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COUNTRY PROGRAMME AMENDMENT: CHINA

This document consists of:

- Comments and Recommendation of the Fund Secretariat
- Country Programme Amendment for China

COMMENTS AND RECOMMENDATION FROM THE FUND SECRETARIAT

COMMENTS

1. The objective of the Amendment is to include in the Country Programme the consumption of the ODS in the sector of tobacco expansion, a sector which is missing in the approved country programme.

2. The document begins with a description of CFC-11 consumption and future projection in the tobacco sector in China, including structure of the tobacco industry, current situation of tobacco expansion units and an estimate of the unconstrained demand for CFC-11 expansion equipment. Then the programme of the Government for a step-by-step elimination of CFC-11 and its implementation is presented, with an analysis of technological alternatives and strategy for phasing out CFC-11 in the tobacco sector and options for phase-out strategy. Following that, the Amendment gives a schedule of actions to be implemented and the administrative organization and structure of the Chinese tobacco sector. At the conclusion of the document, a list of investment projects is proposed.

3. CFC-11 has so far been used to expand tobacco as a means to improving the quality of the cigarettes and reducing the consumption of the tobacco used. Currently, 70 tobacco expansion units are installed in the country, each consuming 30 metric tonnes (MT) of CFC-11 annually. Therefore, the total current consumption in this sector is 2,100 MT. However, an unconstrained scenario of tobacco expansion can bring the number of expansion units to 300, consuming 9,000 MT of CFC-11 by the year 2000.

4. The Government of China has decided to phase-out CFC-11 in the tobacco sector. Due to the urgent demand for tobacco expansion units between 1994-96, the Government will permit the number of CFC expansion units to increase from 70 in 1993 to 100 in 1996, with the corresponding increasing of CFC-11 consumption from 2,100 MT to 3,000 MT.

5. In 1997, the production of CFC-11 expansion units will stop, starting the CFC-11 phase-out. By the year 2005, all the existing CFC expansion units will have been eliminated and complete the phase-out in this sector. In terms of funding requests, the Government has decided to use the 70 CFC expansion units existing in 1993 as the basis.

6. The chosen technology is using CO_2 as substitute for CFC-11 for tobacco expansion. The technology is proven and commercially available.

7. The Amendment compares four options of implementing the strategy, i.e. import CO_2 expansion units, secure technology transfer and local manufacture of CO_2 expansion units, and combinations of the two. The result is in favour of secure technology and local manufacture of CO_2 expansion machines of a capacity of 360 kg/hr. on the grounds of cost-effectiveness and meeting the future needs of the other 64 medium-sized and 62 small-sized cigarette factories for tobacco expansion machinery.

8. The estimated incremental costs for implementing the phase out programme in the sector are US $94.4 million. This includes the incremental capital costs (including the cost of patent rights and production license) and incremental operating costs.

RECOMMENDATION

The Fund Secretariat recommends as follows:

9. To approve the Amendment to the Country Programme of China. Approval of the amendment does not denote approval of the projects therein or their funding levels.

AMENDMENT TO THE PEOPLE'S REPUBLIC OF CHINA COUNTRY PROGRAMME FOR PHASING OUT OZONE DEPLETING SUBSTANCES

Executive summary

Tobacco expansion sector in China: PRC's tobacco industry consists of 180 cigarette and cigar factories. The total cigarette output is 32 million cases and the tobacco consumption is 1.6 million MT per year (a case consists of 50,000 cigarettes or approximately 50 kg tobacco). Tobacco expansion is an important part of the cigarette making technology. Blending a certain proportion of expanded tobacco in cigarettes, not only improves the taste of smoking and the quality of the cigarette, but also reduces the amount of tobacco used per cigarette.

The number of CFC expansion units in PRC is 70 at the end of 1993. Their annual CFC-11 consumption is 2,100 MT. China consumes 1.6 million MT of tobacco annually. Supposing that the calculation is based on blending 10 per cent of the expanded tobacco in cigarettes, 160,000 MT of expanded tobacco is required annually. Therefore, an unconstrained scenario of tobacco expansion can reach 300 expansion plants consuming 9,000 MT of CFC-11 annually. The percentage of ODS consumption of the tobacco sector to the country total will, therefore, increase from 1.9 per cent in 1991 to 7.1 per cent in 1996 and to 7.8 per cent in 2000. This ratio indicates that ODS consumption in the tobacco sector should be taken into account.

Selection of technology: At present, the well-established, commercially available and CFC-free tobacco expansion technology is the $C0_2$ (carbon dioxide) expansion technology. China National Tobacco Corporation (CNTC) has recently imported $C0_2$ tobacco expansion equipment . Based on availability and positive experience, PRC has decided to select the $C0_2$ expansion technology to replace present CFC-11 tobacco expansion equipment and to eliminate the CFC consumption in the tobacco sector.

Strategy of phase-out: Presently, there are 70 YP-1 units installed in China and their annual consumption of CFC-11 is 2,100 MT. These 70 YP-1 units can by no means satisfy the urgent demand for tobacco expansion equipment of cigarette factories. In order to meet the urgent demand for expansion units during that period, the Chinese Government will permit increasing the number of YP-1 units from 70 in 1993 to 100 in 1996. That is, during the period 1994-96, the annual consumption of CFC-11 in the tobacco sector will increase to 3,000 MT.

Phaseout of CFC-11 will start in 1997 and by the year 2005, all YP-1 equipment will be phased out and the CFC-11 consumption will be zero. In this regard, the Chinese Government fully realizes the significance of ozone layer protection and the need to share the responsibility. Therefore, China's Leading Group for Ozone Layer Protection recommends that while committing to full elimination of CFC-11 in the tobacco sector, China applies for grants from the Multilateral Fund for the incremental cost of phasing out 70 CFC expansion units which are operational at the end of 1993.

Selection of equipment size: Presently, $C0_2$ expansion units with a capacity of around 567 kg/h are available from manufacturers in the USA, the UK and Italy. If the $C0_2$ expansion equipment is freely imported to replace the existing and potential CFC expansion units, the consumption of CFC-11 would be reduced quickly. However, the investment cost is very high (in the region of US$432 million. But

such a strategy can not solve the problem completely, since China has an additional 64 medium-sized cigarette factories with annual production of 100-300,000 cases and 62 small factories with annual production of less than 100,000 cases. These medium- and small-sized cigarette factories also need $C0_2$ expansion equipment but with smaller capacity.

Small-to-medium scale $C0_2$ tobacco expansion equipment is not commercially available. However, international suppliers believe that the large-sized expansion equipment, for example with a capacity of 360 kg/h, could easily be scaled-down or redesigned and developed to suit the needs of the Chinese market. Further, the very large size of the Chinese market raises sufficient interest on the part of the international suppliers of $C0_2$ equipment to develop and produce medium-scale equipment.

Options for implementation plan: The most effective way to develop and manufacture the $C0_2$ expansion equipment with 360 kg/h capacity seems to be designing and developing the equipment by joint efforts and close cooperation of both foreign and Chinese experts and companies. It further seems possible to secure patent rights and production license by combining the technology transfer with trade. For example, three sets of $C0_2$ expansion units with 360 kg/h capacity can be ordered from an international supplier with the condition that the patent rights and production license are issued to CNTC. For this route, the cost of one imported $C0_2$ expansion unit of 360 kg/h capacity is estimated at US$4.8 million, while each Chinese-built equipment would cost about US$2.8 million. Each 360 kg/h CO_2 unit will replace two YP-1 units.

