to market-driven system, which decreases the government's ability to manage enterprises directly or to set up a mechanism for implementing phaseout through administrative means.
- **Need to ensure consistency between CFC production and consumption phaseout.** Since the Sector Plan for CFC production phaseout was approved in March 1999, the CFC production phaseout targets were agreed between ExCom and China. The controlling of CFC production has already started. The foam sector must therefore comply with the supply decrease.
- **Suitable alternative technologies must be available**.
  - ✈ Safety and health issues. Though there are some alternative technologies available for the conversion, but there is a need for investment and training in safety and health issues.

- ✈ Quality of products and ease of operation. Compared to CFC-11 technology, alternative technologies are more complicated and it is more difficult to ensure quality control of products.

- ✈ HCFC-141b. As a HCFC, HCFC-141b is a transitional substitute and will be regulated in future. Enterprises using HCFC-141b as alternative will have to face a second round of phaseout.

- ✈ Financial issue. Due to the low thresholds for costs of conversion, enterprises have had to invest a great deal of capital cost for the conversion. For many enterprises, it is very difficult to solve the financial issue.

- **Enterprises have limited knowledge about CFC phaseout.** Enterprises, especially small users, do not have sufficient knowledge about CFC phaseout policies, technical options and costs and they also do not have sufficient knowledge about their obligations and rights in ODS phaseout. Smaller enterprises have limited opportunities to obtain affordable alternative technologies as they lack information on substitutes and alternative technologies. There is a need to improve research, propagation and public education.

- **Market competition** Since the production costs for CFC technology and alternative technology are different, the different costs would result in unfair competition. This would especially affect enterprises that planned to phaseout CFC earlier without MLF funding.

III. PHASEOUT STRATEGY

3.1 The Foam sector phaseout strategy had been established based on the historical development and the present structure of foam industry, which includes the present conditions of ODS phaseout, as well as forecasts on production and consumption of CFCs and their substitutes, with the objective of developing and implementing the most cost effective phaseout program possible. Since the foam sector is a fast developing sector, it is very important that the strategy is designed to minimize any adverse impact on the foam sector.

3.2 This Sector Plan only addresses the PU foam sector (PU Rigid foam, PU Flexible foam and Integral skin foam); and is limited in terms of its funding application, action plan and operational mechanism to the phaseout of remaining CFC-11 consumption as a foaming agent in the PU foam sector.

A. Phaseout Schedule

3.3 Foam Sector Plan phaseout targets for the PU foam are:

- All eligible CFC-11 consumption will be phased out by the end of 2007;
- Thereafter, any remaining ineligible CFC-11 consumption will be phased out by controlling CFC-11 supply; and
- The total CFC-11 consumption will be phased out by the end of 2009.

3.4 The consumption phaseout of CFC-11 for PU foam and other sectors are shown in the following table.

Table 18 Projected Consumption of CFC-11 by Sectors (tons)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CFC-11 production		18,153	16,700	16,400	15,000	13,100	10,400	7,700	4,130	3,800	300	0
Net import		1,500	1,200	800	500	0	0	0	0	0	0	0
Total available		***19,653***	***17,900***	***17,20***	***15,500***	***13,100***	***10,40***	***7,700***	***4,130***	***3,800***	***30***	***0***
Approved by projects by projects	3,588	1,306	237									
Approved targets for this sector plan			1,500	2,500	2,500	2,500	3,000					
Consumption by ongoing projects	5,498	5,724	5,102	5,608	6,130	6,250	6,750	4,250	1,500	0	0	0
Consumption Phased out*	865	1,080	2,359	1,994	1,978	2,380	2,500	2,500	2,750	1,500	820**	820**
Consumption of CFC-11 by sector												
Foam	**19,162**	**18,452**	**16,400**	**14,700**	**12,900**	**10,700**	**8,200**	**5,800**	**3,000**	**1,600**	**820**	**0**
Tobacco	1,037	1,000	1,000	880	700	500	300	150	0			
I&C	606	595	586	577	570	534	454	386	309	247	198	
HH Ref.	4,800	1,500	1,200	1,200	1,000	1,000	0					
Total consumption	***25,60***	***21,547***	***19,186***	***17,35***	***15,170***	***12,734***	***8,95***	***6,336***	***3,309***	***1,847***	***1,01***	***0***

* Annual impact of completed ongoing projects.

