



**United Nations  
Environment  
Programme**

Distr.  
LIMITED

UNEP/OzL.Pro/ExCom/42/13  
2 March 2004



ORIGINAL: ENGLISH

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EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Forty-second Meeting  
Montreal, 29 March - 2 April 2004

**REPORT ON THE INTERMEDIATE EVALUATION OF THE SOLVENT SECTOR  
PHASE-OUT PLAN IN CHINA**

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**LIST OF ABBREVIATIONS**

ATSS	Alternative Technology Support System
CNAO	China National Audit Office
CNCCC	China National Chemical and Construction Corporation
DIA	Domestic Implementation Agency
EPB	Environmental Protection Bureau
EXCOM	Executive Committee of the Multilateral Fund
FECO	The Foreign Economy Cooperation Office
IEA	Intermediate Execution Agent
LEL	Lower Explosive Limit
MC	Methylene Chloride
MII	Ministry of Information Industry
MLF	Multilateral Fund
MP	Montreal Protocol
nPB	n-PrThe Director of the Ozone Cellopyl Bromide
OD	Ozone Depleting
ODP	Ozone Depletion Potential
ODS	Ozone Depleting Substances
PCB	Printed Circuit Board
PCE	Perchloroethylene
PMO	Project Management Office
SEPA	State Environmental Protection Administration
SSP	Solvent Sector Plan
STOC	Solvents, Coatings, and Adhesives Technical Option Committee
SWG	Special Working Group
TCA	1,1,1-trichloroethane
TCE	Trichloroethylene
TA	Technical Assistance
TOR	Terms of Reference
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

## **Executive Summary**

### **(a) Main Findings**

1. The solvent sector represented in 1999 about 6% of China's overall ODS consumption. After 275 ODP tonnes of solvents had been phased-out through individual solvent projects plus 213 ODP tonnes of OD solvent use through refrigeration projects from 1992 to 1999, the Solvent Sector Plan (SSP) was approved in March 2000 with a funding volume of US\$ 52 million. The SSP was proposed as a way to improve effectiveness of implementation compared to the project-by-project approach which was used primarily to phase-out large users and was thought unsuitable to deal with the large numbers of remaining small users.
2. Overall, the SSP has been implemented successfully so far. The reduction of national consumption of CFC-113, TCA and CTC as defined in the SSP for 2001 and 2002 has been achieved and verified. National consumption figures for 2003 will be available only late in 2004; their verification usually takes place in the fourth quarter of the following year.
3. The actual phase-out figures reported as a result of contracts concluded with enterprises willing to convert in exchange for compensation correspond to approximately 75% of the reduction of national consumption reported for CFC-113, less than 50% for TCA and even less for CTC. These figures include phase-out from individual projects approved in earlier years. Nevertheless, the total phase-out achieved from 2000 to 2002 was significantly higher than from 1992 to 1999.
4. The planned and actual phase-out figures reported to the 42<sup>nd</sup> meeting of the Executive Committee in the Supplementary Report to the 2003 Progress Report have been made clearer and more consistent compared to earlier reports.
5. The difference between the actual phase-out reported by companies with conversion contracts and the reduction of national consumption must have been achieved by enterprises on their own. The availability of CFC-113 in the market is shrinking in line with the phase-out requirements under the SSP, and its use is moreover controlled through obligatory user licenses. Only illegal imports could result in an increase of consumption. For TCA and CTC control and verification of production and consumption are less stringent so far. For TCA, a similar sector approach as for CFC-113 is planned to phase-out production and imports until the end of 2009. CTC for solvent consumption has officially been phased-out by mid-2003; no more user licenses are issued but there might still be some illegal use, in view of the abundant availability of CTC in the market. The implementation of the CTC sector phase-out agreement will change this situation during the next years.
6. As repeatedly reported by SEPA and UNDP (with the details required by the agreement), the production of CFC-113 for feedstock uses exceeded largely the maximum of 10 ODP tonnes defined in the agreement, while the limits for CTC for feedstocks and process agent uses were respected. According to the 2003 verification report for the CFC production sector phase-out agreement, the annual production of CFC-113 for feedstock use exceeded 1,900 mt in 2003, thanks to a new plant put into operation in 2003 by the only producer Jiangsu Changsu 3F. The verification report analyzed transfers of CFC-113 for the manufacturing of CFC-115, CFC 113a, and CTFE and confirmed that none of the quantities destined for feedstock use were deviated for solvent use.

7. As a reaction to a decreasing interest of companies to participate in bidding for phase-out contracts, new forms of contracts have been developed (vouchers, gradual phase-out, reimbursement). The most novel approach used by the SSP is the voucher system which offers incentives to a chosen vendor or Intermediate Execution Agent (IEA), to find and assist small users in their phase-out effort. The approach has promise because it can greatly increase SEPA's outreach. Whether it can be implemented at the required scale in the time still available remains to be seen but it is certainly worthwhile for other Article 5 countries to observe. The numbers of enterprises entering into phase-out contracts has sharply increased from 32 in 2002 to 226 in 2003 which is about 80% more than planned. This number has to multiply to assist more than one thousand companies still using CFC-113. There remains the risk that many enterprises will have to phase-out the use of CFC-113 without assistance, as its production and availability will be further reduced to 1,100 ODP tonnes in 2004, 550 ODP tonnes in 2005 and zero in 2006. In this context, recovery and recycling of CFC-113 becomes important which is foreseen in the SSP but not yet developed.

8. Conversion of enterprises has often taken more time than planned, in particular but not only in 2003, when SARS delayed travel and equipment installation. The average duration to complete a phase-out contract is about two years. While this is half of the average duration of earlier individual projects, it is more than the calculated average of 18 months and might make it difficult to realize the 2003 phase-out targets. In all cases of delays observed in the companies interviewed it could be traced back to changes in the equipment specifications after the order had been placed and the supplier had started construction. This indicates an uncertainty about the best technology choice which was confirmed in the interviews.

9. Technical assistance for OD solvent phase-out is coordinated through the China Cleaning Engineering Technical Cooperation Association (CCETCA) and the Alternative Technical Support System (ATSS). They provide assistance at national and enterprise level through a network of national experts and vendors of solvent substitutes. While the outreach has been expanded in particular through the use of Intermediate Executions Agents, the geographical and sub-sector coverage as well as the technical competence offered is still limited. The enterprises expressed keen interest in more technical advice for the design stage of the conversion and were found also in many cases far less effective than possible in using the substitute solvents. CCETCA is just beginning to undertake the development of cleanliness standards. No clear direction or strategic approach has yet been developed for this difficult task.

10. Nearly all conversion projects now use domestically supplied chemicals and equipment. This is a complete switch from only two years ago and is very promising for the success of the SSP. Not only are solutions more affordable but projects will also experience fewer delays. However, while earlier individual projects had all converted to non-OD substitutes, in particular aqueous cleaning, the reduced costs of domestically produced transitional solvents (HCFC-141b and nPB) have resulted in the rapidly increasing use of these OD solvents which will require another conversion one day.

11. Old equipment has more often than not been put aside while 'waiting for instructions how to destroy it', in spite of SEPA's practice of reporting the project as completed only after equipment destruction has been documented. While important and required to avoid further use of ODS equipment, it has to be kept in mind that destruction of old equipment may not guarantee sustainable phase-out as equipment made for non-OD halogenated solvents or transitional solvents like HCFC-141b and nPB can typically use CFC-113 or TCA as well, often with only minor adjustments needed. Furthermore, cold-cleaning with OD solvents can be done without equipment, for example in simple tanks or even in a bucket.

12. Financial and Management (on projects > US\$ 100,000) and Performance Audits by national auditors and Technical Audits by international consultants are performed each year on the SSP implementation. As the SSP effort moves to smaller users the number of Financial and Management Audits will decline, because very few will receive more than US\$ 100,000. . However, the SSP as a whole will always remain subject to an annual UNDP Financial and Management Audits, combined with audits of a sample of randomly selected sub-projects. Performance and Technical audits will also become possible only for a sample of beneficiary enterprises in view of their rapidly increasing numbers.

**(b) Recommendations**

13. SEPA supported by UNDP should

- (a) Employ more Intermediate Execution Agents and national experts throughout China to be able to reach the phase-out goals established for 2004 and 2005;
- (b) Plan realistic implementation schedules by not expecting voucher enterprise conversions to only take one year. Smaller use does not typically equate to a simplified conversion effort;
- (c) Evaluate the technology support centres after the first year supporting the voucher system;
- (d) Create a planned approach for developing cleanliness standards;
- (e) Review the auditing and verification approach with a view to focus in future on the national rather than enterprise level, supported by checks in selected enterprises, preferably in combined missions of national and international experts;
- (f) Develop a strategy to support the military with its phase-out effort, following the completion of the on-going survey on solvent uses by the military. According to experience in other countries, this area may account for a large portion of the remaining ODS solvent consumption in China.
- (g) National experts should study the list of essential use exemptions found in Article 2 countries and formulate appropriate strategies to deal with similar circumstances in China.
- (h) An effective monitoring system should be established to monitor that CTC available in the market is not diverted to solvent use. Such monitoring should take place in the context of implementing the CTC sector phase-out agreement and when providing technical assistance to solvent users.
- (i) Further develop the technical support for solvent companies as outlined in section 5.4 of this report.