Various options can be considered to phase out 70 sets of CFC-11 expansion equipment in China. Among these options, so-called Option 4 is preferred on the basis of a cost/benefit analysis. According to this option, for all factories, large or small, technology transfer of 360 kg/h CO_2 unit will be secured and all YP-1 units will be replaced with locally produced $C0_2$ equipment. Factories with large production capacity, would receive more than one replacement unit. This project will be implemented in two phases: Incremental investment cost of Phase I is US$ 17.6 million and involves the importation of 3 units while transferring the technology. Investment cost of Phase II is calculated at US$ 76.8 million and envisages the local production of 32 sets.

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List of Exhibits

1. Introduction

The People's Republic of China qualifies as a party operating under Paragraph 1 of Article 5 of the amended Montreal Protocol. PRC ratified the Vienna Convention for Ozone Layer Protection in September 1989 and the Montreal Protocol on Substances that Deplete the Ozone Layer (hereafter referred to as the Protocol) in June 1991. In accordance with the guidelines of the Montreal Protocol, PRC prepared its Country Program for the Phaseout of Ozone Depleting Substances, ODS, (hereafter referred to as CP) in 1992. The CP was approved by the PRC's State Council in January 1993 and by the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol (hereafter referred to as the Multilateral Fund) in March 1993. The approved CP did not, however, include the tobacco expansion sector which further research has revealed is a large consumer of ODS. This CP Amendment is, therefore, specifically designed to implement the Protocol in the tobacco sector.

This Amendment describes the current consumption of CFC-11 in PRC's tobacco sector; the trends of development; the estimated unconstrained consumption of CFC-11 by the year 2005; the technical problems; and the proposed programme for phasing out ODS in the tobacco sector.

Tobacco and its products are special kinds of expendable goods and the tobacco sector has its own characteristics described as follows: First, cigarette smoking is harmful to the human body, but on the other hand it has many consumers. The Chinese Government widely publizes that smoking is harmful for the health, but there are approximately 300 million smokers in PRC and it is almost impossible to stop smoking in a short period. Therefore, not only should the output quantity of tobacco products be controlled, but also the demand for cigarettes should be met while the trends should be actively detracted and the harmful factors of smoking should be reduced. Second, in order to restrict smoking, each country levies heavy taxes on tobacco and its products. The Chinese Government is also carrying out the policy of "trying to prohibit a business by taxing it heavily." Therefore, the tax revenue from tobacco and its products has become one of the most important sources of finance for the state. Therefore, the tobacco sector in PRC bears the task of both satisfying consumers' demand for cigarettes as well as accumulating development and construction capital for the country.

In order to comply with regulations of the Protocol and meet the set targets, ODS should be eliminated from the tobacco sector. This effort which includes using substitute processes to replace present ODS-based tobacco expansion equipment, developing new expansion media, and implementing the phaseout strategy by new technology and equipment, must be technically and financially supported by the international community.

Led by the China Leading Group for Ozone Layer Protection and coordinated by the National Environmental Protection Authority (NEPA), this Amendment was compiled by an expert group consisted of four experts from the Environmental Science Center of Peking University and the China National Tobacco Corporation (CNTC), respectively. The Amendment was prepared by following to the format and contents of the CP and was based on "Tobacco Sector Programme for Phasing out Ozone Depleting Substances" supplied by the CNTC. The compiling programme was also supported by UNIDO.

2. CFC-11 consumption and future projections in PRC's tobacco sector

2.1 Structure of tobacco industry

PRC's tobacco industry consists of 180 cigarette and cigar factories. The total cigarette output is 32 million cases and the tobacco consumption is 1.6 million MT per year. Of the 180 factories, 54 have the capacity for producing more than 300,000 cases of cigarettes per year; 64 between 100,000-300,000 cases and the rest less than 100,000 cases. A province-by-province breakdown of these factories, indicating the output amounts are summarized in Exhibits 1 and 2.

Compared to foreign cigarette factories, the number and size of the Chinese cigarette factories are very different. This is a result of the development level of the Chinese economy and it is not expected that the size of cigarette factories will change in the near future.

Exhibit 1. Cigarette production by province

PROVINCE	NUMBER OF ENTERPRISES	PRODUCTION 1000 CASES
ANHUI	8	2,060
BEIJING	1	140
FUJIAN	6	850
GANSU	4	290
GUANGDONG	8	1,530
GUANXI	7	1,040
GUIZHOU	8	2,030
HAINAN	1	100
HEBEI	3	1,170
HEILONGJIANG	6	760
HENAN	16	3,000
HUBEI	11	2,160
HUNAN	9	2,360
INNER MONGOLIA	2	290
JIANGSU	3	810
JIANGXI	2	500
JILIN	3	660
LIAONING	4	450
NINGXIA	1	50
QUINGHAI	1	30
SHAANXI	6	1,390
SHANGDONG	11	2,260
SHANGHAI	1	860
SHANXI	2	220
SICHUAN	12	1,940
TIANJIN	1	220
TIBET	0	0
XINJIANG	1	120
YUNNAN	9	4,660
ZHEJIANG	3	840
SMALL LOCAL FACTORIES	30	(INCLUDED IN EACH PROVINCE)
TOTAL	180	32,790

Exhibit 2. Size of factories by province

PROVINCE	ENTERPRISES PRODUCING	
	> 300,000 CASES	> 100,000 CASES
ANHUI	3	2
BEIJING	0	1
FUJIAN	2	0
GANSU	0	2
GUANGDONG	2	5
GUANXI	1	3
GUIZHOU	2	5
HAINAN	0	1
HEBEI	2	1
HEILONGJIANG	1	3
HENAN	6	6
HUBEI	2	6
HUNAN	4	5
INNER MONGOLIA	1	0
JIANGSU	3	0
JIANGXI	1	1
JILIN	2	1
LIAONING	2	0
NINGXIA	0	0
QUINGHAI	0	0
SHAANXI	2	2
SHANGDONG	4	5
SHANGHAI	1	0
SHANXI	1	1
SICHUAN	3	8
TIANJIN	1	0
TIBET	0	0
XINJIANG	0	1
YUNNAN	6	4
ZHEJIANG	2	1
TOTAL	54	64

Exhibit 3. Location of CFC-11 using equipment (1993)

PROVINCE	LARGE FACTORIES WITH CFC-11 EXPANSION UNITS	TOTAL NUMBER OF CFC-11 UNITS AT BOTH LARGE AND SMALL FACTORIES
ANHUI	3	8
BEIJING	0	1
FUJIAN	2	5
GANSU	0	0
GUANGDONG	2	8
GUANXI	1	3
GUIZHOU	2	7
HAINAN	0	1
HEBEI	2	5
HEILONGJIANG	1	1
HENAN	2	6
HUBEI	2	8
HUNAN	0	0
INNER MONGOLIA	0	0
JIANGSU	3	3
JIANGXI	1	1
JILIN	2	5
LIAONING	2	3
NINGXIA	0	0
QUINGHAI	0	0
SHAANXI	0	0
SHANGDONG	0	0
SHANGHAI	0	0
SHANXI	0	0
SICHUAN	1	1
TIANJIN	1	1
TIBET	0	0
XINJIANG	0	1
YUNNAN	0	0
ZHEJIANG	1	2
TOTAL	28 factories having 44 units	70 (4xG13C and 66xYP-1)

2.2 Current situation of expansion units in PRC using CFC-11

Tobacco expansion is an important part of cigarette making technology. Blending a certain proportion of expanded tobacco in cigarettes, not only improves the taste of smoking and the quality of the cigarette, but also reduces the amount of tobacco used per cigarette. Further, blending expanded tobacco lowers the tar content of cigarettes and, therefore, reduces the damage to human health. It has both significant economic and social effects, so that expanding tobacco is an inevitable trend in the development of the cigarette industry.