** Ineligible consumption phaseout targets

Table 19 Maximum CFC-11 consumption and Annual Program in Foam Sector (tons)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Consumption of CFC-11 in **Foam sector**	**16,400**	**14,700**	**12,900**	**10,700**	**8,200**	**5,800**	**3,000**	**1,600**	**820**	**0**
Phaseout target approved for this sector plan	1,500	2,500	2,500	2,500	3,000					

B. Approach to PU Foam Sector Phaseout

3.5 The overall approach to the phaseout of CFC-11 under the this Sector Plan will include multiple approaches to reflect the diverse structure of the industry with regard to size, number of enterprises, technology and regional considerations. The strategy will limit the supply of CFC-11 at the national level under the CFC Production Sector plan and will control imports. The PU Foam Sector Plan will be implemented through a series of Annual Programs based largely on performance indicators. Major policy initiatives supporting the foam sector plan include the use of a bidding system for most phaseout actions, industrial restructuring, a technical support system particularly for smaller enterprises, initiatives to provide market incentives for enterprises to phaseout early.

3.6 Large, medium and small consumers of CFC-11: , Most large and medium consumers of CFC-11 will be phased out through using a bidding system resulting in CFC phaseout contracts with each enterprise similar to the approach being used in the Halon Sector Plan. A number of "group" projects would be implemented through a bidding system. Some small consumers of CFC-11 may be phased out through an indirect approach using a Technical Support System (TSS) supplying technical assistance, preferred technology options and design, as well as substitutes and formulations. A funding and control mechanism on CFC phaseout for each of the proposed approaches is included in Chapter VI. This multiple path approach is the most effective way to reach the many small foam enterprises. Ineligible enterprises will not be funded.

3.7 Substitutes and replacement technology must:

- Be benign to the Ozone Layer and the environment;
- Ensure worker safety and health;
- Discourage replacement with low ODP substance or high GWP substance;
- Provide equal capacity as former substances and technologies used; and
- Be cost effective.

3.8 The implications of using various substitutes was carefully considered in preparing the foam sector strategy. The technology used for each sector is briefly described below:

- Flexible PU foam will use CO_2 technology; substitution of flexible PU box foam will be fast-cooling process, or positive and negative pressure process;
- Rigid PU foam will use pentanes or HCFC-141b; the substitution of semi-rigid foam is 100% water-based technology or HCFC-141b; this is considered the most appropriate technology for this category, and the ExCom's guidelines with respect to use of HCFC-141b will be followed.
- New substitutes, such as HFC-245, will be adopted when available.

3.9 The foam phaseout strategy will result in the actions summarized below and described in more detail in Chapter VII.

3.10 The key step is to reduce national level supply on an annual basis to meet agreed annual phaseout targets. Then CFC users in foam sector will be forced to take phaseout actions.

C. Actions

3.11 Phaseout actions will include the following:

- Control supply by phased reductions in CFC-11 production, and introduction of import controls;
- Ban CFC-11 consumption in the PU foam sector;
- Control consumption by providing consuming enterprises with alternative technologies to implement CFC phaseout;
- Phaseout large consumers and some medium and small consumers in accordance with the phaseout schedule under CFC phaseout contracts and industrial restructuring/consolidation. Implement CFC phaseout for remaining small-scale users through the TSS, through group projects, regional projects;
- CFC phaseout contracts will obligate the participating enterprises to stop using CFC by a specific date;
- Formulate and promulgate policies to ensure implementation of phaseout projects;
- Introduce training and awareness campaigns to promote products using substitutes, which would encourage enterprises to actively participate in CFC phaseout;
- Technical assistance to establish technologies and to provide enterprises with alternative designs and substitute chemicals and formulations, as well as with technical support services;
- Continue introducing alternative technologies through FSWG and industrial associations;
- Set up an effective system of supervision and implementation, including introduction of a management information system to ensure monitoring and enforcement of phaseout plans;
- Promote research and development of substitutes and alternative technologies, promote marketing development of substitutes and alternative technologies; and
- Formulate technical indexes, implementation standards and operating regulations of substitute and alternative technologies.

