Sida Evaluation 05/06

Phasing out Ozone Depleting Substances in the Solvent Sector in China

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and Economic Co-operation

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The assignment

An Agreement was signed between the Government of Sweden, represented by Sida, and the United Nations Development Programme (UNDP) in October 1997 to support the implementation of the project "*Sweden-UNDP-China Technology Transfer. Demonstration and Contribution to Sectoral Funding Strategy for Phasing Out of ODS Consumption in the Solvent Sector in China*". The project was delayed and activities continued until the final dissemination workshop in October 2001.

Upon completion of the project, the assignment has been to evaluate how well objectives were met. A team consisting of two consultants undertook the project evaluation mission in the end of 2003.

Mr. Darrel Staley addressed the technical aspect of the project. He has project monitoring and evaluation experience under the MLF and technical knowledge in the solvent sector. Ms. Ann Jennervik addressed the impact aspect of the project. She has experience in monitoring and evaluation of Technology Transfer in the field of environmental support financed by ODA. The project has been jointly evaluated, since the technical and institutional issues are interlinked. The work has been guided by UNDP.

The evaluation was carried out during an eight-day mission to China that included visits to the three demonstration projects. Interviews were conducted in China and Sweden with relevant organisations and experts. Project files at UNDP, Sida, and from the Swedish experts were reviewed to understand the project's background, progress, and results.

For abbreviations used, please see full wording in Appendix 5.

Table of Contents

Executive Summary

The Sweden-UNDP-China Solvent Project was discussed between parties involved during the autumn of 1997. It was set up to assist the Chinese efforts of phasing out ODS in the Solvent sector. The design was modelled from the Swedish experience of a rapid and cost efficient phase-out achieved by establishing independent nodes of expertise in alternative cleaning processes and a close collaboration between responsible authorities and OD solvent consuming industries. The solvent sector is considered to be one of the most difficult in terms of ODS phase out, because of the widespread use at small and medium scale enterprises and the variety of industrial processes using the OD solvents. The *development objective* of the project was to promote the rapid adoption of appropriate ODS-free and process/resource efficient alternatives in the solvent sector in China. The *specific objectives* were to establish a sustainable mechanism to facilitate the transfer of ODS-free cleaning technology and to demonstrate the applicability of relevant ODS-free and process resource efficient technologies in the solvent sector. Between 5 and 7 feasibility studies for alternative solutions should be made for representative industries in the sector. At least three should be implemented as demonstration of appropriate alternatives. Shanghai was chosen as the most appropriate location of demonstration projects, since the city hosted more than 50% of the estimated 3700 OD solvent consuming enterprises. The sustainable technology transfer mechanism should have its node in Shanghai, collaborating with core experts from universities, enterprises and other institutes from other parts of China.

Main *counterpart* in the project was SEPA (NEPA at the time), being the co-ordinating agency for Montreal Protocol funded projects in China, and the ministry who directs the activities of the line ministries involved in various aspects of the ODS phase-out. UNDP, represented by the UNDP Office in Beijing and the Montreal Protocol Unit in UNDP New York, was managing the project. Sida contributed financially with USD 1 000 000 using additional funds outside the Swedish contribution to the MLF. Sida and UNDP signed the Project Agreement in October 1997. The project should continue for three years until the end of the year 2000. The Chinese Government in-kind contribution was 1 000 000 RMB Yuan, and UNDP contributed with USD 200 000, covered under a MLF funded project, CPR/97/G62 – Solvent Sectoral Funding Strategy.

This *project evaluation* mission should have been done upon project completion. Project completion was delayed for almost a year, mainly due to lengthy discussions on suitable alternatives for conversion of the enterprises selected for demonstration. After the terminal project meeting it was recommended by a technical expert to install additional fire safety measures at one of the demo projects. This equipment was also financed from resources in the project. When the installations were finalised, the evaluation had to be postponed due to travel restrictions caused by SARS. The main purpose of the evaluation has been *to determine how well the project objectives were met.* The technical and institutional aspects of the project are interlinked and have been evaluated during an 8 days mission to China with visits to the demonstration projects and through interviews in China and Sweden with organisations and experts involved.

Input to the project has been delivered principally as agreed. The Swedish experience with the benefits of an integrated approach to the issue of efficient ODS free cleaning processes have been provided to the Chinese counterparts. It has been done through three series of workshops and training, in October 1997, May 1998 and March 1999 and through discussions over a long period of time regarding suitable alternatives for the seven possible demonstration enterprises selected. The integrated approach takes a holistic view on the cleaning in each type of manufacturing processes, starting with assessing the reasons for cleaning. It consequently includes an overview and optimisation of the process as a whole.

Close collaboration between the enterprises, experts and responsible authorities is a key to success. A combination of financial, legislative and other regulatory mechanisms, carefully designed to suit the needs and conditions, gives the necessary framework of the concept. Two extensive manuals for ODS alternatives, one for electronic enterprises and one for metal parts cleaning, and a report on key policy, monetary, technical and financial aspects of phasing out the ODS in the solvent sector have been provided in English. For demonstration purposes, three alternatives to the use of OD solvents have been implemented and financed from the project resources. A no-clean alternative was implemented in a PCB-manufacturing enterprise, one aqueous cleaning alternative was chosen for demonstration of plastics cleaning and for one enterprise cleaning metal parts, a combustible hydrocarbon solvent selected. SAES[1] was appointed as the node for the transfer of technology and was provided with analysis equipment for performing cleanliness tests.

The project was well received and at the final project meeting a successful implementation was concluded. Revisiting the *effects and results* nearly two years after that event, we regret to conclude that *the project objectives were not met.* The assistance given has not led to the establishment of a sustainable technology transfer mechanism. Of the people trained in the project, many have left for other jobs or retired, and SAES is not actively promoting services in the field. Only a few of the experts that participated in the project have been met or contacted during the evaluation, and only one of them mentioned possessing and using the documents provided through the project. The main message from the Swedish experts, the need for an integrated approach, has not been translated into the Chinese context, neither literally nor as a concept. Legislative measures and financial incentives have been discussed, but found inappropriate in the Chinese setting and not compatible with the policy on ODS phase-out. The linkage between the industrial processes and technical solutions for conversion has not been established in terms of combining the fields of expertise. Only the problems with OD solvent phase-out at medium-scale, and not at the small-scale enterprises have been addressed in the project.

The demonstration effect has not been achieved, outreach activities to the remaining OD solvent consumers have not continued and the industries are somewhat reluctant to reveal conversion data that gives them a competitive edge. Finally, the project has not achieved a sustainable phase out of ODS in the demonstration projects. The most successful conversion, to "no-clean", includes purchase of a new soldering machine, and if old machines cannot be retrofitted the concept is not economically viable for the typical small-scale enterprise. The most remarkable finding though is that another of the three demo projects has turned back to ODS. They replaced the combustible hydrocarbon with nPB, a more efficient and non-flammable chemical produced in China. This alternative was discussed at length during the project and deemed inappropriate due to its ozone depleting effect.

Several reasons, and conceivable reasons, for this disheartening result are given in this summary evaluation report. At the same time we find many good reasons to continue the promotion of the rapid adoption of appropriate ODS-free and process/resource efficient alternatives in the solvent sector in China. In the implementation of the Solvent Sector Plan, the input and elaborated findings from this project will be useful. The main result might have been the deduction of financial support needed for the total phase out in the sector from 150 million USD to 52 million USD, based on cost-efficiency calculations for alternatives for the enterprises in this project. A saving of 100 million USD to the MLF is a really successful result in itself. Our recommendations are therefore to further use the project input and try to solve the remaining issues. Specifically we recommend continuing the following work with a high momentum:

- Create a small but efficient core group of experts working in a network and utilising analysis equipment and technical knowledge provided in the project

[1] Shanghai Academy of Environmental Sciences

- Update a simplified database, with open access for all actors involved in the efforts, of remaining OD solvent consumers, and group them in relevant sub-sectors corresponding to optimal alternatives for conversion
- Revisit the need and possibilities for efficient policy measures in the Chinese context, utilising relevant information from the Swedish example
- A clear division of roles and responsibilities and the need for a day-to day project management function was addressed as an area of improvement during the project implementation. It might still be an area to consider
- Further clarification of to what extent cost-efficient alternatives like the no-clean will be part of the solution, and explore the possibilities of a total phase-out.

Much of the resources needed are in place today, and was improved by the assistance given in the project.

1. Main objectives of the Project

China is developing a strategy to efficiently and cost-effectively phase out use of all remaining ozone depleting substances (ODS) in its solvent sector. The Technology Transfer/Demonstration and Contribution project financed by Sweden (through Sida) was set up to establish a sustainable technology transfer mechanism. Plans included the demonstration of three cost-effective and appropriate ODS-free alternative technologies in China. The development objective was *to promote the rapid adoption of appropriate ODS-free alternative technologies.*

Table 1.1 Summary of objectives, inputs, outputs and expected results in the project

Development objective: To promote the rapid adoption of appropriate ODS-free alternatives			
Objective	**Expected results[2]**	**Input**	**Output**
A sustainable technology transfer mechanism	Establishment of STNG[3]	SAES[4] appointed by ShEPB[5] Equipment for cleanliness analysis provided. Training to use equipment.	No current activities in the field. Key person left. Services available upon request.
	Core group (20) training in energy and resources conservation and ODS-free alternatives.	Members selected. Training at seminars during two or three expert missions. Visit to Ericsson, Nanjing, no-clean demonstration.	Many moved to other jobs or retired. 5 work with the Solvent Sector plan. It was not possible to get answers to questionnaire on their use of new knowledge.
	50 govt officials and 7 from beneficiary industries training in energy and resources conservation and ODS-free alt.	One three-day workshop. Training to industries also during two or three expert missions. Industries part of long effort to discuss appropriate solutions for conversion.	Awareness of the ozone issue in the industries. Major changes in the ministerial structure. Many govt officials moved to other jobs. No current activity in other ministries.