## **1 Purpose and Scope of Evaluation**

### **1.1 Overview**

14. In 1999, solvents represented a small portion of China's ODS challenge (~6% of total ODP consumption). However, because of its complexity and large numbers of small users (~2,000), the solvent sector has the potential for being the most difficult sector to phase-out while maintaining minimal adverse economic impact. From the time of the first Country Programme (approved in March 1993, up-date in March 2000), it was always planned to complete the phase-out in the solvent sector by 2010. At the 30<sup>th</sup> Executive Committee meeting in March 2000 China's Solvent Sector Plan (SSP) was approved with a funding volume of US\$ 52 million stretched over 10 years to facilitate phase-out of 4,000 ODP tonnes of solvent consumption.

15. This intermediate evaluation of the Solvent Sector Plan in China is part of the 2003 and 2004 Monitoring and Evaluation Work Programmes. The evaluation report is submitted as scheduled to the 42nd Meeting of the Executive Committee, based on information collected during evaluation missions to China in November 2003 and January 2004.

### **1.2 Terms of Reference**

16. According to the Terms of Reference, this evaluation assessed the validity of progress achieved thus far and potential for on-going successfully implementation of the China SSP, with particular reference to the following issues:

- (a) To verify the phase-out of ODS solvent consumption, as reported in the annual reports and work programmes presented by UNDP. This will not repeat the annual audits but analyze their methodology, completeness and reliability, thus assessing the quality of the monitoring system established;
- (b) The flexibility clause implies that the evaluation will not attempt to trace the funding provided to each contracted user of solvents. However, it will try to document to which degree activities planned in the annual programmes have been implemented and approved funding been obligated and disbursed. The reasons for implementation delays and hesitations of enterprises to bid for and implement conversion plans will receive particular attention;
- (c) To establish whether the annual reports on the status of implementation in the previous year and the annual programmes for the following year, presented by UNDP jointly with SEPA, provide sufficient information to assess the effectiveness and sustainability of solvent phase-out in China and to enable the Executive Committee to decide on the proposed annual tranches.

- (d) While the SSP is independent from phase-out agreements for the production sector of CFC-113, TCA and CTC, the decreasing availability of these substances following the implementation of such agreements will help the phase-out of their use in the solvents sector. The future market developments for OD and non-OD solvents will be outlined to the extent possible based on existing data and materials. In this context, recycling and reclaiming of CFC-113 will be reviewed as well.
- (e) To analyze whether the institutional mechanisms and policies established appear appropriate and sufficient to complete the implementation of the phase-out plan as scheduled
- (f) To establish lessons learnt during the implementation of this sector plan, with regard to the methods used for its preparation, monitoring and reporting, the delays of its implementation, its overall cost-effectiveness, its institutional set-up and policies used, and its applicability for sector or national phase-out plans in other countries, taking into account the particular conditions in China.

17. The above TOR show that in contrast to the national and international audits which focus on immediate results and compliance with annual targets, the emphasis of this evaluation is on overall results achieved so far, policies, sector developments, reliability and appropriateness of audit procedures, perspectives for further phase-out, and adjustments proposed to successfully continue implementation of the SSP.

### **1.3 Work Plan**

18. The evaluation approach used to address the issues outlined above was two fold. First a document review was performed of annual reports and work programmes, audit results, and database lists. This desk review was followed by interviews with enterprises, SEPA, auditors, and UNDP as the implementing agency. See Appendix 1 for a complete list of mission meetings.

19. Early in the planning stages the work plan for the solvent evaluation mission was modified to include attendance of the consultant at the International Cleaning Technical Forum and Exposition in Beijing held November 20-23, 2003. This additional visit to Beijing enabled meetings with several beneficiary enterprises and facilitated mission planning with SEPA and UNDP for the field visits to enterprises in January.

20. The January 5-13, 2004 mission accomplished the following three data collection objectives:

- (a) Field visits to six beneficiary enterprises,
- (b) Interview with the Chengdu region Intermediate Execution Agent (IEA),
- (c) Meetings with key implementation organizations in Beijing, including the SEPA Special Working Group (SWG) on solvents, two auditing agencies, National Solvent Experts, Joint Operational Office (on import and exports), and UNDP.



## 2 Institutional Structure and Policy Framework

### 2.1 Overview

21. Using various policies the Government of China executes the SSP. State Environmental Protection Administration (SEPA) has the primary responsibility to manage and coordinate the implementation of each year's annual programme for OD solvent phase-out. Directly supporting SEPA in this role is the Ministry of Information Industry (MII). The Ministry of Commerce and the General Administration of Customs also work with SEPA to control imports and exports of OD solvents.

22. UNDP as implementing agency works closely with SEPA to supervise overall implementation of the SSP, replenish the local project bank account, report twice annually to the Executive Committee on implementation progress, and submit annual work programmes and the corresponding funding requests to the Executive Committee.

### 2.2 Institutional Structure

23. Within SEPA, management and implementation support functions are as follows:

- (a) The Foreign Economy Cooperation Office (FECO), is responsible for financial management of the ODS phase-out through its Financial Accounts Division.
- (b) The Project Management Office (PMO), also known as Division III in FECO, has operational responsibility for implementing China's ODS phase-out effort. PMO supervises the implementation of the Country Programme and has several sectorial working groups.
- (c) Special Working Group (SWG) supports PMO with implementation of the solvent sector phase-out. The group currently has four members, two members within SEPA and two members from MII. This small group manages all of the daily activities necessary to prepare and supervise enterprise phase-out contracts, complete technical assistance projects, oversee audits, monitor production quotas and consumption licences and fulfil various reporting requirements.
- (d) Domestic Implementation Agency (DIA). China National Chemical and Construction Corporation (CNCCC) was appointed DIA from March 2001 to February 2003. During this time they carried out various tasks to support implementation of the SSP the SWG, mainly by supervising implementation of projects, facilitating procurement actions, submitting status reports on project implementation, and identifying and alerting PMO to any issues regarding enterprise-level activities. The SWG has now absorbed these responsibilities.
- (e) Alternative Technical Support System (ATSS): This is a complex network of industry associations, demonstration centres, national experts, and equipment and chemical suppliers. It was created to support the implementation of the SSP, in particular the phase-out of smaller users. The ATSS works closely with the SWG and MII.

24. Within MII, SSP implementation support functions are coordinated through China Cleaning Engineering Technical Cooperation Association (CCETCA). This organization primarily handles the more technical sector-wide challenges encountered during SSP implementation. One of its secondary functions is the communication of technical cleaning matters through journals and technical forums. Within CCETCA there is an executive committee, technical journal department, and an international communication department. Also, over half of the national solvent-cleaning experts work through CCETCA.

25. SEPA relies on Environmental Protection Bureaus at municipal and provincial levels throughout China to implement and monitor the SSP, in particular for identifying solvent users and keeping contact with them.

### 2.3 Policy Framework

26. The Government of China has established policies in several areas to ensure a cost-effective and orderly phase-out of OD solvents.

27. Production: Production of CFC-113 will be reduced each year in China in line with the maximum allowable consumption under the SSP, until 2006 when it will no longer be produced. Implementation and verification of this phase-out falls within the scope of the CFC Production Sector phase-out agreement which is implemented in parallel with SSP. It is planned that TCA production will be phased out using a sector plan currently under preparation, taking production down to zero by the end of 2009. It is also worth noting that a ban has been in place since 1998 on newly built equipment that produces an MP Annex A (CFC-113) or Annex B (CTC or TCA) OD solvent. This ban does not include Annex C (HCFC-141b) and non-controlled OD solvents (nPB).

28. International Trade: Export of all OD solvent is banned (except HCFC-141b and nPB). Import of CFC-113 and CTC are also banned. Import of TCA will be phased out in line with the production quotas, starting in 2002 and ending in 2010. Currently limits for import and production of TCA are issued initially up to 80% of the national consumption level of that particular year, based on the actual situation and consumption. Towards the later part of that year, decision is made whether to issue the remaining balance towards the year of the year. Once the TCA sector phase-out plan is finalized and approved, full production and import control will be imposed.

29. Consumption: Annual consumption of each OD solvent must be in line with the phase-out schedule agreed in the SSP (see table 2 below). For CTC, full phase-out happened last year as scheduled (less any unknown illegal consumption). No user licenses were issued for 2004. For TCA the policy on production phase-out remains to be issued but undoubtedly it will follow the consumption phase-out prescribed in the SSP. Newly built equipment that specifically *uses* MP Annex A (CFC-113) or Annex B (CTC or TCA) OD solvent has been banned since 1998. This ban does not include Annex C (HCFC-141b) and non-controlled OD solvents (nPB).

30. However, this regulation may not be very effective as equipment made for non-OD halogenated solvents or transitional solvents can typically use OD solvents, often without distinction. Furthermore, cold-cleaning using OD solvents can be done with simple tanks or even a bucket.