3.12 A phased approach will be used to implement the PU Foam Sector Plan. Phaseout actions will begin in 2001 and be completed by January 1, 2010 as described in the Action Plan (Chapter VII). The phased approach will build on the phaseout actions already being taken and currently underway, including the several umbrella projects under implementation and being prepared and the large number of ongoing individual projects . It is anticipated that these types of projects will cease to be prepared/approved once the PU Foam Sector Plan is approved.

IV. POLICIES

4.1 Due to the lack of readily available, low cost substitute technology and limited capital resources; and the need to maintain quality, market share and profitability, most enterprises will not phase out CFC on a voluntary basis. Even though they can receive some financial assistance from MLF, many enterprises are still reluctant, or lack motivation, to phase out CFCs. This is because of their preferences for existing techniques and the disadvantages in changing technological processes (for example, operating cost might rise or product quality might suffer).

4.2 Therefore, to fulfill CFC phaseout, besides the financial help from MLF, the Government will establish policies, promote transfer and dissemination of suitable substitute technologies and initiate training for workers. Only if the Government establishes and enforces policies and regulations, can it influence activities of enterprises and consumers to participate actively and quickly in the Foam Sector Plan.

A. Policy Objectives

4.3 The objectives of phaseout policies are to:

- Achieve the phaseout targets both set in Country Program and the sector plan, following the general policy framework designed in Country Program;
- Encouraging the active participation of the enterprises is a key element in achieving the phaseout targets in foam sector plan;
- Adopt key issues in the sector plan, the policies and regulations established and enforced by government, should promote transfer and dissemination of suitable substitute technologies;
- Ensure phaseout of CFC-11 consumption according to schedule;
- Provide an effective policy support for CFC-11 phaseout process;
- Encourage the production of low cost, technically suitable substitutes for CFC blowing agent; and
- Ensure normal development of foam sectors and improvement of living standards of their employees, at the same time fulfilling phaseout goals.

B. Policy Design

4.4 China's policy design for CFC phaseout will be based on:

- The law for prevention of atmospheric pollution issued April 29, 2000;
- Chinese situation, taking into account characteristics of the foam sector with large numbers of small size enterprises scattered extensively, demands for foam production, to promote consolidation and regrouping between the enterprises;
- Framework of policies for ODS phaseout in Country Programme;
- Existing policy and regulation system, keeping continuity and consistency of policies;
- Feasibility must be ensured and supervision and management must be available;

- Economic efficiency and fairness must be considered.
- China's policies for CFC-11 phaseout will focus on controlling the production and import of CFC-11, and monitoring exports, to ensure the agreed goals are reached. At the same time, it is necessary to meet the demand for foaming agent and promote development of foam sector by ensuring supply of alternatives technology and substitutes.

C. Description of Policy Instruments

Table 20 Policy Framework for ODS Foam Sector

Objective	Policy	Timetable		Agencies that issued the documents
		Issued	Implemented	
Control production and consumption of CFC	*Circular on Bans of Establishment of New Production Sites for Production and Consumption of ODS.*	**Nov. 11, 1997**	January 1, 1998	NEPA, SPC, SETC, SICA
	Circular on data reporting for ODS production, consumption, and import and export		1994	NEPA
	Circular on implementing pollutant discharge registration .		1997	NEPA
	Circular on using the reporting and registration data base management system for ODS .		1997	NEPA
	notice of strengthening of supervision by local EPBs in ozone protection .		1997	NEPA
Control supply of CFC	A tradable production quota system	1999	1999	SEPA
	Import Quota System of CFC	January, 2000	April, 2000	SEPA
Control consumption of CFC	New technical standards and product specifications			SEPA
Incentives for enterprises to take part in phasing out	Bidding System to enterprises	after Sector Plan approval	after Sector Plan approval	SEPA
Guarantee safety production	Safety regulations for using flammable substances as blowing agent	2002	2003	SEPA
	Measure of restricting and managing toxic blowing agent	2002	2003	SEPA
Protect environment	Environmental regulations for using toxic blowing agent;	2002	2003	SEPA
Accelerate phaseout	Regional Policies	after Sector Plan approval	after Sector Plan approval	SEPA
Stop use of CFC	Ban of CFC Consumption	January, 2008	January, 2009	SEPA

4.5 **Circular on Bans of Establishment of New Production Sites for Production and Consumption of ODS**. In 1997, SEPA, SPC, SETC and ICA issued the circular requiring all regions not build, enlarge or renovate ODS-producing equipment, and other equipment

using ODS as material. The adopted measures ensured that no new CFC consumption enterprise was established for achieving CFC phaseout goals in China. Therefore, the production capacity of CFC based products has not been increased.