[2] In the agreed Project document, the expected results are named "Success Criteria".
[3] Sectoral Technical Nodular Group
[4] Shanghai Academy of Environmental Sciences
[5] Shanghai Environmental Protection Bureau

Development objective: To promote the rapid adoption of appropriate ODS-free alternatives			
Objective	**Expected results[6]**	**Input**	**Output**
	At least 100 managers training in energy and resources conservation, ODS-free alternatives and project management.	Seminar on MP obligations and the ozone issue.	Awareness rising. No specific action being reported.
	Financial and regulatory report.	Basis for the report delivered by Swedish experts.	Issues discussed. No report available.
	A library of information and a centralised technology information database. Two manuals on ODS-free technology available. Application of the technologies through project preparation.	Two manuals produced by Swedish experts.	The final project proceedings book describes the three demo projects. It is available at SAES in English and Chinese. Swedish training manuals not available. No library or database available.
Three demonstration sub-projects successfully implemented and evaluated	Feasibility studies prepared for at least 6 projects	Proposals given from Chinese experts. Revised and discussed. Cleanliness tests performed.	3 specifications for new equipment, bidding documents.
	At least 3 pilot sub-projects designed and implemented as demonstration of relevant alternatives.	Procurement procedure. Assistance during implementation.	3 projects designed and implemented successfully. Low demonstration effect.
	Demonstration of relevant ODS-free technologies with increased energy efficiency and reduced production costs.	No active demonstration efforts. Competition is seen as an obstacle to reveal design.	Some visits by other industries, mainly in the metal parts sector to Shanghai Automobile Acc.
	Project objectives presented and findings disseminated.	Convening a final dissemination workshop. Information on participation of persons outside the project not provided.	Documentation in the final project proceedings book, available in Chinese and English.
	Findings incorporated into the Solvent Sector Plan.	Swedish expert in the project also part of the negotiation team. Technical inputs from Swedish expert. Discussions and suggestions to SEPA. Help with translation.	Varied statements. From: Influenced the cost of ODS phase out directly to Not evident. Sector plan produced in an early stage of the process.
	Appropriate mechanisms recommended for the implementation of follow-up projects.	Input given in the Finance and Regulatory report.	No specific results reported. Start of ODS phase-out activities at local level in Shanghai. Institutional framework set up.
	Other funding mobilized for the remaining 4 projects.	No efforts documented or reported.	One conversion to no-clean outside the project for unknown reasons

[6] In the agreed Project document, the expected results are named "Success Criteria".

2. Background to the Project

2.1 Chinese situation

By the late 1990s China began to consider unique methods for achieving phase-out in the OD solvent sector. There were several compelling factors that led to their search. A primary factor was the dispersed use of OD solvents within China. The challenge of how to phase-out many thousands of small users scattered over a very large geographic area. Experience with the MLF project-by-project modality throughout the early to mid 1990s made it clear that targeting single large scale enterprises one at a time would not achieve the phase-out of smaller users in time. Another concern was whether a sufficient supply of alternative chemicals and cleaning equipment could be provided at a reasonable price. Previous experience had shown that imported solutions were too expensive for most Chinese enterprises. Further complications arise from the fact that there are six primary use sub-sectors; electronics, precision cleaning, metal cleaning, dry cleaning, adhesives and coatings and aerosols. Typically a seventh sub sector is used for all of the miscellaneous uses that do not fit into the main six sub categories. The three primary use sub sectors in China are precision, metal and electronics cleaning.

China's desire to find a more effective approach to this difficult sector ultimately led them to ExCom approval of their Solvent Sector Plan in March of 2000. A ten-year, 52 million USD plan that would allow a more cohesive autonomous approach and only require annual evaluation of progress. A high level overview of the planned approach is as follows. First an Alternative Technology Support System (ATSS) was to be created. Its purpose is to ensure that there is enough overall support for OD solvent consumers during the phase-out effort. Although it is designed to assist all users, its primary purpose is to service the small enterprises. ATSS consists of the following key elements:

- Three alternative technology support centres to provide:
  - Design and engineering services
  - Technical consulting
  - Technical supervision
- Qualified local manufacturers designing and producing alternative cleaning equipment at reduced cost
- Dealers who are trained in the ability to recommend alternative technologies
- Procurement agents to facilitate competitive bidding for equipment
- Local manufacturers to develop and produce alternative chemical cleaning agents
- Industrial associations will be included to help identify users and to promote phase-out actions.

Phase-out activities under ATSS will make use of a voucher system to help small users obtain technical services, equipment, and non-ODS solvents delivered by the ATSS participants.

The Chinese strategy for ODS-phase out has also been to seek a replacement chemical with equal performance. Preferably it should be produced within the country. Since the Montreal Protocol was set up because of the environmental damage mainly caused by the developed countries, extra efforts need to

be supported. No particular aims to seek environmentally friendly solutions or avoidance of new chemicals or transitional alternatives in general are therefore explicit parts of the Chinese policy to phase out ODS.

2.2 The Swedish background

The Swedish strategy for ODS phase out and bilateral cooperation under the Montreal Protocol has some specific aims. First of all, there is recognition that development assistance thinking needs to be more integrated into the Montreal protocol. This means that ODS phase out must be seen in a wider context. Being the first (and for a long time the only) international environmental agreement with a financial mechanism, the ozone issue could be a spearhead to efficient environmental management in general. It could help introduce the concept of cleaner production on a broader scale and enhance the development, implementation and functioning of environmental regulations. In Sweden, a key to success has been a close collaboration between industry and environmental authorities in finding appropriate solutions and legal mechanisms. Innovative legislation and financial mechanisms were an important part in the rapid and successful total phase out of ODS in Sweden.

The electronic industry is a large and important part of Swedish economy. Swedish based and Swedish owned companies have customers and subcontractors worldwide. This has two important implications for the implementation of the Montreal Protocol. First, that the Swedish industry itself transfers better and cleaner technology to the electronics industry in Article 5 countries. Second, environmental labelling schemes and accreditation are driving forces for improved environmental management both up and down the supply and consumption chain.

Sweden's own OD solvent phase-out experience was noteworthy for two reasons. It was swift and the alternatives chosen were those with the least overall environmental impact. Many times the trade off for a more environmentally friendly solution is an increase in financial cost. For example, it can be argued that flammable hydrocarbons have a relatively low overall environmental impact. However, successful implementation requires improvements in safety management and more capital investment to manage the increased safety risk of fire.

Choice of alternatives is not always a compromise. For a subset of applications (especially for the electronics sub sector) no-clean technology provides the best cleaning solution, which is to avoid cleaning altogether. It was clear in this evaluation that the Swedish team pushed hard to implement this "perfect" solution where possible for the Chinese enterprises.[7] Ten years ago, the technical solutions used in Sweden were to some extent non-traditional. The concept of no-clean was tested and found adequate for many enterprises, despite their original hesitance over lower quality, less value for these products in the market. No-clean alternatives were advocated for reasons of improved cost efficiency and overall environmental effect. Sweden has also been remarkable in its persistence to avoid chlorine[8] even if it means using flammable solvents. Although it is an expensive choice initially, with an ever-present safety concern, Sweden helped prove that flammable cleaning alternatives can work well for the implementing enterprise as a less expensive long-term solution with positive environmental trade offs.

[7] "It is probable that [no-clean] would be the best approach for between 80% and 90% of the electronics products produced in India." Brian Ellis, international expert on electronics cleaning and UNEP Solvents Technical Options Committee member

[8] Chlorine is an active chemical. Some would argue that there is an implicit advantage to the environment if you can avoid its use all together.

Sweden has also long opposed the use of transitional solvents. These are solvents that may be less harmful to the ozone layer than the original three OD solvents but nevertheless will ultimately have to be phased out as well. The Swedish opposition is based on three reasons, better alternatives exist, it is contra-productive to spend money from environmental funds on transitional solutions and the global warming potential of many transitional solvents are high. These solvents are called transitional because they are regulated by the Montreal Protocol and will also eventually have to be phased out. HCFC 225 and HCFC 141b are both typically used to replace CFC-113 applications in the electronics sub sector.

A newer solvent on the scene for metal cleaning is nPB. This solvent is similar to TCA in its cleaning strength. The ozone depletion potential for nPB has been hotly debated. Because it has a relatively short atmospheric lifetime the damage nPB can do to the ozone layer depends greatly on where it is released on earth. Different regions on earth have convection systems that vary in their ability to transport chemicals from the troposphere to the stratosphere where ozone layer damaged occurs. This added variable has required new models to allow researchers to correctly determine the ozone depletion potential. Primarily because of the difficulty to establish a single ODP number, regulations have just recently started to address nPB. Most agree now on a number of ~0.02. For this reason, its adoption as an alternative will also likely be transitional in nature.

Among others Sweden had also noticed shortcomings with the project-by-project approach of the MLF. In addition to China's concern about the pace, the focus of this concern was also financial. There is an "inherent bias" from the beneficiary enterprise and in some cases the implementing agency to propose projects with alternatives that may not be the most cost efficient. This bias stems from each party's wish to maximize their own benefit from the agreement. Projects with low implementation costs and higher operational savings do not offer high tech advanced equipment and tend to reduce project management implementation fees. An explicit goal of the Sida project was to demonstrate that low cost solutions could be successfully implemented and sustained. When the project proposal was submitted to Sida for decision, the debate within MLF was whether the alternatives with low investment cost but higher technical assistance costs would be eligible under the Montreal Protocol. To avoid a stalemate on this issue and assist China in a rapid phase-out, the project was financed by global environmental funds over and above the Swedish financial contribution to the MLF.