The developed countries, such as the USA and Japan, selected CFC-11 as the medium for tobacco expansion in the early 1970s. In the middle of the 1980s, 150,000 MT of expanded tobacco were produced annually in the developed countries by using CFC-11 technology and the consumption of CFC-11 was approximately 6,000 MT per year.

The PRC did not use CFC expansion equipment until 1986, when the CNTC bought two G-13C tobacco expansion plants from RJR Reynolds Company, USA. These plants were put into operation in 1987. Each plant uses 30 MT of CFC-11 per year and can produce approximately 180 kg/hour of expanded tobacco, that is approximately 756 MT/year (calculated assuming 14 h/day and 300 day/year operation). CNTC developed a locally produced model of the G-13C (model name YP-1) which has similar technical characteristics as the G-13C. The first YP-1 was put into operation at the end of 1989. Its price was 1.09 million RMB at that time (in 1989, this was worth approximately US$200,000). The batch production of YP-1 started in 1990 and current capacity of manufacturing is 50 sets annually.

The tobacco expansion capacity of the G-13C and YP-1 CFC expansion equipment is 180 kg/h (assuming that the moisture content of tobacco is 12 per cent). The tobacco expansion ratio is 70 per cent and the consumption of CFC-11 to produce one kilogram expanded tobacco is about 0.04 kg. The structure of the tobacco after being expanded by this equipment remains the same and the taste of smoking changes very slightly. Blending 10 per cent expanded tobacco in a cigarette can lower approximately 2 mg of the tar content per cigarette. The tobacco consumption can be reduced by 2.2 kg per case (one case uses, on the average, about 50 kg of tobacco).

The number of CFC expansion units in PRC is 50 sets at the end of 1992, and 70 sets at the end of 1993. Exhibit 3 shows the number of CFC-11 expansion units in each province.

Compared to US$ 1 million cost of one imported set of G-13C, the locally made YP-1 costs now only 1.6 million RMB. In addition, it occupies less room while expanding tobacco quickly and of satisfactory quality. Therefore, it is well accepted by the cigarette factories in PRC.

Exhibit 4. Tobacco expansion requirements by province

PROVINCE	PRODUCTION		15% EXPANDED TOBACCO, MT	REQUIRED NO YP-1 AT 756 MT/YEAR
	1000 CASES	MT		
ANHUI	2,060	103,000	15,450	20
BEIJING	140	7,000	1,050	1
FUJIAN	850	42,500	6,375	8
GANSU	290	14,500	2,175	3
GUANGDONG	1,530	76,500	11,475	15
GUANXI	1,040	52,000	7,800	10
GUIZHOU	2,030	101,500	15,225	20
HAINAN	100	5,000	750	1
HEBEI	1,170	58,500	8,775	12
HEILONGJIANG	760	38,000	5,700	8
HENAN	3,000	150,000	22,500	30
HUBEI	2,160	108,000	16,200	21
HUNAN	2,360	118,000	17,700	23
INNER MONGOLIA	290	14,500	2,175	3
JIANGSU	810	40,500	6,075	8
JIANGXI	500	25,000	3,750	5
JILIN	660	33,000	4,950	7
LIAONING	450	22,500	3,375	4
NINGXIA	50	2,500	375	0
QUINGHAI	30	1,500	225	0
SHAANXI	1,390	69,500	10,425	14
SHANGDONG	2,260	113,000	16,950	22
SHANGHAI	860	43,000	6,450	9
SHANXI	220	11,000	1,650	2
SICHUAN	1,940	97,000	14,550	19
TIANJIN	220	11,000	1,650	2
TIBET	0	0	0	0
XINJIANG	120	6,000	900	1
YUNNAN	4,660	233,000	34,950	46
ZHEJIANG	840	42,000	6,300	8
TOTAL	32,790	1,639,500	245,925	325

2.3 Estimation of the unconstrained demand for CFC-11 expansion equipment

In the 1980s, the annual growth rate of the tobacco market in PRC was 4-to-5 per cent. Recently, this growth has been reduced to 1-to-2 per cent. The growth trend of the Chinese population is nearly the same. In parallel to the rapid development of the national economy, the standard of living of Chinese population is also going up. This is followed by a rapid increase in demand for high quality and low tar content cigarettes with an aim to reduce the negative impact of cigarette smoking on human health. The preferred way to improve the quality of cigarettes and to lower the tar content is blending a certain proportion of expanded tobacco in the cigarette.

China consumes 1.6 million MT of tobacco annually. Supposing that the calculation is based on blending 10 per cent of expanded tobacco in cigarettes, 160,000 MT of expanded tobacco is required annually. A larger number of tobacco expansion units is required to meet this market demand. For example, if the annual output of one YP-1 is taken as 756 MT, China requires around 217 sets of YP-1 expansion units to reach a 10 per cent blending ratio. Alternatively, blending 15 per cent expanded tobacco in cigarettes, 325 sets will be needed. Exhibit 4 summarizes the tobacco expansion requirements by province.

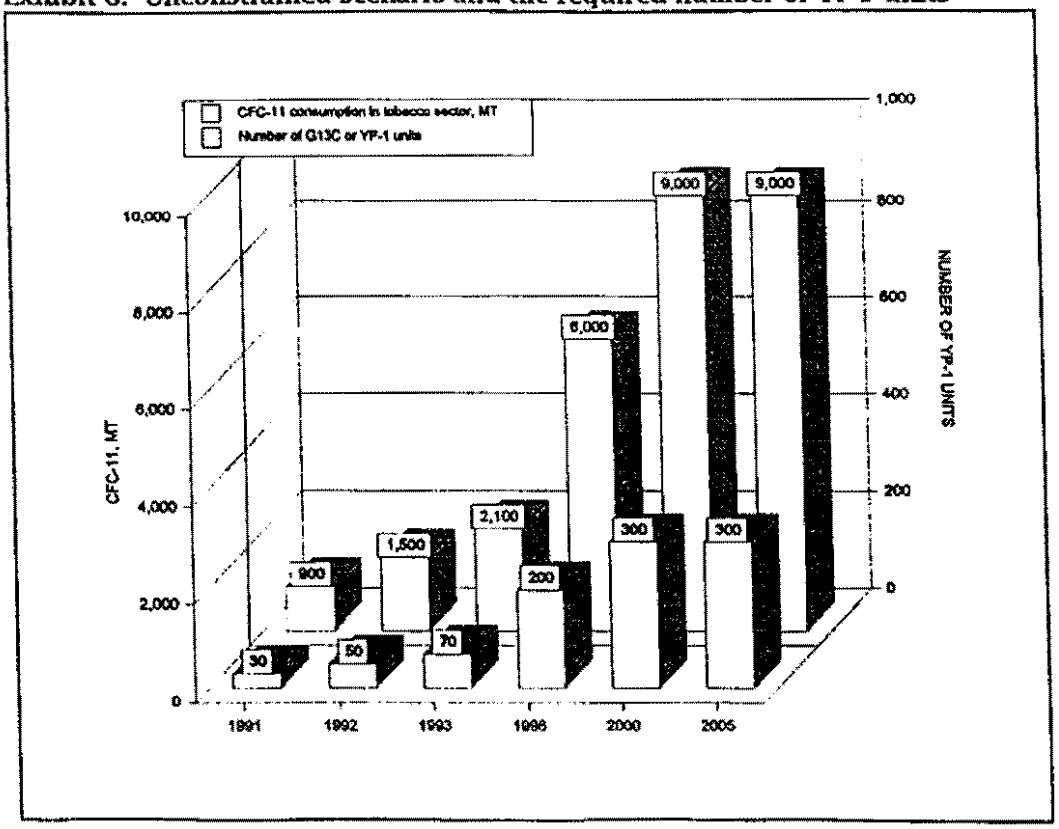
However, the geographical distribution and capacity of individual cigarette factories in China yield to a different calculation. Every large factory, that is production capacity more than 300,000 cases per year, will require 2 or 3 sets of YP-1; every medium-sized factory, that is production capacity between 100,000-to-300,000 cases per year, will need 1 or 2 sets of YP-1; and every small factory with production capacity less than 100,000 cases per year, will need 1 set of YP-1. Therefore, the total need will be around 300 sets of YP-1 equipment. Presently, the local manufacturing capacity of YP-1 expansion units is around 50 sets per year. Taking a more conservative capacity figure of 40 sets per year, the unconstrained demand for YP-1 units and for CFC-11 are given in the Exhibits 5 and 6. In Exhibit 5, the number of installed CFC expansion units in 1991, 1992 and 1993 are actual numbers.