### 3 Solvent Sector Plan

#### 3.1 Overview

31. As early as 1996, China began studying ways to improve the efficiency of the project-by-project approach used for phase-out in the solvents sector. After three years of planning at the national level and another year by an international team, the SSP was approved in the March 2000 at the 30<sup>th</sup> meeting of the Executive Committee. In combination with the CFC Production Sector Phase-out Plan, OD solvents are controlled from production through final consumption.

#### 3.2 Funding and Consumption Phase-out Schedules

32. Table 1 below shows the planned annual disbursements required to implement the SSP. The first two (2000 & 2001) MLF tranches were approved jointly with the SSP agreement in March 2000, the first one was released then and the second after the 33rd meeting of the Executive Committee in March 2001. Further tranches depend on the verification that actual national consumption of OD solvents is indeed less than the maximum allowable consumption target noted in column 3 of table 2 below. Second, goals approved by the Executive Committee in annual work programmes for enterprise level phase-out activities need to be achieved (see table 2, column 10 and 11).

**Table 1: Annual Programme Amounts (US\$ 1,000s)**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
CFC113	4,800	4,800	4,050	3,600	3,600	3,600	3,300	4,000	0	0	0	31,750
TCA	1,450	1,455	1,455	1,455	1,455	1,455	1,455	1,455	1,455	1,455	1,455	16,000
CTC	0	0	325	200	200	325	0	0	0	0	0	1,050
TA	500	700	500	500	300	300	300	25	25	25	25	3,200
<b>Total</b>	<b>6,750</b>	<b>6,955</b>	<b>6,330</b>	<b>5,755</b>	<b>5,555</b>	<b>5,680</b>	<b>5,055</b>	<b>5,480</b>	<b>1,480</b>	<b>1,480</b>	<b>1,480</b>	<b>52,000</b>

Source: The Multilateral Fund Secretariat: Policies, Procedures, Guidelines, Criteria Annex VIII.26: Agreement for ODS Phase-out in China's Solvent Sector, Montreal 2002

**Table 2: Annual Consumption of ODS under Main Data of the Solvent Sector Plan (ODP Tonnes)**

1	2	3	4	5	6	7	8	9	10	11	12	13
Annual Work Programme	Chemical	Maximum Allowable Consumption (ODP Tonnes)	Actual Consumption	Consumption Above/Below Target	Annual Funding Tranches as per Agreement (US\$)	Approved Funds* (US\$)	Funds Disbursed * (US\$)	Phase-Out as per Agreement (ODP Tonnes)	Approved Phase-Out* in Annual Work Programme (ODP Tonnes)	Actual Phase-Out* (ODP Tonnes)	Actual Contracted Phase-out Volumes** (ODP Tonnes)	Actual Achieved Phase-out***
2000	CFC	3,300.0	3,246.0	-54.0	6,750,000	6,750,000	4,863,974	600	372.8	378.5	378.4	0
	TCA	621.0	571.0	-50.0				8	10.0	10.1	7.4	
	CTC	110.0	110.0	0.0				0	0.0	8.4	0	
2001	CFC	2,700.0	2,674.4	-25.6	6,955,000	6,955,000	0	500	524.0		541.6	394.2
	TCA	613.0	457.5	-155.5				8	10.0	10.6	9.8	
	CTC	110.0	<110	-				0	0.0	0	8.4	
2002	CFC	2,200.0	2,192.3	-7.7	6,330,000	6,330,000	0	500	500.0		535.8	329.7
	TCA	605.0	380.6	-224.4				25	25.0	43.2	42.1	
	CTC	110.0	<110	-				55	55.0	17.9	0	
2003	CFC	1,700.0			5,755,000	5,755,000	0	600	500.0		475.3	478.4
	TCA	580.0						78	25.0	37.9	52.2	
	CTC	55.0						55	55.0	0	0	
2004	CFC	1,100.0			5,555,000			550				178.9
	TCA	502.0						78			2.8	
	CTC	0.0										
2005	CFC	550.0			5,680,000			550				
	TCA	424.0						85				
	CTC	0.0										
2006	CFC	0.0			5,055,000							
	TCA	339.0						85				
	CTC	0.0										
2007	CFC	0.0			5,480,000							
	TCA	254.0						85				
	CTC	0.0										
2008	CFC	0.0			1,480,000							
	TCA	169.0						84				
	CTC	0.0										
2009	CFC	0.0			1,480,000							
	TCA	85.0						85				
	CTC	0.0										
2010	CFC	0.0			1,480,000							
	TCA	0.0										
	CTC	0.0										
<b>Total</b>	<b>CFC</b>				<b>52,000,000</b>	<b>25,790,000</b>	<b>4,863,974</b>	<b>3,300.0</b>	<b>1,896.8</b>	<b>378.5</b>	<b>1,931.1</b>	<b>1,381.2</b>
	<b>TCA</b>							<b>621.0</b>	<b>70.0</b>	<b>10.2</b>	<b>101.8</b>	<b>114.3</b>
	<b>CTC</b>							<b>110.0</b>	<b>110.0</b>		<b>26.3</b>	<b>8.4</b>

Source: 2003 China Solvent Sector Plan Overview and Supplementary Report on 2003 Progress Report

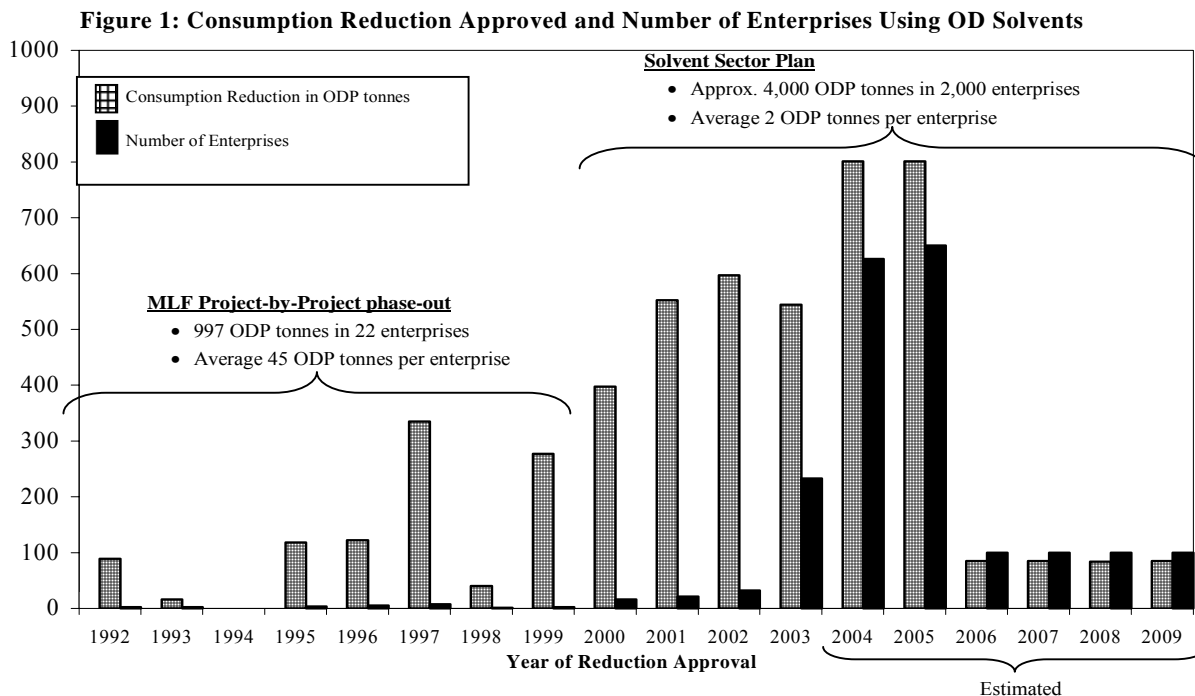
\* According to the 2002 Progress Report

\*\* According to the Annual Progress Report on the Implementation of Solvent Sector Plan, does not including 345.4 ODP tonnes of CFC-113 and 49.1 ODP tonnes of TCA from approved on-going projects

\*\*\* According to Supplementary Report on 2003 Progress Report and Performance Audit on 2002 Phase-out Targets of the China Solvent Sector Phase-out Plan (including phase-out achieved from completion of on-going individual projects).

33. An additional phase-out of 345.5 ODP tonnes of CFC-113 and 49.1 ODP tons of TCA from individual projects is reported which keeps the total actual phase-out figures in line with phase-out requirements until the end of 2002.

34. In the first ten years of China's phase-out efforts (including the first three years of the SSP) phase-out projects have been completed or approved for less than 100 large solvent users. These large users account for approximately 2,500 ODP tonnes, roughly half of the total phase-out effort required. Phase-out of the remaining approximately 2,500 ODP tonnes will require the cooperation of almost 2,000 small users. As can be seen in figure 1 below, the next two years present the largest challenge as China tries to seek out the hundreds of remaining CFC-113 users to assist them to phase-out before the end of 2005.