2.3 Initiation of the project

The Project was initiated by three coinciding courses of events. The Swedish EPA had since the beginning of the 1990s realised the fact that the rapid growth of ODS use in some Article 5 countries could soon jeopardize the positive effect to the ozone layer of the phase out in Article 2 countries. The solvent sector is regarded as one of the most difficult and threatening in terms of succeeding with the MP. Sweden realized that it possessed a unique level of experience in the solvent sector. Much of this experience was gained through two inter-Nordic projects, the TRE-project for the Electronics Sector and the AMY-project for the metal cleaning sector. These projects had the benefit of active participation from the industry (users) and responsible authorities. Independent technical institutions were responsible for coordination. A unique hallmark of the projects was to exclude financing from the chemical and equipment suppliers, based on an explicit requirement of the users. They felt they didn't want to be overly influenced or steered by the suppliers. About 3.5 million USD were spent on the two programmes between 1988 and 1993. The model and experience was used to develop a bilateral offer for assistance under the Montreal Protocol and during 1994 was sent to India, Brazil and Pakistan for consideration. The offer had been requested through contacts made during ExCom meetings and other MP meetings.

At the same time an internal discussion on roles and responsibilities of Swedish authorities with respect to international cooperation in the field of environment took place. It ultimately led to the development of guidelines for bilateral assistance under the Montreal Protocol, with Sida as the implementing agency. During this period Sweden was also discussing possible areas for cooperation with China, specific topics included strengthening environmental efforts and supporting the development of democracy. Assistance to ODS phase out was put forward as a possible area for collaboration. UNDP as one of the implementing agencies under the MP was active in China, and showed an interest in managing a bilateral programme for Sweden.

In August 1996 the Chinese Ministry of Chemical Industry sent an assistance proposal to analyse the present status on the use, control and alternatives of ODS as chemical process agents, to Sida. Swedish EPA and Sida considered the process agent area too large and complicated. They wished to steer the focus to a sector where they felt the Chinese work could really benefit from Swedish experience. During the autumn of 1996 the solvent sector project was solidified by discussions between the Swedish EPA, Chinese ministries and UNDP. The content and model was very similar to the offer for assistance sent to India, Brazil and Pakistan in 1994, but put in the Chinese context. All in all, the preparation phase was thorough, and all parties involved invested time and efforts. The content of the Swedish model was fully incorporated into the project proposal. Major discussion points continued to revolve around division of roles and responsibilities. Key discussions included which Chinese Ministry should take the lead, and which technical institute should be given responsibility as the STNG.

3. Evaluation methodology

The evaluation has been done through interviews with parties involved in the project, and by the examination of various documents from the project. All three of the demonstration project sites were inspected. The methodology has mainly been based on crosschecking information received through interviews with different persons and organisations.

It has not been possible to find a sufficiently detailed list of all training activities from the projects files. Instead, such information was compiled on what has been retrievable, and is therefore not complete. The main reports from the project that were submitted to Sida are a progress report covering the period October 1997–June 1998, and reports before and after each TriPartite Review meeting, held in March 1999, June 2000 and October 2001. A Terminal report of the project was sent to the Ambassador of Sweden in December 2001 and to Sida in March 2002. Before each TPR-meeting, an annual programme/project report (APR) based on standard format for UNDP projects was produced. The first section of the APR gives the numerical rating of the relevance and performance of the project, for each objective and output. The enterprises, SAES, the Swedish Experts, SEPA and UNDP have rated the performance. The second section gives a textual assessment, but it is not clear from the text to what extent it is the UNDP officer's opinion and/or a compilation of comments added by the parties that are used to arrive at a numerical rating.

The written documentation is listed in Annex 3. The relevant documents from the Sida file were assessed first. The documents that were submitted by UNDP as a background to the mission were the Project Document and Agreement, next the APRs and TPRs and finally the terminal report.
UNDP set up meetings in Beijing during the first two days of the mission. Meetings in Shanghai on the following six days were set up by SAES. For further details, see Annex 2. The evaluation team asked for participation from Shanghai Environmental Protection Bureau (local EPB), and for meetings with as

many as possible of the experts involved in the training activities during the project. Unfortunately, only a few of the national experts were met. Therefore the evaluators asked for a mailing list of the ones still active in the field, and for SAES and SEPA to submit a small questionnaire, trying to get first hand and more specific information of the effects of the training received. SAES found it difficult to locate the experts. Much of the project took place several years ago, many of the experts do not have e-mail, some are retired, and many have moved to different jobs. SEPA promised to send the questionnaire to their roster of 13 National experts in the Solvent sector, even if not all of them took part in the project. Within the timeframe of the evaluation, it has not been possible to retrieve any answers to the questionnaire[9].

This evaluation is also based on information from other relevant material from the evaluator's personal archives, and from earlier experience with the project and activities linked to the project.

A Draft Summary Report was submitted to UNDP 2003-11-19. No comments were received during the two months before final editing.

4. Findings regarding a Sustainable ODS-free Technology Transfer Mechanism

Table 4.1 Training for capacity building activities in the project

Activity	Duration and participants	Main subjects	Results
First mission Oct. 97[10]	Two weeks. 7 Swedish experts. 82 Chinese participants. SEPA/other ministries, 8 Industry 27 SAES 17, ShEPB 15 Exp/univ. 15	Presentation of MP/International agreements. Costs and Financing. Workshops on electronics and Metal parts. Visits to 6 companies, evaluations. Prep of alternatives for conversion. Presentation of SAES, inspection of analysis equipment. Presentation of methods for cleanliness analysis.	Extensive information presented. Written documentation provided (partly beforehand and in Chinese). Core group of experts identified. Requirements assessment of institutional strengthening at SAES. 6 enterprises visited, described and several conversion alternatives presented. Recommendations by Swedish experts.Discussions and answers. Diverse group of participants.
Second mission May 1998	One week. Swedish experts. 4 Chinese participants 43 SEPA/ ShEPB 8 Industries 14 SAES 9 Core experts	Project planning 3 days electronics group, metal group. Demonstration of cleanliness measurement by the Swedish experts at SAES. Visit to the Ericsson factory (PCB) at Nanjing No-clean technology demonstrated.	Detailed project plan for the coming work. Test program for the electronics industries worked out. Disagreement on no-clean.One day meeting with Swedish experts, SEPA and UNDP for input to Solvent Sector Strategy. Good interaction in discussions. 5 of the core experts changed.
Third mission March 1999	One week. 5 Swedish experts.? from China (documentation not found)	Visit to industries involved, review and evaluation of proposals. 3 days training in cleanliness tests at SAES. Visit to newindustry.	Evaluation of test programme electronics. New industry with interest in no-clean entered the programme. Mission report not found

[9] The questions were how much they had personally participated in the project, what was learned from by the project and if/how they had been able to use that knowledge.

[10] Took place before the contract was signed. Partly financed as a preparatory mission in a separate agreement.

Activity	Duration and participants	Main subjects	Results
Terminal mission Oct 2001	3 days. x Swedish experts, x from China (documentation not found)	Dissemination of results. Site inspection and discussion of results for the demonstration projects.	Official closing and thanks for all efforts put into the project. Mission report not found
Study to formulate the sector phase out plan[11]	Two levels of training. a) 45 local env. officials and 15 ind. managers b) 260 enterpr.	Comprehensive data survey of more than 85% of ODS solvent consumers in Shanghai. Formulation of policies on regulation and financial mechanism.	Second level organised by each district/county. First training of its kind in Shanghai.

4.1 Strengthening of capacity at SAES

Establishment of an independent institute for the selection and support of alternatives implementation was considered a crucial part of cost effective phase-out of OD Solvents when the project was designed. This institute would possess all of the necessary expertise and equipment to bridge the gap of required technical capacity. In the Swedish phase-out, those independent institutes[12] played a very central role. Especially it was deemed by the industry that the independence was important, and they did not want to use chemical or equipment suppliers as advisors. At the very start of the project, SAES was assigned to fulfil this function and an ODS-centre was set up at the institute. The institute's core mission was based in the natural sciences part of the environmental field and the atmospheric science research on the stratospheric ozone layer. Engineer research and process management was not within the main scope of activities. Such research institutes are under the Ministries of different industrial branches in China. By using SAES for this project, SEPA (NEPA at the time) sought to strengthen and broaden the scope of its own institute. The decision was also intended to enhance cooperation and collaboration between ministries and institutes.

Environmental management is a holistic field of expertise. Almost all environmental issues are cross cutting. Entering into new fields like cleaner production methods mostly requires both additional expertise and close collaboration. Half way through the project, SAES hired a retired expert from the electronics industry for a part time assignment. This gave an excellent additional capacity, but perhaps somewhat limited sustainability.

SAES was provided with new high standard equipment for performing cleanliness tests. Equipment provided in this project includes:

- One – Ion Gas Chromatograph: This device is used to determine the chemical composition of contaminants. (See Fig 4.1)
- One – Surface Insulation Resistance (SIR) tester: This device is used to measure the electrical insulation quality of printed circuits. The presence of contaminants can significantly alter the SIR characteristics. (See Fig 4.2)
- Two – Ultrasonic bench top cleaning tanks[13] used to test clean products with various cleaning chemicals.

[11] Probably covered under CPR/97/G62 Solvent Sector Funding Strategy, the UNDP contribution to the project.

[12] IVF (Industrial Research and Development Corporation) fulfilled that function for the electronics sub sector. YKI (Institute for Surface Chemistry) and IM (Swedish Institute for Metals Research) fulfilled it for the metal parts cleaning.

[13] They were not mentioned or shown initially during our visit to the SAES laboratory. When asked for we got the information that they were still unpacked since the recent renovation of the SAES building.

The amount of USD 84 000 was spent for all four pieces of equipment, which is a reasonable cost. Adding a device to test ionic contamination would have made a more complete set. This would allow for comparison with documented cleanliness standards for printed circuit boards. We'an Computer, for example, found it necessary to do their ionic contamination testing at Shanghai Railway with an Omega meter purchased as part of their own MLF project. Surface Insulation Resistance measurements for We'an were completed by IVF in Sweden. The reason these tests were not performed at SAES is not clear. Perhaps SAES had limited capacity to perform the tests or equipment was not set up in time.