The CP estimated the consumption of ODS for the whole country at 48,000 MT in 1991, 84,000 MT in 1996 and 116,000 MT in 2000. The percentage of the ODS consumption of the tobacco sector to the country total will, therefore, increase from 1.9 per cent in 1991 to 7.1 per cent in 1996 and to 7.8 per cent in 2000. This ratio indicates that the ODS consumption in the tobacco sector should be taken into account.

Exhibit 5. Forecast of unconstrained demand for CFC-11 in tobacco expansion sector

	1991	1992	1993	1996	2000	2005
Number of G-13C or YP-1 units	30	50	70	200	300	300
CFC-11 consumption in tobacco sector, MT	900	1,500	2,100	6,000	9,000	9,000
Total CFC consumption in China, MT (Country Programme data)	48,000			84,000	116,000	
Per cent share of the tobacco sector in the total consumption in China	1.9			7.1	7.8	

Exhibit 6. Unconstrained scenario and the required number of YP-1 units



3. Programme for step-by-step elimination of CFC-11 and its implementation

3.1 Technological alternatives for phasing out CFC-11

At present, tobacco expansion technologies commonly adopted worldwide are CFC-11 and $C0_2$ (carbon dioxide) expansion technologies. Another technology based on high pressure nitrogen as the expansion medium has not spread because of its high degree of technological complexity and its failure to achieve expansion levels comparable to CFC-11 or $C0_2$ technologies. Steam expansion can be used as a part of turning tobacco into thread to increase tobacco's stuffing capacity. However, the expansion effect is limited and the effect of reducing the tar content in cigarette is not obvious, therefore, this technology cannot take the place of CFC-11 expansion technology. Another alternative technology using propane is also being developed. Although the tobacco expansion results obtained on pilot scale equipment are promising, the equipment is not yet commercially available.

CNTC has recently imported $C0_2$ tobacco expansion equipment with yield capacity (tobacco input with 20 per cent water content) of 567 kg/h, and with expansion rate greater than 90 per cent. It consumes 0.5-0.6 kg $C0_2$ per kilogram of expanded tobacco. Blending 10 per cent of expanded tobacco in cigarettes reduces the tobacco consumption by approximately 2 kg per case while lowering the tar content by about 2 mg per cigarette. The $C0_2$ expansion technique requires higher temperatures in the expansion tower (higher than 300°C) and therefore, gas or fuel oil must be used to support combustion. The cost of one imported $C0_2$ unit reaches US$8 million.

Comparison of CFC-11 and $C0_2$ tobacco expansion technologies shows that both have similar expansion performances and economic and social benefits. Therefore, PRC has decided to select the $C0_2$ expansion technology to replace present CFC-11 tobacco expansion equipment and to eliminate the CFC consumption in the tobacco sector.

Parallel to efforts directed to replace the CFC consuming equipment in the tobacco expansion sector, there is scope to improve the operational YP-1 equipment. Particularly, reducing leaks and using recovery and recycling techniques can help to decrease CFC consumption.

3.2 China's strategy for phasing out CFC-11 in tobacco sector

Presently, there are 70 YP-1 units installed in China and their annual consumption of CFC-11 is about 2,100 MT. These 70 YP-1 units can by no means satisfy the urgent demand for tobacco expansion equipment of cigarette factories. It is expected that, with the development of a market-oriented economy, the situation will become more serious in the coming years. It is not economically feasible for each tobacco factory to directly import the $C0_2$ tobacco expansion equipment. Therefore, technology transfer for the design, development and manufacture of an appropriate tobacco expansion unit is urgently required. It is estimated that transferring the technology and setting up of the production line of expansion units in China needs at least two years. In order to meet the urgent demand for expansion units during that period, the Chinese Government will permit increasing the number of YP-1 units from 70 in 1993 to 100 in 1996. That is, during the period 1994-96, the annual consumption of CFC-11 in the tobacco sector will increase to 3,000 MT.

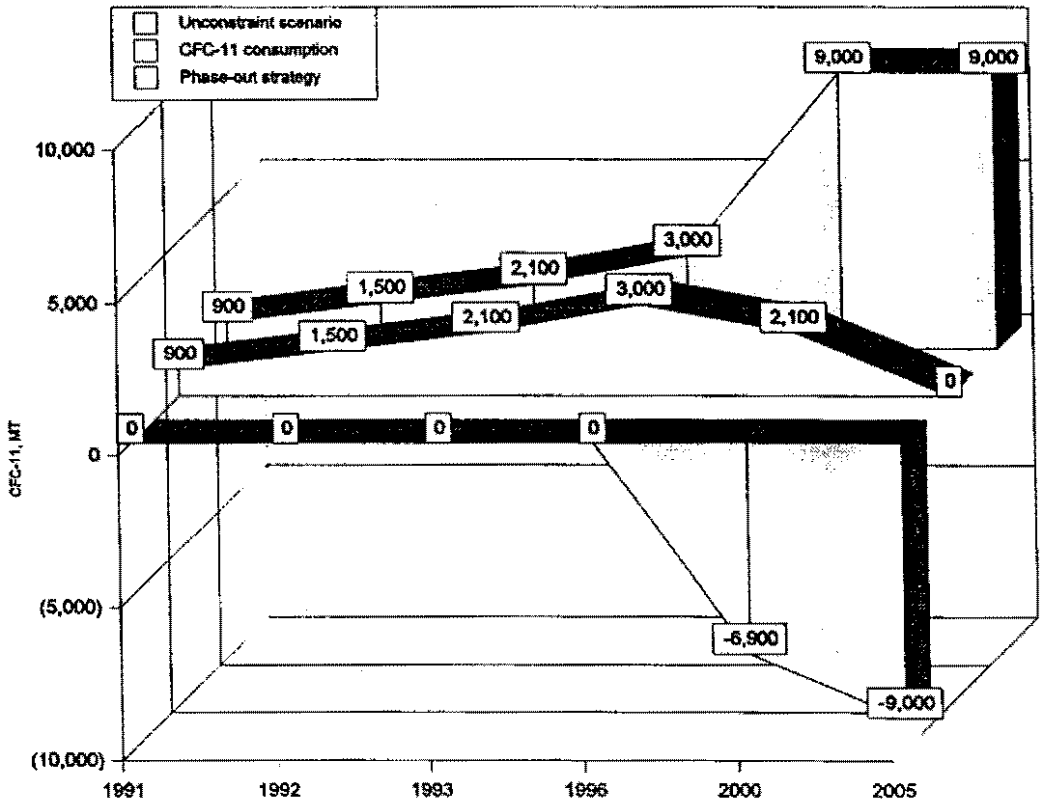
Phaseout of CFC-11 will start in 1997 and by the year 2005, all YP-1 equipment will be phased out and CFC-11 consumption will be zero. The schedule of the CFC-11 phaseout is shown in Exhibit 7, and the comparison of unconstrained consumption and strategy for the elimination of CFC-11 is illustrated in Exhibit 8.