Source 1: The Multilateral Fund Secretariat, inventory data on solvent projects approved for China.

Source 2: SEPA & UNDP 2003 Annual Progress Report on the Implementation of Solvent Sector Plan

35. It is very likely that some portion of end user enterprises will not be identified, CTC provides an example. Although roughly 100 tonnes of CTC was used as a solvent at the national level, users responsible for over 60% of the solvent could never be identified. Although enterprise level phase-out contracts were not possible for more than half of the reported use, national consumption levels have now reportedly been brought to zero. As production and consumption licenses are no longer issued, from a legal standpoint CTC, as a solvent, is phased-out, albeit there remain some doubts with regard to possible continued use without license as long as CTC is still produced in China for non-solvent uses. An effective monitoring system should be established to monitor that CTC available in the market is not diverted to solvent use.

### 3.3 Consumption Phase-out Methods

#### 3.3.1 Annual Usage Certificates

36. In addition to issuing certificates for OD solvent production, China also annually grants user certificates (consumption licenses). The advantage of this policy is two fold. First, it provides information for the correct list of final users. Second, it makes the consumers very much aware that they are relying on a solvent that will soon be phased-out. Of course, it would not be impossible for Enterprise A to be issued a certificate and to provide some OD solvent to Enterprise B. Many supply chains are long and have various middlemen along the way that make a living by repackaging chemicals. This would not increase national consumption but SEPA may lose its grip on the final user list.

### **3.3.2 Reduction Contracts with Individual Enterprises**

37. China realized early on that the project-by-project approach worked fairly well for large enterprises but was too slow and costly for smaller solvent users. Nevertheless, China has spent the first three years of SSP implementation basically using the same modality, albeit administered under the sector plan by SEPA, to phase-out the remaining medium and large solvent users. For the first time in 2004 the implementation programme calls for the use of three new phase-out methods. Most important among them is the voucher system for small users.

### **3.3.3 Voucher System**

38. This phase-out method utilizes chemical suppliers or other industry representatives to work as Intermediate Execution Agents (IEAs) who identify enterprises to apply to SEPA for grant funding. Grants are paid in the form of a voucher or coupon to buy equipment and substitute chemical cleaning agents. The voucher's value is a function of the quantity and type of OD solvent in use at the enterprise. IEAs are also responsible for verifying the claimed consumption level. For their efforts the IEAs are paid 10% of the coupon amount granted.

39. In 2003 the three selected IEAs worked in separate regions and registered 70 small user enterprises (28 in Guangzhou, 21 in Xian, and 21 in Sichuan), which is a good start. According to members of the SWG there are plans to expand the effort into at least Shanghai and Shenzhen in 2004. There are only two more years of CFC-113 use left. To reach zero consumption in 2006, an even more aggressive voucher system expansion should be planned to maximize the chances of reaching the remaining users of China's most popular OD solvent.

40. For 2003 the IEAs focused their data gathering effort on the remaining OD solvents, specifically CFC-113 and TCA. It is recommended that they include CTC in future searches. Although officially phased out in 2003, it is likely that because of remaining stockpiles, illegal imports, or unlicensed domestic sales, some level of use will continue in the near future. The IEAs are certainly one of the best chances SEPA has to detect remaining CTC solvent use.

41. Two other concerns come to mind regarding China's novel approach to the worldwide problem of finding an effective way to phase-out small OD solvent users. The first is the requirement that enterprises using the voucher system need to complete their phase-out effort within one year. Experience gained during the phase-out of larger users has shown that two or more years are typically required to complete conversion to an alternate cleaning process. It is incorrect to assume that enterprises that use smaller quantities of OD solvents have less complex applications and can be phased-out faster. A second concern is the likely shortage of technical support. Instead of the typical 10 to 15 reduction contracts of past years, in 2004 close to 100 enterprises will have to be dealt with. This number is more than in all previous years under the MP combined. As the IEAs are not capable of offering technical support, the burden of helping the enterprises to make an informed choice of alternatives will fall to the network of technical experts. Are there enough experts and between them do they have the necessary variety of skills that will be required to support the remaining conversions? This resource issue will be discussed in more detail in the Technical Assistance section.

### **3.3.4 Gradual Self Phase-out**

42. This consumption phase-out method requires the least support from both a financial and administrative perspective. As the name implies, enterprises participating in the gradual self phase-out method are required to manage and fund their own phase-out. SEPA simply monitors their gradually declining annual consumption. This method includes enterprises that would not have been eligible to receive MLF funding under traditional Executive Committee rules for phase-out projects, for example, those that started using OD solvents after 1995, are foreign owned, or export to Article 2 countries. Without grant funding to provide the incentive, data gathering on this group of enterprises will be difficult if not for the annual consumption license requirement.

43. A surprising number of enterprises fall into this category in the 2004 implementation programme. Of the 226 enterprises participating in 2004, 143 have entered into agreements with SEPA to stop OD solvent use on their own. Even in its first year this method will contribute almost 140 ODP tonnes or more than 20% of the phase-out expected in 2004.

### **3.3.5 Reimbursement Mechanism**

44. It is almost certain that SEPA will not be able to find all enterprises in time to assist them with their conversion to other cleaning alternatives. The concept of the reimbursement mechanism is to provide financial aid to enterprises that are discovered after they have completed the conversion on their own. Again using the example of CTC, when SEPA finds a previously unidentified user of part of the 60 unaccounted for ODP tonnes, it could reimburse them for their independent phase-out effort. The correct level of reimbursement would be based on records demonstrating the company's annual consumption prior to final phase-out of CTC reported for 2003.

45. Although the reasoning seems sound, it is unlikely unclear whether that the limited resources available to fund future efforts will be used to support for this approach modality. In the worst case where the lack of OD solvents has contributed to bankruptcy it will obviously be too late to help. In other cases, it funding may be a welcome boost to the enterprises that have survived the conversion challenge. Of course, it may also be decided that the limited and the funding available may be better spent on the challenge presented by remaining users.

### **3.3.6 Enterprises not Receiving Assistance**

46. Ultimately, consumption of all OD solvents will be phased-out because their production and hence their availability will cease. The common goal of the various phase-out methods described above is to lessen the adverse impact on economic development that would result from simply halting production. However, there are some cases where phase-out will occur without financial aid or technical assistance. For example, enterprises that go out of business or transfer their cleaning operation to an upstream supplier.

### 3.4 Technical Assistance

47. Just as SEPA has devised several methods for giving financial aid to converting enterprises it has also created various ways to provide technical assistance. CCETCA is the formal technical body that coordinates and accomplishes activities that support the entire cleaning sector for China. ATSS on the other hand, was designed and created specifically for SSP implementation. Both organizations have national solvent experts, some of whom support both groups.

48. Although the ATSS was designed to assist all users, its primary purpose is to service small enterprises. ATSS consists of the following key elements:

- (a) Three alternative technology support centres:
  - (i) Guangzhou No. 5 institution
  - (ii) Tianjin No. 46 institution
  - (iii) Shanghai Academy of Environmental Services
- (b) Local manufacturers of alternative chemical cleaning agents and equipment
- (c) Suppliers of chemicals and equipment who are trained to recommend alternative technologies
- (d) Approximately 13 national solvent cleaning experts

49. Starting this year small enterprises will be able to redeem their vouchers for ATSS services. More will be known after this first year of voucher redemption. Visits during previous assessments indicated a low level of activity at the support centres. Consequently, there is a concern about their true level of capability and enterprises' awareness of their services.

50. The annual work programmes always funded various technical assistance projects. For example the 2004 plan calls for the following activities:

- (a) Creation of a national training centre;
- (b) Strengthening of the ATSS;
- (c) Increase public awareness campaign;
- (d) Support for usage of alternative solvents;
- (e) Study on essential uses;
- (f) Implement a programme against illegal production, import and use of OD solvents;
- (g) Study on substitutes for medical uses;
- (h) Develop standards and technical specification study;
- (i) Train and audit on CTC consumption;
- (j) Provide support for international and national experts.

51. Most of these activities will be accomplished through the two technical assistance organizations CCETCA and ATSS.



52. The development of standards and technical specifications is a technical assistance activity that is particularly complicated. The two most important areas to consider are specifications for equipment procurement and cleanliness standards. Equipment specifications are defined at the enterprise level while efforts to create cleanliness standards are by definition more generalized.

53. How clean is clean enough? While the answer to this question depends on each client's requirements and standards, in general terms, the product needs to be cleaned well enough to effectively support the production steps that follow the cleaning process. Also, the final product's theoretical life should not be reduced to unacceptable levels because of cleaning steps performed during its manufacture. The problem is determining the appropriate cleanliness level for thousands of different products, some of critical importance and some not. Vast amounts of money have been spent to develop standards for military hardware. These resources were invested because human life is dependant on their performing as expected. For example, it is not acceptable to endanger a fighter pilot's life because of poor cleaning of the printed circuit board (PCB) that controls part of his airplane. However, if the same high standard is used to clean the PCB in a child's toy, resources would be wasted for a product whose failure is not critical. Money invested to develop cleanliness standards should be spent wisely on only the most critical product applications. Since it is unfeasible to develop standards for all types of products at every level of performance criticality, another approach is required.

