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TOBACCO SECTOR PLAN FOR CFC-11 PHASE-OUT IN CHINA

(submitted by UNIDO)

This document consists of:

Part I: Note from the Fund Secretariat issued to provide the background of China's tobacco sector strategy

Part II: Tobacco Sector Plan For CFC-11 Phase-Out In China.

PART I

(Note from the Secretariat)

This note is issued by the Fund Secretariat to provide the background of China's Tobacco Strategy.

Background

1. The Executive Committee approved at its 15th Meeting an amendment to the China country programme (UNEP/OzL.Pro/ExCom/15/45 paragraph 77) to include CFC consumption in the tobacco expansion sector, which was not included in the approved country programme.

2. The amendment to the country programme included a phase out strategy proposed by the Government of China for this sector. The carbon dioxide technology was selected by the Government as replacement for CFCs for tobacco expansion. The amendment to the country programme compared different options for implementing the strategy, namely to import carbon dioxide expansion units, secure technology transfer and manufacture of expansion units locally, and combinations of the two. The result of the analysis favoured the option to secure technology and manufacture machines locally, with estimated incremental costs of US $94.4 million. However, the approval of the amendment to the country programme did not denote approval of the projects included therein or their funding level.

The tobacco sector plan for CFC-11 phase out in China

3. At its 24th Meeting, the Executive Committee approved, under UNIDO's work programme, a request from the Government of China for the development of a tobacco sector plan for CFC-11 phase out in China. UNIDO has completed the work and is submitting this document to the Executive Committee for its consideration.

4. The document provides details on:

(a) The current situation of the tobacco industry in China, the technologies used for expansion of tobacco including CFC based and carbon dioxide based technologies, the consumption of CFC-11 used for tobacco fluffing, and policies and actions envisaged by the Government of China to phase out CFC-11 in this application;

(b) The Government of China has selected the carbon dioxide tobacco expansion technology to replace that based on CFC-11 on the basis of its cost effectiveness and on its universal availability;

(c) The phase out strategy by the Government of China, whereby CFC-11 is proposed to be completely phased out by 30 June 2006 through the manufacture of large carbon dioxide-based equipment;

(d) The establishment of a policy scheme to achieve the proposed CFC-11 phase out through controls on import/export, trade and supply of expanded tobacco manufactured using CFC-11, and production of expanded tobacco using alternative technologies; encourage development of alternative technologies, improve quality, capacity scale and service; and initiate training and technical assistance programmes as instruments to control CFC-11 consumption in the tobacco sector.

(e) An analysis of the incremental costs including costs to be supported through the Multilateral Fund (US $41 million including US $1 million as technical assistance) and those to be absorbed by the industry in China (US $69.2 million);

(f) An overall action plan providing annual targets for: reduction in CFC-11 consumption, closure of existing manufacturing plants for tobacco fluffing and funding requirements, in the period 2000-2005;

(g) Funding arrangements, operating mechanism and roles and responsibilities of the institutions involved in the implementation of this Sector Plan.

PART II

MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

TOBACCO SECTOR PLAN FOR CFC-11 PHASEOUT IN CHINA

Summary

September 1999

A Sector Plan has been developed for phaseout of CFC 11 in the Chinese tobacco industry that will: 1) ensure phaseout of CFC-11 consumption at sector level; and 2) implement a cost-effective action plan that can be monitored by indicators at sector level. The Sector Plan is consistent with the MLF's principles and guidelines, including those on incremental costs.

National production of tobacco products was 1.4 million tons in 1997 and was generated by a total of 179 enterprises. The industry is fragmented with many small and medium sized enterprises and a few large enterprises. Future production will be controlled at about 1.4 million tons, but the proportion of expanded tobacco will increase from about 4% to 15%. Currently, 58 of the 179 tobacco enterprises use CFC-11 expansion equipment (and 11 have more than one unit). There are a total of 73 CFC-11 units, of which 56 were installed before 25, July 1995. These 56 units have an aggregate capacity of 54,000 tons per year of expanded tobacco and, in 1997, operated at average of 36% of capacity and consumed 1090 tons CFC 11. CO_2 technology has already been introduced in China. By 1999, 21 CO_2 expanded tobacco facilities with 17,300kg/h capacity were already in operation and 5 CO_2 units with 4,500/kg/h capacity were still under construction. Installation of these CO_2 units gave rise to a phaseout of over 1,000 tons CFC-11 in 1997; without these units, 1997 CFC-11 consumption would have been more than 2,000 tons. CO_2 units have a much larger capacity than CFC 11 units. There are significant economies of scale in CO_2 units and capacity may be more than doubled with only a 25% (or less) increase in capital cost. The minimum sizes of equipment suitable for China are 567 kg/h and 1050 kg/h expanded tobacco. Annual tobacco savings arising from the use of 567 and 1,150 kg/hr CO2 units compared to a 180kg/hr CFC-11 unit are:

Cost Savings from Tobacco Expansion Units

	Unit size: CO_2 expansion		CFC-11
	567 kg/hr	1150 kg/hr	180 kg/hr
Annual (7000 hr) output, tons	3,970	8,050	1,260
Tobacco saving, tons, US$ 2/kg	1,729	3,506	514
Total saving, US$1,000.	3,457	7,012	1,027
Saving per kg expanded tobacco, US$/kg	0.889	0.889	0.824

- Tobacco loss 2% for CO_2 units and 1% for CFC-11 units; expansion rate 80% for CO_2 and 70% for CFC-11 units.

The overall action plan for the industry is divided into two parts: a) replacement of all MLF eligible CFC-based units with equivalent capacity non-CFC technology with funding from MLF resources, together with the closure of all remaining CFC-based units in order to eliminate 100% of CFC-11 use by 30 June 2006; and b) development of the Tobacco Sector to meet overall industry goals, in particular an increased output of expanded tobacco, improved cost efficiency and lower tar and nicotine levels in the tobacco. (These actions have already started). Item a) above constitutes the action plan for the Tobacco Sector Plan for CFC-11 Phaseout in China with proposed funding by MLF, as defined by the eligibility guidelines for MLF projects. This section of the action

plan does not include any support to enhance performance of the tobacco industry. Item b) above is being implemented in parallel with item a) above and will be fully funded by Chinese resources.

The goals of the Sector Plan are to 1) phase out all CFC-11 consumption in the Tobacco Sector through a phased programme starting 1 July 2000, with 100% of CFC-11 use eliminated by 30 June 2006; and 2) implement a phased programme to construct several CO_2-based units with an aggregate capacity equaling that of the present units, whilst closing all other CFC-based units.

CFC-11 Phase out Schedule in Tobacco Sector, tons CFC-11

Year	1997	1999	2000[1]	2001	2002	2003	2004	2005	2006
CFC-11 Consumption	1090	Not controlled	1000	880	700	500	300	150	0
Amount of phaseout			90	120	180	200	200	150	150

The main components of the Sector Plan are:

CO_2-based Facilities: Four of the replacement facilities will be large CO_2 units in regional, centralized locations, providing expanded tobacco to several of those nearby enterprises which have closed their smaller CFC-based units. Nine small CO_2 units will be installed within medium sized enterprises that are closing their CFC–based units. These units would be implemented without the direct support of MLF resources. (It is proposed that the associated incremental costs be allocated to closures of CFC units.)

Closure of CFC-based Units: CFC-11 reduction will be controlled on a sector-wide basis through the implementation of a quota system, with initial quotas based on consumption in the baseline year of 1997. Quotas will be purchased from enterprises in phases in so that each year's CFC-11 reduction target is met. An ODS Phaseout Contract will state the conditions for closure and dismantling of equipment together with the compensation available to eligible units. CFC-11 units not eligible for MLF support will be closed and dismantled before 30 June 2006, through administrative measures undertaken at China's expense.

An effective system of supervision and implementation, including establishment of a management information system which ensures enforcement of the phaseout plans will be set up under the Sector Plan. STMA will be responsible for implementation of the Sector Plan. SEPA's PMO will provide overall management, monitoring and supervision of the Sector Plan. Successful implementation of the Sector Plan will require technical assistance (TA). TA will include: technical and safety norms for the alternative technology, standards for the quality of expanded tobacco and a quality control system.

Incremental costs are determined as follows: the total incremental cost to China (TIC), and MLF eligible incremental cost (EIC) is calculated following MLF guidelines.

[1] Years 2000 through 2005 are defined as the 12-month periods starting June 30 of the named year.

Incremental costs included in calculations of TIC and EIC are defined as: the cost of replacing eligible CFC-11-based facilities with an equivalent capacity of CO_2 facilities; and the cost of technical assistance activities. EIC was calculated in line with the principles for financing incremental costs established by MLF. The formula for incremental costs is:

EIC = IC of one-off investment - saving on operating IC
- saving on future baseline investment

Eligible incremental cost for tobacco sector phaseout is US$ 77,000,000 in constant terms, as summarized below. (This is equivalent to US$ 82,800,000 in current terms.)

Tobacco Sector Incremental Costs (constant 1999 US$ 1,000)

	TIC	EIC
Investment in CO_2 units	83,937	83,937
Contingency for capital costs	4,197	4,197
Cost of conversion for land, building and other supporting costs	13,500	0
Subtotal of investment costs	101,634	88,134
Incremental operating costs	-8,960	-8,960
Saving on future baseline investment	-3,135	-3,135
Subtotal of incremental conversion costs	89,539	76,039
TA	970	970
Total incremental costs	90,500	77,000

Proposed MLF Funding**:** It is recognized that MLF financial resources are limited. Therefore, China proposes to limit the request for MLF funding for the Tobacco Sector to US$ 41 million (including US$ 1 million for technical assistance), or less than half of the calculated eligible incremental (in current terms).

Proposed Allocation of MLF Funds: The proposed allocation of MLF funds (excluding TA) is not directly related to the defined eligible incremental costs:

Installation of 4 large units CO2 units	75% of MLF funding
Funding for CFC-11 closures	25% of MLF funding

Normally, the agreed incremental cost from MLF would be used to directly fund the installation of a corresponding capacity of replacement CO_2 units. The different allocation of MLF funds, above, is derived from the approach to sector phaseout. The main reasons for the allocation are: 1) proposed MLF funding is well below eligible incremental costs; 2) actual CFC-11 phaseout occurs with the closure of the 56 eligible CFC–based units; 3) investments in replacement facilities are not shared equally by the enterprises which are closing CFC-11 facilities; and 4) incentives are needed to encourage early and active cooperation between the affected enterprises. This approach

is called for given the imbalances and financial hardships caused to enterprises when closure is enforced without the respective enterprise directly benefiting from replacement CO_2 facilities. It is proposed that MLF resources for incremental costs would be allocated to partially compensate for lost revenue resulting from the closure of CFC-based equipment, and to partially fund the installation of several new large CO_2 units.

Cost Comparison with Project by Project Approach In any case, a project by project approach would be difficult to implement given the large differences in scale between CO_2 and CFC units. However it is assumed that the installation of large regional CO_2 units would be not possible under a project approach. Thus replacement capacity would correspond to a total of 17 small CO_2 units instead of the 4 large and 9 small units proposed under the Sector Plan. Incremental costs of 17 small units would be US$ 90.2 million in constant dollars or US$ 13.2 million more than the Sector Plan incremental cost.

Summary of Annual Programs The action plan will be implemented through a series of Annual Programs beginning 1 July 2000 and ending 30 June 2006. Annual Programs will include quota reductions (CFC unit closures), and will also include CO_2 unit supply and TA activities in most years. In each Annual Program, quotas for CFC-11 use will be cancelled at the beginning of that year.

The proposed annual allocation of MLF funds under the Sector Plan are:

Annual Allocation of MLF Funds (US$ millions)

Category	Total	2000	2001	2002	2003	2004	2005
Investment cost for CO_2 units	30.0	7.5	7.5	7.5	7.5	0	0
CFC-11 closures	10.0	2.0	2.0	2.0	2.0	1.0	1.0
TA	1.0	0.4	0.3	0.2	0.1	0	0
Total	41.0	9.9	9.8	9.7	9.6	1.0	1.0

MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL
ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

Tobacco Sector Plan for CFC-11 Phaseout in China

September 1999

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I. INTRODUCTION

1.1 **Background**. China signed the Vienna Convention for the Protection of the Ozone Layer in 1989, and ratified the London Amendment of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1991 (hereinafter Montreal Protocol). In 1992, the Chinese Government (hereinafter the Government) established a Leading Group for Ozone Layer Protection. This Leading Group has overall responsibility for all phaseout activities. In 1993, the Government approved the China Country Programme for the Phaseout of Ozone Depleting Substances (hereinafter Country Program), and started implementing ODS phaseout actions in China with support of the Multilateral Fund (MLF) of the Montreal Protocol. 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 the implementation of phaseout programs under the four international MLF Implementing Agencies.

1.2 In 1998, China completed an update of its Country Program. Several sector plans were developed based on China's experiences of a project-by-project and umbrella-project approach to ODS phaseout, which have since proven to be more effective. Three sector plans were approved by the Executive Committee Multilateral Fund of the Montreal Protocol (ExCom) before April 1999. Progress on ODS phaseout is well underway in most sectors.

1.3 In the Tobacco Sector, only two technical assistance projects have received support from MLF. Two separate tobacco CFC-11 phaseout projects were prepared, but due to discrepancies over thresholds, they were not formally submitted to ExCom. As early as 1990, China's tobacco industry began CFC-11 phaseout by installing several CO_2 tobacco expansion units. By August 1999, 21 CO_2 units were in operation and 5 were under implementation, primarily in the larger enterprises.

1.4 Currently, issues affecting CFC-11 phaseout in the Tobacco Sector include technology, scale, capital costs, and available financial resources:

- Tobacco enterprises have difficulty in obtaining alternative technology which is suitable given the structure of China's tobacco industry and which is economically feasible. CO_2 expanded tobacco technology is widely used as an alternative to CFC-11 expansion technology in Article 2 and Article 5 countries. However, CO_2 expansion equipment is significantly more expensive than CFC-11 equipment, and has a much larger capacity. Many of China's tobacco factories do not need the larger sized CO_2 units and are not able to afford the much larger investment required in the CO_2 equipment.
- Eligible incremental costs are lower than the actual cost of investing in a replacement. Premature closure of many of the CFC-based units without provision of a substitute CO_2-based unit will cause substantial losses in revenue to the respective enterprise.
- Tobacco enterprises are scattered across China and most CFC-11 tobacco expansion units are situated in small and medium sized tobacco factories. Tobacco expansion is only a small part of the entire tobacco production process. Many of these smaller enterprises have only limited resources available for the replacement of CFC-11 technology and they would prefer to use this limited capital for more productive investments.