From the answers to our questions we got the impression that the equipment is currently not well utilized. It is also doubtful whether SAES has capacity within its organisation to perform the necessary tests. Training on how to do the tests was provided from IVF to three persons at SAES during three days in March 1999. In general, the tests performed on this equipment require a high level of technical expertise. The persons trained generally had a high level of chemical expertise and test performance skills. The specific industrial cleaning processes and how the cleanliness tests relate requires specific experience from areas outside SAES field of expertise. Even with the training provided it could be difficult to perform the tests as part of the regular activities at SAES.

SAES was very much engaged with the expert mission activities. Between 5 and 10 persons from SAES took part in the seminars, workshops, training and discussions. Their exact role during the feasibility studies and implementation of demonstration projects is less clear from the documentation we have been able to retrieve as a background to the evaluation. One example from the cleanliness tests for different alternatives at the Shanghai Clock factory has been studied to possibly provide insight to the ongoing relations. The correspondence via e-mail between the Swedish expert and SAES discusses the tests during March–September 1999. Initially the Swedish expert submitted a test proposal. The ensuing discussion was about the need for full-scale tests instead of lab scale, and what solvent(s) that should be tested. The main reason for the lengthy communication was unexpected results and incomplete information on how the tests had been performed. This in turn led to new questions and the passing of more time. Further communication complications were experienced because of vacations, language barriers and some technical problems with e-mails systems (conversion between languages).

4.2 Transfer of knowledge

A lot of very complete technical documents and knowledge have been shared in this project. The level of intense discussions and questioning of the proposals made is actually a quite remarkable item. Expert technical advice provided under MLF conversion projects is typically accepted without as much debate around technical merit of the proposed alternative. One positive explanation may be that it is a sign of high interest and willingness to learn more. Other explanations can be found in "cultural communication". The Swedish experts were to some extent more impatient, blunt and outspoken than the norm. They often felt frustrated by delays and incomplete answers back. The Chinese experts also expressed some marginal comments on the difficulties to receive answers back. Of course language and communication shortcomings play a large role.

Upon closer examination of certain back and forth discussions, other reasons occur. One was lack of counterpart capacity, but mainly the deviating opinions can be attributed to core issues like the possibility of using more low cost solutions for the Chinese effort. In this case the Swedish experts felt that the Chinese enterprises gave the same quality assurance arguments against the no-clean concept, as had the Swedish electronic industry initially. One Chinese enterprise finally volunteered for the no-clean conversion but it was only after a long discussion on market competition. It was necessary to explain that a smooth low cost conversion and ongoing low cost production processes would be required for enterprises in this industry to stay in business.

As discussed at the end of section 2.2, there is a widespread recognition amongst Swedish experts in the field that the construction of MLF assistance based on the concept of incremental costs could be counter productive. Instead of seeking the optimal low cost solution, the enterprises try to get renewed and modernized equipment, and they are often at the mercy of expert's advice from the suppliers of equipment and chemicals. In this project, such recognition could have led to an overly suspicious attitude towards Chinese arguments, questions and proposals. It is not possible here to make an overall judgement, due to limited time and scattered information, but some tendency towards overestimating costs and problems from the Chinese side can be shown. More important is that in spite of successful demonstration and the lengthy discussions on the subject, the same basic questioning about the feasibility of the no-clean concept for Chinese medium scale enterprises remains.

An important goal of the Sida project was to provide experience to help strengthen the plans for the solvent sector approach. Interviewed opinions on effectiveness vary widely. One statement from the Swedish side is that cost efficiencies experienced on the Sida demonstration projects help correctly arrive at the 52 million USD cost when initial discussion were as much as three times this level. Others interviewed from the Chinese counterparts and UNDP believed Sida provided no tangible benefit besides raising general awareness of the OD solvent issues, because of its relatively small scale.

4.3 Project management issues

Delays in schedule and decision-making have been drawbacks for all parties involved in the project. Again, the reasons are several. Initial plans were probably over ambitious from a schedule perspective. The financing from Sweden, through Sida and by ordinary appropriations for support to global environmental issues (i.e., not through the bilateral programme under the Montreal Protocol) requires time for assessment and discussion. Division of roles and responsibilities between the parties involved was a point of clarification. Design and implementation of capacity building projects were not the mainstream activities for UNDP as an implementing agency under the Montreal Protocol at the time. When the project started there were clear "Homework" lists produced, responsibilities divided and time and targets set for the coming phase. However, the day-to-day project management function was unclear and led to delays, difficulties in planning etc. Basically the ownership of the project was not clear to parties involved. "Sweden" had initiated the model, but the Swedish experts expected traditional clear terms of reference for each input. UNDP is more familiar with the project-by-project approach where experts typically take full responsibility for implementing the alternative solution. The primary role for SAES was also somewhat confusing. SAES was both a core institution for the project on the Chinese side responsible for assisting with implementation and at the same time a beneficiary of the institutional strengthening efforts. The confusion generated by the unclear roles and responsibilities can be sensed from the early project reports and efforts were made to correct them.

As discussed under 4.2 above, it could to some extent be questioned if all parties involved shared the same objectives. A project manager with capacity to objectively assess the relevance of arguments and do a follow-up on questions and answers would have facilitated an improved mutual understanding.

A result from the project's aim to strengthen local capacity and provide examples of division of roles and responsibilities between central and local authorities was the start of ODS phasing out actions by Shanghai EPB. Shanghai government established a leading group and an expert group to promote ODS phase-out. Actions like data registration and survey for ODS production and consumption were taken by the local government. A Shanghai action plan for phase out of ODS was developed, and local regulations adopted like the ban on installation of Halon fire fighting equipment and the recycling of CFC in automobile servicing stations. Local capacity is much needed if wide spread use of ODS should be controlled and plans for phase out implemented.

4.4 Sustainability

The methods chosen for technology transfer were the train-the-trainers concept and to build core technology capacity at a Sectoral Technical Nodular Group. Some of the major technology transfer barriers to implementation have been assessed above. It appears that the technology was transferred according to the project document plans. On the other hand, observations during the evaluation mission found few examples of remaining capacity built up through the project and utilised for the continuing work to phase out OD solvents. The most crucial factor for sustainable capacity building in certain fields is though the future market and financing for the services that can be provided. SAES has no market plan for this segment, they are available upon request, but have little current activities. Consequently most of the SAES staff being trained in the project has moved on to other jobs either within or outside the organisation.

A few of the current national experts in the solvent sector were met and interviewed during the evaluation mission. One of the experts has explicitly mentioned and used the training material provided, while others more remembered vivid discussions back and forth and some minor bits and pieces of information. During and after the evaluation mission several attempts have been made to get in contact with the core group members to ask them what benefit they have had from the assistance provided in the project. Unfortunately, no results have been reported. The general comments have been that it is very difficult to locate the members; many have changed jobs or retired. Only a small portion of the documents and training material provided in the project have been compiled, processed and translated to suit the needs of the Chinese experts. Judging from the content and the few comments provided during the evaluation it is hard to believe that it was considered inadequate or of limited use for the continued Chinese efforts. So the reason this material was not made available cannot be because it lacked value. Instead the reason seems mainly to be that it just has not happened.

Another reflection of train-the-trainers concept was the idea of having demonstration projects, showing optimal conversion alternatives for industries with the same structure. This concept has not been working so well in the Chinese context. The competition is seen as a major obstacle to share in-depth information, despite that willingness to demonstrate the solution was explicitly part of the agreement to convert.

One major problem for the sector phase out is how to reach and address the consumption at small-scale enterprises. Besides the input on financial and regulation mechanisms, this sub-sector was not addressed in the project. Only medium scale enterprises were selected as demonstration projects. The financial and regulation mechanisms part of the project has not been finalised. On the basis of the Swedish experience, a report adapted to Chinese context should have been produced. There is a major obstacle to discussing these issues in detail, since they are very closely related to internal state policy and continued negotiations of the MP. The sector approach will in theory give room for the Chinese side to design optimal financial and regulatory mechanisms for a rapid and cost efficient phase out, but it may also affect policies in other sectors. Internal Chinese policy decisions like these must also consider the principle of indemnified industrial development. At its root the issue has to do with the advantage Article 2 countries experienced using comparatively cheap and efficient ODS during their industrial development period. The MP has tried to consider ways to balance this advantage even as Article 5 countries phase out. Complications in this touchy area quickly outweigh the possibilities for an in-depth and unprejudiced detailed discussion on the design of appropriate finance and regulatory mechanisms.

4.5 Cost assessment

As shown in Table 4.2 below, the major part of the project budget was planned to enhance the cleaning technology capacity for efficient phase out of the OD solvent consumption in the total sector. Nevertheless, the main efforts in terms of time and TA (technical assistance) was spent on selecting the enterprises suitable for demonstration and deciding on the alternative cleaning process to be implemented.

Table 4.2 Project Costs in thousands of USD

	Budgeted	%	Actual	%
Services and mission costs of international experts	250	25	435	45
Demonstration projects	50	5	182	19
Strengthening capacity at SAES	0 [14]	0	65	7
Analysis equipment at SAES	355	36	84	9
Database information system	50	5	32	3
Training workshops	100	10	53	5
Studies of policies, regulation and financial mech.	20	2	12	1
Sundries, Support & Management Services	175	18	112	11
Total	1 000	100	975	100

The cost of international experts is also remarkably high for four missions ranging between 3 and 14 days. In addition to this, time was spent on communication and assistance between meetings. It has not been possible to get a more detailed breakdown of this cost. Calculating from the UN maximum fee for expert assistance, 500 USD per day, and rough estimates for travel costs, around 600 days of expert assistance should have been input to the project. This is double the original budget of 300 days. About 130 of the 600 days were spent for visits in China. Reports from the meetings show requests from the Chinese side to have fewer experts visiting on each mission. With fewer experts at once it would have been easier to coordinate the missions and achieve more focussed assistance.

[14] Originally budgeted as part of "Services and mission costs of international experts"

5. Findings regarding Demonstration projects

Project objectives were clearly defined for the OD solvent alternatives implemented at the demonstration projects. Table 5.1 summarizes how the chosen alternatives met the objectives.