4.6 Based on the requirement of (i) Circular on data reporting for ODS production, consumption, and import and export (NEPA, 1994), (ii) Circular on implementing pollutant discharge registration (NEPA, 1997), (iii) Circular on using the reporting and registration data base management system for ODS (NEPA, 1997), and (iv) Notice of strengthening of supervision by local EPBs in ozone protection (NEPA, 1997), SEPA will ask all CFC consumer to register their consumption and other required data. The concerned management agencies (for example, local EPBs) should report to their higher administrative level on data and information collected both from enterprises and by other channels. But there are a large number of ODS consumers distributed all over China, some enterprises, especially some smaller users, do not have sufficient knowledge about ODS phaseout policies, because the network of research, propagation and education is not perfect. SEPA will force implementing of policies ulteriorly.

4.7 **Production quota system:** A tradable quota system doe CFC production is the key instrument in the policy framework. It will reduce the uncertainty in implementing the CFC-11 consumption phaseout strategy. The production quota will be reduced annually. Shortage of CFC supply can encourage the use of substitutes and alternative equipment.

4.8 **Import Quota:** A policy for controlling import and export of ODS has been issued by Chinese government and has been implemented from April 2000. The import of CFC-11 will be controlled by quota system. Thus, the aggregate supply of CFC-11 will be controlled and gradually reduced to meet the performance indicators under both sector plans. The Foam Sector Plan will control aggregate CFC-11 consumption with phased annual reductions achieved through ODS Phaseout Contracts and NO-CFC-Mix-material Supply System, managed and monitored through the performance indicators shown in the Annual Programme. Performance indicators will be verified annually audits.

4.9 **New technical standards and product specifications:** New technical standards and product specifications will be formulated and issued, and form the basis for controlling production quality. New standards and regulations that are consistent with alternative technology will prevent CFC-based product from entering market and promote application of substitutes.

4.10 **Bidding System:** This system introduces a market mechanism in the phaseout process and enterprises are free to bid based on their corporate strategies and market outlooks. By introducing a competitive bidding system into CFC-11 consumption phaseout, China will disburse funds to prospective participants who submit competitive bid price for ceasing CFC-11 use.

4.11 **Safety regulations for using flammable substances as blowing agent:** Because some substitutes are flammable, safety regulation must be established to prevent fire accidents.

4.12 **Measures to restrict and managing toxic blowing agents**: the application of toxic blowing agent will be prohibited. Methylene Chloride (MC) is a highly volatile substance, and it is classified as a probable human carcinogen by the USEPA and International Agency for Research on cancer (IARC). China issued exposure limits for MC in 1996. At

present it is difficult for the enterprises in China to meet the safety measures which include proper encapsulation of the production lines, ventilation, industrial hygienic monitoring, and labor training.

4.13 **Environmental regulations for using blowing agent**: Environmental regulations for using blowing agent will be established to control the emission of volatile organic compounds.

4.14 **Regional Policies:** Each region can set up its own ban on the basis of actual situation to phaseout CFC-11 before deadlines. Regional projects are encouraged and supported preferentially. It is very important to promote regrouping and consolidating of enterprises and to accelerate phasing CFC out in China.

4.15 **Ban of consumption in Foam Sector:** The ban of CFC-11 consumption will be issued by January 2008, and CFC-11 use will be banned in foam enterprises from January 1, 2010.

V. INCREMENTAL COST ANALYSIS

A. Introduction

5.1 Based the phaseout strategy in chapter III, the incremental cost for phaseout of CFC-11 consumed by PU foam enterprises, as also for supporting activities for the entire foam sector phaseout, have been calculated using a computer-based model. The components of incremental costs are as follow:

Direct Phaseout Cost:

CFC-11: Incremental costs for phaseout of CFC-11 consumption in PU foam enterprises;

Indirect Phaseout Cost:

- Incremental cost for development and implementation of the TSS (Technical Support Systems), particularly to reach small users;
- Incremental costs for monitoring and management costs; and
- Incremental cost for technical assistance (such as popularization of technology, implement strategy, publicity and management).