1.5 In order to overcome these difficulties, a Sector Plan approach has been developed and this proposed plan is presented herein. The Tobacco Sector Plan will: 1) Ensure phaseout of CFC-11 consumption at sector level; 2) Implement a timely and cost-effective action plan that can be completed and monitored through indicators at sector level; and 3) Improve efficiency by reducing management and implementation costs.

1.6 **Preparation of Tobacco Sector Plan**. In March 1998, ExCom approved US$200,000 for the preparation of a *Strategy on the Overall Phaseout Plan in The Tobacco Sector in China*. Subsequently, SEPA and State Tobacco Monopoly Administration (STMA) jointly established a Special Working Group for CFC-11 Phaseout in the Tobacco Sector. A team of experts from the Zhengzhou Tobacco Institute at Peking University worked alongside STMA officers and UNIDO experts to prepare the Sector Plan. The Tobacco Sector Plan was developed from the basis of the National Tobacco Development Plan, the Chinese Government's obligations under the Montreal Protocol and the *Updated Country Program,* and takes into account experience gained in the preparation of the *Sector Plan for Halon Phaseout in China* and the *Sector Plan for Phaseout CFC Production in China*. The Tobacco Sector Plan is consistent with MLF principles and guidelines, as well as related documents on incremental costs.

II. CURRENT STATUS AND FORECAST

A. Sector Background

2.1 The tobacco sector is important in China, notwithstanding the recognized health issues related to the industry. The industry makes a substantial financial contribution to national and provincial governments and is an important provider of employment in many areas. The industry is 100% State owned and all enterprises operate under the State Tobacco Monopoly Administration (STMA) which controls the China National Tobacco Corporation. STMA's management role is similar to that of a holding company for all sector production enterprises and it is effectively responsible for sector strategy, policy development, production allocation and targets, together with all major investment decisions. Under the People's Republic of China Tobacco Monopoly Law, the STMA is responsible for: overall management and planning of research; the production, sale, import and export of tobacco, related products and machinery; the issue of technology standards and monitoring of production.

2.2 National production of tobacco products stood at 1,684 billion cigarettes (1.39 million tons tobacco) in 1997, divided between 179 tobacco enterprises. The industry's structure is fragmented, with many small and medium sized enterprises and a few large-scale enterprises. Each enterprise produces and markets several brands of varying quality and price and there is significant competition between enterprises. Given the importance of the sector in generating revenue and providing employment, it is unlikely that any significant overall restructuring will take place in the foreseeable future that would affect the CFC-11 phaseout program. Some consolidation of the very small enterprises is however possible (these units do not have facilities for expanding tobacco).

2.3 Total output of tobacco products increased at an annual rate of 9 % during the period 1990 - 97. Over the next decade, production will be controlled at around the current level of 1.39 million tons, but the proportion of expanded tobacco will increase from the current level of approximately 4% to an average of approximately 15%. The medium term goals of the industry are: 1) to implement a recently enacted national policy to reduce product tar and nicotine levels by 20%; 2) to promote cost and product efficiency and competition between the enterprises; and 3) to finance and implement the conversion to non-CFC technology in the tobacco expansion sector. These goals are inter-linked, since expanded tobacco is key in achieving lower tar and nicotine targets and reducing production costs. Achievement of these goals is made more complicated by the large amounts of capital required to invest in non-CFC technology and the likelihood that MLF resources for CFC-11 phaseout will cover only a small proportion of capital funding required. In order to meet targets for reduced levels of tar and nicotine, the average tobacco product will need to contain about 15% of expanded tobacco. Thus, although the total output of tobacco products will not increase significantly over the next few years, output of expanded tobacco must continue increasing at as high a rate as during the period 1995-98.

B. Consumption of CFC-11 and Expanded Tobacco

2.4 Tobacco expanding techniques allow large savings in the amount of tobacco used in production. A typical tobacco factory in China produces about 8,000 tons of tobacco products per year. Use of 10% expanded tobacco (expanded by 70% using the CFC-11 process) gives a potential saving of 329 tons tobacco per year, with a corresponding saving in cost of about US$ 0.66 million per year (calculated at US$2/kg tobacco).

2.5 Where technically and economically feasible, further savings in the cost of tobacco and blend can be achieved by increasing the expansion rate and by adding larger quantities of expanded tobacco to the blend. However, as the proportion of expanded tobacco in a blend increases, the weight of tobacco in the cigarette falls; in consequence, the tobacco burns faster and the number of puffs available to the smoker is noticeably reduced. Whilst most suppliers of CO_2 expanding equipment claim 100% expansion is achievable, practical experience shows that the aroma and taste of expanded tobacco is adversely affected if the expansion rate is set above 80%. In practice, factories in Article 2 countries expand tobacco at 80%. Although cigarettes can be modified to counter these negative effects, there is a clear limit to the total quantity of expanded tobacco that can be added to a blend (15-20%), and to the expansion rate (80%) before consumer confidence is lost.

2.6 In the early 1970s, developed countries began to use CFC-11 as an expansion agent. In the mid-1980s, 150,000 tons of expanded tobacco were produced worldwide, consuming 6,000 tons of CFC-11 per year. China did not produce expanded tobacco until 1987, when two CFC-11 expansion units were imported from USA and put into operation. In 1989, the first locally manufactured CFC-11 expansion unit, similar to the imported design, went into operation. These two designs are the only CFC-11 based systems operating in China at present and both have the same production capacity of 180kg/h expanded tobacco. A single unit can produce about 1,260 tons per year of expanded tobacco with a CFC-11 consumption of about 60 tons per year. The average expansion rate is around 70%.

2.7 There are two factories manufacturing CFC-11-based equipment in China: Jilin Chemical Machinery Plant and Beijing Changgao Company. Local equipment is popular in China because it has low capital cost, is easy and quick to install, occupies a small area and output is closely matched to requirements of the enterprise. Also, the equipment starts to generate profit quickly after investment and produces expanded tobacco of good quality.

2.8 There are currently 179 tobacco enterprises in China, of which 58 use CFC-11 expansion equipment. 11 enterprises have more than one CFC unit. There are 69 locally manufactured expansion units and 4 imported expansion units (see Annex I). Of the total 73 CFC-11 units, 56 units were installed before 25 July 1995 and are thus eligible for MLF support. These 56 units have an aggregate capacity of 54,000 tons per year of expanded tobacco (0.18ton/h X 24h x 254(year working days) x 90%(operating rate) x 56 lines). In 1997, these 56 units operated on average at 36% capacity.

2.9 Table 1 shows the consumption of CFC-11 in China's Tobacco Sector between 1995 and 1998. Detailed data is given in Annex I.

Table 1 CFC-11 Consumption and Expanded Tobacco Production

CFC-11 consumption (tons)				CFC Units	Amount of expanded tobacco (tons)				Expansion rate (%)
1995	1996	1997	1998	1997	1995	1996	1997	1998	1997
803	966	1090	1003	73	11603	17297	19622	20800	68

2.10 Initially, most enterprises were unfamiliar with CFC-11 expansion technology, which resulted in a low operating rate. As enterprises become familiar with the technology, the operating rate, expansion rate and mixing rate of expanded tobacco is increasing. Use of expansion technology in China is now mature and consumption of CFC-11 would continue to increase if unconstrained. Expanded tobacco output will also increase sharply when policy limiting nicotine levels in tobacco comes into force in 2000.

2.11 Due to the high demand for expanded tobacco and in spite of the absence of MLF support in the early stages, CO_2 technology has already been introduced in China as a main alternative to CFC technology. Up to now, 21 CO_2 expansion facilities have been installed in China with a total capacity of 17,300kg/h, and 5 CO_2 tobacco expansion units, with a capacity of 4,500/kg/h, are still under construction.

2.12 Use of expanded tobacco is an important tool in reducing tobacco consumption as well as tar and nicotine content. Initially, many tobacco factories were cautious in adding expanded tobacco to high-grade cigarettes for fear that the taste might be impaired. In consequence, expanded tobacco was introduced gradually into their products. Since the mid-1990s, however, production of expanded tobacco has risen sharply. It is estimated that future demand for expanded tobacco and expansion equipment will increase rapidly and cause CFC-11 consumption to increase as well. According to STMA's objectives to reduce tar and nicotine levels in cigarettes by 20%, expanded tobacco production could reach 15-20% of the total tobacco market by 2003. This target would require a production of about 200,000-280,000 tons of expanded tobacco by 2003. Achieving this ambitious target will be difficult without the installation of additional expansion units and the operation of all existing expansion units at high efficiency. It is assumed here that the lower level of 200,000 tons will be achieved in 2003 (Table 2).

2.13 Consumption of CFC-11 in the tobacco industry increased up to 1996 and then remained relatively constant in 1997 (and 1998). The reasons for this lower growth were:

- Use of CO_2 expansion equipment is increasing rapidly. Due to the restrictions set by the Montreal Protocol, CO_2 expansion equipment has been set up faster than usual, especially after China officially banned new CFC installations in November 1997.

- The three largest enterprises accounting for about 40% of tobacco output have already installed CO_2 equipment and stopped use of CFC-based equipment; thus all of their present expanded tobacco output is generated by CO_2 units. Indeed, these enterprises account for a significant portion of the increased expanded tobacco output in recent years.
- The efficiency of CFC-11 equipment has been improved. Use of CFC-11 has been reduced per unit of expanded tobacco produced.

2.14 Production of expanded tobacco over the next few years is expected to increase at 25% per year. Given the current operation of all existing expansion units (CFC-11 and CO_2) at sub-capacity, growing market acceptance of expanded tobacco products and the recent policy decision to reduce tar and nicotine levels by 20%, this growth rate is considered achievable. (This expected growth rate is at the low end of the STMA target.) Demand for expanded tobacco is shown in Table 2. Assuming total tobacco consumption remains at about 1.4 million tons, expanded tobacco will account for about 14% of the market in 2003.

Table 2 Demand for Expanded Tobacco, tons

Year	1999	2000	2001	2002	2003
Total production of expanded tobacco*	78,000	98,000	122,000	153,000	200,000
From CO_2 units	49,000	63,000	80,000	103,000	140,000
From CFC units	29,000	35,000	42,000	50,000	60,000

* Based on the Strategy on Expanded Tobacco Development, STMA.

2.15 Without implementation of the Tobacco Sector Plan, CFC-11 consumption of current facilities would continue to increase and it is estimated to reach 2,900 tons by 2003 (as shown in Table 3). This calculation assumes that expansion efficiency would increase by 2% per year to reach an industry average of 75% expansion by 2003 and that no CFC units would be closed.

Table 3 Calculation of CFC-11 Consumption Growth without Sector Plan, tons

Year	1999	2000	2001	2002	2003
Total CFC-11 consumption	1,700	2,000	2,300	2,600	2,900

C. Progress of CFC-11 Phaseout in the Tobacco Sector

2.16 China has implemented several policies and actions aimed at phasing out use of CFC-11 in the Tobacco Sector. The policy actions are described in Chapter V. In addition, as early as the 1990s, STMA encouraged use of CO_2 expansion technology and approved the establishment of about 26 CO_2 units. With STMA encouragement, domestic institutes and enterprises took active steps to develop an alternative technology; the progress they have made will provide a basis for CFC-11 phaseout.

2.17 Operation of the 21 CO_2 units resulted in the phaseout of over 1,000 tons CFC-11 in 1997. Indeed, without the contribution of these CO_2 units, CFC-11 consumption would have been more than 2,000 tons in 1997, compared to the recorded figure of 1090 tons.

III. TECHNICAL OPTIONS

Selection of Tobacco Expansion Technology

3.1 Several alternative technologies are available to replace use of CFC-11 in the tobacco industry. China has selected CO_2 tobacco expansion technology for its CFC-11 phaseout program on the basis of cost efficiency considerations and the fact that commercial acceptance of CO_2 technology extends worldwide and in particular throughout China. This technology is available from five international suppliers including one located in China. The standard sizes for a unit are 570 kg/h expanded tobacco (minimum size) and 1150 kg/h expanded tobacco (though larger capacities are available). Capital and operating costs vary considerably from those for CFC-11 units; an evaluation of costs and benefits is included here to facilitate the incremental cost analysis presented in Annex II.

Costs and Benefits of CO_2 Expanded Tobacco Technology

3.2 A summary of the investment and operating costs for CO_2 expanded tobacco technology for each of the five international suppliers is given in Table 4. This table shows capital costs, where available, for both 567 and 1150 kg/h units. It has been assumed that the units will run for 7,000 hours per year i.e. for approximately 80% of the time.

3.3 Tables 4 and 5 show the comparative costs of producing 3, 970 tons and 8,050 tons of expanded tobacco per year. Economies of scale are significant and for both Airco Diet and Day & Zimmermann units capacity can be more than doubled with an increase in capital costs of less than 25%.

3.4 Four of the five tobacco machinery manufacturers claim an expansion rate of 100% or more for the CO_2 tobacco expansion process; however, this is not achievable without suffering an increase in the tobacco loss during operation and a marked degradation in aroma and taste. For comparative purposes, it is assumed that the tobacco expansion rate for CO_2 units will be 80% in the base case, with increased tobacco losses of 2%. (This compares to a 70% expansion rate and 1% tobacco losses for CFC units.) In practice, however, it may not be possible to achieve 80% expansion under Chinese conditions. To illustrate the effect on incremental costs, a sensitivity analysis has been carried out at 90% and 100% expansion with respective tobacco losses at 3% and 4.5% - even though these conditions are unrealistic.