The Chinese Government fully realizes the significance of ozone layer protection and the need to share the responsibility. Therefore, China's Leading Group for Ozone Layer Protection recommends that while committing to full elimination of CFC-11 in the tobacco sector, China apply for grants from the Multilateral Fund for the incremental cost of phasing out 70 CFC expansion units which were operational at the end of 1993.

Exhibit 7. Schedule of CFC-11 phaseout in the tobacco expansion sector

	1991	1992	1993	1996	2000	2005
Unconstrained CFC-11 consumption, MT/year	900	1,500	2,100	3,000	9,000	9,000
Strategy for the elimination of CFC-11, MT/year	900	1,500	2,100	3,000	2,100	0
Number of remaining YP-1 units	30	50	70	100	70	0

Exhibit 8. Strategy for the phasing out of CFC-11 in the tobacco expansion sector



3.3 Local manufacture of $C0_2$ expansion units with 360 kg/h capacity

Presently, $C0_2$ expansion units with a capacity of around 567 kg/h are available from manufacturers in the USA, the UK and Italy. If the $C0_2$ expansion equipment is freely imported to replace the existing and potential CFC expansion units, the consumption of CFC-11 would be reduced quickly. However, the investment cost is quite high (one imported $C0_2$ expansion unit of 567 kg/h capacity costs about US$8 million). If every one of the 54 large factories with annual production of more than 300,000 cases imports one $C0_2$ expansion unit of 567 kg/h capacity, the total investment cost will be US$432 million. But such a strategy can not solve the problem completely, since China has an additional 64 medium-sized cigarette factories with annual production of 100-300,000 cases and 62 small factories with annual production of less than 100,000 cases. These medium- and small-sized cigarette factories also need $C0_2$ expansion equipment but with smaller capacity. A strategy envisaging the erection of centralized expansion facilities for a number of small cigarette factories is not suitable because of the large distances between factories and poor transportation possibilities.

Small-to-medium scale $C0_2$ tobacco expansion equipment is not commercially available. However, international suppliers believe that the large-sized expansion equipment, for example with a capacity of 360 kg/h, could easily be scaled-down or redesigned and developed to suit the needs of the Chinese market. Further, the very large size of the Chinese market raises sufficient interest on the part of the international suppliers of $C0_2$ equipment to develop and produce medium-scale equipment.

The most effective way to develop and manufacture the $C0_2$ expansion equipment with 360 kg/h capacity seems to be designing and developing the equipment by joint efforts and close cooperation of both foreign and Chinese experts and companies. It further seems possible to secure patent rights and production license by combining the technology transfer with trade. For example, three sets of $C0_2$ expansion units with 360 kg/h capacity can be ordered from an international supplier with the condition that the patent rights and production license are issued to CNTC. For this route, the cost of one imported $C0_2$ expansion unit of 360 kg/h capacity is estimated at US$4.8 million, while each Chinese-built unit would cost about US$2.8 million. Each 360 kg/h CO_2 unit will replace two YP-1 units.

3.4 Options for phaseout strategy

Various options can be considered to phase out 70 sets of CFC-11 expansion equipment in China. Among those options, the following four are appropriate (see Exhibit 9 for an overview):

Option 1: For large factories that have two or three YP-1 units, import large scale (567 kg/h) $C0_2$ expansion units to replace these YP-1 units.

For the large or medium-sized factories that have one YP-1 unit, import medium-scale $C0_2$ equipment (360 kg/h) to replace YP-1 units.

Option 2: For large factories that have two or three YP-1 units, import large scale (567 kg/h) $C0_2$ expansion equipment to replace these YP-1 units.

For the large or medium-sized factories that have one YP-1 unit, secure technology transfer and install similar scale and locally produced $C0_2$ equipment (360 kg/h) to replace YP-1 units.

Option 3: For the large factories that have two or three YP-1 units, secure the technology transfer agreement to replace these YP-1 units with locally-made large-scale $C0_2$ equipment (567 kg/h).

As in Option 1, for the large or medium-sized factories that have one YP-1 unit, secure technology transfer and install similar scale and locally produced $C0_2$ equipment (360 kg/h) to replace YP-1 units.

Option 4: For all factories, large or small, secure technology transfer and replace all YP-1 units with locally produced $C0_2$ equipment of 360 kg/h capacity. Factories with large production capacity, would receive more than one replacement unit.

For comparison of the four options, the assumptions used to assess the economic costs are presented in Exhibit 10. Without taking incremental operating costs into consideration, each option is measured in terms of the net present value, the cumulative amount of CFC-11 that is phased out and the unit abatement costs according to the assumptions presented in Exhibit 10. Exhibit 11 gives an overview of the main data used in these calculations. Exhibits 12, 13, 14 and 15 list the details for options 1, 2 ,3 and 4, respectively. Finally, Exhibit 16 presents the results of calculations and indicates that Option 4 is the most cost-effective and the optimal strategy. Therefore, Option 4 is planned to be adopted in the Chinese tobacco sector.

Exhibit 9. Summary of options for phase-out strategy

	Large factories with two or three YP-1	Large/medium-sized factories with one YP-1
Option 1	**IMPORT** large-scale (567 kg/h) $C0_2$ expansion equipment	**IMPORT** medium-scale (360 kg/h) $C0_2$ expansion equipments
Option 2	**IMPORT** large-scale (567 kg/h) $C0_2$ expansion equipment	Secure **TECHNOLOGY TRANSFER** and **LOCALLY PRODUCE** medium-scale (360 kg/h) $C0_2$ equipment
Option 3	Secure **TECHNOLOGY TRANSFER** and **LOCALLY PRODUCE** large-scale (567 kg/h) $C0_2$ equipment	Secure **TECHNOLOGY TRANSFER** and **LOCALLY PRODUCE** medium-scale (360 kg/h) $C0_2$ equipment
Option 4	Secure **TECHNOLOGY TRANSFER** and **LOCALLY PRODUCE** medium-scale (360 kg/h) $C0_2$ equipment	

Exhibit 10. Assumptions for economic assessment

ITEM	UNIT	ASSUMPTION
Cost of YP-1	US$ million	0.2
Expected Lifetime of YP-1	years	12
Annual depreciation rate for YP-1	per cent	8.33
Cost of imported 567 kg/hour CO_2 unit (one off price)	US$ million	8
Cost of imported 567 kg/hour CO_2 unit (20% discounted, minimum 3 units)	US$ million	6.4
Cost of imported 360 kg/hour CO_2 unit (one off price)	US$ million	6
Cost of imported 360 kg/hour CO_2 unit (20% discounted, minimum 3 units)	US$ million	4.8
Cost of locally produced 567 kg/hour CO_2 unit	US$ million	4
Cost of locally produced 360 kg/hour CO_2 unit	US$ million	2.8
Cost of retooling Chinese manufacturing factories to produce CO_2 units	US$ million	1
Cost of establishing a Tobacco Expansion Technology Institute	US$ million	1
No. of imported large (567 kg/h) units required to secure technology transfer	nos	3
No. of imported small (360 kg/h) units required to secure technology transfer	nos	3
Time required by supplier to develop 360 kg/h CO_2 units	years	2
Time required to import, install, and commence operation of CO_2 unit	years	2
Time required to transfer technology for large plants	years	3
Time required to transfer technology for small plants	years	4
Discount rate	per cent	10
Incremental operating costs of CO_2 expansion	US$/kg	0.17
Currency exchange rate	US$1.0 = RBM 8.7	