B. Key Input for Cost Calculation

5.2 Key model inputs for the incremental cost calculation include:

- Eligible consumption by sub-sectors (table 5-7);
- Forecast for production, consumption, import and export of CFC-11 (table 18);
- Cost of phaseout for each subsector (table 22-25); and
- Model assumption for incremental costs calculation.

5.3 The baseline of incremental costs is calculated based on ExCom guidelines and the results are presented in table 22-24. Since the real cost to China, calculate in accordance with ExCom guidelines, is much higher than the threshold, (using the MLF cost effectiveness in PU foam sector at $7.83/kg for PU rigid, $6.23/kg for PU flexible and $9.66/kg for integral skin respectively), China requests that the ExCom consider the issue in relation to these total costs.

Table 21 Key Input for Cost Calculation

Consumption of 1999 (tons ODP)	19,162
of which by approved projects	6,718
of which by identified PU rigid	5,160
of which by identified PU flexible	6,222
Of which by identified integral skin	34
of which by the umbrella project	237
of which by un-known users	791
Eligible consumption for identified PU rigid (tons ODP)	
large PU rigid	3,266
SME PU rigid	1,496
Phaseout cost per unit to MLF for PU rigid (US$/kgODP)	7.83
Incremental Cost for PU rigid phaseout (US$/kgODP)	12.55
Sub-total	**4,762**
Eligible consumption for identified PU flexible (tons ODP)	
Medium-I size PU flexible	4,202
Medium-II size PU flexible	1,082
SME PU flexible	469
Phaseout cost per unit to MLF for PU flexible (US$/kgODP)	6.23
Incremental Cost for PU flexible phaseout (US$/kgODP)	11.07
Sub-total	**5,753**
Eligible consumption for identified integral skin (tons ODP)	
Phaseout cost per unit to MLF for integral skin (US$/kgODP)	9.66
Incremental Cost for integral skin phaseout (US$/kgODP)	9.66
Phaseout cost per unit to MLF for PU foam sector (US$/kgODP)	6.96
Real Cost for PU foam phaseout (US$/kgODP)	11.73
Sub-total	**34**
Eligible consumption for unidentified PU producers (tons ODP)	554
Phaseout cost per unit for unidentified PU producers (US$/kgODP)	6.23
Weighted averaged eligible rate	91%
Residual Consumption to be phased out in the baseline year (tons ODP)	12,444
Residual Consumption to be phased out in the baseline year under the umbrella project (tons ODP)	237
Residual Consumption to be phased out in the baseline year under this sector plan (tons ODP)	12,207
of which by ineligible users	1,104
of which by eligible users	11,103
Residual Consumption to be phased out under this sector plan (tons ODP)*	13,640
of which by ineligible users	1,640
of which by eligible users	12,000

* The residual consumption of CFC-11 is estimated to increase at 3% per year for the existing enterprises without phaseout projects.

C. Model Assumptions

- 1999 is the baseline year;

- Price of related materials are assumed to remain constant over time;
- Inflation rate is 2.5% per year after 2000;
- Consumption increasing rate is 3% for existing enterprises which have no phaseout projects;
- Any individual phase out activity will be completed within three years (if target approved in 2001, 50% would be completed in 2003 and 50% in 2004)
- Cost information of substitute technologies is shown in Table 22-24);
- Incremental costs of other technical assistance.