Table 4 Comparative Costs for 567kg/hr CO_2 Tobacco Expansion Units

Plant size: 567 kg/hr 7000 hr	Airco Diet	Day & Zim'mann	DIET Consort.	Qinh'gdao	Sicplant. Int.
Annual output, tons	3970	3970	3970	3970	3970
Capital cost, US$1000.	8060	8650	8241	5676	6710
A: 10 year depreciation[1], US$1000	806.0	865.0	824.1	567.6	671.0
CO_2 use, kg/ton tobacco.	400	330	350	350	200
CO_2 tons per year.	1587.6	1309.8	1389.2	1389.2	793.8
B: Cost per year, US$1000. ($CO_2$ at 320 US$/ton)	508.0	419.1	444.5	444.5	254.0
Steam use, kg/hr.	600	600[1]	950	950	454
Tons per year.	4200	4200	6650	6650	3175
C: Cost per year, US$1000.	56.1	56.1	88.8	88.8	42.4
(Steam at 13.36 US$ per ton)					
A + B + C, US$1000.	1370.1	1340.2	1357.4	1140.0	967.4

[1] Estimate (no data available).

Nominal capacity is reported as 567kg/hr. In annex II, a nominal capacity of 570kg/hr is used.

Table 5 Comparative Costs for 1150 kg/hr CO_2 Tobacco Expansion Units

Plant size: 1150 kg/hr 7000 hr	Airco Diet	Day & Zim'mann	DIET Consort.	Qinh'gdao	Sicplant. Int.
Annual output, tons.	8050	8050	Not	8050	8050
Capital costs, US$1000.	9997	9940.0	Known	8212.0	11820
A: 10 year depreciation, US$1000.	999.7	994.0		821.2	1182.0
CO_2 consumption kg/ton tobacco	400	330			200
CO_2 tons per year	3220.0	2656.5			1610.0
B: Cost per year, US$1000 ($CO_2$ at 320 US$/ton)	1030.4	850.0			515.2
Steam consumption, kg/hr	1200	1200[1]			920
Tons per year	8400	8400			6440
C: Cost per year, US$1000.	112.2	112.2			86.0
(Steam at 13.36 US$ per ton)					
A + B + C, US$1000.	2142.3	1956.2			1783.2

[1] Estimate (no data available)

3.5 Table 6 shows the annual tobacco savings arising from use of 567 and 1,150 kg/hr CO_2 units compared to a 180kg/hr CFC-11 unit.

[1] 10 year depreciation is used in this comparison. In annex II, the useful life of the equipment is assumed to be 15 years when calculating operating cost savings.

Table 6 Cost Savings in Tobacco Expansion

	Unit size: CO_2 expansion		CFC-11
	567 kg/hr	1150 kg/hr	180 kg/hr
Annual (7000 hr) output, tons	3,970	8,050	1,260
Less tobacco loss, tons	3,890	7,889	1,247
Input tobacco, tons	2,161	4,383	734
Tobacco saving, tons	1,729	3,506	514
Total saving, US$1,000.	3,457	7,012	1,027
Saving on per kg expanded tobacco US$/kg	0.889	0.889	0.824

- All units operate for 7,000 hours per year.
- Tobacco loss is at 2% for CO_2 units and 1% for CFC-11 units; expansion rate is 80% for CO_2 and 70% for CFC-11 units respectively.
- Price of tobacco assumed to be US$2/kg (precise survey result: US$1.64/kg).

3.6 It is clearly more beneficial to use 1,150kg/hr in place of 567kg/hr capacity units. For models of similar capacity, however, the final net savings do not vary significantly between manufacturers – particularly considering the limited data available on their performance and the assumptions made in calculation.

3.7 The supplier of the CO_2 expansion system to China will eventually be decided on through a system of international competitive bidding; this will take into account the CO_2 expansion processes in operation in China at the time. Detailed information on operating costs, reliability, tobacco losses and expansion rates would be determined during the process of procurement.

IV. PHASEOUT STRATEGY

A. Objective and Goals

4.1 The objective of the Sector Plan for the phaseout of CFC-11 use in the Chinese tobacco industry is to develop a cost effective action plan to eliminate use of CFCs whilst simultaneously building up a sufficient production capacity of suitable alternative facilities. This action plan would enable the industry to meet its targets of expanded tobacco production, improve industry cost efficiency and lower tar and nicotine levels in its products. The overall industry action plan is divided into two parts:

- Replacement of all MLF eligible CFC-based units with an equivalent capacity of non-CFC technology with partial funding from MLF resources, accompanied by phased closure of all other CFC-based units, eliminating 100% of CFC-11 use in the industry by the agreed date, 30 June 2006; and

- Development of the Tobacco Sector to meet overall industry goals, including increased output of expanded tobacco, improved cost efficiency and lower tar and nicotine levels in tobacco products (these actions have already started).

4.2 Item 4.1 a) above constitutes the action plan for the Tobacco Sector Plan for CFC-11 Phaseout in China as described herein, for proposed funding by MLF as defined by the eligibility guidelines for MLF projects. This section of the action plan does not include any support for enhancing the performance of the tobacco industry.

4.3 Item 4.1 b) is being implemented by the industry in parallel with item 4.1 a) and will be fully funded by Chinese resources. This document will not describe this section of the plan except in the few cases where the Sector Plan will benefit from any external cost efficiencies (such as an interim supply of CO_2-based expanded tobacco during construction of the project-supported units).

4.4 The goals of the Sector Plan are:

- Phaseout of all CFC-11 consumption in the Tobacco Sector by means of a phased program starting 1 July 2000, with 100% of CFC-11 use eliminated by 30 June 2006 (a detailed schedule is provided in Table 7 below and in the action plan in Chapter VIII); and
- Implementation of a phased program to build several large CO_2-based units with an aggregate capacity equal to that of the current units, whilst simultaneously closing all other CFC-based units.

Table 7 CFC-11 Phaseout Schedule in the Tobacco Sector, tons CFC-11

Year	1997	1999	2000[2]	2001	2002	2003	2004	2005	2006
CFC-11 Consumption	1090	Not controlled	1000	880	700	500	300	150	0
Amount of phaseout			90	120	180	200	200	150	150

B. Phaseout Strategy

4.5 The Sector Plan strategy provides for the fact that the scale and form of the replacement technology differs considerably from that of existing CFC-based facilities. The alternative technology will require completely new equipment and facilities, and the number of such facilities will be much smaller than the present number of CFC-based units. Thus, an action plan is needed for the implementation of a phased program, to be followed simultaneously on a sector-wide level, which will:

a) close/dismantle all CFC-based units through a system of CFC-11 consumption quotas controlling the aggregate annual use of CFC-11 by the industry;

b) increase supply of non-CFC based units (CO_2 technology), with an aggregate capacity

[2] Years 2000 through 2005 are defined as the 12 month period starting June 30 of the named year.

equaling that of the CFC-based units closed; and

c) develop a program through a system of bidding to enable CO_2 units to supply expanded tobacco on a regional basis to some of the nearby tobacco enterprises that closed CFC units

4.6 On the basis of the commercial technology available and the structure and requirements of the Chinese tobacco industry, the most cost-effective way to meet the phaseout target is to set up CO_2 units with a capacity equal to that of the eligible CFC-11 units: this corresponds to four large CO_2 units (1,150kg/h) and nine small CO_2 units (nominal capacity of 570 kg/h). The 13 proposed CO_2 units have an aggregate capacity of 9,730kg/hr compared to 10,080kg/hr for the 56 CFC-11 units being replaced. (The various unit sizes were selected taking into consideration the structure, size and dispersed location of tobacco industry facilities.)

4.7 The main components of the strategy are:

4.8 **Four large CO_2-based Expanded Tobacco Centers** Four of the replacement facilities will be situated in regional, centralized locations and will provide expanded tobacco to several nearby tobacco enterprises which have closed their smaller CFC-based units. The four large CO_2 units will be implemented via a bidding system currently under development. Ownership, location and the division of output between tobacco enterprises will be decided in the bidding process. In aggregate, the replacement facilities will equal the capacity of the closed CFC-based units; however, in view of the dispersed location of the enterprises, replacement cannot take place on a one-to-one basis at enterprise level. Thus, the Sector Plan will take advantage of overall industry growth, whereby several CO_2-based units already exist and others will continue to be built over the next few years. Typically, CFC-based units closed early on in the project will receive supplies of expanded tobacco from existing CO_2 units nearby that are not yet operating at full capacity. This arrangement will allow CFC units to close earlier than would otherwise have been possible, since it takes about 18-24 months to buy and install a new CO_2 facility.

4.9 **Nine small CO_2 replacement facilities** Nine small CO_2 units will be installed within medium sized enterprises that are closing CFC–based units. These units will for the most part produce expanded tobacco for their own consumption. (However, some of these nine units could provide expanded tobacco to other nearby tobacco enterprises, but this arrangement would not be a direct part of the Sector Plan - rather, an informal marketing arrangement promoted by STMA.) These units would be implemented without direct support from MLF resources. (It is proposed that their associated incremental costs are allocated to the closure of CFC units.)

4.10 **Closure of CFC-based Units** The main step in implementing CFC-11 reduction will be the sector-wide control of total CFC-11 use, achieved through the implementation of a quota system, as summarized below:

a) Initial quotas for CFC-11 use will be assigned to all enterprises using CFCs, based on their consumption in the baseline year of 1997;

b) Initial quotas will be purchased back from the enterprises in phases through a process of negotiation between STMA and affected enterprises, in order to meet each year's CFC-11 reduction target;

c) An ODS Phaseout Contract between STMA and each affected enterprise will state the terms and conditions for the immediate closure/dismantling/destruction of the CFC unit and the level of compensation for MLF eligible units; and,

d) CFC-11 units not eligible for MLF support (installed after 25 July 1995) will be closed/dismantled/destroyed in later years but before 30 June 2006. STMA will implement these closures through administrative measures at China's expense

4.11 . Each year's Annual Program will establish and implement the action plan for closures during the corresponding 12 month period. To ensure realization of the phaseout target and to facilitate monitoring and control, each CFC-11 unit will be completely closed down and dismantled according to the annual plan, rather than being partially closed down by reducing CFC-11 consumption per unit.

a) Older CFC units will, in general, close first; and,

b) CFC-11 units in isolated tobacco factories will be closed/dismantled under mandatory measures and will then be forced to purchase any requirements for expanded tobacco on the open market. Factories in this category which are eligible for MLF support will receive compensation.

4.12 **Policy Approach to Strategy** The quota system will represent the main policy measure, supplemented by control and monitoring. An effective system of supervision and implementation, including the establishment of a management information system ensuring enforcement of the phaseout plans will be established under the Sector Plan. Successful implementation of the policy-based approach will require some technical assistance. Such assistance will include: technical and safety norms for the alternative technology, standards for the quality of expanded tobacco and a quality control system.

4.13 STMA will be responsible for implementation of the Sector Plan. STMA's role in the industry and its overall managerial capacity will ensure the realization of phaseout targets. STMA will also play a key role in ensuring that all projects receive sufficient finance and are implemented at an appropriate point in the plan. This assurance is particularly important given that the funds likely to be available from MLF will cover only a proportion of the total incremental cost of phaseout. SEPA's PMO will provide overall management, monitoring and supervision of the Sector Plan.

V. POLICIES

5.1 Tobacco expansion is an important process in cigarette production which directly affects the quality and cost of the end products. Most enterprises would not replace their CFC-11

expansion technology on a voluntary basis, given the lack of a low cost alternative, the need to maintain product quality, potential loss of market share and with it profitability. Even though these enterprises are entitled to some financial assistance from MLF, given their preferences for existing expansion technology and the disadvantages involved in changing technological processes (for example, a significant rise in the production capacity of the new technology), many enterprises are reluctant, or lack the motivation, to phase out ODS.

5.2 Therefore, alongside the financial support from MLF, the Chinese Government will need to establish policies, promote the transfer and widespread introduction of suitable substitute technologies and initiate employee training schemes in order to complete CFC-11 phaseout in the Tobacco Sector.

5.3 Policy Objectives The objectives of phaseout policies are to:

a) Ensure phaseout of CFC-11 use in the Tobacco Sector as scheduled;

b) Provide incentives to CFC-11 users to phaseout quickly;

c) Provide effective policy support for the CFC-11 phaseout process;

d) Encourage production of alternatives to CFC-11 expansion technology; and

e) Ensure continued development of the Tobacco Sector, including improvements in the living standards of employees.

5.4 Policy Design Policy design for ODS tobacco phaseout will be based on:

a) The situation in China, especially with regard to recent reforms of economic system, characteristics of the Tobacco Sector, and features of enterprises' activities;

b) Policies for ODS phaseout in the Country Program and other Sector Plans;

c) Continuity and consistency with existing policy and regulatory systems;

d) Feasibility, supervision and management; and

e) Considerations regarding economic efficiency and fairness.

5.5 China will adopt various policy measures to ensure achievement of a cost-effective CFC-11 phaseout in the Tobacco Sector. Policy measures under development include control and command measures, market-based instruments and voluntary agreements. China's policies for ODS tobacco phaseout will focus on controlling consumption of CFC-11, to ensure goals are reached. At the same time, supply of alternatives and substitutes for the production of expanded tobaccos will be encouraged. The key points are:

- To control import and export of expanded tobaccos manufactured using CFC-11; to strictly control (or ban) trade of expanded tobaccos manufactured using CFC-11; to control supply of expanded tobacco manufactured using CFC-11; and to promote the production of expanded tobacco manufactured using alternative technologies;
- To encourage the development of alternative technologies, improve quality, capacity scale and service; and
- To initiate information campaigns, training, education and technical assistance, as important instruments in the control of CFC-11 consumption in the Tobacco Sector.