54. Lacking specific cleanliness standards there are two other basic approaches. The most common is to simply establish a baseline with the existing successful cleaning process before it is discontinued. With this goal established, the alternative process can be installed and improved as necessary to meet the known benchmark. The second method is to perform functionality testing. This can either be done directly after the cleaning step or with the final product. Once an acceptable level of quality has been reached (failures/unit produced) it can be assumed that the level of cleanliness is adequate. Both methods have their drawbacks. Using benchmark data may cause a company to waste money by continuing to clean products too well. On the other hand, functionality testing can be difficult to establish. It is simple enough to determine whether something works just after it is manufactured. Simulating product life in various operating environments is more challenging.

55. Because of product diversity and varying product expectations it is not reasonable to expect a single method for answering the question "How clean is clean enough?" Efforts in Article 2 countries have shown that success is possible and affordable by utilizing a wise mix of all three methods. It is recommended that prior to spending resources budgeted for development of standards this year, CCETCA may instead take a step back and prepare a comprehensive sector wide strategy for cleanliness requirements. Such a strategic plan would include at least:

- (a) Roles and responsibilities of government agencies, manufacturing enterprises and user groups;
- (b) Description of all known solvent use sub-sectors in China;
- (c) Hierarchical mapping of various applications within each sub-sector to better understand the relative importance of cleanliness requirements;<sup>2</sup>

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<sup>2</sup>An example of sub-sector mapping of different uses and their associated cleanliness requirements can be found on page 15 of the following document: Protecting the Ozone Layer, UNEP DTIE Ozone Action Programme Technical Brochure Updates Volume 2 - Solvents, Coatings, and Adhesives, France 2001. This document is also available at: <http://www.unepie.org/ozonaction/library/tech/vol2solvent.pdf>

- (d) Tentative work plan to efficiently assign tasks and spend limited resources on agreed efforts to develop standards.

### 3.5 Audits on Implementation of Consumption Phase-out

56. As shown in Table 3 several audits of SSP activities are performed. Each year the UNDP sponsors a Financial and Management Audit for all projects with a funding volume greater than US\$ 100,000. The China National Auditing Office (CNAO) generally carries out these audits. Last year's audit of 32 contracts will probably remain the peak effort, as in future years there will be less projects funded with US\$ 100,000 or more. In 2003, 78 enterprises received vouchers whose average value is only US\$ 38,000 and all are less than the threshold for obligatory audit. Also in 2003, 143 companies agreed to gradual reduction contracts with no funding. However, the SSP as a whole will always remain subject to an annual UNDP Financial and Management Audits, combined with audits of a sample of randomly selected sub-projects.

**Table 3: Audits Performed on Solvent Sector Plan Implementation Effort**

Type of Consumption Phase-out Audit	Scope	Auditor	Year of Audit Effort Period Covered		
			2001	2002	2003
<b>Financial and Mgmt Audit</b>	All Projects > US\$ 100,000	CNAO	2000	2001	2002
<b>Performance Audit</b>	National level	CNAO, Independent *		2001	2002*
	Enterprise level			2000	2000 & 2001*
<b>Technical Audit</b>	National level	International and National Consultants		2001	2001, 2002, 2003
	Enterprise level				
<b>Verification of CTC Phase-out</b>	National level	Independent *		2001	2002

\* Independent audit performed by Beijing Zhong Tian Hua Zheng CPA Co., Ltd

57. Performance audits prepared by national auditors were begun in the third year of SSP implementation. Their purpose is to re-assure SEPA and UNDP that programme implementation advances as planned and that there is no abuse of public funding. In addition, there are annual technical audits carried out by international and national consultants hired by UNDP. Since tranches for the first two years (2000 and 2001) were approved together with the original agreement, a performance technical audit was not required until approval of the 2002 tranche was considered.

58. The terms of reference for the performance audits seem very comprehensive. They combine enterprise and national level verification of ODS consumption and also analysis of policies, which is more evaluation than usual audit work. The technical audits focus on enterprise level (performance of equipment, delays, destruction of equipment, and remaining technical problems).

59. Verification of China's solvent phase-out effort should in the future focus on the national rather than enterprise level, supported by checks in selected enterprises, because it will soon become unmanageable to audit all enterprises converted under the plan. SEPA and UNDP should also examine, whether the national and international audits can be combined.

## **4 Enterprise Level Effectiveness**

### **4.1 Overview**

60. To better understand the effectiveness of the phase-out effort at enterprise level, 12 enterprises with phase-out contracts under the SSP were interviewed. Six of them were consulted at the November 2003 Technical Forum in Beijing and six at their factories in January 2004. A standard set of 19 questions was asked. A list of enterprises interviewed, questions asked and responses given is presented in Annexes 1 and 2. The enterprises were all medium to large-scale users. 10 of the 37 enterprises which received grant funding in 2000 or 2001 were interviewed.

### **4.2 Results Achieved and Possible Improvements**

#### **4.2.1 Awareness**

61. In nearly every case, enterprise awareness was a result of SEPA communication efforts. The large majority of enterprises give credit to SEPA and its use of conferences, meetings, training and publications to bring about awareness of the OD solvent phase-out plan.

62. It will take an even larger communication effort to revisit the OD suppliers and move further down the supply chain to those companies that repackage and label smaller containers to supply the small user. It is not enough to issue usage certificates to companies that redistribute OD solvents. The message will have to go out to the real end users.

63. Aerosol cans provide a good example. A variety of products that contain OD solvents are sold by mid-supply-stream repackaging enterprises. Many times OD solvents are mixed into aerosol products to reduce flammability. This consultant has visited many repackaging enterprises in several other countries. Since projects in the first 10 years of China's effort for the solvent sector have not addressed this particular issue it is likely that customer lists of the intermediate suppliers have not been surveyed yet. Assembling lists like this will be a necessary step to get to the real end users.

#### **4.2.2 Reasons for Conversion**

64. Although grant funding is a likely reason for conversion it was not specifically mentioned by the enterprises. Instead the responses showed a mix of other reasons (government regulation, customer request and solvent cost). Grant as incentives provided for conversion do not seem to be the main driving factor.

### 4.2.3 Alternatives Selected

65. Nine of the twelve enterprises interviewed had determined their final cleaning process configuration. Of these nine, only two were able to find a single cleaning process to replace the OD solvent previously used. In many cases, the primary alternative was able to perform most of the cleaning tasks but a second process had been found necessary for a small minority of tasks. Past cleaning with OD solvents was certainly a more straightforward process. Unfortunately, it is not possible during short factory visits to determine if the primary alternative is really incapable of doing all cleaning tasks or if further adjustments would allow it to do the entire job. Whatever the reason for multiple cleaning processes, it is definitely more complicated and expensive to maintain more than one process. At some point it may make sense for China to consider a technical assistance programme to help enterprises with two cleaning systems to try to reduce to one. This idea would be even more attractive if the secondary system utilizes a transitional OD solvent like HCFC-141b or nPB.

### 4.2.4 Equipment and Chemical Suppliers

66. In every enterprise interviewed, domestic suppliers provided the alternative cleaning equipment. This is the exact opposite of a similar review of MLF solvent projects in China in 2001 where it was found that all equipment was imported at very high cost and usually with many delays. The relatively inexpensive locally made machines seem to be doing a reasonable job of meeting the enterprises' operating requirements. One common complaint was noted: solvent use rates were increasing with the new machines and alternative solvents. One very likely reason for the increased emissions is a misunderstanding of the operating principles of a vapour degreaser.

67. This mistake was noted during several factory tours. Possibly the most basic principle of successfully operating a vapour degreaser is to maintain the vapour blanket. This is necessary for two reasons. First, the vapour blanket is required for proper cleaning and drying of the product in the vapour phase. Second, it is necessary to form a barrier or lid over the boiling sump. The machines supplied have the capability to fulfil this requirement. However, in many factories visited, ventilation systems were installed directly over the cleaning machines. During operation, the fans effectively vacuum the containment blanket off the boiling solvent, dramatically increasing solvent emissions from the degreaser. This installation design flaw may have arisen from the need to meet the lower explosive limit (LEL) when using flammable hydrocarbon solvents. In this case, less expensive machines will probably not be able to contain emissions sufficiently to stay below alarm levels. Instead of purchasing expensive imported machines with low emissions, most enterprises chose to simply enclose the cleaning machine and apply negative air pressure. For hydrocarbon solvents, the required LEL is achieved albeit at the price of higher emissions. In the case of non-flammable solvents like TCE, PCE, MC, nPB, HCFC-141b, and HCFC-225 it is a big mistake to install air ventilation over a vapour degreaser as this drastically increases emissions and solvent use, while also diminishing cleaning effectiveness.