Table 22: Baseline of Conversion Cost for Rigid PU foam

Incremental Capital Costs												
Cost of Foaming Equipment												
Size of Enterprise	Technology	No. of Enterprise	No. of Equipment	Equipment								
				HC Dispenser			141b Dispenser			Spray foam unit		
				Amount	Unit Cost	Cost	Amount	Unit Cost	Cost	Amount	Unit Cost	Cost
Large	HC	18	58	18	340,000	6120000				40	18000	720000
	HCFC-141b	37	117				78	80000	6240000	39	18000	702000
Medium	HCFC-141b	72	237				79	80000	6320000	158	18000	2844000
Small	HCFC-141b	25	47							47	18000	846000
Subtotal		**152**	**459**			**6,120,000**			**12,560,000**			**5,112,000**
						Total cost of foaming equipment						**26,171,200**
Cost of Trial, Technology Transfer and Training												
	Unit Cost	No. of Enterprise										
Trial	10,000											
Technology Transfer	10,000											
Training	10,000											
	30,000	152		**Total cost of Trail, Technology Transfer and Training**								**4,560,000**
									Total Incremental Capital Costs			**30,731,200**
Incremental Operating Costs I (HCFC-141b conversion)												
Before Conversion				**After Conversion**								
Chemicals	Ratio	Price ($/kg)	Cost	Chemicals		Ratio	Price($/kg)	Cost				
Polyol	100	1.31	0.49	Polyol System		100	2.37	0.88				
CFC-11	33	1.24	0.15	HCFC-141b		22	2.4	0.20				
MDI	133	1.45	0.73	MDI		147	1.45	0.79				
Unit Cost ($/kg)			1.37	Unit Cost ($/kg)				1.87				
Foam Production			26,124,242					27,848,442				

(kg)												
Foam Cost ($)			35,824,586					52,068,305				
Cost Difference Between CFC-11 Foam and HCFC-141b Foam Per Year								16,243,719				
Net Present Value of Incremental Operating Cost for Two Years (10%/yr.)								**28,264,07**				
						Total Cost of Incremental Operating Cost I						**28,264,071**
Incremental Operating Costs II (Pentane conversion)												
Before Conversion				**After Conversion**								
Chemicals	Ratio	Price ($/kg)	Cost	Chemicals		Ratio	Price($/kg)	Cost				
Polyol	100	1.31	0.49	Polyol System		100	1.8	0.67				
CFC-11	33	1.24	0.15	N-Pentane		17.16	1	0.06				
MDI	133	1.45	0.73	MDI		117	1.45	0.63				
Unit Cost ($/kg)			1.37	Unit Cost ($/kg)				1.36				
Foam Production (kg)			9,178,788					9,564,297				
Foam Cost ($)			12,587,017					13,041,932				
Cost Difference Between CFC-11 Foam and HCFC-141b Foam Per Year								454,915				
Net Present Value of Incremental Operating Cost for Two Years (10%/yr.)								**791,553**				
						Total Cost of Incremental Operating Cost II						**791,553**
						Total Cost of Incremental Operating Cost						**29,055,624**
						Incremental cost for rigid foam sub-sector						**59,786,824**

The increase in %age for additional foam production (from 26,124,242 to 27,848,442) in the table is based on the OORG density report; different percentages of density increases have been applied to different applications (panels, pipes. Spray foam)

Table 23 Baseline of Conversion Cost for Flexible PU foam

Incremental Capital Costs						
Cost of Foaming Equipment						
Size of Enterprise	Technology	No. of Enterprise	No. of Equipment	No. of equipment selected for replacement	Cost per plant	Cost
Large	LCD	60	68	6	480,000	28800000
Medium and Small	LCD	49	55	2	480,000	13920000
Box foam	VPF	500	500	10	100000	10000000
Subtotal		**609**	**623**	**18**		**52,720,000**
		Total cost of foaming equipment				**57,992,000**
Cost of trial, technology transfer and training for LCD conversion						
	Unit Cost	No. of Enterprise				
Trial	15,000					
Technology Transfer**	50,000					
Training	15,000					
Subtotal	80,000	89				**7,120,000**
Cost of trial, technology transfer and training for VPF conversion						
	Unit Cost	No. of Enterprise				
Trial	10,000					
Technology Transfer	10,000					
Training	10,000					
Subtotal	30,000	100				**3,000,000**
Incremental Operating Costs						
Number of production lines	Technology	Cost per plant	Cost			
89	LCD	-50000	-4450000			
100	VPF	To be determined	To be determined			
			Total Incremental Operating Costs			**- 4,450,000**
Total incremental costs of flexible foam sub-sector						**63,662,000**

**: China will investigate all options of reducing the technology transfer costs through group procurement in accordance with ExCom guidelines.