5.6 Table 8 shows the policy framework for CFC-11 phaseout in the Tobacco Sector:

Table 8 Policy Framework for CFC-11 Phaseout in the Tobacco Sector

Objective	Policy	Timetable	
		Issued	Implemented
Controlling consumption	1. Ban: Notice on banning newly-built equipment which produces or uses ODS.	Nov. 11, 1997	Nov. 11, 1997
	2. Quota system: The government will issue consumption quotas on tobacco plants, SEPA/STMA will phase out CFC-11 by buying quotas from enterprises.	6 mos. after Sector Plan approval	6 mos. after Sector Plan approval
	3. Final ban: After June 30, 2006, consumption of CFC-11 in The Tobacco Sector will be banned.	3 mos. after Sector Plan approval	June 30, 2006
Controlling trade	4. Management system for trade: Banning import of expanded tobacco and cigarettes produced with CFC-11. Controlling export of expanded tobacco and cigarettes using CFC-11	6 mos. after Sector Plan approval	6 mos. after Sector Plan approval
Encouraging supply of substitutes	5. Policies of encouragement: to encourage the development, production and management of alternative technologies.	2000-2005	
Standards, campaign and training	6. Establishment of standards and technical norms	2000	2000
	7. Publicizing alternative technologies, sponsoring technical training, project training, international and domestic workshops.	2000-2005	2000-2005

5.7 Controlling consumption of CFC-11 in the Tobacco Sector includes:

(1) Ban. On 11 November 1997, SEPA, the State Planning Committee, the State Economic and Trade Committee, and the Industrial and Commercial Agency issued a ban - *Notice on banning newly-built equipment which produces or uses ODS*. Under the ban: all regions are prohibited from building, enlarging or renovating ODS-producing equipment and other equipment consuming ODS; environmental bureaus at all levels are prohibited from approving the Environmental Impact Assessment reports for these projects; all levels of governmental planning, economic and trade administrations are prohibited from setting up or putting into use this equipment; and finally, no level of financial industry may support the installation of such equipment. All departments and branches should follow the regulation absolutely, and in particular at every level of the Environmental Protection Bureaus.

(2) Consumption Quota System for CFC-11 consumption in the Tobacco Sector.
The consumption quota system includes the following points:

a) SEPA and STMA will issue annual CFC-11 consumption quotas to tobacco enterprises that consume CFC-11 as an expansion agent. The first year's quota will be determined according to consumption during the baseline year, namely 1997.

b) SEPA and STMA will purchase back quotas by negotiations with concerned enterprises.

c) Enterprises using CFC-11 should not consume more than their quota permits.

d) After quota is surrendered, CFC-11 using equipment will be closed/dismantled.

(3) Final Ban. CFC-11 consumption in The Tobacco Sector will stop by 30 June 2006

5.8 Controlling trade includes:

(4) Management system for trade:

a) Ban on import: six months after Sector Plan approval, import of expanded tobacco and cigarettes using CFC-11 will be banned.

b) Export management: six months after Sector Plan approval, a declaration system will be enforced governing export of expanded tobacco and cigarettes produced using CFC-11.

c) Ban on export: After 30 June 2006, export of expanded tobacco and cigarettes produced using CFC-11 will be banned.

5.9 Encouraging supply of substitutes includes:

(5) Establishment of standards and technical norms. Because the alternative technology requires the renewal of equipment and redesign of technology, product quality and safety of production need to be assessed. New safety regulations and quality standards consistent with alternative technology need to be established.

(6) Policies for promotion and training.

a) **Promotion:** it is necessary to disseminate knowledge about the depletion of Ozone Layer by CFCs and to raise public awareness of the issue by means of TV & radio broadcasts and through the media.

b) **Training:** STMA and the local Tobacco Monopoly Bureau will provide training for officials to increase awareness and managerial skills, together with training for tobacco technicians to enhance understanding of alternative technologies and their applications.

c) **Training for project implementation:** during implementation of the project, relevant staff members will receive training.

d) **International and domestic workshops:** workshops will be held throughout the Tobacco Sector to publicize the need for the phaseout of CFC-11 and the alternative technologies available.

VI. INCREMENTAL COSTS ANALYSIS

A. Scope of Cost Analysis

6.1 This chapter discusses the incremental costs of phasing out CFC-11 in the Tobacco Sector and explains the results of calculations carried out with a computer-based model. The model was developed to provide a basis for deciding the most cost-efficient phaseout profile for China, and for determining both the total incremental costs to the Chinese economy and the eligible incremental costs for which to request funding. Assumptions, inputs and the calculation methodology for the model are given in Annex II to this chapter. Demands to meet specific

phaseout targets in order to qualify for annual funding grants are also listed at the end of the chapter.

6.2 Two costs of phasing out CFC-11 in the Tobacco Sector are analyzed within the model: the total incremental cost to China (TIC), and the eligible incremental cost (EIC) for MLF support under its guidelines.

- TIC: In the calculation of TIC, general principles for financing the incremental costs of a project were followed[3]. Double counting was avoided. The methodology identifies costs when they first arise. Cost items to be borne by China are identified.
- EIC: EIC is the eligible funding level which may be requested from MLF for phasing out CFC-11 in the Tobacco Sector. TIC is the starting point for the calculation of EIC, after which financial commitment by the tobacco enterprises are taken into account.

6.3 Incremental costs included in calculations of TIC and EIC are defined as:

- Replacement of eligible CFC-11-based facilities with an equivalent capacity of CO_2 facilities; and
- Technical assistance and supporting activities (e.g. training, promotion, etc).

6.4 EIC is calculated in line with the general principles for financing incremental costs as established by MLF. Methodology and key parameters are shown in Annex II. The formula for calculating incremental costs is:

$$EIC = (CC - NPV(FI)) + NPV(FB_b - FB_p)$$

where

CC is the capital cost of the conversion project,

FI is the value of future baseline investments (which would occur in the absence of conversion),

Fb_b is the value of future baseline benefits (that would occurred in the absence of conversion),

Fb_p is the value of future benefits of the conversion project, and

NPV refers to the net present value of the costs/benefits stream.

B. Factors Influencing Incremental Cost

6.5 The main factors influencing the incremental costs of CFC-11 phaseout in the Tobacco Sector are: 1) scale of replacement facilities; 2) tobacco expansion rate achieved (and associated tobacco losses); 3) other operating cost factors, for example the cost of CFC-11 and CO_2 units;

[3] (UNEP/Ozl.Pro/2/3 Appendix I of Decision II/8, para. 1). (UNEP/OzL.Pro/4/15 Decision IV/18 (section I.6).

(Supporting document: UNEP/OzL.Pro/2/3 Annex IV, Appendix I). (UNEP/Ozl.Pro/4/15 Annex VIII).

4) the number of years accounted for when calculating incremental operating costs/benefits; 5) costs assigned to the future cost of maintaining operation of existing CFC facilities at production capacity level while replacement CO_2 units are being installed; and 6) the discount rate.

6.6 Demand for expanded tobacco is likely to continue to grow well beyond the 1997 baseline level. EIC does not take this growth into account. Hence, when CFC units are closed, additional savings in operating costs will be lost; these must be borne by the respective enterprises. Indeed, the phaseout program will impose further costs on the industry that are not reflected in the calculations presented herein.

6.7 Technical Assistance. The cost of technical assistance (TA) required to achieve CFC-11 phaseout includes such items as policy development and the implementation of policy measures, codes, quota systems, public awareness, development of alternate technologies, technical assistance to enterprises, testing facilities and development of the management information system as a monitoring tool for the entire Tobacco Sector phaseout plan. The cost of technical assistance is estimated at $1.0 million for the entire phaseout period. These costs will be broken down into detailed components and costs prescribed as part of each Annual Program. Chapter VII includes a detailed breakdown of cash flow requirements for TA over each stage of the phaseout program.

C. Eligible Incremental Costs (EIC)

6.8 Based on the above analysis, total phaseout costs for CFC-11 in the Tobacco Sector are summarized in Table 9. EIC represents the value of funds eligible for incremental costs as defined by ExCom guidelines. Costs in Table 9 are given in 1999 constant dollars; costs in Table 10 are given in current dollars with 2.5% per year inflation .

6.9 Eligible incremental costs for tobacco sector CFC-11 phaseout are US$ 77,000,000 in constant terms (see Table 9) or US$ 82,800,000 in current terms, including the effect of inflation (as shown in Table 10).

Table 9 Tobacco Sector Incremental Costs (constant 1999 US$ 1,000)

	TIC	EIC
Investment in CO_2 units	83,937	83,937
Contingency for capital costs (5%)	4,197	4,197
Conversion cost for land, building and other supporting costs	13,500	0
Subtotal of investment cost	101,634	88,134
Incremental operating cost	-8,960	-8,960
Saving on future baseline investment	-3,135	-3,135
Subtotal of incremental conversion cost	89,539	76,039
TA	970	970

Total incremental cost	90,500	77,000

Table 10 Phaseout Targets and Eligible Incremental Costs (in current US$ 1,000)

	Total	2000[4]	2001	2002	2003	2004	2005	2006
Consumption (tons)		1,000	880	700	500	300	150	0
Phaseout amount (tons)		90	120	180	200	200	150	150
One-off investment	91,189	16,576	14,563	16,586	17,000	13,069	13,396	0
Contingency	4,559	829	728	829	850	653	670	
Incremental operating costs	(9,734)	(1,769)	(1,555)	(1,770)	(1,815)	(1,395)	(1,430)	
Saving on future baseline investment	(4,173)	0	0	0	(4,173)	0	0	0
TA	1,000	400	400	100	100	0	0	
Total incremental cost (rounded)	82,800	16,000	14,100	15,700	12,000	12,300	12,600	0

D. Proposed MLF Funding, Financing Plan and Allocation of MLF Resources

6.10 **Proposed MLF Funding**. It is recognized that MLF financial resources are limited. Therefore, China proposes to limit the request for MLF funding for the Tobacco Sector to US$ 41 million (including US$ 1 million for technical assistance), or less than half of the calculated eligible incremental costs as shown in Table 10.

6.11 **Financing Plan** Capital costs required for phasing out all remaining CFC-11 consumption in the tobacco industry are summarized below in current dollars:

Investment for CO_2 units	US$ 91.2 million
Contingency on capital cost (5%)	US$ 4.5 million
Land, building and other facilities	US$ 13.5 million
Total	US$ 109.2 million

The proposed financing sources are:

MLF (excluding TA)	US$ 40.0 million
Chinese enterprises	US$ 69.2 million
Total	US$ 109.2 million

[4] Years 2000 to 2006 are defined as the 12 month periods starting July 1 of the said year.

6.12 Thus, proposed MLF funding (excluding TA) would represent about 37% of the capital costs required. STMA confirms that the participating enterprises will guarantee the availability of 100% funding for the conversion plan under the Sector Plan.

6.13 **Proposed Allocation of MLF Funds.** As shown below, the proposed allocation of MLF funds (excluding TA) is not directly related to the defined eligible incremental costs:

Installation of 4 large CO_2 replacement units	75% of MLF funding
Funding for CFC-11 closure actions	25% of MLF funding

6.14 Normally, the agreed incremental cost from MLF would be used to directly fund the installation of a corresponding capacity of replacement CO_2 units. A different allocation of MLF funds is proposed above to reflect the approach to sector phaseout incorporated into the action plan. The main reasons for the allocation are: 1) proposed MLF funding is well below eligible incremental costs; 2) actual CFC-11 phaseout occurs with the closure of the 56 eligible CFC–based units; 3) investments in replacement facilities are not shared equally by the enterprises due to close CFC-11 consuming facilities; and 4) incentives are needed to encourage early and active cooperation between the enterprises due to close CFC-11 consuming facilities. A different approach to the allocation of MLF funds is called for, given the imbalances and financial hardships caused to enterprises when closure is enforced without the respective enterprise directly benefiting from a new CO_2 unit. It is proposed that MLF resources for incremental costs would be allocated to partially compensate for lost revenue resulting from the closure of CFC-based equipment and to partially fund the installation of several new large CO_2 units. This allocation would provide some incentive for the closures as well as encouraging enterprises to take advantage of the new CO_2 expansion centers.

6.15 Implementation of the 4 large CO_2 units will proceed under a bidding system to select contractors, locations, costs, budgets and schedule (and associated enterprises). Any saving made at the bidding stage will be allocated to 1) costs associated with transportation of expanded tobacco and 2) higher allocation of funds to closures.

6.16 If this allocation fails to provide sufficient incentive for the enterprises to participate, subsequent Annual Programs will provide an adjustment subject to ExCom approval.

6.17 The proposed annual flow of MLF funds to implement the action plan is shown below:

Table 11 Annual Allocation of MLF Funds, US$ millions

Category	Total	2000	2001	2002	2003	2004	2005
Investment cost for CO_2 units	30.0	7.5	7.5	7.5	7.5	0	0
CFC-11 closures	10.0	2.0	2.0	2.0	2.0	1.0	1.0
TA	1.0	0.4	0.3	0.2	0.1	0	0
Total	41.0	9.9	9.8	9.7	9.6	1.0	1.0

E. Cost comparison with project-by-project approach

6.18 In any case, a project by project approach would be difficult to implement given the large

differences in scale between CO_2 and CFC units. However it is assumed that the installation of large regional CO_2 units would be not possible under a project approach. Thus replacement capacity would correspond to a total of 17 small CO_2 units instead of the 4 large and 9 small units proposed under the Sector Plan. Incremental costs of 17 small units would be US$ 90.2 million in constant dollars or US$ 13.2 million more than the Sector Plan incremental cost.

VII. ACTION PLAN

A. Overall Action Plan

7.1 This chapter presents the action plan implementing CFC-11 phaseout under the Tobacco Sector Plan, according to the schedule proposed in Chapter IV. The contents of this chapter include annual phaseout targets, costs incurred by China in meeting these targets, MLF funds requested to meet those targets (based on the cost analysis presented in Chapter V), and key policies, technical assistance and other actions that will be implemented in order to achieve the phaseout objectives. The proposed action plan will begin on 1 July 2000 and end on 30 June 2006. The action plan will be implemented through a series of Annual Programs. The first draft Annual Program is available as a separate document. The Government has committed itself to complying with the agreed overall and annual phaseout targets and providing all counterpart funding, assuming MLF approves the Tobacco Sector Plan and the Annual Programs. The Government will implement the Sector Plan in a cost-effective manner through a bidding system, through an operating mechanism and policies ensuring efficient implementation.

7.2 STMA will be responsible for deciding the number of CFC-based tobacco expansion units to be closed and dismantled each year in order to meet the phaseout target. In the 2000 Annual Program (1 July 2000 to 30 June 2001), quotas for CFC-11 use equal to 90 tons CFC-11 will be cancelled, and about 7 CFC-based expansion units will be closed and dismantled. The procurement of one large CO_2 -based unit will begin with MLF support; the procurement of 2 small CO_2 units will start without direct MLF support; and several activities will be undertaken regarding technical assistance. For subsequent years, only the number of expansion units, together with the number of tons CFC-11 to be phased out is given in here. The Annual Programs for subsequent years will further elaborate details of closures and investments. The specific units to be dismantled in each future Annual Program will be decided by considering the operational status of equipment installed in previous years, the progress on construction and the situation of CO_2 expansion centers, preparation for technical conversion and the specific situations of individual enterprises.