Exhibit 11. Basic data to construct different phase-out scenarios

Province	Nos of firms	Production		Possible nos of YP1 for 15% expansion	Nos of firms with production, 1000 cases		Nos of firms with >300 & YP1's	Total nos of YP1 installed as of end '93	Options 1,2 & 3 Nos of CO2 units for		Option4 Nos of 360 kg/h CO2 units
		1000 cases	1000 MT		>300	>100			567 kg'h	360 kg/h2	
ANHUI	8	2,060	103	20.4	3	2	3	8	2	1	4
BEIJING	1	140	7	1.4	0	1	0	1			
FUJIAN	6	850	43	8.4	2	0	2	5	1	1	2
GANSU	4	290	15	2.9	0	2	0	0			
GUANGDONG	8	1,530	77	15.2	2	5	2	8	1	3	4
GUANXI	7	1,040	52	10.3	1	3	1	3		2	2
GUIZHOU	8	2,030	102	20.1	2	5	2	7	2	1	4
HAINAN	1	100	5	1.0	0	1	0	1			
HEBEI	3	1,170	59	11.6	2	1	2	5	1	1	3
HEILONGJIANG	6	760	38	7.5	1	3	1	1			
HENAN	16	3,000	150	29.8	6	6	2	6	2		3
HUBEI	11	2,160	108	21.4	2	6	2	8	2	1	4
HUNAN	9	2,360	118	23.4	4	5	0	0			
INNER MONGOLIA	2	290	15	2.9	1	0	0	0			
JIANGSU	3	810	41	8.0	3	0	3	3	0	2	2
JIANGXI	2	500	25	5.0	1	1	1	1			
JILIN	3	660	33	6.5	2	1	2	5	1	1	3
LIAONING	4	450	23	4.5	2	0	2	3		2	2
NINGXIA	1	50	3	0.5	0	0	0	0			
QUINGHAI	1	30	2	0.3	0	0	0	0			
SHAANXI	6	1,390	70	13.8	2	2	0	0			
SHANGDONG	11	2,260	113	22.4	4	5	0	0			
SHANGHAI	1	860	43	8.5	1	0	0	0			
SHANXI	2	220	11	2.2	1	1	0	0			
SICHUAN	12	1,940	97	19.2	3	8	1	1		1	1
TIANJIN	1	220	11	2.2	1	0	1	1			
TIBET	0	0	0	0.0	0	0	0	0			
XINJIANG	1	120	6	1.2	0	1	0	1			
YUNNAN	9	4,660	233	46.2	6	4	0	0			
ZHEJIANG	3	840	42	8.3	2	1	1	2		1	1
TOTAL	150	32,790	1,640	325.3	54	64	28	70	12	17	35

30 very small local factories are not included.
44 YP-1 units are installed in 28 factories.

Exhibit 12. Detailed data for Option 1

Year	Basis situation		OPTION 1							
			567 kg/h CO2		360 kg/h CO2		Elimination of YP1's			Total cost, $ million
	No of YP 1	CFC-11, MT	Nos	Cost,, $ million	Nos	Cost, $ million	Nos	Annual CFC-11, MT	Cumulative CFC-11, MT	
1994	70	2,100	0	0.0	0	0.0	0	0	0	0.0
1995	70	2,100	3	19.2	0	0.0	0	0	0	19.2
1996	70	2,100	3	19.2	2	9.6	0	0	0	28.8
1997	61	1,830	3	19.2	4	19.2	9	270	270	38.4
1998	48	1,440	3	19.2	4	19.2	13	390	660	38.4
1999	31	930		0.0	4	19.2	17	510	1,170	19.2
2000	14	420		0.0	3	14.4	17	510	1,680	14.4
2001	6	180		0.0		0.0	8	240	1,920	0.0
2002	0	0		0.0		0.0	6	180	2,100	0.0
2003	0	0		0.0		0.0	0	0	2,100	0.0
2004	0	0		0.0		0.0	0	0	2,100	0.0
2005	0	0		0.0		0.0	0	0	2,100	0.0
TOTAL			12	76.8	17	81.6	70	2,100	14,100	158.4

Exhibit 13. Detailed data for Option 2

Year	Basis situation		OPTION 2							
	No of YP 1	CFC-11, MT	567 kg/h CO2		360 kg/h CO2		Elimination of YP1's			Total cost, $ million
			Nos	Cost,, $ million	Nos	Cost, $ million	Nos	Annual CFC-11, MT	Cumulative CFC-11, MT	
1994	70	2,100	0	0.0	0	0.0	0	0	0	0.0
1995	70	2,100	3	19.2	1	4.8	0	0	0	24.0
1996	70	2,100	3	19.2	2	9.6	0	0	0	28.8
1997	61	1,830	3	19.2	2	5.6	9	270	270	24.8
1998	50	1,500	3	19.2	2	5.6	11	330	600	24.8
1999	37	1,110		0.0	2	5.6	13	390	990	5.6
2000	24	720		0.0	2	5.6	13	390	1,380	5.6
2001	20	600		0.0	3	8.4	4	120	1,500	8.4
2002	16	480		0.0	3	8.4	4	120	1,620	8.4
2003	12	360		0.0		0.0	4	120	1,740	0.0
2004	6	180		0.0		0.0	6	180	1,920	0.0
2005	0	0		0.0		0.0	6	180	2,100	0.0
TOTAL			12	76.8	17	53.6	70	2,100	12,120	130.4

Exhibit 14. Detailed data for Option 3

Year	Basis situation		OPTION 3							
			567 kg/h CO2		360 kg/h CO2		Elimination of YP1's			Total cost, $ million
	No of YP1	CFC-11, MT	Nos	Cost,, $ million	Nos	Cost, $ million	Nos	Annual CFC-11, MT	Cumulative CFC-11, MT	
1994	70	2,100	0	0.0	0	0.0	0	0	0	0.0
1995	70	2,100	1	6.4	1	4.8	0	0	0	11.2
1996	70	2,100	2	12.8	2	9.6	0	0	0	22.4
1997	67	2,010	2	8.0	2	5.6	3	90	90	13.6
1998	59	1,770	2	8.0	3	8.4	8	240	330	16.4
1999	49	1,470	2	8.0	3	8.4	10	300	630	16.4
2000	39	1,170	3	12.0	3	8.4	10	300	930	20.4
2001	27	810		0.0	3	8.4	12	360	1,290	8.4
2002	12	360		0.0		0.0	15	450	1,740	0.0
2003	6	180		0.0		0.0	6	180	1,920	0.0
2004	0	0		0.0		0.0	6	180	2,100	0.0
2005	0	0		0.0		0.0	0	0	2,100	0.0
TOTAL			12	55.2	17	53.6	70	2,100	11,130	108.8

Exhibit 15. Detailed data for Option 4

Year	Basis situation		OPTION 4							
	No of YP 1	CFC-11, MT	567 kg/h CO2		360 kg/h CO2		Elimination of YP1's			Total cost, $ million
			Nos	Cost,, $ million	Nos	Cost, $ million	Nos	Annual CFC-11, MT	Cumulative CFC-11, MT	
1994	70	2,100	0	0.0	0	0.0	0	0	0	0.0
1995	70	2,100	0	0.0	1	4.8	0	0	0	4.8
1996	70	2,100	0	0.0	2	9.6	0	0	0	9.6
1997	70	2,100	0	0.0	3	8.4	0	0	0	8.4
1998	68	2,040	0	0.0	5	14.0	2	60	60	14.0
1999	64	1,920		0.0	5	14.0	4	120	180	14.0
2000	58	1,740		0.0	6	16.8	6	180	360	16.8
2001	48	1,440		0.0	6	16.8	10	300	660	16.8
2002	38	1,140		0.0	7	19.6	10	300	960	19.6
2003	26	780		0.0		0.0	12	360	1,320	0.0
2004	14	420		0.0		0.0	12	360	1,680	0.0
2005	0	0		0.0		0.0	14	420	2,100	0.0
TOTAL			0	0.0	35	104.0	70	2,100	7,320	104.0