Table 5.1 Alternatives Compliance with Demonstration Project Objectives

	Wen'an Computer Company	Cosmopolitan Plant	Stability Phonic Plastic Company
OD solvent free	Yes	No	Yes
Applicable and relevant to a wide range of enterprises	Yes	No	No
Applicable and relevant to low OD solvent consuming enterprises	Yes	No	No
Financially sustainable	Yes	Yes	Yes[15]
Process and resource efficient	Yes	Yes	No

Phasing out ODS in a sustainable and cost-efficient manner requires an integrated approach and adaptation of lessons learned in the Chinese solvent sector context. The Project Agreement basically identifies two barriers to be overcome.

1. Lack of information on and access to optimal alternative technologies, and
2. Lack and/or insufficiency of institutional capacity, financing services and enabling framework for an efficient phase-out.

Attempting to choose the optimal alternative to CFC-113 or TCA always seems to be an exercise in compromise. First the alternative must not harm the ozone layer. Next cost and cleaning requirements must be met. These primary requirements can easily be met by the variety of alternatives. The compromise usually shows up in increased occupational health and safety risks, and/or local environmental risk. By the time of this evaluation about 99% of the ozone depletion potential (ODP) tonnes were phased out in the demonstration projects (see table 5.2). As explained in this section, not all non ozone-depleting alternatives introduced in the demonstration projects were sustainable or environmentally sound. Although it could not be verified during the evaluation, the alternative introduced after project completion at Cosmopolitan likely has an ozone depleting effect.

Any solvent phase-out effort is further complicated by the complexity of the solvent sector itself. Unlike all other sectors using ODS, the solvent one has many sub-sectors with almost unlimited variations in final use. And it is the exact details of the final use that really determines the appropriate alternative. Considerations include investment cost and running costs, cleanliness requirements, occupational health and environmental effects.

[15] At current lower production rates that do not require a complicated combination of hydrocarbon cleaning and aqueous drying.

Table 5.2 Annual consumption of ODS before and after the project

	Wen'an Computer Company	Cosmopolitan Plant	Stability Phonic Plastic Company	Total
Baseline OD solvent tonnes[16] (CFC-113)	5.9	4.0	8.0	17.9
Baseline ODP tonnes[17]	4.7	3.2	6.4	14.3
Current OD solvent tonnes – estimated	0	8 (nPB)	0	8
Current ODP tonnes – estimated	0	0.2	0	0.2

5.1 A representative selection of projects

The project was designed to show an assortment of alternative conversion techniques. To successfully demonstrate an alternative modality to Multilateral Fund phase out projects, a reasonable number of solvent cleaning sub sectors would have to be considered. In this respect the project has been successful. Each of the three demonstration enterprises covered a different sub sector: metal, electronics, and miscellaneous (plastics) cleaning. As shown in table 5.3, only three cleaning sub sectors account for over 80% of CFC-113 solvent consumption in China. Sub sector illustration would have been improved by including a precision cleaning project. Together two of the sub sectors demonstrated, metal and electronics, represent the vast majority of remaining OD solvent cleaning challenges.

Of the three OD solvents used for industrial cleaning (CFC-113, CTC, and TCA) only CFC-113 conversions were considered in the Sida project. Considering CFC-113 accounts for ~ 80% of the solvent ODP tonnes remaining to be phased out in China, CFC-113 demonstration projects seem appropriate.

There is an ongoing structural change in the industrial sectors concerned. Enterprises selected for demonstration were mainly state-owned companies. It is difficult to judge to what extent structural changes and the entrance of Joint ventures and foreign owned companies will contribute to the phase out of OD solvents but it clearly is part of the ongoing changes.

[16] Actual weight of cleaning solvent.

[17] A relative measure of the harm to the ozone layer.

Table 5.3 Industries involved in the project. Assistance given and findings regarding results

Enterprise	Initial Visit (1997)	Demo Project (1999)	Demo Project (2000)	Alternative chosen for project	Alternative in use today	Comments
Shanghai Hero Company, Ltd.	Yes	No	No	Not applicable, not chosen	Not clear. It is reported that the product requiring cleaning no longer produced	Proposed aqueous cleaning with vacuum drying considered to expensive by Hero. Also stopped producing pens requiring cleaning prior to gold plating. Vacuum deposition equipment failed and demand for product reduced.
Shanghai Stability Photic Plastic Spray Paste partnership Company (previously Shanghai Clock Factory)	Yes	Yes (testing only)	**Yes**	Aqueous cleaning with SX-2, ultrasonics, & centrifuge/oven drying and Hydrocarbon solvent cleaning with D-80	Aqueous cleaning with SX-2 & centrifuge/oven drying	Converted CFC-113 vapour degreaser still available for use with D-80. Market demand for certain products and higher production rates require hydrocarbon cleaning.
Shanghai Cosmopolitan Automobile Accessory Company, Ltd.	Yes	Yes	**Yes**	Hydrocarbon solvent cleaning with D-80, ultrasonics, & vacuum drying	Halogenated solvent cleaning with DSL-3.8 and ultrasonics. cleaning no	Alternative change was required to clean different parts at higher production rates. Although not specifically identified, technical data available indicates the solvent is nPB with an ODP of ~0.02.
Shanghai No. 2 Electronic Meter Plant	Yes	Yes	No	Not applicable, not chosen	Not applicable, product requiring longer produced.	Production of taxi valuation machines replaced with magnetic cards that do not require CFC-113 solvent cleaning.
Shanghai Telephone Equipment Plant	Yes	No	No	Not applicable, not chosen	Low residue no-clean technology	The effort was outside the project. Reason for conversion to no-clean technology is unknown.
Shanghai Communication Equipment Company	Yes	No	No	Not applicable, not chosen	Not applicable, product requiring cleaning no longer produced.	Stopped producing telephone exchange machines that required CFC-113 solvent cleaning.
Shanghai Wen'an Computer Technology Company, Ltd	No	Yes	**Yes**	Low solids flux & paste, no-clean	Low solids flux & paste, no-clean	Determined that purchasing a new wave soldering machine was more economical than retrofitting.
Donghai Computer Company	No	No	No	Not applicable, not considered	Not applicable, not considered	Company performed aqueous cleaning tests on PCBs for Shanghai No. 2 Electronic Meter Plant
Shanghai Railway	No	No	No	Not applicable, not considered	Not applicable, not considered	Company used Omega meter purchased in their multilateral fund project to do tests for Shanghai We'an Computer Technology Company, Ltd

5.2 Applicability to small user enterprises

Although solvent cleaning sub sector variety was achieved, no small ODS consumers (<3.5 ODP tonnes of CFC-113 annually) were considered in this project. This is noteworthy because it is estimated that up to 20% of the remaining OD solvent use is consumed by small enterprises. These small enterprises may account for more than 80% of the remaining OD solvent users (see table 5.3). This geographically dispersed and difficult to monitor user group has proven the most challenging to convert using the MLF project-by project approach. However, this project only included medium sized CFC-113 users, and specific problems on how to contact and inform small users were not really addressed.

Table 5.4 Classification of CFC-113 Solvent Consumers Based on 1996 information

	Consumption (tonnes of OD solvent)					% of
Size	**Precision**	**Metal**	**PCB**	**Others**	**Total**	**Consumption**
Large	646	851	60	285	1,842	49
Medium	488	298	175	136	1,097	29
Small					816	22
Total	39%	39%	8%	14%	3,755	100

Source: 2001 Country Evaluation Report on MLF Solvent Projects in China

5.3 Appropriateness and sustainability of chosen alternatives

Shanghai Wen'an Computer Technology Company, Ltd. was the only demonstration project that selected an appropriate alternative (no-clean) that proved sustainable. The other two enterprises found it necessary to pursue other alternatives less than two years after project completion. In one case unforeseen contamination variation was the problem. In the other the drying phase of the chosen alternative could not keep pace with increasing production rates.

The implementation of low solids no-clean wave soldering technology at Wen'an Computer proved to be the most successful conversion (see Fig. 4.6). The ultimate cleaning solution is to avoid the need to clean at all. This alternative should always be considered first for both economical and environmental reasons. The project would have been even more impressive for demonstration purposes if the original wave solder machine could have been economically retrofitted. The amount of resources required to purchase a new soldering machine does not make the demonstrated approach a viable solution for most small user enterprises.

The aqueous cleaning alternative chosen for Shanghai Stability Photic Plastic Spray Paste partnership Company is possibly the most suitable for many enterprises in China. China produces aqueous cleaning machines similar to the one imported for this conversion (see Fig. 4.7 & 4.8). The aqueous cleaning chemical SX-2 is produced in China. Unfortunately, certain stubborn soils (silicon based form release agents) and increasing production rates forced the enterprise to consider other partial solutions. Stability Plastic systematically determined that hydrocarbon cleaning with D-80 was required for certain products prior to coating. In particular, products with large residual amounts silicon based mold release agents. To efficiently clean these products at higher production rates, the original CFC-113 vapour degreaser was converted to a hydrocarbon cleaning station. Final water rinse and drying is then performed at the end of the aqueous cleaning line in centrifuges and an oven (see Fig. 4.9). Regrettably, this modified and somewhat complicated process requires both fire risk mitigation equipment and the

use of the high energy consuming water-drying equipment. Drying of rinse water by centrifuge and then oven definitely requires more energy than the original CFC-113 vapour degreaser. Clearly this project has not demonstrated process and resource efficiency. Both energy input and time required for drying are the primary detractions from aqueous cleaning.

The most debated conversion effort took place at Shanghai Cosmopolitan Automobile Accessory Company, Ltd. Finally, the decision was made within the project to convert the existing CFC-113 vapour degreaser to use a combustible hydrocarbon (see Fig. 4.3) to clean the somewhat geometrically complicated parts. A vacuum drying chamber (see Fig. 4.4) was also purchased to speed the drying phase. More flammable and faster drying hydrocarbon solvents were also tested. However, for safety reasons they were not selected. Similar to the plastics cleaning project, as soon as product demand increased the enterprise found the less flammable but slower evaporating solvents could not dry fast enough to keep up with the increased production rates.