B. Summary of Annual Programs

7.3 Annual Programs will include quota reductions (CFC unit closures), and in most years will also include the supply of CO_2 units and technical assistance activities. In each Annual Program, CFC-11 use quotas will be cancelled as of July 1 at the start of the said year and CFC-based units will also close as of that date. Implementation of the agreed CO_2 unit will start in that year, but will be implemented over the following 18-24 months. It is possible that TA activities may run

over into the following years action plan.

7.4 **Quota reductions and funding requirement for 2000 to 2006** are summarized below:

Table 12 Annual Program Targets

Year (July 1 to June 30)	2000	2001	2002	2003	2004	2005	2006	Total
CFC Units to be closed	~7	~8	~10	~12	~12	~12	~12	73
Quota reduction, tons CFC-11	90	120	180	200	200	150	150	1090
Incremental cost ($ million)	9.9	9.8	9.7	9.6	1.0	1.0	0	41.0

7.5 **Establishment of CO_2 Units** Four regional CO_2 tobacco expansion units will be included under the Sector Plan with direct financial support from MLF resources, with one unit to start implementation in each year during the period 2000- 2003. According to the distribution of tobacco factories, schedule for CFC-based closures and location of existing CO_2 expansion units, these 4 CO_2 expansion units will provide expanded tobacco to replace output from nearby CFC-based units which are being closed down. Nine additional CO_2 units will be added under the Sector plan, but these will be funded in full from local financial resources.

7.6 The most likely locations of the large CO_2 units would be in the premises of four of the existing local tobacco enterprises. The contractors of CO_2 expansion centers will be decided through a bidding system. Procedure for bidding is currently being developed based on the bidding system under other Sector Plans and consistency with UNIDO guidelines. The selected enterprise would be responsible for providing buildings and infrastructure, land and any other supplementary investment.

7.7 STMA would encourage those enterprises receiving compensation from CFC-based closure decisions to invest jointly in the new CO_2 expansion centers. The investor would then benefit from expanded tobacco at a lower price, according to the proportion of its investment.

7.8 Technical Assistance activities. TA activities to be supported under the Sector plan are summarized below:

(a) *Training of personnel involved in implementation of phaseout activities* -- It is necessary to provide training for: 1) environmental staff and decision makers to increase their understanding and managerial capacity; and 2) industrial managers and technicians to enhance their understanding of the alternative technology and its application. This type of training will need to be repeated every year for the first few years of implementation.

(b) *Development of a Management Information System (MIS) for CFC-11 phaseout in the Tobacco Sector* - The MIS is an important tool in the management and supervision of all phaseout activities. It is used to monitor performance in tobacco sector phaseout and to compile progress reports on the implementation of the tobacco sector plan as required by ExCom and UNIDO. An information management center will be established in PMO and a sub-station in STMA.

(c) *Establishment of standards and technical norms*

(d) *Expanded tobacco transportation technology.* As described in Chapter III, expanded tobacco transportation is key in insuring that the expanded centers

operate successfully and minimize losses.

C. Financing Plan and Allocation of MLF Resources

7.9 Normally, the incremental cost from MLF must be used to directly fund the corresponding capacity of replacement CO_2 units. However, two factors are different in this case: 1) It is likely that MLF funding will represent only a small portion of the capital costs required to implement the Sector Plan; and 2) actual CFC-11 phaseout occurs with the closure of the 56 eligible CFC–based units and only 13 enterprises will undertake conversion projects. Given the imbalances and financial hardships caused when enterprises do not directly benefit from closure decisions by receiving a replacement CO_2 unit, a different approach for the allocation of MLF resources is called for. It is proposed that MLF resources covering incremental cost would be allocated to partially compensate for lost revenue resulting from CFC-based closures, and to partially fund the several new CO_2 units. This allocation would provide some incentive for the closures as well as encouraging enterprises to participate in the new CO_2 expansion centers. The allocation proposed is:

1) for CFC-11 closures 25% of MLF funding for incremental costs
2) for 4 large CO_2 units 75% of MLF funding for incremental costs

7.10 **Funding for CFC-based closures** There are 56 CFC-11 tobacco expansion units with a total CFC-11 consumption of 980 tons eligible for MLF funding. The amount of compensation received for closure of one CFC-11 expansion unit will be calculated using the following formula, which accounts for the unit's CFC-11 consumption in 1997, expenditure on equipment to be dismantled and depreciation in equipment's value. The proposed formula is:

$$Q = A + B * N + C * (1 – E/F)$$

where,

Q is the amount of compensation for one CFC-11 expansion unit;
A is constant, representing the basic funding for one CFC-11 unit;
B is constant, representing compensation at consumption level;
N is the CFC-11 consumption of the respective expansion line in 1997;
C is the average price of CFC-11 expansion equipment;
E is the number of years over which the equipment has been used; and,
F is the average life span of the equipment.

7.11 There are 17 CFC-11 expansion lines that were established after 25 July 1995 with a total CFC-11 consumption of 79 tons. These lines are non-eligible for compensation from MLF and will be eliminated by mandatory measures by STMA according to the Tobacco Sector phaseout timetable and at China's expense.

7.12 **Funding for New CO_2 Units** Enterprises implementing CO_2 units will bear a substantial portion of the capital costs of the new facilities due to the level and proposed allocation of MLF resources. Thus, careful attention to the financing arrangements for each investment project is required. Each ODS phaseout contract for the supply of new CO_2 units will require submission by the enterprise of a verified financing plan for such implementation and confirmation that the enterprise will provide all supplementary funding required. STMA will assist the enterprises in

securing financing as needed in order to complete each project in a timely and successful manner.

VIII. OPERATING MECHANISM

8.1 This chapter describes funding arrangements, operating mechanism and roles and responsibilities of the institutions involved in the implementation of this Sector Plan

A. Agreement between SEPA and UNIDO

8.2 Following approval of the Sector Plan by ExCom, an Umbrella Financial Agreement for the Implementation of the China Sector Plan for the Phaseout of CFC-11 in the Tobacco Sector will be signed between SEPA and UNIDO, hereafter referred to as the Agreement. This Agreement will be similar to UNIDO's umbrella financial agreements for implementing individual projects. However, this Agreement will allow UNIDO to disburse grants to SEPA according to the progress of Annual Program implementation rather than to contractors for the provision of goods and services. The Agreement will come into effect when the following conditions are met:

a) The first Annual Program has been approved by UNIDO and ExCom;
b) SEPA and UNIDO have approved the Project Implementation Manual; and
c) CFC-11 consumption quotas for the Tobacco Sector have been issued by SEPA.

B. Financial Arrangements

8.3 Funds for the Sector Plan will be approved in two steps:

(a) first, SEPA, through UNIDO, requests ExCom to consider this Sector Plan and to agree to fund each Annual Program in accordance with Chapters 5 and 7, provided that the annual phaseout targets and other performance indicators described in Chapter 7 have been met, and

(b) secondly, SEPA, through UNIDO, will submit its funding request to the first meeting of ExCom in each year for the implementation of the Annual Program for that year as of 2000. (The year 2000 is defined as the 12 month period starting on 1 July 2000. Subsequent years are defined similarly.) The annual funding request will be consistent with this Sector Plan. For example, UNIDO, on behalf of SEPA, will submit the 2000 annual program before 15 January 2000 for approval by ExCom by March 2000. SEPA will submit the Annual Program for 2001 to ExCom by 15 January 2001 for approval in the first ExCom meeting of 2001.

8.4 Approval of funds will be based on the achievement of CFC-11 phaseout targets and other performance indicators as agreed in the previous year's Annual Program. The consumption target for 2000 will only be confirmed after the end of the annual program year (30 June 2001). Thus, the 2001 Annual Program funding request would be based on the first semi-annual progress report of the Annual Program for 2000, reflecting progress from 1 July 2000 up to 31 December 2000 and available by 15 January 2001.

8.5 Funding requests for Annual Programs from 2001 to 2005 will be based upon the

achievement of the previous year's CFC-11 phaseout targets and the current year's semi-annual progress report. For instance, approval of the funding request for 2002 annual program will be based upon the phaseout achievement in 2000 and the semi-annual progress report of 2001.

8.6 In the unlikely event that China fails to meet key performance indicators in a given year (CFC-11 consumption exceeds target and/or lack of sufficient progress in installing CO_2 units), UNIDO and SEPA would agree on remedial actions. New funding requests to ExCom will go forward only after phaseout targets are met.

8.7 Remedial actions will be built into the CFC-11 consumption quota system and would take effect if phaseout targets were not achieved. Enterprises consuming CFC-11 in excess of quotas will be penalized in accordance with the quota system, which means that their quotas for the following year will be withdrawn. For example, if an enterprise with a CFC-11 consumption quota of 10 tons consumes 13 tons in 2000, its quota for 2001 will be withdrawn and its CFC-11 consuming expansion plant will be closed immediately. Thus, the excess 3 tons can be offset. The remaining 7 tons will be shared amongst the other enterprises. If according to the Annual Program, this enterprise is one already required to dismantle its equipment in 2001, then 3 tons will be deducted from the total national consumption allowed in 2001. The payment to this enterprise for dismantling/destroying its equipment will be reduced. Other remedial actions will be taken if necessary.

8.8 By the time any over-consumption for a previous year is confirmed, the current year's Annual Program will have already received funding and be well underway. Then, the proposed remedial action is to bring the program back on-track by the end of the current year. That is, cumulative consumption for the previous and current years must not exceed the combined target for these two years. For instance, if the consumption in 2000 exceeds its target, actions would be taken to ensure that the cumulative consumption of 2000 and 2001 does not exceed the total target consumption over this two-year period. Remedial actions taken to ensure this result would be submitted to ExCom along with the funding request for the following year (2002 in the above-mentioned example). ExCom would then be in a position to either approve funds or condition release of funds for the Annual Program of the following year upon evidence that the remedial actions were successful and that the combined two-year consumption did not exceed the combined target. This remedial action allows the momentum of the plan to be maintained and phaseout schedule to be adhered to, even in a particular year when difficulties regarding implementation arise.

8.9 If the combined phaseout target for the two years cannot be met, funds for annual programs of following years may be reduced. Under this plan, grants will be approved for implementing annual programs and advanced through UNIDO to SEPA for achieving specific phaseout targets. As such, SEPA may request use of the funds in spite of delays in meeting the targets. However, if it became clear that a delay was persistent and the phaseout targets could not be achieved within the schedule of Montreal Protocol controls, funds proportional to phaseout shortfalls would be returned to the Multilateral Fund.

8.10 Annual Programs comprise the following components:

(a) schedule and detailed program for CFC-11 phaseout in the Tobacco Sector, including closures, allocation of MLF compensation for closures;
(b) action program for supply of all CO_2 units scheduled to begin implementation that year, allocation of MLF funding for such supply, financing plans and the implementation

status of all projects;

(c) progress report on performance of previous year Annual Program and any agreed remedial actions for current year (not required for the 2000 Annual Program);

(d) performance of current year (not required for the 2000 Annual Program); and

(e) objectives for following year's Annual Program - its phaseout targets, CO_2 units due to be built and funding requirements for each activity, including any substantial changes from overall Sector Plan as approved by ExCom, together with the description of other activities due to occur in the following year, such as policies to be adopted and TA activities.

8.11 UNIDO will approve TA activities consistent with the Annual Program in accordance with agreed terms of reference and TA funds approved under the Annual Program for that year.

After funds for implementing an Annual Program are approved by ExCom and received by UNIDO, UNIDO will transfer the funds to SEPA by depositing them in a separate bank account ("ODS phaseout account") to be set up by SEPA. Funds will be transferred to this account in three tranches:

First Disbursement - 100% of funds for TA and 30% of funds for enterprise activities.

Condition: Annual Program has been approved by ExCom and UNIDO.

Second Disbursement - 60 % of funds for enterprise activities.

Condition: ODS phaseout contracts have been signed with enterprises scheduled to close CFC–11 units, and contract(s) has been signed with enterprise(s) due to start implementation of CO_2 unit(s) that year.

Third Disbursement -- 10 percent of the funds for enterprise activities.

Conditions: UNIDO is satisfied with the progress report and audit result of the current Annual Program; UNIDO agrees the Annual Program of the following year.

8.12 **Disbursement from SEPA's ODS phaseout account to enterprises and agencies** Funds will be used according to the following arrangements:

8.13 Part of the funds (about 25%, excluding TA amount) will be paid to enterprises for dismantling CFC-11 tobacco expansion units under ODS Phaseout Contracts signed by the enterprises, STMA and SEPA. The disbursement mode and amount will be determined by STMA using an agreed formula taking into account the enterprise's CFC quota. The minimum payment for each closure would be set at the remaining value of equipment and dismantling costs.

8.14 Part of the funds (about 75% excluding TA amount) will be paid to the enterprise(s) due to install CO_2 facility(ies) under ODS Phaseout Contracts signed by the enterprises, STMA and SEPA.

8.15 A separate part of the funds as approved by MLF for TA will be paid to agencies undertaking TA projects, as approved by UNIDO.

8.16 SEPA will sign an "ODS phaseout contract" with enterprises implementing closures and installing CO_2 units and a TA contract with relevant agencies. The phaseout contract will be negotiated between STMA and the respective enterprise and then submitted to SEPA for approval, signature and subsequently disbursement of funds. Funds will be disbursed from the

ODS phaseout account to recipients in accordance with the above-mentioned contracts.

8.17 The conditions and amount of disbursements from SEPA to enterprises or agencies are described below:

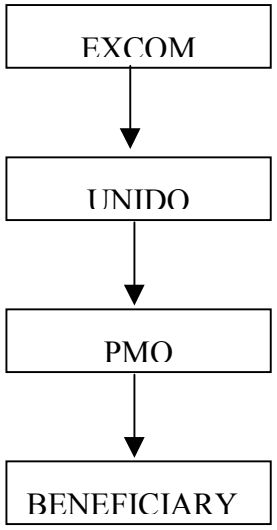
(a) For enterprises that close and dismantle CFC-11 plants—payment conditions of a ODS phaseout contract are:
(i) 30%--upon signing the contract;
(ii) 60%--equipment dismantled and CFC-11 quota reduction confirmed;
(iii) 10%--dismantling/scrapping of equipment confirmed by SEPA and STMA.
(iv) Disbursement requests will be prepared by STMA and submitted to PMO.