Exhibit 16. Results of economic assessment

	Unit	Option 1	Option 2	Option 3	Option 4
Incremental investment cost	US$ mill.	158.4	130.4	108.8	104.0
NPV of investment cost	US$ mill.	105.8	87.3	69.2	56.3
Unit abatement cost (UAC = NPV of investment cost/2,100,000 kg CFC-11 phased-out annually)	US$/kg	12.3	10.1	8.4	8.1
Cumulative amount of CFC-11 saved between 1994-2005	MT	14,100	12,120	11,130	7,320

3.5 A schedule of actions

The schedule of phaseout includes two phases:

a) Phase I (1994-1996):
Carrying out studies and experiments to compare non-CFC tobacco expansion techniques with the CFC-11 technique. Through international technical cooperation and by organizing the domestic capabilities, to start with the design, development and local manufacture of $C0_2$ expansion equipment with capacity of 360 kg/h. Establishment of an institutional framework to transfer and assimilate the CO_2 expansion technology and arrange the local batch production. This institute will study tobacco expansion technologies and import the initial three sets of CO_2 equipment (two of them will be installed in Zhengzhou Plant and Shijiazhuang Plant, respectively).

b) Phase II (1997-2005):
The production of CFC-11 expansion equipment will be stopped in 1997, and all exiting CFC-11 expansion equipment will be replaced by $C0_2$ expansion equipment with capacity of 360 kg/h and batch produced locally. All CFC-11 consumption will be phased out by the year 2005.

3.6 Implementation of phaseout strategy

Implementation of the phaseout strategy involves, among others, the following:

- Managing the use and production of CFC-11 tobacco expansion equipment and controlling the production of YP-1 equipment in a planned way.
- Developing and managing the production and spread of the expansion technologies and equipment which do not destroy the ozone layer, in a planned way.
- Implementing the licensing agreement for the design, development and manufacturing of $C0_2$ tobacco expansion equipment and organizing its sale by the monopoly.
- Increasing the awareness of the public of ozone layer protection through wide reaching publicity campaigns in the tobacco sector.
- Encouraging the research and development efforts directed to phaseout of controlled substances. Giving awards to individuals and to teams who make a big contribution to the phaseout of the controlled substances.

3.7 The administrative organization and structure of the Chinese tobacco sector

The National Council issued the Regulation of Monopoly of Tobacco on 23 September 1983, and the Law of Tobacco Monopoly of the People's Republic of China was ratified by the 20th Plenary Session of the 7th Standing Committee of the National People's Congress of the People's Republic of China on 29 June 1991. According to this law, the state would organize the production and the management of the tobacco monopoly goods in a planned way and improve the quality of the tobacco products so as to protect the interests of the consumers and to ensure the national revenue.

Station Bureau of Tobacco Monopoly and China National Tobacco Corporation are in charge of tobacco monopoly, production and trade. They are the authoritative administrations of the tobacco sector to implement the Convention and the Protocol. Led by the Leading Group for Ozone Layer Protection, they are responsible for developing and implementing a strategy to phase out CFC-11 step-by-step in the tobacco sector.

CNTC has appointed a number of its staff members to form a special organization which supervises and monitors the imports and consumption of CFC-11 levels and is entrusted with the task of executing the CFC elimination programme in the Chinese tobacco sector. The organization reports on the production of CFC expansion equipment and the CFC-11 consumption to the China Leading Group for Ozone Layer Protection.

3.8 Proposed investment project

In evaluating the cost of different items, it is assumed that the hardware costs account for 75-80 per cent of total cost for installing a new set of CO_2 expansion equipment. Other costs such as construction, installation, adjustment and auxiliary equipment make up the remaining 20-25 per cent of the total cost.

The incremental cost of replacing CFC expansion technology with CO_2 expansion technology consists of two parts. One part is the difference between the total cost of importing or locally manufacturing the CO_2 expansion equipment and the cost of eliminating CFC expansion equipment and the other part is the difference between the running costs of the two types of equipment.

The phaseout is implemented in two phases. The summary of all cost items for each phase such as capital investment, incremental operating costs and the amount of CFC-11 eliminated in each stage are listed in Exhibit 21. Since Phase I will build the foundation of the complete phaseout strategy, it should be carried out first. Then Phase II should be implemented on the basis of the first.

The results presented in Exhibit 21 are based on the following calculations:

a) Calculation of operation cost of 180 kg/h CFC-11 plant YP-1. Exhibit 17 indicates that expanding 1 kg tobacco using YP-1 equipment costs US$ 0.212.

b) Calculation of operation cost of 567 kg/h CO_2 plant. Exhibit 18 indicates that expanding 1 kg tobacco using CO_2 equipment costs US$0.298.

c) Incremental operating costs are calculated in Exhibit 19.

d) An overview of all basic data used in Phase II calculations is given in Exhibit 20.

Exhibit 17. Operation cost of 180 kg/h YP-1 CFC-11 plant

	Cost item	Unit	Unit price, RMB	Consumption per 1 kg expanded tobacco	Cost per 1 kg expanded tobacco, RMB
1	CFC-11	kg	24	0.040	0.960
2	Vapour	kg	0.0716	1.900	0.136
3	Electric power	kWh	0.4	0.240	0.096
4	Water	kg	0.00025	1.400	0.000
5	Compressed air				0.040
6	Labour (5 workers per shift)				0.130
7	Management fees				0.040
8	Equipment maintenance				0.170
9	Other consumables				0.030
10	Workers' safety				0.010
11	Miscellaneous				0.020
	Subtotal				1.632
12	Equipment depreciation				0.210
	Total				1.842
				US$/kg	0.212

Exhibit 18. Operation cost of 567 kg/h CO_2 plant

	Cost item	Unit	Unit price, RMB	Consumption per 1 kg expanded tobacco	Cost per 1 kg expanded tobacco, RMB
1	Liquid CO_2	kg	1.4	0.500	0.700
2	Gas N_2	kg	5.5	0.034	0.187
3	Coal gas	m^3	0.8	0.125	0.100
4	Vapour	kg	0.0716	1.500	0.107
5	Electric power	kWh	0.4	0.460	0.184
6	Compressed air				0.040
7	Labour (50 workers per shift)				0.310
8	Management fees				0.060
9	Airconditioning				0.110
10	Equipment maintenance				0.725
11	Other consumables				0.030
12	Workers' safety				0.020
13	Miscellaneous				0.020
	Subtotal				2.593
14	Equipment depreciation (*)				0.000
	Total				2.593
				US$/kg	0.298

(*) Although calculated at RMB1.76/year, it is not applicable since it is assumed that the CO_2 units will be financed by the Multilateral Fund.