68. Domestic suppliers of chemicals have also made great advances in the last couple of years. In addition to lower priced aqueous cleaners found in 2001 there now seems to be a full range of domestically available cleaning agents. The only concern here is that two of the lower priced and very effective solvents have ODP. Like all Article 5 countries China can continue to use solvents like HCFC-141b and HCFC-225 until 2040. At this point nPB is not yet a controlled substance under the MP. Because HCFC-141b and nPB are manufactured

domestically and are capable solvents they are starting to be utilized substantially in the implementation of the SSP. The sector impact of this trend will be discussed in Section 5 below but several points are relevant for the individual enterprises as well.

69. HCFC-141b made in China is a good solvent to replace CFC-113. However, users should note that because of the abundance of domestically made CFC-113 in the past it was used in many sub-optimised applications. CFC-113 is actually a mild solvent and is excellent for more delicate uses like electronics or even precision cleaning applications. For the more robust metal cleaning operations many other solvents are a better choice. Under no circumstances should SEPA allow TCA with an ODP of 0.10 to be replaced with HCFC-141b with an ODP of 0.11. No gain would be made in terms of ODP reduction by such a conversion, and in many cases, cleaning requirements could not be met.

70. NPB is a more aggressive locally made replacement for metal and other such robust cleaning tasks that traditionally would have used TCA. However, users need to keep in mind that the UNEP Scientific Assessment Panel has determined that nPB does have an ODP value of 0.02. This is an ODP that is similar to the value for HCFC-225, which is already regulated under the MP. In addition to the probability of inclusion in the MP, nPB is relatively new and therefore its health effects are not as well understood as they are for the traditional solvents. For this reason, particular attention should be paid to safety procedures outlined for its use. Additionally it may be worth noting that several of the enterprises that had chosen this alternative, complained of the bad smell.

#### **4.2.5 Implementation Schedule**

71. A common problem encountered with phase-out contracts is an over-ambitious implementation schedule. Repeated experiences show that conversion projects can rarely be completed in less than two years. The cleaning step in a manufacturing process is crucial and its modification must be done correctly to ensure ongoing product success. Many enterprises realize too late the crucial importance of carefully planning the complexities of the conversion. By the time they react it requires a revision to an equipment purchasing specification that is already being processed by the equipment supplier. Changing equipment specifications after a contract has been signed always causes delays. For international suppliers the problem is magnified but even when domestic equipment is ordered, late changes still wreak havoc. For the interviewed enterprises this issue was the primary reason given for delays. The SWG and national experts may want to consider spending more time explaining to the enterprises the importance of writing valid equipment specifications and then resisting to change them once the contract with the supplier has been signed. Although cleaning processes have many variables it may be of some benefit to have at least basic equipment specification templates prepared in advance by the national experts.

#### **4.2.6 Funding Issues**

72. No systemic funding issues were noticed during the interviews.

#### **4.2.7 Equipment Disposition**

73. Disposal or destruction of old equipment is important to make sure that the phase-out achieved under the SSP is sustainable. It is necessary to ensure that the beneficiary enterprise does not retain the old OD solvent cleaning equipment only to revert back to OD solvent use. Also, it is important to avoid selling the equipment on the secondary market to another OD solvent user. No clear trends were drawn from enterprises on this subject. Of five enterprises that were reported as completely converted, two had disposed of the equipment, two had not and one had retrofitted all original equipment. Both enterprises that had completed without disposition said they were awaiting directions from SEPA on what to do with the “sealed” OD solvent equipment. The SWG has an explicit procedure for equipment disposal and they normally do not close projects until the equipment disposition has been finalized and documented in the PCRs. All equipment relinquished from the enterprise should receive clear disposition direction from SEPA as soon as possible. Nothing is gained by waiting until project closure to provide direction.

74. As the predominant choice of alternatives moves more towards conversion to domestically produced HCFC-141b and nPB, there will be more retrofitting of existing machines. Making use of existing equipment will reduce the funding and time required for conversion projects. It also means less equipment will be disposed of at the end of project implementation. To generate the maximum economic and environmental benefit from this approach, national experts should make sure that as existing machines are being modified to work with a new solvent they are also upgraded to reduce emissions. Older machines should receive sliding covers, deeper freeboard, extra cooling coils (refrigerated if possible) and repair of plumbing leaks.

#### **4.2.8 Technical Assistance**

75. The enterprises interviewed felt that they received the technical support required for their conversions. It is also interesting to see that help came from every possible source including SWG, ATSS, CCETCA, international and national experts, and equipment and chemical suppliers. Some of the larger companies with technical staff remarked that they had to use more of their internal resources than expected. Although the enterprises thought that technical assistance was adequate they would have welcomed even more.

#### **4.2.9 Improvements Suggested by Enterprises**

76. When asked about how to improve the SSP phase-out process, 8 of 10 enterprises said they would prefer to be more informed and better prepared in the beginning of the project. Additional information was mostly sought on the variety of alternatives that could possibly meet their requirements. Upon reaching the end of their conversion many enterprises wondered if there was not a better way to get the cleaning task accomplished. More and earlier information would also be welcome on equipment and equipment specifications.

### **5 Sector (National) Level Effectiveness**

#### **5.1 Achievements**

77. Overall, the SSP has been implemented successfully in its first four years, although some delays occurred compared with the targets of the annual work programmes (see table 2 above). The phase-out targeted has been achieved, sector policies have been established, an organizational structure and expert teams assembled. Highlights include:

- (a) The reduction of national consumption of CFC-113, TCA and CTC as defined in the SSP for 2001 and 2002 has been achieved and verified. National consumption figures for 2003 will be available only late in 2004; their verification usually takes place in the fourth quarter of the following year.
- (b) National consumption of CFC-113 for solvent use in 2002 was 2,196 ODP tonnes, which is the same as the quota and the verified production under the CFC production sector phase-out agreement.
- (c) For TCA which is produced in China but more imported, national consumption was verified as 381 ODP tonnes, largely below the maximum allowed level of 605 ODP tonnes for 2002.
- (d) For CTC as cleaning solvent, only approximate data could be provided, resulting from extrapolation of consumption figures from 21 of the originally identified 34 CTC-using companies. National consumption for 2002 was estimated at 27 ODP tonnes, much below the maximum allowed level of 110 ODP tonnes.
- (e) The actual phase-out figures reported as result of contracts concluded with enterprises willing to convert in exchange for compensation correspond to approximately 75% of the reduction of national consumption reported for CFC-113 (1,202 ODP tonnes until the end of 2003), less than 50% for TCA (111.5 ODP tonnes) and even less for CTC (8.4 ODP tonnes). These figures include phase-out of 346 ODP tonnes of CFC-113 and 49 ODP tons of TCA from individual projects approved in earlier years. The total phase-out achieved through phase-out projects from 2000-2002 represents a significantly higher phase-out than achieved in the years 1992 to 1999. The planned and actual phase-out figures reported to the 42<sup>nd</sup> meeting of the Executive Committee in the Supplementary Report to the 2003 Progress Report have been made clearer and more consistent compared to earlier reports.
- (f) The difference between the actual phase-out reported by companies with conversion contracts and the reduction of national consumption must have been achieved by enterprises on their own. This is easy to believe for CFC-113 which is manufactured by one producer only who gets an annual production quota corresponding exactly to the maximum allowable consumption level under the SSP, and whose production and sales are verified under the CFC production sector phase-out agreement, while no imports are allowed. Therefore, availability of CFC-113 in the market is shrinking in line with the phase-out requirements under the SSP, and its use is moreover controlled through obligatory user licenses. Only illegal imports could result in an increase of consumption. For TCA and CTC control and verification of production and consumption are less stringent so far. For TCA, a similar sector approach as for CFC-113 is planned to phase-out production and imports until the end of 2009. CTC for solvent consumption has officially been phased-out by mid-2003; no more user licenses are issued but there might still be some illegal use, in view of the abundant availability of CTC in the market. The implementation of the CTC sector phase-out agreement will change this situation during the next years.

- (g) Contracts were concluded in 2002 and 2003 with another 258 enterprises to phase-out about 1000 ODP tonnes; as a reaction to a decreasing interest of solvent companies to participate in bidding for phase-out contracts, new forms of contracts as discussed in section 3.3 above, have been developed (vouchers, gradual phase-out, reimbursement). They are designed to attract in particular small users and the numbers of enterprises entering into phase-out contracts has consequently sharply increased (from 32 in 2002 to 226 in 2003 which is about 80% more than planned and encouraging for future phase-out prospects).
- (h) Domestic suppliers for equipment and chemicals have been identified to complete conversion projects with substantial cost savings;

78. As a problem it has to be noted that as discussed in section 4.2.5 above, conversion of enterprises has often taken significantly more time than planned, in particular but not only in 2003, when SARS delayed travel delayed. As the performance audit from November 2003 established, of 21 enterprises which had signed the 2001 ODS reduction contracts in July and September 2001, only 5 had completed the conversion by the end of October 2003, phasing out 64.5 ODP tonnes of CFC-113 (of a total of 541.6 ODP tonnes contracted) and 3.9 ODP tonnes of TCA (of 10.6 ODP tonnes contracted). Since then, a further 271.8 ODP tonnes of CFC-113 and 3.4 ODP tonnes of TCA were phased out during November-December 2003, and 178.9 ODP tonnes of CFC-113 and 2.8 ODP tonnes of TCA during January-February 2004.