(b) For enterprises selected to install CO_2 expansion unit(s) under Annual Program with MLF support:
(i) 20% on signing contract for main equipment supply
(ii) 70% on delivery of equipment
(iii) 10% on operation of equipment
(iv) Disbursement requests will be prepared by STMA and submitted to PMO by STMA.

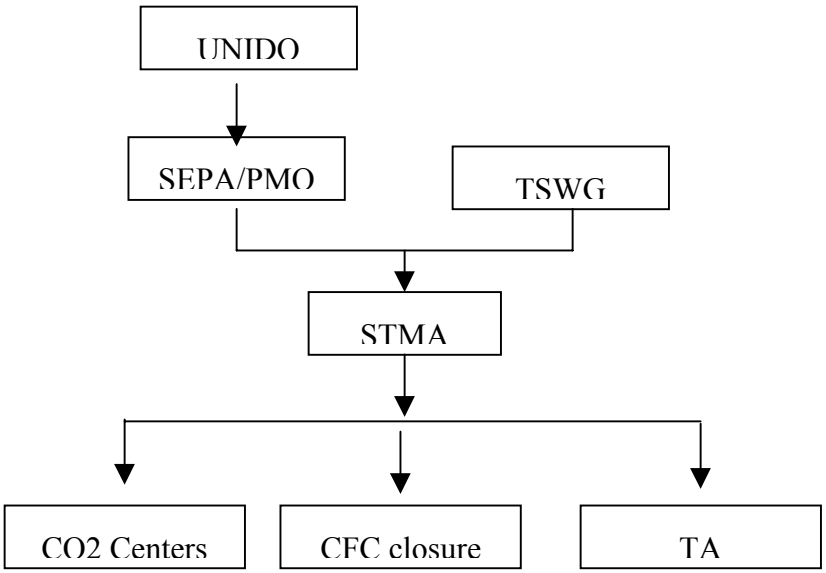
(c) TA activities—payment will be made to agencies that undertake TA projects or training in accordance with the progress of contract execution.

8.18 Thus, use of MLF funds is directly linked to ODS phaseout activities of enterprises as stated in each Annual Program. Payment shall be made only when documentation is available that agreed actions in the ODS Phaseout Contracts are proceeding as scheduled. ODS Phaseout Contracts would be consistent with the Annual Program.

8.19 **Financial Flow Chart**:



Organizational Flow Chart:



C. Roles and Responsibilities

8.20 **Management and Coordination Mechanism** Similar to the mode of execution for the China Sector Plan for Halon Phaseout, the Tobacco Sector Plan will be executed by SEPA, acting on behalf of the Government. Two organizations - SEPA and STMA - will be responsible for formulating and executing each Annual Program. STMA will be responsible for the implementation of each Annual Program.

8.21 Responsibilities of each of the concerned parties are listed below: The Tobacco Sector Plan will be executed by SEPA. SEPA's PMO will manage and coordinate the execution of each year's Annual Program. STMA will be the local implementing agency and will report to PMO and to UNIDO when required. Roles and responsibilities of each key agency are outlined below. Each of these tasks and responsibilities will be explained in detail in the Implementation Manual to be prepared and agreed prior to start of project implementation.

8.22 **UNIDO** will be responsible for overall execution of the Tobacco CFC-11 Phaseout Sector Plan and accomplishment of its objectives as approved by ExCom. UNIDO will:

a) Establish working and reporting arrangements with SEPA and/or STMA;

b) Verify that the conditions under which budgeted funds are released in each Annual Program are accomplished and release the funds to a special ODS account established by SEPA;

c) Conduct all necessary audits and verifications;

d) Participate in the selection of consultants for TA and endorse candidates selected;

e) Review and approve bidding documents for procurement of equipment partially purchased by the project, as well as a short list of qualified equipment vendors;

f) Have access to bid proposals and participate as an observer in the technical and financial evaluation of these proposals conducted by STMA and/or TSWG by a local Procurement Agency acceptable to UNIDO;

g) Review Annual Programs, interact with SEPA, PMO and STMA and, if found acceptable, submit each year's Annual Program to ExCom on behalf of SEPA; and

h) Report to ExCom on implementation progress.

8.1 **SEPA**, through its PMO, will be responsible for overall project management and coordination for the project, including:

a) Set up of a Tobacco Sector Working Group (TSWG) comprised of staff from SEPA/PMO, STMA and selected technical experts from the industry;

b) Set up an implementing and monitoring mechanism as well a computerized data base in English which shall include the status of implementation of the Sector Plan for all (MLF) eligible and non-eligible tobacco enterprises using CFC-11;

c) Report to UNIDO biannually on progress implementation;

d) Request UNIDO to replenish the ODS account, based on agreed expenditures report;

e) Make disbursements requested by STMA and approved by TSWG;

f) Issue CFC-11 use quotas for all tobacco companies (both eligible and non-eligible for MLF compensation) using CFC-11 for tobacco expansion.

g) Monitor CFC-11 quota system;

h) Implement all TA activities with support of STMA;

i) Verify and certify CFC-11 phase-out and disposal of CFC-11 equipment; and.

j) Undertake audits of ODS account and Annual Programs as may be required by the Government, UNIDO and ExCom.

8.1 **STMA** will be responsible for executing the project, with support from PMO and the TSWG as required, to undertake and complete the following:

a) Issue jointly with SEPA quotas for CFC-11 use for all tobacco companies (both eligible and non-eligible for MLF compensation) using CFC-11 for tobacco expansion. The quotas will authorize the companies to use CFC-11 for a period of time in accordance with the CFC-11 phase-out schedule established in the Sector Plan and the Annual Programs;

b) Supervise the yearly consumption of CFC-11 at enterprise level and report to PMO;

c) Prepare, with support from PMO/TSWG, six months in advance, the next year's Annual Program for the Tobacco Sector and submit it to SEPA;

d) Prepare disbursement requests for beneficiaries surrendering their quota and certify that each enterprise has stopped using CFC-11 on agreed schedule and scrapped key items of CFC-11 consuming equipment and submit to PMO;

e) Determine regional or sub-regional enterprises which are due to install CO_2 expansion equipment through bidding system;

f) Request technical assistance to determine the size of the equipment to be installed in the new CO_2 expanding facilities, identify all available potential suppliers, determine civil works to be executed, available buildings, facilities and services, establish a feasible timeframe for purchasing, installing and commissioning the equipment, and prepare bidding documents for purchase of equipment through competitive bidding according to Government procurement guidelines (acceptable to UNIDO);

g) Verify that each selected enterprise has the necessary funds to finance installation of the CO_2 equipment, and that the enterprise has agreed to carry out all necessary alterations to infrastructure, is in a position to purchase auxiliary equipment and services when needed, and will operate the CO_2 facility according to the Sector Plan;

h) Request PMO authorization to proceed with the investment and supervise the bidding process due to be conducted by selected Procurement Agency;

i) Prepare disbursement requests to PMO to release the funds allocated for this purpose, according to the ODS Phaseout Contracts;

j) To release the final payment, STMA shall collect and submit to PMO the CFC-11 enterprise quotas for the annual amount of CFC-11 to be phased-out. (Any excess quotas reduced will be credited to the next year's Annual Program);

k) Report to PMO on status of enterprise project implementation;

l) Visit beneficiary enterprises to check production, conversion status and CFC-11 phased-out;

m) Establish an electronic data-base, and make it available to TSWG, SEPA/PMO and UNIDO, on the status of implementation in each tobacco enterprise;

n) Provide assistance for auditing by SEPA/MOA, the Montreal Protocol Executive Committee and/or UNIDO as may be authorized by them;

o) Report to PMO on technical, managerial, procurement or implementation problems which might arise; and

p) Prepare and submit a final Sector Plan implementation report.

8.1 **UNIDO** will be responsible for supervising implementation of this Sector Plan, replenishing the ODS phaseout account on time, reporting to ExCom on progress and making annual requests to ExCom for each Annual Program.

8.2 **STMA**, with support from PMO, will organize the formulation and implementation of each Annual Program and will make progress reports to PMO regularly. PMO will report to UNIDO on the progress of CFC-11 phaseout in China's Tobacco Sector. Beneficiaries include all enterprises eligible for the receipt of funds and institutions undertaking TA projects. Responsibilities of the respective beneficiaries will be elaborated in their respective ODS Phaseout Contracts or TA contract

D. Supervision and Reporting

8.3 STMA will execute Annual Programs, keep abreast of CFC-11 phaseout progress and submit progress reports to PMO four times a year. PMO will make semi-annual and annual reports to UNIDO. The reports will be prepared in a format agreed by SEPA and UNIDO. UNIDO will report to ExCom on progress under each Annual Program twice a year. Each year the funds request for an Annual Program will be submitted along with a semi-annual report of the current year. The annual progress report will be submitted to the ExCom along with the audit report of UNIDO.

8.4 In accordance with the Agreement, UNIDO will entrust an audit organization with the task of conducting an independent audit of each Annual Program's implementation and an independent financial audit of the ODS phaseout audit during the implementation of this plan. UNIDO will supervise implementation of Annual Programs, including spot check of project records and periodic check on enterprises.

8.5 SEPA will be responsible for conducting a local annual audit according to Chinese regulations for the ODS phaseout account and for implementation of each year's Annual Program. This audit will be carried out by the State Audit Bureau.

8.6 **Disposal of CFC-11 Equipment and Certification** Confirmation of the dismantling/destruction of CFC-11 equipment and certification as specified in the ODS phaseout contracts between SEPA and enterprises should be obtained from an authorized organization. SEPA will be responsible for preparing a completion report for each closure, and confirming that all terms and conditions of the ODS Phaseout Contract, including the disposal of equipment, have been fulfilled. UNIDO will retain the right to carry out factory inspections.

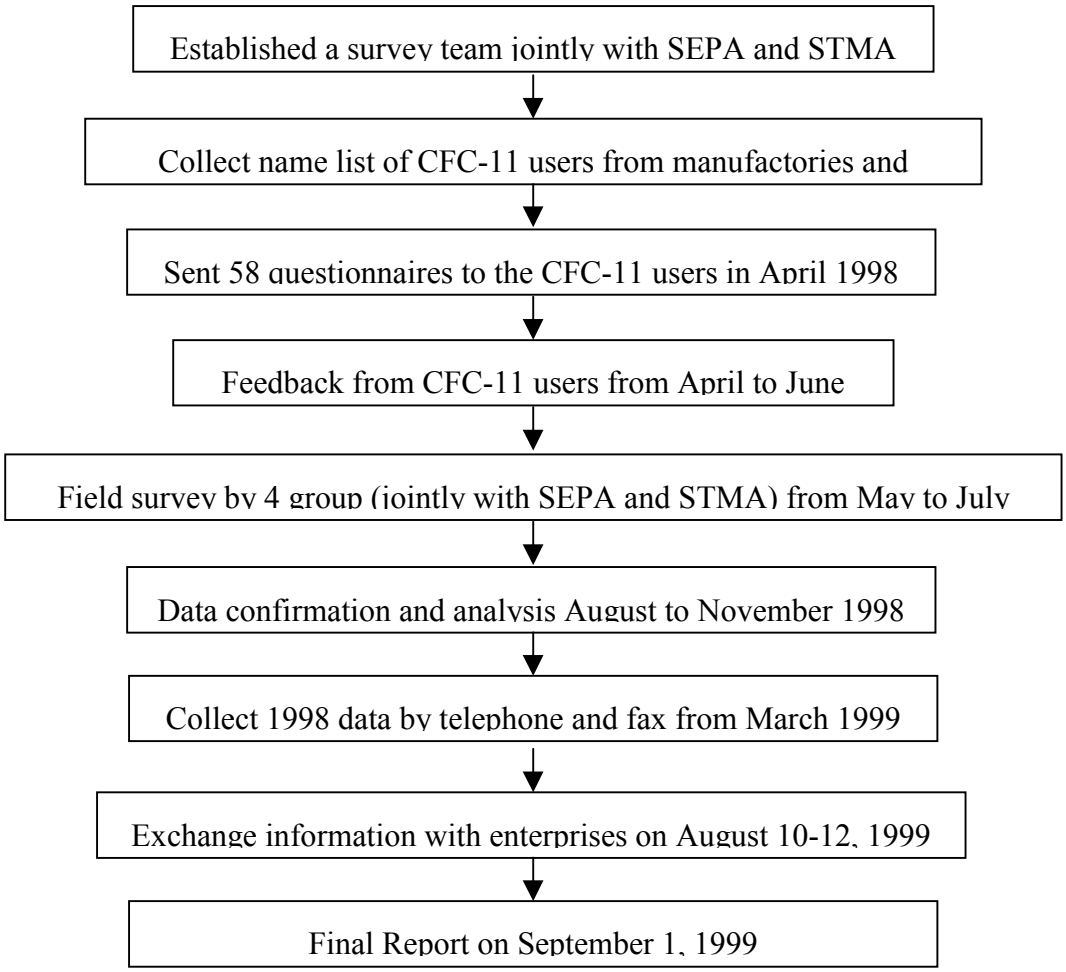
Annex I
CFC-11 Consumption in the Tobacco Sector

Introduction

Objective In order to prepare the Tobacco Sector Plan for Phaseout CFC-11 in China, a survey was conducted by an expert team with the guidance of SEPA and STMA. The survey focused on data collection on use of CFC-11 in 58 CFC-11 consuming tobacco factories in China.

Methodology The first data collection was made between April 1998 to July 1998. For the first set of data collected, questionnaires were sent to factories one month before the field survey. Then the survey groups visited the enterprises to collect both production and financial data relating to CFC-11 consumption, combining data collection with on-site inspection of CFC-11 equipment. Following the field survey, each group prepared a report, which provides the basis of this survey report. From March 1999 to July 1999, the survey team collected and confirmed 1998's CFC-11 consumption by fax and telephone.

The work flow chart is as follows.