Exhibit 19. Option 4: Calculation of incremental operating costs

Item	Unit	Amount
Operating cost of CFC expansion using YP-1 equipment (180kg/h*14h/day*300day/year)	US$/kg	0.212
Operating cost of CO_2 expansion using 567 kg/h equipment	US$/kg	0.298
Incremental operating cost of CO_2 expansion with respect to CFC-11 expansion	US$/kg	0.086
Annual output of 360 kg/h CO_2 expansion (360 kg/h*14 h/day*300day/year)	kg/year	1,512,000
Annual incremental operating cost of one CO_2 expansion unit with respect to CFC-11 expansion	US$/year	130,519
Annual incremental operating cost of three CO_2 expansion units with respect to CFC-11 expansion	US$	391,556
Total incremental operating cost for three CO_2 expansion units and for four years	US$	1,566,223

Exhibit 20. Option 4: Basic data for Phase II calculations

Year	360 kg/g CO_2 units		Phase-out of YP-1's		Incremental operating cost US$	Remarks
	Nos	Cost, US$	Nos	Cost, US$		
1994	0	0				
1995	0	0				This year is taken as the start of project financing
1996	0	0				
1997	3	8,400,000				This year is the start of Phase II activities of the project
1998	5	14,000,000				
1999	5	14,000,000				
2000	6	16,800,000	6	1,200,000	393,000	Incremental operating cost is calculated at US$ 131,000 per 360 kg/h CO2 unit per year
2001	6	16,800,000	10	2,000,000	1,048,000	
2002	7	19,600,000	10	2,000,000	1,703,000	
2003			12	2,400,000	2,489,000	
2004			12	2,400,000	2,882,000	
2005			14	2,800,000	3,144,000	
2006					2,489,000	
2007					1,703,000	
2008					917,000	
Total	32	89,600,000	64	12,800,000	16,768,000	
NPV		51,813,894		8,956,402	10,227,709	Net present values are calculated in 1995 and for the period 1995 to 2008, whenever applicable

Exhibit 21. Option 4: Project schedule and costs

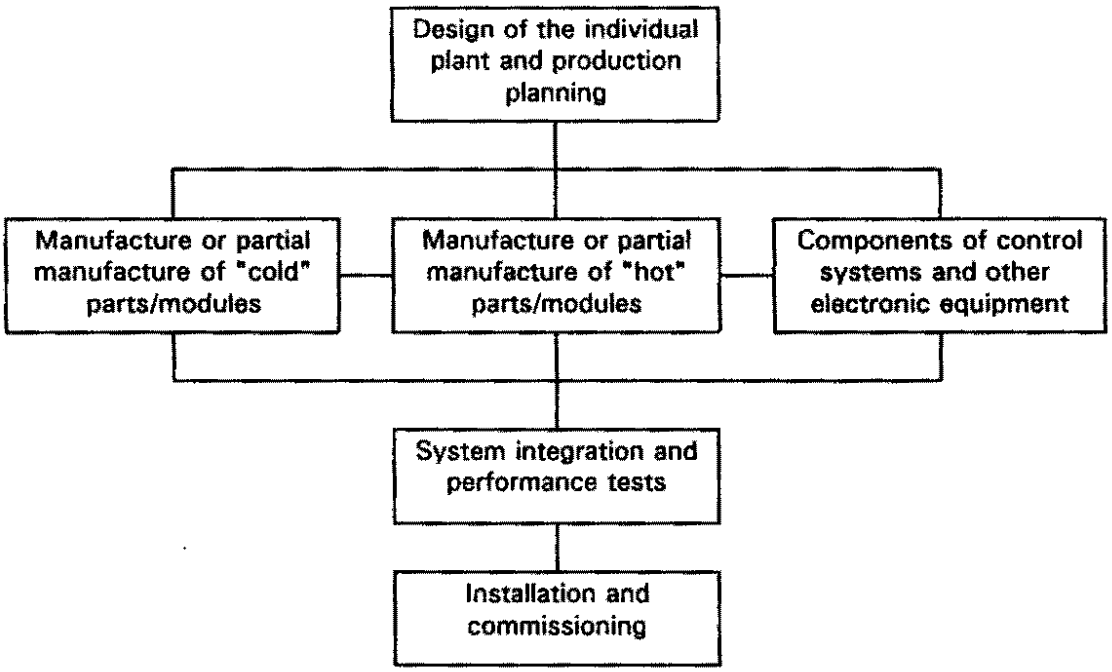
	Activity	Cost, US$	CFC-11 Phaseout MT
PHASE I: TECHNOLOGY TRANSFER (1994-1996)			
1	Establishment of a "Tobacco Expansion Technology Research Institute" to act as a focal point for the technology transfer (please see Annex 1)	1,000,000	
2	Installation of three sets of 360 kg/h CO_2 expansion equipment	17,150,000	180
2.a	First batch of three sets, 100 per cent imported	14,400,000	
2.b	Retooling of Chine facilities to produce CO_2 expansion equipment	1,000,000	
2.c	Other costs associated with technology transfer. These include training of CNTC personnel by international supplier of carbon dioxide unit, visits to suppliers of modular, hot-end, and cold-end components, and visits of components suppliers to CNTC and Chinese manufacturing facility	750,000	
2.d	On-going technical assistance until technology transfer has been successfully concluded to ensure successful local production of CO_2	500,000	
2.e	Costs to equip and train for dismantling YP-1 equipment and actual dismantling of the first batch of units to be replaced	500,000	
3	SUBTOTAL OF CAPITAL INVESTMENT COSTS (1 + 2)	18,150,000	
4	Cost of eliminating 3 YP-1 units at US$ 200,000 each	600,000	
	NET CAPITAL INVESTMENT COST OF PHASE I	17,550,000	
4	Incremental operating cost for three units and for four years(Exhibit 20)	1,566,223	
5	Net present value of incremental operating cost	1,241,180	
	TOTAL COST OF PHASE I	18,791,180	180
PHASE II: PRODUCTION OF CO_2 EQUIPMENT TO REPLACE CFC-11 EQUIPMENT (1997-2005)			
6	Incremental capital cost of 32 sets of CO_2 equipment with 360 kg/h capacity and to replace 64 YP-1 units (re.: Exhibit 20, between 1997-2002)	89,600,000	1,920
	Net present value of incremental capital cost	62,694,481	
7	Cost of eliminating 64 YP-1 units at US$ 200,000 each (re.: Exhibit 20, between 2000 and 2005)	12,800,000	
	Net present value of eliminating YP-1's	8,956,000	
8	Total incremental capital investment cost	76,800,000	
9	Net present value of the total incremental capital investment cost	53,738,481	
9	Incremental operating cost for 32 sets of CO_2 equipment with 360 kg/h capacity and for four years (re.: Exhibit 20, between 2000 and 2008)	16,768,000	
10	Net present value of total incremental cost	10,227,709	
	NPV OF TOTAL COST OF PHASE II	63,966,190	1,920

Note: In calculating the total costs for Phase I, it is assumed that incremental capital investment will be made up in front, while incremental operating costs will be paid over an operational period of four years.

Annex 1. A note on "Tobacco Expansion Technology Research Institute"

The constituent modules of the CO_2 tobacco expansion unit involve different equipment design and manufacturing technologies. Furthermore, each plant may require individual plant design and layout specific to the present cigarette making line. Exhibit A.1.1 below schematically describes the design and manufacturing process of the CO_2 tobacco expansion unit.

Exhibit A.1.1 Design and manufacturing processes of CO_2 expansion unit



As is seen from the exhibit, a number of equipment manufacturers and suppliers will be involved in the design and manufacturing activities. There will be an obvious need to plan and coordinate the contribution of these subcontractors. Furthermore, technology packages have to be prepared for each subcontractor, either specifying the part or module or providing design and manufacturing data.

It is proposed here that a "Tobacco Expansion Technology Research Institute" will be established within the CNTC. This Institute will, among others:

a) Act as the focal point of technology transfer for the 360 kg/h CO_2 tobacco expansion unit;

b) Plan the gradual localization of the production;

c) Prepare design and manufacturing packages for the Chinese subcontractors;

d) Coordinate the activities of the subcontractors and control their quality;

e) Arrange the system integration, performance tests and commissioning of the plants;

f) Provide training to operators and maintenance crews;

g) In cooperation with the Multilateral Fund observers, arrange the destruction of replaced CFC expansion equipment.