One reason for the lengthy discussions on suitable conversion was the environmental effects of the chemicals proposed. The Chinese experts brought up nPB as a possible alternative. As it was considered to have ozone depletion potential by the Swedish experts they found it inappropriate to finance this alternative with project resources. The final agreement was to convert to hydrocarbons.

The enterprise has now switched to a non-flammable, fast drying, powerful cleaning solvent, DSL-3.8, that is locally manufactured and performs the cleaning task very well. During the inspection of the demonstration projects, some information was given about the chemical, and a material safety data sheet written in Chinese was provided. The solvent is likely nPB with an ODP of ~0.02. NPB has many of the characteristics of other halogenated solvents, including being non-flammable, powerful cleaner and inexpensive to produce. In addition it does not have global warming potential like the traditional solvents. It does have occupational health concerns with a moderate exposure limit, is not yet well regulated, and has ozone depletion potential. Studies place the ODP for nPB at 0.02[18]. Even though it is lower than the transition solvents (HCFCs) it is still ozone depleting.

As noted during the factory visit, the exhaust ventilation system installed on this project to reduce the concentration of the combustible solvent D-80 is no longer necessary with a non-flammable solvent. In fact, the induced draft completely negates the vapour degreaser's containment system. Emissions of OD solvents from this cleaning station will be greatly reduced if the exhaust fan is not used.

An important consideration for MLF projects is the disposition of the original OD solvent cleaning equipment. Before project closure it is necessary to demonstrate that the equipment will not be used again for OD solvent. In two enterprises the CFC-113 vapour degreasers were retrofit for use with hydrocarbon solvents. In the case of the electronics cleaning application the original CFC-113 vapour degreaser was reported as being destroyed as witnessed by UNDP. Ensuring that OD solvent equipment is not used again has proved somewhat difficult for MLF projects. This issue gets at the heart of the question of a country's ability to monitor conversion projects and the ozone phase-out effort in general. The questions are about who should verify equipment disposition, reversion to OD solvents, use of smuggled solvents, etc.

5.4 Low cost solutions

The intention of the project was to demonstrate that it is possible to implement ODS-free solutions at a low cost and in some cases even with substantial operational savings to the small use enterprises. For example, the project document discusses the possibility of small use enterprises visiting the three

[18] For reference: TCA has an ODP of 0.1, HCFC-141b is 0.1, and HCFC-225 is 0.03.

demonstration projects to replicate the appropriate alternative. Other possible approaches included low cost changes to production techniques to reduce the need to clean. Another aim was to design legal and fiscal incentives to create momentum and a "carrot and stick" incentive. This approach was based on the Swedish experience of phase-out in the solvent sector. The risk for the concept of incremental cost to hamper alternatives with low investment but higher cost-efficiency is a Swedish policy-issue in the further negotiations of replenishment to the MLF. On the other hand, an ongoing Chinese strategy has been to find alternatives where indigenous suppliers would be able to provide necessary chemicals and cleaning equipment. Chinese institutions, apparently operating within the framework of State Universities, have developed and commercialised chemicals that are used in a number of MLF projects. These seem to be mostly alkaline detergents for metal degreasing. These are very competitive, compared with imported products of similar performance.

As discussed in section 4.4, competition appeared to be a substantial hurdle to the replication idea for small users. Our impression was that general concepts and even visits would be allowed but the truly critical design details were not for sharing. There were also no examples of low cost changes to production methods. All demonstration projects were initially set up to purchase either imported equipment or chemicals. No evidence was provided for the availability of indigenous solutions. Additionally, no easily transferable low capital alternatives were demonstrated in the Sida project. Aqueous cleaning and hydrocarbon vapor degreasing cannot be considered low capital answers. No clean technology implemented at Wen'an may have been the closest to a low cost example. Yet in this particular case a low cost way could not be found to easily modify the existing machine so a new machine was bought. The purchase of a new "low solids" wave-soldering machine requires substantial capital investment. Undoubtedly, for those companies that can control the cleanliness of incoming supplies and are able to modify existing equipment, no-clean technology offers operational savings that quickly pay for implementation cost.

5.5 Safety, health and environmental considerations

In general, it seems the project experts clearly explained the strengths and weaknesses of the different alternatives to the enterprises. In most cases necessary precautions were put in place during implementation to address heightened risk. For example, using combustible hydrocarbon solvent increased risk of fire. Ventilation systems, monitors and in one case a fire extinguishing system was installed to mitigate this safety risk (see Fig. 4.5). Risk mitigation was not always complete or consistent.

For the electronics enterprise the choice of low solids no-clean technology has greatly improved the enterprise's status in all of these areas. As a side note, it is also commendable and worth mentioning that the company is attempting to implement no-lead soldering.

The orderly and well laid out cleaning station at the plastics coating enterprise provides a reasonably safe work area for employees. A few simple changes would greatly improve on an already good situation. Employees responsible for handling the concentrated aqueous cleaning chemical should always wear appropriate rubber gloves (not the cotton ones demonstrated) and safety goggles while transferring this caustic solution. The enterprise may also want to consider having the material safety data sheet available at the company or better yet in exactly the same location the SX-2 is stored. An emergency eye wash station is another inexpensive way to improve worker safety. As previously mentioned, in certain production scenarios the enterprise finds it necessary to use the combustible hydrocarbon cleaning station. Although a lower (flammable) explosive limit monitor was installed there was only one small hand held fire extinguisher located outside the cleaning enclosure. In addition to jeopardizing the employee, one small extinguisher is hardy sufficient to battle 100 litres of burning solvent.

Personal protective equipment (e.g., gloves, goggles, apron) for employees handling cleaning solvents was also a concern at the metal cleaning project. A material safety data sheet was available at Cosmopolitan.

5.6 Cost-Efficiency of the alternatives implemented

It is not possible to draw real cost efficiency conclusions about the Sida demonstration projects relative to other similar MLF projects. From the information available during this evaluation it is difficult to perform comparisons between the demonstration projects and MLF threshold values. Instead it can be said that the UNDP tracked costs for buying and installing equipment to perform the conversions seems very reasonable.

Cost efficiency upper limits for MLF are 19.73 USD/kg for CFC-113 and 38.50 USD/kg for TCA OD solvent projects. The information below was provided in the final project report:

	Wen'an Computer	Cosmopolitan Plant	Stability Ph.Plastic
Cost efficiency of project USD /kg ODP	7.09	16.76	5.8

All three values seem to be below the MLF standard for CFC-113 projects, but a closer review shows that the cost efficiency numbers are not derived in the same way as for MLF projects. In addition to implementation costs, MLF considers the net present value of four years of incremental operations costs or savings. This project considered only one. Since all projects had incremental operating savings, considering four years would have improved the cost efficiency values. On the other hand, values would have been much less efficient if all project costs had been included. For example, no costs for the considerable hours of Swedish expert consulting were considered. Also, an additional 27 000 USD (17%) was spent on demonstration project costs after the final project report figures were published.

6. Findings re contribution to and impact on the realisation of the MLF Agreement for ODS Phase-out in China Solvent Sector

The project raised awareness of the ozone issue on a broad scale. About 260 industrial managers and engineers in the Shanghai area were informed through efforts by the district level of Shanghai EPB. Several ministries were brought together for information and discussion initially. During the evaluation mission it was understood though that mainly SEPA has continued the work. There has also been a large change in the ministerial structure, and many of the persons participating in the project have changed jobs.

The education provided to national experts in the project made a major change from the previous situation, and gave additional resources to the elaboration and design of the Solvent Sector Plan. Again, few of the experts trained had stayed on board, and the reasons for this are several. Change of jobs and retirement has been pointed out. Basically, the sustainability of expert skills depends on the requirement for and the financing of assistance. The idea to establish core expertise at technical centres like SAES was difficult to realize in practice. Chinese technical centres in this area tend to be overrated, and need to be assigned long-term core functions including finance to continue functioning.

Analysis equipment has been provided and can be utilised for necessary cleanliness tests providing the market is there.

Money savings on SSP ($100M USD) might have been influenced by findings in the project at a strategic point of time. Although a general result of cost-efficient demonstration projects cannot be attributed to its outcome. The demo projects were only moderately successful and it took way to much consulting help to implement them. Again, this is not a conclusion that can be generalised to the future implementation of SSP. Cost-efficient alternatives exist for sub sectors, but their possible total impact in the Chinese context was not clarified through the project. The project documentation has the technical basis for explaining cost effective conversion and can still be of good use if it is compiled and more widely distributed. So far it is spread on various hands, and has not been integrated in the implementation of SSP.

The no-clean concept was introduced and discussed in China through the project. The objections to it still remain. Reasons might be less technical and feasibility based than part of Chinese policy and strategy issues.

The project on solvents was actually a catalyst to energize ShEPB to lead a 1997 survey for data on all OD substance uses. This data in turn provided background information for the Solvent Sector Finance Plan. The project had a clear aim to strengthen local capacity and provide examples of division of roles and responsibilities between central and local authorities. Local capacity is much needed if wide spread use of ODS should be controlled and plans for phase out implemented. Unfortunately the work of ShEPB within the solvent sector plan has not continued at the same level of action.

A major concern of the SSP, how to reach out to the small-scale enterprises was not addressed in the demonstration part of the project. One of largest concerns listed in SSP is lack of domestic equipment and chemical suppliers. Except for one partial alternative (SX-2) no domestic sources were demonstrated in the project.

7. Conclusions and Recommendations

The project reports states that the project was well received. At the final project meeting a successful implementation was concluded. Input to the project has been delivered principally as agreed.
The Swedish experience with the benefits of an integrated approach to the issue of efficient ODS free cleaning processes have been provided to the Chinese counterparts. Three sub projects to demonstrate alternatives to the use of OD solvents have been implemented and financed from the project resources. Revisiting the *effects and results* nearly two years after the terminal project meeting the conclusion is that the project objectives were not met. No sustainable technology transfer mechanism has been established as a result from the assistance provided in the project. The demonstration projects were only moderately successful, needed a lot of consultancy assistance and a sustainable phase out of ODS in the demonstration projects has not been achieved. Conclusions on the project can be summarized:

- The project may have been most successful in the level of awareness raised.
- The main conceivable result is the influence from cost-efficiency calculations for alternatives in the demonstration projects to the negotiations of the China Solvent Sector Plan. It might have led to a substantial deduction of financial support needed for the total phase out in the sector.