Background to the CFC-11 expanded tobacco sector

The State Tobacco Monopoly Administration (STMA) is responsible for the production, sale, import and export of tobacco, tobacco products and tobacco machinery.

Two sets of CFC-11 expansion equipment of G-13C type were first imported from the USA in 1986 and were first used in 1987. The first YP-1 CFC-11 expansion equipment, which was designed and constructed by the Chinese manufacturer and which is similar in technique to the G-13C model went into operation at the end of 1989. These two types of equipment are the only ones being used in China and they have the same production capacity of 180kg/h at 12% moisture. There are two YP-1 equipment manufactories in China: Jilin Chemical Machinery Plant and Beijing Changgao Company. YP-1 equipment is popular in China because it occupies only a small surface area, generates profit quickly after investment and produces expanded tobacco of good quality with high economic efficiency.

According to the equipment capacity, a single G-13C or YP-1 plant can produce about 1500 tons of expanded tobacco with a CFC-11 consumption of 60 tons per annum. The expansion rate is around 70%. When 10% expanded tobacco is added to a blend, the tobacco required is reduced by about 6% and the tar level is decreased by about 1mg.

Survey Results

CFC-11 consumption The survey shows that there are 179 tobacco factories in China of which 58 use CFC-11 expansion processes. Of these, 11 enterprises have more than one CFC unit. There are 70 YP-1 expansion plants and 3 G-13C expansion plants, which are listed in the Appendix. Of the total 73 CFC-11 units, two have never been installed or commissioned due to the Ban on *newly-built equipment which produces or uses ODS* in Nov. 1997[5], six have been installed, but are not currently in operation. Of the total 73 CFC-11 units, 56 units were installed before July 25, 1995 and are thus eligible for MLF support. These 56 units have an aggregate capacity of 54,000 tons per year expanded tobacco（0.18ton/h x 24h x 254 (working days in year) x 90% (operating rate) x 56 lines） and, in 1997, operated at an average of 36% of capacity.

Based on the data survey, the CFC-11 consumption was 803 tons in 1995, 966 tons in 1996, 1090 tons in 1997 and 1003 tons in 1998.

Annex Table 1 shows the consumption of CFC-11 in China's Tobacco Sector between 1995 and 1998.

Annex Table 1 CFC-11 Consumption and Expanded Tobacco Production

CFC-11 consumption (tons)				CFC Units	Amount of expanded tobacco (tons)				Expansion rate (%)
1995	1996	1997	1998	1997	1995	1996	1997	1998	1997
803	966	1090	1003	73	11603	17297	19622	20800	68

[5] Ban: *Notice on banning newly-built equipment which produces or uses ODS*----issued by SEPA, State Planning Committee, State Economic and Trade Committee, and Industrial and Commercial Agency in Nov. 1997.

Initially, most enterprises were not familiar with CFC-11 expansion technology, which resulted in a low operating rate. As enterprises become familiar with the technology however, the operating rate, expansion rate and mixing rate of expanded tobacco will increase. Currently, expansion technology is mature in China, and the consumption of CFC-11 would continue to increase if unconstrained.

Due to the high demand for expanded tobacco and restrictions imposed by the Montreal Protocol, CO_2 technology has already been introduced in China as a main alternative to CFC-11 technology. There are 21 CO_2 expanded tobacco facilities with capacity 17,300kg/h already installed and 5 CO_2 expanded tobacco units with capacity 4,500/kg/h under installation.

Use of expanded tobacco is an important means to reduce tobacco consumption and tar and nicotine content and to improve tobacco quality. Initially, many tobacco factories were cautious in adding expanded tobacco to high-grade cigarettes for fear that taste might be impaired. Thus, enterprises introduced expanded tobacco gradually into their products. Since the mid-1990's, however, production of expanded tobacco has been rising sharply. It is estimated that demand for expanded tobacco and expansion equipment will increase quickly in the future and, therefore, CFC-11 consumption will increase as well. According to STMA's objectives to reduce tar and nicotine by 20% in cigarettes, expanded tobacco production would reach 20% of total tobacco market by 2003. This target would require a production of about 200,000 tons expanded tobacco by 2003. Achieving this ambitious target will be difficult without the installation of additional expansion units and the operation of all existing expansion units at a high efficiency level.

Consumption of CFC-11 in the tobacco industry increased up to 1996 and then remained about constant in 1997 (and 1998). The reasons for this lower growth were:

- Use of CO_2 expansion equipment is increasing rapidly. Due to the restrictions set by the Montreal Protocol, CO_2 expansion equipment has been set up faster than usual, especially after China's ban of new CFC installations in Nov 1997.
- The three largest enterprises accounting for about 40% of tobacco output have already installed CO_2 equipment and phased out use of CFC-based equipment; thus all of their expanded tobacco output is now generated by CO_2 units. Indeed their consumption accounted for a large proportion of the increase in expanded tobacco output in recent years.
- The efficiency of CFC-11 equipment has improved. To reduce use of CFC-11, enterprises have developed production techniques and the use of CFC-11 has been reduced per unit of expanded tobacco produced.

Distribution of CFC-11 consumption CFC-11 consumption is not evenly distributed throughout China. Guizhou, Henan, Hubei and Guangdong provinces have 36 CFC-11 expansion plants and in 1997 consumed 55% of the total CFC-11 used by China's tobacco sector (see Annex Table 2).

Annex Table 2 CFC-11 Consumption in Four Provinces

Provinces	1995		1996		1997		Plant (Sets)
	Tons	Percent %	Tons	Percent %	Tons	Percent %	
Guizhou	242.3	30.2	297.4	30.8	216.6	22.2	7
Henan	77.0	9.6	102.6	10.6	139.8	14.3	12
Hubei	89.9	11.1	110.8	11.5	122.9	12.6	8
Guangdong	59.6	7.4	92.9	9.6	117.7	12.1	9
Subtotal	468.8	58.3	603.7	62.5	597.0	55.0	36
China	803.4	100	966.2	100	1090.0	100	73

Expanded tobacco production by CFC-11 The increased rate of CFC-11 expanded tobacco production stood at about 22% per annum in the years 1995 to 1998. CFC-11 consumption increased by about 8% per annum. Given that expansion rates did not increase between 1995 to 1998, the main reason for the increase in efficiency during this period was improved CFC-11 leakage prevention in the expansion equipment.

Expansion rate The expansion rate of CFC-11 units was around 68%. Most enterprises operated at 60-80%. A few enterprises reported an expansion rate of over 80% or lower than 60%.

Tobacco prices The average price of tobacco was 13.6RMB/kg (1.64$/kg) during 1995-1999. Annual average tobacco prices are shown in Annex Table 3.

Annex Table 3 Tobacco Prices during the period 1995-1999

	1995	1996	1997	1998	1999	Average
Average Prices (RMB/kg)	12.7	14.2	13.6	13.1	14.2	13.6
Average Prices (US$/kg)	1.53	1.71	1.64	1.58	1.72	1.64

Annex Table 4 Data on CFC-11 consumption at Enterprises Level in China's Tobacco Sector

No	Name	Consumption of CFC-11(tons)					Installation		Production of Expanded Tobacco (tons)					Price of Tobacco (RMB/kg)					Expanded Rate(%)				
		95	96	97	98	(99)	Set	Date	95	96	97	98	(99)	95	96	97	98	(99)	95	96	97	98	(99)
1	Zheng Zhou	31.0	29.6	11.8	15.9	14.4	1	93-5	322	348	374	413	467		18.7	18.7	20.0	20.0	58	58	59	58	59
				11.8	15.9	14.4	1	93-5	322	348	374	413	467		18.7	18.7	20.0	20.0	58	58	59	58	59
				11.8	15.9	14.4	1	93-5	322	348	374	413	467		18.7	18.7	20.0	20.0	58	58	59	58	59
2	Zhu Ma Dian	19.6	24.5	41.0	26.0	36.0	1	92-12	476	682	952	777	777	10.0	16.3	16.3	16.3	16.3	67	67	67	67	67
3	Luo Yang			7.6	11.9	12.3	1	96-12			171	297	322			6.0	6.0	6.0			70	64	70
				3.9	11.9	12.3	1	96-12			85	297	322			6.0	6.0	6.0			70	64	70
4	An Yang	0.0	2.5	9.7	18.9	29.0	1	95-9		34	397	309	486		6.5	10.7	15.0	15.0		70	70	70	70
						29.0	1	97-10					486					15.0					70
5	Luo He	11.0	30.0	12.5	10.0	15.0	1	94-10	125	357	304	410	500	15.0	15.6	15.2	14.5	14.3	50	70	70	70	70
				12.5	10.0	15.0	1	94-10	125	357	304	410	500	15.0	15.6	15.2	14.5	14.3	50	70	70	70	70
6	Nu Zhou	5.9	5.0	9.2	16.3	15.2	1	94-9	198	170	338	303	293	6.3	9.8	10.1	9.9	9.9	75	75	75	75	75
7	Kai Feng	9.6	10.9	6.0	3.0	3.0	1	92-8	275	276	164	54	90	10.0	10.0	10.0	10.0	10.0	65	65	67	70	70
8	Shao Guan	27.4	38.5	34.0	31.0	42.0	1	91-12	451	626	735	700	1000						75	76	78	78	80
							1	94-9															
9	Nan Xiong	0.0	5.3	12.6	12.9	13.3	1	95-6		121	305	313	320		13.8	14.2	14.6	14.6		77	76	76	76
10	Zhan Jiang	17.0	20.6	23.2	22.7	21.0	1	93-12	376	438	341	369	497	11.7	11.7	11.7	11.7	18.5	73	73	73	74	74
						9.3	1	98-8					250					18.9					74
11	Lian Jiang	0.0	1.0	5.0	2.7	4.7	1	95-6		42	185	103	180		12.1	11.9	11.8	11.8		70	70	70	70

No	Name	Consumption of CFC-11(tons)					Installation		Production of Expanded Tobacco (tons)					Price of Tobacco (RMB/kg)					Expanded Rate(%)				
12	Hai Nan	0.0	0.0	4.6	11.5	15.0	1	92-9			91	299	400			26.6	14.5	20.5			70	70	70
13	Meng Zhou	14.6	18.7	25.5	16.2	21.9	1	93-10	397	470	425	420	407	9.7	10.1	11.3	13.1	13.5	75	75	72	75	76
14	Nan Hai	0.6	8.8	12.2	14.2	14.6	1	92-3	10	153	275	372	384	7.9	7.9	9.2	6.1	7.0	60	60	60	60	60
15	Gui Yang	217.0	261.8	172.5	149.3	160.0	2	92-10	1961	2314	1879	1878	2146		15.6	16.1	15.7	14.7				60	57
16	Gui Ding	0.0	0.0	3.6	29.0	32.0	1	96-10			51	380	400			8.5	8.5	8.5			57	64	68
17	Gui Ding 2	2.4	6.6	14.4	15.3	15.0	1	92-9	66	245	323	348	350	13.3	14.3	12.0	12.9	13.4	60	65	68	70	70
18	Tong Nen	14.5	29.0	6.3		15.0	1	91-8	224	388	3		225	8.1	13.0	12.6		11.8	72	69	72		68
19	Zhun Yi	0.0	0.0	19.0	33.7	32.7	1	96-8			254	577	566			15.0	15.0	15.0			70	70	70
20	Bi Jie	8.4	0.0		5.2	18.0	1	93-10	255			158	545				19.5	19.5	84			85	85
21	Wu Han	41.7	48.0	43.0			1	92-4	311	368	612			7.0	7.2				49	49	49		
22	Li Chuan	6.1	1.4	25.0		2.4	1	92-4	203	254	335		32	15.0	15.0	15.0		15.0	70	70	70		70
23	Zhao Yang	0.0	7.6	21.8	23.0	13.0	1	92-3		162	387	427	189		11.1	5.4	4.2	4.2					
24	Hong An	6.7	7.0	12.0	18.0	19.0	1	92-3	62	167	250	190	200	16.4	16.4	16.4	16.4	16.4	63	65	65	65	66
25	Guang Shui	5.9	1.2	2.6	6.2	6.2	1	92-6	14	18	32	68	77						60	60	64	65	65
26	Dang Yang	12.3	19.1	16.9	12.6	13.9	1	92-9	298	407	310	362	310	5.0	5.5	6.0	6.5	7.0	62	61	51	47	52
27	Xiang Fan	11.5	20.3	23.0	28.1	28.0	1	92-3	260	356	322	274	285						56	57	48	47	50
28	Xian Nin	5.6	6.2	6.4	9.8	11.1	1	93-2	170	172	168	234	273	17.5	17.5	17.5	17.5	17.0	70	70	70	72	72
30	He Fei	0.0	0.0	5.2	13.0	13.5	1	96-12	0	0	128	213	220			10.0	10.0	11.0			85	85	85
31	Hu Yang	0.0	0.0	0.0	7.0	15.0	1	97-10	0	0	0	150	330				7.0	8.0				65	65
32	Ben Bu	28.0	27.5	20.5			1	92-12	870	890	700			8.0	8.0	8.0			66	68	70		
33	Wu Hu	0.0	0.0	5.0	15.0	6.0	1	96-12	0	0	87	432	110			8.0	7.0	10.0			51	51	51