Table 24 Baseline of Conversion Cost for Integral Skin PU foam

Incremental Capital Costs												
Cost of Foaming Equipment												
Size of Enterprise	Technology	No. of Enterprise	No. of Equipment	Equipment								
				Mold Modification			Heating Facility			In-mold Coating Unit		
				Amount	Unit Cost	Cost	Amount	Unit Cost	Cost	Amount	Unit Cost	Cost
Medium	Water Blown	4		36	500	18000	4	5000	20000	12	2000	24000
Subtotal		**4**				**18,000**			**20,000**			**24,000**
						Total cost of foaming equipment						**68,200**
Cost of Trial, Technology Transfer and Training												
	Unit Cost	No. of Enterprise										
Trial	10,000											
Technology Transfer	10,000											
Training	10,000											
	30,000	4										**120,000**
								Total Incremental Capital Costs				**188,200**
Incremental Operating Costs												
Before Conversion				After Conversion								
Chemicals	Ratio	Price ($/kg)	Cost	Chemicals*	Ratio	Price($/kg)	Cost					
Polyol	100	1.31	0.4	Polyol System	100	2.37	1.19					
CFC-11	33	1.24	0.1		□	□	□					
MDI	133	1.45	0.7	MDI	100	1.45	0.73					
				In-mold Coating	5	1.5	0.04					
				Cleaning Agent	5	0.5	0.01					
Unit Cost ($/kg)			1.3	Unit Cost ($/kg)	□	□	1.96					
Foam Production (kg)			137,03		□	□	137,030					
Foam Cost ($)			187,91				274,061					
Cost Difference Between CFC-11 Foam and Water Blown Foam Pe							80,668					

Year											
Net Present Value of Incremental Operating Cost for Two Year (10%/yr.)						140,362					
						Total Cost of Incremental Operating Cost					**140,362**
						Incremental cost for Integral Skin foam sub-sector					**328,562**

D. Calculation Methodology

Incremental Costs for Phaseout CFC-11 Consumption

5.4 Calculation of incremental costs for CFC-11 phaseout in PU foam sector is based on its **annual phaseout eligible amount** and **weighted average phaseout cost per unit**. Detailed calculating equation is:

$$IC = \Sigma \text{ annual phaseout eligible amount} * \text{weighted average phaseout cost per unit}$$

where IC is incremental costs;

Annual eligible phaseout amount is determined by phaseout strategy. The data are shown in Table 19.

Weighted average phaseout cost per unit for CFC-11 is determined by the phaseout costs of single project and the distribution of CFC-11 consumption in different sub-sectors

Annual eligible phaseout amount

5.5 The annual eligible phase out amount is determined by CFC production, distribution of CFC consumption in different sectors, and net import.

Weighted average phaseout cost per unit

5.6 **Weighted average phaseout cost per unit** is given as follow, for different sub-sectors and different users. Detailed cost effectiveness is shown in Table 22-24.

Table 25 Actual per unit cost to China for Sub-sectors

Eligible Consumption (tons)	Incremental Capital cost (US$)	Incremental Operating cost (US$)	Total Incremental cost (US$)	Real Cost per unit (US$/kg)
Rigid PU foam subsector				
4,762	30,731,200	29,055,624	59,786,824	12.55
Flexible PU foam subsector				
5,753	68,112,000	(4,450,000)	63,662,000	11.07
Integral skin subsector				
34	188,200	89,367	277,567	9.66
Weighted average				
				11.73

Incremental Costs for Indirectly Phaseout Activities

5.7 The indirectly phaseout activities are referring to technical assistant projects. They include:

- Technical support to the development of phaseout policies;
- Technical support to the development of new standards;
- Training and promotion of public awareness ; and
- Incremental cost of TSS and technical support to those technical centers and dealers in the Action Plan

E. Incremental Costs

Table 26 Incremental Cost for CFC-11 Phaseout in PU Foam Sector

	Phaseout cost to China (US$ 1,000)	Phaseout costs calculated by MLF threshold
Replacement CFC-11 for PU foam users	148,900	88,300
Technical Assistance	5,000	3,500
Incremental cost needed for this sector plan	**153,900**	**91,800**

Table 27 Phaseout Targets

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Max. CFC-11 consumption for PU Foam (tons)	19,162	18,452	16,400	14,700	12,900	10,700	8,200	5,800	3,000	1,600	820	
Approved targets for the annual plan (tons)			1,500	2,500	2,500	2,500	3,000					
Phased out Target for eligible users (tons)					750	2,000	2,500	2,500	2,750	1,500		
Phased out Target for ineligible users (tons)											820	820

5.8 Based on the overall CFC-11 phaseout strategy described in Chapter III, the incremental costs to China are given in Table 26. A schedule for phasing out CFC-11 is presented in Table 27. The real phaseout cost to China is US$153,900,000 which is calculated based on relevant ExCom guidelines. If the MLF thresholds are used, the calculated funding would be US$91,800,000.