- Activities at a local level in Shanghai were initiated by the project. They have resulted in good data and local policy interventions leading to an efficient phase-out in other sectors. Momentum has not been sustained.
- The carrying concept on technical capacity building is good in theory but breaks down without the right enabling framework. SAES added a new sphere of activity, but the assistance given was not compatible with the counterpart capacity.
- Transferred technology is fleeting. Personnel changes, lost documentation and files, no further real life experience. Of the people trained in the project, many have left for other jobs or retired. Only a limited number of the experts that participated in the project are still active, and few examples of using the experience and documents provided through the project have been shown.
- The main message from the Swedish experts, the need for an integrated approach, has not been translated into the Chinese context, neither literally nor as a concept. Legislative measures and financial incentives have been discussed, but found inappropriate in the Chinese setting and not compatible with the policy on ODS phase-out. The linkage between the industrial processes and technical solutions for conversion has not been established in terms of combining the fields of expertise.
- Communication barriers were prevalent, literally and mentally. Swedish experience presented might seem far-fetched, massive lectures without relating to previous Chinese experience is difficult to absorb. Things take time in China; the schedules were partly too aggressive, day-to-day was management missing and delays cause frustration to all parties involved. Beneficiary of aid does not always accept cost effective answers. A better outcome is sought.
- Solvents sector is difficult and encompasses many specific technical problems. Even alternatives chosen specifically for demonstration may not go smoothly. For example, hydrocarbon solvents are problematic to adapt to changes in production rate.
- Only the problems with OD solvent phase-out at medium-scale, and not at the small-scale enterprises have been addressed in the implementation of alternative solutions.
- The concept of demonstration facility did not work in this project. Probably mostly due to fear for losing a competitive edge and the lack of outreach activities directed to potential enterprises seeking alternatives to CFC.
- Not one of the conversion projects implemented met all five objectives set up for selection. The most successful conversion, to "no-clean", included purchase of a new soldering machine. If old machines cannot be retrofitted for less cost than buying new, the concept is not economically viable for the typical small-scale enterprise.
- The most remarkable finding though is that another of the three demo projects has turned back to ODS. nPB is alive and well in China, and suits all policy aims of being efficient, produced in the country, reasonable exposure limits for the workers, and is very close to being a drop in replacement for TCA metal cleaning applications. All requirements but the ozone depletion potential- even if it is relatively low.

Several reasons, and conceivable reasons, for this disheartening result are given in this summary evaluation report. At the same time we find many good reasons to continue the promotion of the rapid adoption of appropriate ODS-free and process/resource efficient alternatives in the solvent sector in China. In the implementation of the Solvent Sector Plan, the input and elaborated findings from this

project will be useful. Our recommendations are therefore to further use the project input and try to solve the remaining issues. Specifically we recommend continuing the following work with a high momentum:

– Create a small but efficient core group of experts working in a network and utilising analysis equipment and technical knowledge provided in the project

– Update a simplified database, with open access for all actors involved in the efforts, of remaining OD solvent consumers, and group them in relevant sub-sectors corresponding to optimal alternatives for conversion

– Revisit the need and possibilities for efficient policy measures in the Chinese context, utilising relevant information from the Swedish example

– A clear division of roles and responsibilities and the need for a day-to day project management function was addressed as an area of improvement during the project implementation. It might still be an area to consider

– Further clarification of to what extent cost-efficient alternatives like the no-clean will be part of the solution, and explore the possibilities of a total phase-out.

Much of the resources needed are in place today, and was improved by the assistance given.

8. Lessons learned

What was learned from this project could in general terms be referred to as conventional wisdom. Nevertheless, few practical examples exist so far of projects trying to address specific needs for a sectoral approach to the ODS issue. It may therefore be of interest to a wider audience. There are good possibilities of further effective sharing the lessons learned from the project. The evaluation is of benefit to all parties involved in the project, as well as to Sida and to the continuation of MLF assistance. Main lessons learned are:

- Ownership is crucial. Expert assistance during short-term missions is limited to provide useful input. Major changes in governmental structure, changes in roles and responsibilities of organisations involved, and high mobility on a personal level must be taken into consideration. Changes can be inspired from outside, but happens from inside.
- Good governance of any technology transfer mechanism is needed. This includes creating an enabling framework for sustainability of experts trained in the project.
- The need for an integrated approach is there, including relevant policy measures, close collaboration between different disciplines and a holistic perspective.
- The no-clean concept could be cost-efficient also in the Chinese context, and is the main alternative for certain sub-sectors to start with.
- Demonstration projects have limited impact.
- Deeper analysis of information shared and its relevance in the Chinese context would have improved the results. It will still be useful to further tap this potential resource.

- Communication barriers must be addressed. More in-depth discussion on shared goals needed. Delivery is not automatically followed by reception.
- Day-to-day management is needed in a project like this.
- Implementation of a project with major emphasis on technology transfer and soft technologies[19] is different from a traditional conversion project. Reporting, documented discussions and management of the project need to spend more time and effort on assessment of functioning mechanisms for technology transfer.
- A project-by project approach is still prevalent. Focus on effects and results should increase.

Appendices

1. Terms of Reference for the Evaluation
2. List of meetings attended and persons interviewed
3. List of documentation and other references
4. Photos of equipment resulting from the project
5. List of abbreviations

[19] Soft technologies includes knowledge in all necessary areas besides the technical ones, like policy issues, legislative measures, financial structure, statistics etc.

Appendix 1
Terms of Reference for the Evaluation

Project Evaluation

A project evaluation team consists of one consultant with technical knowledge in the solvent sector and another with experience in monitoring and evaluation will be selected to undertake the project evaluation. The Consultants will work under the overall supervision and guidance of UNDP-New York's Montreal Protocol Unit, and in close consultation with the UNDP China Country Office, China State Environmental Protection Administration (SEPA), Shanghai Academy of Environmental Science (SAES) in China, Sida, Swedish and UNDP experts.

Project evaluation will be carried out as follows:

- Review background information and correspondence leading up to the project design, and based upon this information, to compare it with the project document and determine if the general intent of the bilateral programme was designed into the project to address issues identified.
- Review various reports on project implementation, and carry out appropriate field visits and conduct discussions with various participants such as recipient enterprises, institutions, government officials, participating national and international experts.
- Based upon the report reviews, appropriate interviews, as well as first hand observation of the results, the Consultant will determine how well project objectives (as per Objectives in §D of the Project Doc. CPR/97/G67/B/2G/99 of 3rd Dec. 1997) were met, including but not limited to the following:
    - Establish sustainable ODS-free Technology Transfer Mechanism.
    - Establish Sectoral Technical Nodular Group (STNG) to provide technical backstopping to low-ODS consuming enterprises being assisted through the demonstration programme of this project.
    - Strengthen Technical capacity of STNG and technical staff of line ministries to identify, prepare and implement projects with ODS-free alternative technologies.
    - Enhance the capacity of a number of policy/technical bodies to assist the STNG in the dissemination of alternative technologies, including MEI, CEEDI, MMI, MCI, NCLI, appropriate local EPBs, and use of a solvent sector information system in SEPA.
    - Demonstrate at least 3 cost-effective and appropriate alternative technologies in several enterprises in China.
    - Set up a "twinning" arrangement between China and Sweden to facilitate the technology transfer for this project, and to ensure a sustainable process for continued technology transfer.
    - Contribution to and impact on the realisation of the MLF Agreement for ODS Phase-out in China's Solvent Sector.

- Utilize the information obtained to:
  - Determine how well the project was implemented, including processes used (e.g., communications among participants to assure alignment and routine interaction; technology transfer processes, selection of candidate enterprises, training of local experts and the in-country STNG.), time to completion, and phasing out of ODS in China.
  - Assess technical feasibility in China to the implementation of the technologies proposed by Swedish experts, occupational safety- and health aspects of implemented technologies and their cost-effectiveness expressed in USD per kg ODS phased out.
  - Assess social- and cultural aspects that may have influenced the efficiency of the implementation.
  - Define lessons learned.
  - Determine recipients', stakeholders', and consultant's insights into any issues that affected the implementation of the project. Recommend possible ways to overcome identified issues in any similar future projects.
  - Determine unanticipated benefits from the project.
  - Determine if and how this type of project model might be used to transfer technology that is sustainable, and to phase out ODS in other appropriate A5 countries, and within China in other sectors
  - Assess the budget adequacy and how well the budget was followed in the implementation of the project.
  - Assess manpower resources that were ultimately involved in the project in terms of quantity and quality.
- Prepare a summary report and recommendations covering determinations and assessments from the above effort.

Appendix 2
List of meetings attended and persons interviewed

Meetings attended

September 19, 2003 at Swedish EPA, Stockholm.
To discuss Solvent Sector Phase out and International cooperation, China Solvent Sector Phase out and progress and Swedish-Chinese exchange of experiences in the field.

October 14, 2003 at Beijing UNDP building.
To discuss project history and current status

October 15, 2003 – Beijing SEPA building.
To discuss project history and current status

October 16, 2003 – Shanghai Academy of Environmental Science building.
To discuss the SAES role in the project and future efforts

October 17, 2003 – Shanghai Cosmopolitan Automobile Accessory Company, Ltd.
To discuss project participation and inspect current status.

October 18, 2003 – Shanghai Wen'an Computer Technology Company, Ltd.
To discuss project participation and inspect current status.

October 20, 2003 – Shanghai Stability Photic Plastic Spray Paste partnership Company.
To discuss project participation and inspect current status.