79. Further problems are:

- (a) a) the delayed destruction of old equipment which was found in the enterprises visited (see section 4.2.7 above), and which was also confirmed by the performance audit from November 2003, and
- (b) weaknesses in the coverage of all sub-sectors and provinces, outreach capacity and technical qualification of the network of advisers established as well as the lack of cleanliness standards (section 3.4 above).

## **5.2 Alternatives selected**

80. During the first eight years of MLF project-by-project reduction effort, 22 solvent projects were implemented in China. Most conversions were to aqueous cleaning and all projects resulted in a non-ODP solution. The first two years (16 and 21 projects) under the SSP have resulted in a significant change in pattern. As can be seen in Table 4 below, in 2000 and 2001 almost all conversions were to substitute solvents and very little to aqueous cleaning. Of the alternative choices known, more than half of the ODP tonnes phased-out have been converted to nPB or HCFC-141b. As previously discussed, this approach will definitely make the conversion less expensive and simpler. It is much easier to modify an existing vapour degreaser (or even buy a new one) for a “transitional” solvent than to convert to a more complex aqueous cleaning process. Choosing this alternative is now made even more enticing because both the equipment and substitute OD solvent are produced domestically.



**Table 4: Alternative Solvents Chosen and Phase-out Approved (ODP Tonnes)**

OD Solvent	1992-1999			2000 - 2002 under SSP							
	Aqueous & Semi-aqueous	Misc. non-ODP	Total *	Aqueous	Chlorinated non-ODP	Hydro carbon	HFE & HFC	HCFC-141b	nPB	Unknown	Total
CFC-113	842	85	927	51	157	266	56	469	370	470	1839
TCA	53	5	58	0	75	127	0	7	19	393	621
CTC	0	0	0	0	0	0	0	0	23	0	23
<b>Total</b>	<b>895</b>	<b>90</b>	<b>985</b>	<b>51</b>	<b>232</b>	<b>393</b>	<b>56</b>	<b>476</b>	<b>412</b>	<b>863</b>	<b>2483</b>

\* Total 1992-1999 figures do not include phase-out of 12 ODP tonnes from a rare application of CFC-11 as a solvent.

Source 1: The Multilateral Fund Secretariat, inventory data on solvent projects approved for China.

Source 2: China State Environmental Protection Administration

81. Ultimately, China's enterprises will have to move out of HCFC-141b and likely nPB as well, without international grant funding. At this rate of conversion to HCFC-141b and nPB China will likely have at least 100 ODP tonnes for solvent use left by the end of the SSP effort in 2010. However, for China HCFC-141b does not require phase-out until 2040.

### 5.3 Remaining Effort

#### 5.3.1 Small Users

82. Table 5 below provides a comparison of the remaining effort with past progress. It is clear that although good progress has been made the next two years will be the most challenging for China and its SSP implementation infrastructure. CFC-113 is China's most popular OD solvent. An attempt to find and assist all remaining users (estimated at about 2,000) will be made in the next two years when the phase-out effort will peak, both in terms of ODP tonnes and numbers of companies involved, as China has to wrap up production and consumption of CFC-113, by the end of 2005.

**Table 5: Comparison of Past Progress to Remaining Effort (approved phase-out)**

	MLF	China Solvent Sector Plan			
	Project-by-Project	2000 & 2001	2002 & 2003	2004 & 2005	2006-2010
	1992-1999				
ODP Tonnes (%)*	20	20	20	30	10
OD Solvent Users (%)**	1	2	13	64	20

\* Estimation based on 5,000 total ODP tonnes of solvents used.

\*\* Estimation based on 2,000 users of OD solvents.

83. Article 2 countries spent considerable time and effort phasing out OD solvents used in the military. Conservative estimates predict as much as 5% of all solvent used in a country may be within the military. To make matters worse cleaning applications are sometimes unique and lack of accessibility typically slows the conversion effort. SEPA needs to have a clear plan for this important user prior to production phase-out.

### **5.3.2 Geographic region**

84. As countries go China is large and its final OD solvent users are likely spread out amongst its vastness. Past efforts have been focused on the eastern region (Beijing, Shanghai, and Shenzhen) and centrally around Chengdu. This year and next will definitely require more travel than in past years. The voucher system in contribution with the Intermediate Executive Agents (IEA) appears to work well for at least identifying enterprises. SWG members interviewed shared plans to add a few more IEAs but it seems that many more will be needed as soon as possible.

### **5.3.3 Cleaning subsectors**

85. SEPA has used several methods to identify the remaining OD solvent users. However, Article 2 country experience indicates that several cleaning sub-sectors may have remained untouched so far. For example, aircraft maintenance, inks and coatings, aerosols, adhesives, lab uses, solid rocket motor manufacturing, fingerprint detection, fabric protection, fabric spot cleaning, and many unique applications within the military.

### **5.3.4 Essential Uses**

86. It is possible that China has some essential use, in the space programme for example. It would be best to study the list of essential use exemptions found in Article 2 countries and identify a supply source prior to production phase-out. This activity is not as critical for CTC or CFC-113 because it will still be made for the foreseeable future or it can be stockpiled for many years. TCA essential uses are more critical.

## **5.4 Further Developments of the Technical Support System**

87. Further orientations for the technical support system are seen as follows:

- (a) Communication efforts need to move down the consumer supply chain to the companies that repackage OD solvents for the smaller user;
- (b) Technical assistance should be made available for enterprises that have resorted to two or more alternatives when one correctly functioning cleaning system would be more efficient;
- (c) Technical experts should meet as soon as possible with equipment installation vendors to educate companies about the basics of vapour degreasing with a non-flammable solvent;
- (d) National experts should emphasise the advantage of creating good equipment specifications and then resisting temptations to make late changes. The preparation of basic equipment specification templates might help enterprises in the planning of the conversion;
- (e) As conversion efforts trend more toward retrofitting existing equipment, national experts should emphasize the benefits of relatively inexpensive modifications to reduce emissions;

- (f) National experts should offer better information to enterprises about the various alternatives possible, including the need to evaluate such alternatives in terms of cost per unit cleaned rather than cost per kg of solvent used.

88. China has set up a good resource base for technical assistance to solvent companies which will be tested this year and next, not only by the number of users but also the variety of cleaning sub-sectors where the national experts may not yet have gained experience. When they get over the 2004 and 2005 hump then they will be able to assist other countries as international experts.

## **5.5 Sustainability**

89. There are no indications that enterprises which have phased out will revert back to using OD solvents. This is especially true for the new batch of users that now use HCFC-141b and nPB with good results and less costs.

## **5.6 Illegal use**

90. There is always the possibility of illegal consumption of OD solvents. If for some reason illegal supplies of OD solvents were accessible at a lower price, then equipment converted to transitional substances like HCFC-141b or nPB, could be used with such supplies. This is because many old machines can be easily retrofitted to work well with both the transitional or original OD solvents

91. China has established policies that forbid production or consumption of OD solvents without a license. Monitoring for compliance will likely remain an issue for many years after the official phase-out dates. Controlling so many potential users spread over such a large country will require SEPA to have a high level of cooperation from the local EPBs. Monitoring programs should begin looking for ongoing CTC use now and plan to significantly step up efforts to coincide with the CFC-113 phase-out. Monitoring production is an easier method of control. This approach requires watching both potential domestic producers and illegal imports.

92. In 2000 the Joint Operational Office for Exports and Imports was established; it is composed of the Ministry of Commerce, the General Administration of Customs and SEPA. Part of the responsibilities of this office is to monitor illegal trade. Enforcement is the direct responsibility of the General Administration of Customs. From an organizational perspective China once again seems prepared. However, actually finding illegal imports in the field is a difficult task faced by all nations. Recently, three meetings on illegal trade were organized by UNEP at a regional level and SEPA participated actively in these meetings. In the 2003 Annual Implementation Programme, one of the TA activities of "Programme against illegal import, illegal production and illegal consumption of ODS" has been initiated in 2003 and last for an initial period of 3 years.

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**Annex I**  
**Mission Meetings**

November 21-22, 2003 Enterprise Interviews (Contract Year)

- 777 General Factory, state run (2001)
- Zhuhai Lingda Compressor Co., Ltd. (2000)
- Shenzhen Jinghu Display Co., Ltd. (2000)
- Xi'an Qing'an Refrigeration Equipment Co., Ltd. (2001)
- Beijing Pride Laundering & Dyeing Co., Ltd. (2002)
- Changsha Shuguang Electronics Group Co., Ltd. (2000)

January 5-8, 2004 Enterprise Interviews (Contract Year)

- Suzhou Victory Technology Co., Ltd. (2001)
- Suzhou Chunlan Air Conditioner Co., Ltd. (2001)
- Chengdu Xuguang Electronics Co., Ltd. (2001)
- Chengdu Weishida Powder Metallurgy Co., Ltd. (2003 voucher)
- Dongguan Yeedu Semiconductor Co., Ltd. (2001)
- Shenzhen Tianma Microelectronics Joint Stock Co., Ltd. (2000)

January 9 and 12, 2004 Implementing Agency Meetings

- UNDP and SWG
- Independent Auditors: Beijing Zhong Tian Hua Zheng CPA Co., Ltd.
- National Experts
- CNAO Auditors
- Joint Operational Office

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## **Annex II**

### **Questions Asked During Enterprise Interviews**

#### **Awareness**

- 1) How did you become aware of the ODS issue?
- 2) How did you become aware of the possibility of grant funding?
- 3) What was the main reason you decided to convert from ODS (e.g., solvent prices, manufacturing costs, modernization, customer requests, etc.)? (This question added after the Beijing interviews)

#### **Use of OD solvents**

- 4) What OD solvent did/do you use?
- 5) How much originally?
- 6) What for?
- 7) How much after the project?