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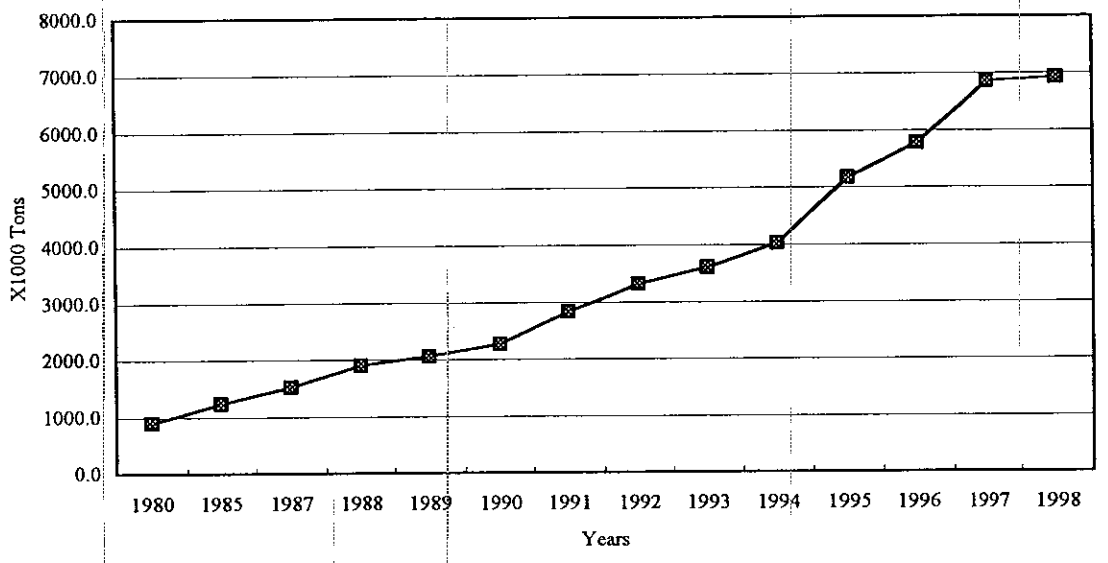
II. THE FOAM SECTOR IN CHINA

A. Sector Background

2.1 The foam sector developed rapidly during the last 20 years. Based on the China Statistics Yearbook of 1999, the production of foam and plastic in 1998 was 7 times the amount produced in 1980. The historic production of foam and plastic is shown below.[1].

Fig 1 Production of Foam and Plastic



2.2 The number of foam enterprises, including CFC and non-CFC based, totals over a thousand. Products include furniture manufacture, domestic electricity products, wrappers, dishware, petrochemicals, cold storage building, and construction. Along with growth in the marketing system and with economic development, the growth in production increased at a rate over 10% per year. In the early 1980s, most foam enterprises were state owned, whereas by the late 1990s, most enterprises have come under private or collectivize ownership, and are largely small and medium enterprises . The capacity and technology of production and management capability, are relatively low. The estimated number of foam producers consuming CFC are shown in table 1

Table 1: ODS Consumption for Foam Sector in 1999

Classification	Main Products	Number of Enterprises	ODS	Consumption of CFCs (tons)
Pipelining and Box PU Flexible	Sponge	550	CFC-11	~9,000
PU Rigid and Integral skin	Spray, boards, tubes and Auto-decoration, furniture	550	CFC-11	~10,000
Refrigeration Foam	Insulation Foam	~30	CFC-11	4,800
Extruded Polystyrene/PS/PE	Dishware, packaging tuck net	~200	CFC-12	4,000
Total		~1,330		~27,800

[1] The production of foam and plastic cannot be separated in the statistic data.