October 20, 2003 – Shanghai Academy of Environmental Science building.
To discuss open questions and plan final mission meeting

October 21, 2003 – Shanghai Academy of Environmental Science building.
To discuss mission accomplishments, remaining questions, and plans for report finalization.

Persons interviewed

Chinese Environmental Protection Administrations

Li Yong Hong, Senior Project Officer, Foreign Economic Cooperation Office, Project Management Division III, Beijing China

Su Yan, Senior Engineer Project Officer, Foreign Economic Cooperation Office, Project Management Division, Beijing China

Wu Jian, Shanghai Environmental Protection Bureau, Pollution Control Division, Shanghai China

Institutions and Associations, National Experts

Hu Jianxin, Centre of Environmental Sciences, Peking University

Yan Guo Jin, China Cleaning Engineering Technical Cooperation Association (CCETCA)

Zhang Yaping, China Cleaning Engineering Technical Cooperation Association (CCETCA)

Qian Hua, Senior Engineer Vice-Director, Shanghai Academy of Environmental Sciences, Shanghai China

Cao Lulin, Executive Deputy Director Professor, Shanghai Academy of Environmental Sciences, Shanghai China

Xie Fei, Deputy Director, China Global Environment Facility (GEF) Office, Beijing China

Enterprises

Shanghai Cosmopolitan Automobile Accessory Company, Ltd., Shanghai, Xu Xue Qiang

Shanghai Wen'an Computer Technology Company, Ltd., Shanghai, Yi Chuan Gang

Shanghai Stability Photic Plastic Spray Paste partnership Company, Shanghai, Zhao Jun Liang

Implementing agency

William Kwan, Programme Coordinator for China, Montreal Protocol Unit, UNDP, New York USA (attended all meetings during the evaluation mission)

Victoria Gyllerup, JPO at UNDP China Country Office and managing the Project between August 1998 and August 2001.

Financing agency

Sara Stenhammar. Senior Environmental Advisor. Swedish International Development Cooperation Agency.

Swedish Experts

Husamuddin Ahmadzai, Swedish Environmental Protection Agency

Per Johander, IVF Industrial Research and Development Corporation

Others

Rasmus Rasmusson, Ambassador and former Swedish Head of Delegation to ExCom.

Evaluation Team

Ann Jennervik, Consultant, Stockholm, Sweden (Mission Member, meetings and interviews held in Sweden)

Darrel A. Staley, Consultant, Enumclaw, USA (Mission Member)

Appendix 3 List of documentation and other references

* From the Sida files
° Provided as background to the evaluation by UNDP
Provided upon request by the Swedish Experts

Project reports

Agreement including Project Document: UNDP CPR/97/G67/A/2G/99 * °

Progress Report Oct 1997–June 1998. MPU UNDP. *

1999 Process report. UNDP. °

Tripartite Review reports: Dec 99, Jun 2000, Dec 2001, and Mar 2002 * °

Annual Programme/Project Reports: Jun 2000 and Oct 2001 * °

"Briefing for Kerstin" Circa 1999 °

Proceeding on China-UNDP-Sweden Summing-up Workshop Demonstration Project of ODS Solvent Phase-out, Oct 29–31, 2001 (Blue Book) °

Analysis of Income and expenditure. W Kwan Revised 31 may 2002. °

Reports from missions

Travel Report, Lennart Cider IVF, 1997-11-10 1st mission. ° #

Comments re Sida project mission Team's Report re Shanghai Mission. Fax from Clinton Norris UNDP Consultant to Laurence Reno UNDP. 1997-12-22. #

Mission Summary. Sida Project Mission Discussions CP updating and Sector Plan. China 16 May to 24 May 1998. 2nd mission. #

Travel report UNDP-Sida Bilateral ODS Phase-out project. 18–22 May 1998 2nd mission. #

Tentative mission schedule 1–5 March 1999, SAES 3rd mission #

Reserapport projektgenomgång (Travel Report midterm review) China Solvent Sector Strategy. Sida Ann Jennervik 1999-03-23. *

Mission schedule and list of participants. Terminal mission Oct 29–31 2001. #

Technical reports (partly working material)

Key Policy, Monetary, Technical and Financial Aspects of the Swedish Phase-out and Some Features of a Revolving Financial Instrument for Implementation, Husamuddin Ahmadzai, Tekn. Dr., Draft 1999-07-01 ° #

Project cycle and responsibilities, summary overview. °

TORs of Implementation of the Four Demonstration Projects in Shanghai Circa 1999 °

Elimination of ODS (CFC-113) used in the production line at Shanghai Second Electric Meter Factory, Yumei Zhu, 1999 °

Phaseout of Ozone Depleting Solvents at Shanghai Hero Co Ltd., Final proposal February 16, 1999. From the files of Husamuddin Ahmadzai

Phaseout of Ozone Depleting Solvents at Shanghai Cosmopolitan Automobile Accessories Ltd., February 21, 1999 #

Additional Test and Alternative Option on ODS Solvent in Shanghai Cosmopolitan Automobile Plant, 2001 #

Report on Cleanliness test of Carburetors, SAES 2000-01-27 °

Phaseout of Ozone Depleting Solvents Shanghai Clock Factory 3 proposals to discuss and test, February 25, 1999 °

Concerning about the ODS alternative test at Shanghai Clock plant. °

Elimination of CFC-113 used in the production line at Shanghai Wenan Computer Industry Development Company Limited, December 1998 * °

Compilation of problems occuring at Cosmopolitan. L Stjernstöm. Fax communication. Partly in Swedish. #

E-mail on programs for the project missions and on suitable ODS-free alternatives. Correspondance between Swedish experts and Chinese core group members. Around 20 pages. From the files of Husamuddin Ahmadzai. #

Results from Surface Insulation Resistance Measurements. IVF Test report 1999-08-18. #

Technical fact-sheet on DSL-3.8 (MSDS) and short report from the conversion to a new chemical. In Chinese. Handed over at the inspection of the demoproject at Cosmopolitan 2003-10-17.

Project background

Proposal to India Re phasing out of Ozone Depleating Substances – Solvents. Swedish environmental Protection agency, Husamuddin Ahmadzai. 1994-02-15. #

Draft Project document Bilateral projects under the MLF. Implementation of ODS-Phase-outs. Husamuddin Ahmadzai to Sida 1996-07-15. *

Fax from Sw Embassy in Beijing to Sida/NATUR Re Montreal Protocol Minutes from meeting with Susan McDade UNDP (In Swedish) 1996-05-14 and 1996-09-06 *

Suggestion Document Investigation on the use, control and alternatives to Ozone Depleting Substances used as Chemical Process agents in China. Ministry of Chemical Industry, MCI China. 1996-08-20. *

Minutes from meeting UNDP- NEPA-SwEPA New York re drafting project document for a Sida financed Solvent Sector Project. 1997-06-03. *

Fax from Sida to UNDP re China. Assistance to the Ozone Protection Programme. 1996-11-21 *

Mail and Draft from Sida regarding division of roles and responsibilities in the project 1997-08-15 and 1997-10-02. *

Decision and project appraisal. Sida Phase-out of ODS Solvents in China. In Swedish 1997-09-25 *

Other references (from the evaluators personal archives)

Country Report on [Multilateral Fund] Solvent Projects evaluated in China, Montreal 2001

Protecting the Ozone Layer, UNEP DTIE OzonAction Programme Technical Brochure Updates Volume 2 – Solvents, Coatings, and Adhesives, France 2001

The Montreal Protocol. Guidelines for the Swedish bilateral Programme. Sida May 1997

William Kenyon and Brian Ellis. Solvent, Coatings, and Adhesives Technical Options Committee members

Answers to evaluator's questions via mail from Jianxin Hu and Zhang Yaping, Chinese national experts. November 2003.

Appendix 4 Photos of equipment resulting from the project

Fig. 4.1 Ion Gas Chromatograph at SAES

Fig. 4.2 Surface Insulation Resistance Tester at SAES

Fig. 4.3 Vapour Degreaser at Cosmopolitan


Fig. 4.4 Vacuum Drying Chamber at Cosmopolitan

Fig. 4.5 Flame Monitor & extinguisher at Cosmopolitan


Fig. 4.6 Low residue no-clean wave solder machine at Wen'an

Fig. 4.7 Aqueous degreaser at Photic Plastic

Fig. 4.8 Aqueous Degreaser UNDP placard at Photic Plastic

Fig. 4.9 Centrifuge dryers and water filters at Photic Plastic

Appendix 5 List of abbreviations

MLF	Multilateral Fund under the Montreal Protocol
UNDP	United Nations Development Programme
ODA	Overseas Development Assistance (Development cooperation)
ODS	Ozone Depleting Substances
OD	Ozone Depleting
SEPA	(The Chinese) State Environmental Protection Administration, previously:
NEPA	National Environmental Protection Agency
Sida	Swedish International Development Cooperation Agency
PCB	Printed Circuit Board
SARS	Severe Acute Respiratory Syndrome
ExCom	The Executive Committee of the Multilateral Fund under the MP
UNEP	United Nations Environmental Programme
EPA	(Swedish) Environmental Protection Agency
TRE-project	
AMY-project	
ATSS	Alternative Technology Support System
EPB	Environmental Protection Bureau
ShEPB	Shanghai Environmental Protection Bureau
SAES	Shanghai Academy of Environmental Sciences
SSP	Solvent Sector Plan
STNG	Sectoral Technical Nodular Group
APR	Annual Programme/Project Report
TPR	Trippartite Review Report
TA	Technical Assistance
ODP	Ozone Depletion Potential
CFC	Chlorofluorocarbon
HCFC	Hydrochlorofluorocarbon
nPB	n-propyl bromide
TCA	1,1,1-trichloroethane
CTC	Carbon Tetrachloride
SIR	Surface Insulation Resistance

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Department for Europe

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Phan Anh, Tran Nhung, Tran Nam Binh
Department for Asia

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04/38 Sida's Work with Culture and Media (Volume 1, Main Report; Volume 2, Annexes)
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Department for Evaluation and Internal Audit

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