#### **Alternative selected**

- 8) What alternative are you going to use?
- 9) Where is the equipment from?
- 10) Where is the solvent from?

#### **Schedule**

- 11) What phase of the project are you in?
- 12) How has the planned schedule gone?

#### **Funding**

- 13) Has project funding gone well?

#### **Opinion**

- 14) What did you think of the Solvent Sector Plan project process?

#### **Issues**

- 15) Have there been any major concerns during implementation?
- 16) Have there been any major ongoing concerns?

#### **OD solvent equipment disposition**

- 17) What happened to the old equipment?

#### **Technical Support**

- 18) How did you get technical support for implementation?

#### **Suggested improvements**

- 19) If you could do it all over again what would you change?

#### **Other Notes**

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**Annex III**  
**Enterprise Responses in Interviews**

Question Number	1,2	3	4	5	6	
Enterprise	Year Approved	Awareness	Reason to convert	OD Solvent Type	OD Solvent Quantity (tonnes/yr)	Cleaning application / sector
<b>November 2003 Tech Forum</b>						
777 General Factory, state run	2001	SEPA publication & training		CFC-113	20	vacuum tube switches / precision
Zhuhai Lingda Compressor Co., Ltd.	2000	Refrig sector ties		CFC-113	74	refrig compressors / metal
Shenzhen Jinghu Display Co., Ltd.	2000	SEPA meeting & LCD sector ties		CFC-113	29	LCDs/precision
Xi'an Qing'an Refrigeration Equipment Co., Ltd.	2001	SEPA fax		CFC-113	62	refrig compressors / metal
Beijing Pride Laundering & Dyeing Co., Ltd.	2002	SEPA newsletter & meeting		CFC-113	17	Dry Cleaning / Dry Cleaning
Changsha Shuguang Electronics Group Co., Ltd.	2000	MII membership		CFC-113 & TCA	25 & 3	LCDs/precision & Metal parts/metal
<b>January 2004 Factory Visit</b>						
Suzhou Victory Technology Co., Ltd.	2001	SEPA conference	Customer & Local Gov	CFC-113	15	PCBs/electronics
Suzhou Chunlan Air Conditioner Co., Ltd.	2001	Newspaper & SEPA conference	Customer & Gov regs	TCA	30	Heat exchangers/metal
Chengdu Xuguang Electronics Co., Ltd.	2001	SEPA materials	Reputation & next generation	CFC-113	40	vacuum tube switches / precision
Chengdu Weishida Powder Metallurgy Co., Ltd. (voucher)	2003	SEPA IEA	Solvent cost & Gov regs	CFC-113	4.5	sintered bearings/metal
Dongguan Yeedu Semiconductor Co., Ltd.	2001	Unknown	Gov regs, customer, solvent cost	CFC-113	70	LCDs/precision
Shenzhen Tianma Microelectronics Joint Stock Co., Ltd.	2000	News	Gov & customer	CFC-113	80	LCDs/precision

**Annex III  
Enterprise Responses in Interviews (continued)**

Question Number	8		9,10	11	12	12	13
Enterprise	Alternative Selected	Alternative OD Solvent Quantity (tonnes/yr)	Alternative Equip/Chem Supplier	Project Complete (ECD)	Schedule Delay (months)	Delay Reason	Funding Issues
<b>November 2003 Tech Forum</b>							
777 General Factory, state run	nPB	20	China/USA	No (Feb 04)	6	SEPA designated lab	Needed more
Zhuhai Lingda Compressor Co., Ltd.	nPB & HCFC-141b	10 & 20	China/USA & China	Yes	Yes	Equip spec change	Needed more
Shenzhen Jinghu Display Co., Ltd.	Aqueous & HCFC-141b	33	China/China & Imported	Yes	No	N/A	Yes
Xi'an Qing'an Refrigeration Equipment Co., Ltd.	Aqueous & TBD Solvent	7	China/China	No (May 04)	3	SARS	No
Beijing Pride Laundering & Dyeing Co., Ltd.	CO <sub>2</sub> & PCE	N/A	USA & China/China	No	No	N/A	No
Changsha Shuguang Electronics Group Co., Ltd.	IPA/water & MC	N/A	China/China	Yes	No	N/A	No
<b>January 2004 Factory Visit</b>							
Suzhou Victory Technology Co., Ltd.	No-clean & HFC	N/A	China & USA/USA	No (May 04)	13	Funding	Yes
Suzhou Chunlan Air Conditioner Co., Ltd.	No-clean	N/A	China/China	No (Jan 04)	14	Equip specs changed & SEPA process long	No
Chengdu Xuguang Electronics Co., Ltd.	nPB	40	China/China	Yes	No	N/A	No
Chengdu Weishida Powder Metallurgy Co., Ltd. (voucher)	N/A	N/A	N/A	No	N/A	N/A	N/A
Dongguan Yeedu Semiconductor Co., Ltd.	HCFC-141b or HC	70 or 0	China/China	No (March 04)	9	SARS, equip specs & solvent choice	No
Shenzhen Tianma Microelectronics Joint Stock Co., Ltd.	IPA & HCFC-141b	80	China/USA & Germany	Yes	7	Unknown	Yes

**Annex III**  
**Enterprise Responses in Interviews (continued)**

Question Number	13	14	15,16	17	18	19	20
Enterprise	Funding Issue Reason	Opinion of SSP process	Issues Implementation or Ongoing	Equipment Disposition	Technical Support	Improvements	Other notes
<b>November 2003 Tech Forum</b>							
777 General Factory, state run	Factory mods	Mixed	nPB smell and higher BP	No	SWG & CCETCA	Study alternatives more first	Yes
Zhuhai Lingda Compressor Co., Ltd.	Factory mods	Mixed	Eventual need to change nPB & HCFC-141b	No	SWG	Study alternatives more first	No
Shenzhen Jinghu Display Co., Ltd.	Final pay awaits all 2000 year completes	Satisfied	Aqueous line too big & HCFC-141b consumption too high.	Yes	SEPA & Equip Supplier	Smaller aqueous & try hydrocarbons	No
Xi'an Qing'an Refrigeration Equipment Co., Ltd.	N/A	Satisfied	No	No	SWG & ATSS	No	No
Beijing Pride Laundering & Dyeing Co., Ltd.	N/A	Satisfied	No	No	ATSS	No	Yes
Changsha Shuguang Electronics Group Co., Ltd.	N/A	Satisfied	Equip supplier & MC consumption is high	No	Suppliers, SWG, CCETCA	First study alternatives more & better equip specs	No
<b>January 2004 Factory Visit</b>							
Suzhou Victory Technology Co., Ltd.	SEPA delay solvent purchase	Satisfied	No	Yes	Enterprise & Chem supplier	No	Yes
Suzhou Chunlan Air Conditioner Co., Ltd.	N/A	Satisfied	No	No	ATSS	More info on alternatives	Yes
Chengdu Xuguang Electronics Co., Ltd.	N/A	Satisfied	nPB smell and worker exposure	Yes	SEPA & Enterprise	More info on alternatives & equip	Yes
Chengdu Weishida Powder Metallurgy Co., Ltd. (voucher)	N/A	N/A	N/A	N/A	N/A	N/A	No
Dongguan Yeedu Semiconductor Co., Ltd.	N/A	Satisfied	No	No	CCETCA & Suppliers	More preparation in the beginning	Yes
Shenzhen Tianma Microelectronics Joint Stock Co., Ltd.	SEPA delay solvent purchase	Unacceptable risk placed on enterprise	Lack of tech assist & tech prob & high HCFC-141b use	N/A	Suppliers	More preparation in the beginning & more info on alternatives	No

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**Annex IV**  
**List of Evaluation Mission Participants**

**State Environmental Protection Administration**

- Sun Fangjuan, Project Officer, State Environmental Protection Administration, Beijing China (Participated in all enterprise interviews and visits)

**Implementing Agency**

- William Kwan, Regional Programme Coordinator Montreal Protocol Unit, Energy and Environment Group Bureau for Development Policy (UNDP), Beijing China (Attended discussions in Beijing)

**Evaluation Team**

- Darrel A. Staley, Consultant, Enumclaw, USA (consultant)
- Ansgar Eussner, Senior Monitoring and Evaluation Officer, MFS, Montreal, Canada (Attended discussions in Beijing)

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