No	Name	Consumption of CFC-11(tons)					Installation		Production of Expanded Tobacco (tons)					Price of Tobacco (RMB/kg)					Expanded Rate(%)				
				3.0	15.0	4.0	1	96-12	0	0	43	432	66			8.0	7.0	10.0			51	51	51
34	Xia Men	14.0	24.0	24.0	15.5	14.0	1	92-4	250	483	510	488	540			20.6	20.7	20.7	75	74	73	70	70
				9.0	15.5	14.0	1	96-7	0	0	179	489	540			20.6	20.7	20.7			73	70	70
35	Long Yan	20.3	42.0	24.3	20.0	20.0	1	92-9	48	279	397	388	500	15.8	21.6	15.3	11.2	13.4	70	70	70	70	70
				23.3	13.8	20.0	1	95-3	0	104	180	178	200		21.6	15.3	11.2	13.4		70	70	70	70
36	Shi Jia Zhang	0.0	0.0	6.5	13.8	20.0	1	92-4	0	0	92	285	362			15.0	15.0	15.0			50	60	60
37	Zhang Jia Kou	139.7	87.6	67.3	37.7		3	91-6		1145	880	545					8.7						
29	Beijing	15.6	10.8	11.8	9.9	12.1	1	90-4	455	425	411	465	566	13.8	13.9	18.3	18.5	19.0	72	72	72	72	72
48	Tianjing	21.0	19.2	31.0	17.5	5.0	1	92-6	430	399	636	471	120	10.0	10.0	10.0	10.0	10.0	78	78	79	78	78
56	Chang Chun			5.8	0.0	0.0	2	85-1	203	195	226	0	0								70	70	70
54	Yan Ji			9.0	20.0	21.0	1	92-1	0	0	225	483	520			14.5	14.5	14.5			55	55	55
43	Si Ping			0.9	6.8	6.0	1	92-2	0	0	13	78	78			5.5	6.2	5.5			72	70	65
46	Haerbing	38.0	14.6	14.1	8.1	10.0	1	92-1	60	175	168	63	125	6.1	9.8	13.1	13.5	13.0	55	55	55	55	55
47	Sheng Yang			0.0	0.0	3.0	1	92-9	0	0	0	0	105					10.0					70
38	Hai Yin	10.5	4.8	0.0	0.0	6.2	1	90-12	201	110	0	0	172	14.2	14.5	0.0	0.0	17.0	72	68	0	0	70
39	Xu Zhou	6.0	6.0	25.0	21.0	24.0	1	91-1	140	144	430	396	475			17.0	17.0	17.0			70	70	70
40	Chen Du	0.0	1.5	6.8			1	96-5	0	0	150												
41	Mian Yang	0.0	0.0	4.7			1	95-11	0	0	174												
42	Chong Qing	0.0	0.2	8.5	1.5		1	92-10	18	12	40	6		22.6	23.8	22.6	12.7		60	60	60	60	
44	Huhehaote	0.0	2.8	26.0	13.1	20.0	1	92-11	0	0	396	317	355							60	65	68	

No	Name	Consumption of CFC-11(tons)					Installation		Production of Expanded Tobacco (tons)					Price of Tobacco (RMB/kg)					Expanded Rate(%)				
45	Wulanbato			0.0	0.0	4.0	1	97-10	0	0	0	0	126					8.4					68
49	Lan Zhou			0.8	15.6	18.0	1	97-1	0	0	20	390	450			30.0	30.0	30.0			71	70	70
55	Tian Shui			7.9	11.0	13.0	1	96-10	0	0	222	310	350			5.7	5.7	5.7			72	40	45
53	Xin Jiang	6.2	13.5	21.5			1																
50	Liou Zhou	4.6	17.7	16.2	15.1	25.0	1	92-10		440	387	368	757	12.6	12.8	11.5	12.1	16.3		80	80	80	80
51	Nan Chang	3.0	20.0	20.0	11.9	14.0	1	92-10	0	244	279	270	270		12.0	12.0	12.0	12.0		70	70	70	70
52	Hang Zhou	27.9	70.4	22.3	30.2	22.8	1	87-10	658	1104	566	772	583	21.4	22.9	19.9	19.9	21.3	95	91	89	92	86
				22.3	30.2	22.8	1	90-8	658	1104	566	772	583	21.4	22.9	19.9	19.9	21.3	95	91	89	92	86
57	Xiamen Huamei			11.3	11.5	12.5	1		215	227	184	215						22.5	55	60	66	66	
58	Shengzheng			15.1	16.0	19.0	1	90-5	175	198	216	259	320	15.6	16.3	17.2	17.0	16.5	75	75	75	72	70
Total/Average		803	966	1090	1003	1103	73		11603	17297	19622	20800	23035	12.7	14.2	13.6	13.1	14.2	67	68	66	66	68

Annex II

Cost Analysis of CFC-11 Phaseout in the Tobacco Sector

Basis of the analysis

Analysis of the incremental cost of converting CFC-11 facilities to CO_2 facilities, given the current usage of CFC-11 and CO_2, is based on the following considerations:

a) Substitute technology is CO_2 with a capacity of 570 kg/h or 1150 kg/h expanded tobacco.
b) Total capacity of CO_2 equipment eligible for calculated incremental cost is the same as the total capacity of CFC-11 expanded equipment installed before July 1995. (There is no ineligible portion due to foreign ownership and product export.)
c) No subassembly of CFC-11 equipment can be used for CO_2 equipment.
d) Incremental operating cost is based on the eligible consumption of CFC-11 in the baseline year.
e) Costs for land and buildings required for CO_2 units are not included in the eligible incremental cost calculation.
f) Average tobacco expansion rates are 70% and 80% for CFC-11 and CO_2 units respectively. Average loss of tobacco for CFC-11 units is 1%; tobacco loss for CO_2 units at an 80% expansion rate is 2%.
g) Eligible capital costs include the cost of equipment installation plus 5% contingency.
h) Baseline year is 1997.
i) Discount rate is 10% per year.
j) The inflation rate used to calculate conversion cost in future years is set at 2.5% per year.
k) Methodology for calculating incremental cost is same as given in UNEP/OzL.Pro/ExCom/20/64:

$$EIC = (CC - NPV(FI)) + NPV(FB_b - FB_p)$$

where

CC is the capital cost of the conversion project,

FI is future baseline investments (which would occur in the absence of the conversion),

Fb_b is future baseline benefits (which would occur in the absence of the conversion),

Fb_p is future benefits of the conversion project, and

NPV refers to the net present value of the costs/benefit stream.

Key Parameters and Phaseout Schedule

Annex Table 5 Key Parameters for Calculation

Unit capacity of CFC-11 equipment	180 KG/H
Number of sets of CFC-11 equipment in 1997	73 sets
Number of sets of CFC-11 equipment eligible for funding by MLF	56 sets
Consumption of CFC-11 in 1997	1090 tons
Eligible consumption in 1997	980 tons

Annex Table 6 CFC-11 Phaseout Schedule (tons)

	1997	1999	2000	2001	2002	2003	2004	2005	2006
Consumption of CFC-11	1090	Not controlled	1,000	880	700	500	300	150	0
Phaseout Amount			90	120	180	200	200	150	150

Base Case

According to the phaseout strategy of the Tobacco Sector Plan, the base case for the phaseout of CFC-11 consumption in the Tobacco Sector in China will be to replace all CFC-11 equipment with 4 CO_2 units with capacity 1,140 kg/h per unit and 9 CO_2 units with capacity 570 kg/h per unit. The expansion rate for CO_2 is 80% at national level and operating cost savings are calculated over a period of 15 years (scenario A).

Capital cost for CO_2 expansion equipment

Annex Table 7 One-off cost of CO_2 equipment

Item CO_2 unit	Cost (RMB1,000)	Cost (US$1,000)	Cost for 5% contingency (US$1,000)
570 kg/hr	47,000	5,676	284
1150 kg/hr	68,000	8,212	411
4 large + 9 small	695,000	83,937	4,197

Operating cost

The basic parameters for calculating incremental operating cost are shown in Annex Table 6. The following are key calculations:

Input tobacco: To produce an output of 1 kg expanded tobacco, input tobacco for CFC-11 unit is 1.01kg. For a CO_2 unit at 80% expansion rate input needs to be 1.01 / (1+1%) x (1+70%) / (1+80%) x (1+2%).

Incremental operating cost for 15 years = incremental operating cost for one year x 8.37

The operating cost comparison is given in Annex Table 6. The incremental operating cost is $9,143 for phasing out 1 ton CFC-11 with saving calculated over 15 years.

Several sensitivity tests have been conducted including: (1) 90% expansion rate with 3%

tobacco loss for CO_2; (2) 100% expansion rate with 4.5% tobacco loss; (3) future operating cost/saving calculated over 4 years.

Supporting Capital Cost for CO_2 Expansion Units

In order to install tobacco expansion equipment using CO_2 technology, enterprises must first increase power supply and invest in land and buildings. The total cost for these ancillary facilities is about US$ 1.5 million per enterprise. This cost has been included in the total incremental cost to China, but it is excluded in the calculation of eligible investment cost.

Saving on Future Baseline Investment

It is assumed that a CO_2 unit has the same average lifetime as a CFC-11 unit. If CFC-11 units are converted to CO_2 units, the entire expanded tobacco sector will benefit from several years' extended lifetime for expansion equipment. (It is assumed the extra lifetime will be approx. 7 years). If CFC-11 units remain in place, however, enterprises would need to invest in new tobacco expansion equipment at the end of the current lifetime of these units. This 7 years' extra lifetime therefore represents a saving on future baseline investment.

The total investment cost for the current 56 CFC-11 eligible units is about 13.440 million US$ (240,000 x 56 US$). In order to extend the lifetime of the CFC-11 units by 7 years, a total investment of 50% of total replacement investment cost (13.440 million US$) would need to be made, or about 6.720 million US$ in the year 2007. The net value in 2003 for the saving made on future baseline investment is about US$4.17 million.

Annex Table 8 Operating cost comparison on per kg expanded tobacco output

Production Data	Unit	CFC-11	CO_2				
Equipment capacity	Kg/h	180	570/1150				
Expansion ratio		70%	80%				
Utilities	Unit	Amount needed		Unitary cost	Total cost		
		CFC-11	CO_2	US$	CFC-11	CO_2	
CFC-11	kg	0.050		1.360	0.068		
CO_2	kg		0.200	0.280		0.056	
Compressed air	m^3	0.018	0.045	0.210	0.004	0.009	
Steam	kg	1.469	0.877	0.012	0.018	0.011	
Water	l	9.900	5.000	0.001	0.004	0.002	
Natural gas	kg	0.020	0.053	0.170	0.003	0.009	
Electricity	kWh	0.250	0.785	0.105	0.026	0.082	
Tobacco	kg	1.000	1.000	2.000	2.000	2.000	
Total operating cost per unit	US$/kg				2.124	2.170	

- CFC-11 price (inc. VAT) is the five-year average price recorded in the CFC production sector.
- CO_2 price is between US$150-400 /ton in China; the price used here is an estimated average price.
- The prices of electricity, water, nature gas also vary widely; figures used here are estimated average prices.
- Price of tobacco is assumed $2/kg. (Actual price is US$1.64/kg.)

Annex Table 9 Incremental Operating Costs for Phaseout of 1 ton CFC-11

	Unit	CFC-11	CO_2
Expansion ratio		70%	80%
Loss of tobacco		1.0%	2.0%
Input tobacco	kg	20,200	19,267
Total production cost	US$	42,897	41,804
Incremental cost per year	US$/yr		-1,093
NPV (4 years)			-3,810
NPV (15 years)			-9,143

Total Incremental Cost

Based on the above analysis, total phaseout costs for CFC-11 in the Tobacco Sector are summarized in Annex Table 10. EIC costs represent the amount of funds eligible for incremental costs as defined by ExCom guidelines. Costs in Annex Table 10 are expressed in 1999 constant dollars. Costs in Annex Table 11 are expressed in current dollars with inflation at 2.5% per year.

Eligible incremental costs for tobacco sector phaseout are US$ 77,000,000 in constant terms (Annex Table 10) or US$ 82,800,000 in current terms (including inflation).

Annex Table 10 Incremental Cost for Base Case (constant 1999 US$ 1,000)

	Total incremental cost	Eligible incremental cost
Investment for CO_2 units	83,937	83,937
Contingency on capital cost	4,197	4,197
Cost of conversion for land, building and other supports	13,500	
Subtotal of investment cost	101,634	88,134
Incremental operating cost	-8,960	-8,960
Saving on future baseline investment	-3,135	-3,135
Subtotal of cost of conversion	89,539	76,039
TA	970	970
Total	90,500	77,000

Annex Table 11 Eligible Incremental Cost for Phaseout CFC-11 in Tobacco Sector (current US$1,000)

	Total	2000	2001	2002	2003	2004	2005	2006
Consumption		1,000	880	700	500	300	150	0
Phaseout Amount		90	120	180	200	200	150	150
One-off investment incremental cost	91,189	16,576	14,563	16,586	17,000	13,069	13,396	0
Incremental operating cost	(9,734)	(1,769)	(1,555)	(1,770)	(1,815)	(1,395)	(1,430)	
Contingency for capital cost	4,559	829	728	829	850	653	670	
Saving on future baseline investment	(4,173)	0	0	0	(4,173)	0	0	0
TA	1,000	400	400	100	100	0	0	
Total incremental cost	82,800	16,000	14,100	15,700	12,000	12,300	12,600	0

Sensitivity tests

Given that growth in demand for expanded tobacco, the phaseout schedule of CFC-11 and the alternative technology chosen have relatively little effect on incremental costs, several sensitivity tests were undertaken to evaluate the effect of expansion rate and the period over which operating costs are calculated. The sensitivity test scenarios and results are summarized in the tables below. Incremental costs included in Annex Table 12 are only one-off investment costs and operating costs. All costs are in constant dollars.

Annex Table 12 Sensitivity Test Scenarios

Scenario	Description
A	Base case, CFC-11 expanded equipment replaced with 4 large (1150kg/h) CO_2 expanded units and 9 small (570/kg/h) CO_2 expanded units. Expansion rate for CO_2 is 80% and for CFC-11 is 70%. Total period over which incremental costs are calculated is 15 years.
B	The expansion rate for CO_2 is 90%, tobacco loss is 3%, other parameters are the same as in scenario A.
C	The expansion rate for CO_2 is 100%, tobacco loss is 4.5%, other parameters are the same as in scenario A.
D	Total period over which incremental costs are calculated is 4 years. Other parameters are the same as in scenario A.
E	The price of tobacco is increased 20%; the other parameters are the same as in scenario A.
F	Project by project approach, to build 17 small CO_2 expansion units rather than 4 large plus 9 small CO_2 units, the other parameters are the same as in scenario A.

Annex Table 13 Sensitivity Test on Incremental Costs (constant US$1,000)

Scenario	Total Incremental Cost of Conversion	Incremental Cost of Investment	Incremental Cost of Operation
A	79,914	88,134	-8,960
B	64,317	88,134	-23,817
C	52,458	88,134	-35,676
D	84,400	88,134	-3,734
E	76,113	88,134	-12,021
F	92,362	101,322	-8,960

*Additional transport costs would be incurred due to centralization, but this cost is not included here.