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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Thirty-fifth Meeting
Montreal, 5-7 December 2001

PROJECT PROPOSAL: THAILAND

This document consists of the comments and recommendations of the Fund Secretariat on the following project proposal:

- National CFC phaseout plan — World Bank

PROJECT EVALUATION SHEET
THAILAND

ODS use in sector (2000): 3,601.5 ODP tonnes

Sub-sector cost-effectiveness thresholds: N/A

Project Titles:

(a) National CFC phaseout plan

Project Data	
Enterprise consumption (ODP tonnes)	3,601.50
Project impact (ODP tonnes)	
Project duration (months)	108
Initial amount requested (US $)	14,922,947
Final project cost (US $):	
Incremental capital cost (a)	
Contingency cost (b)	
Incremental operating cost (c)	
Total project cost (a+b+c)	23,426,266
Local ownership (%)	100%
Export component (%)	0%
Amount requested (US $)	540,000
Cost effectiveness (US $/kg.)	
Counterpart funding confirmed?	
National coordinating agency	National Ozone Unit
Implementing agency	World Bank

Secretariat's Recommendations	
Amount recommended (US $)	
Project impact (ODP tonnes)	
Cost effectiveness (US $/kg)	
Implementing agency support cost (US $)	
Total cost to Multilateral Fund (US $)	

PROJECT DESCRIPTION

Introduction

1. The World Bank has submitted on behalf of the Government of Thailand a national CFC phase-out plan to the 35th Meeting along with the draft performance based agreement to be entered into between the Government of Thailand and the Executive Committee.

Objective of the Project

2. The project aims at eliminating, over a period of 9 years (2002-2010), the remaining consumption of the controlled substances under Annex A, Group I of the Montreal Protocol, and part of the remaining consumption of 1,1,1 TCA of Thailand. The remaining consumption of CFCs of Thailand as of the end of 2000 is calculated as the difference between the consumption of 2000 and the consumption captured in on-going projects as of 31 December 2000, or 3,568 ODP/tonnes – 633 ODP/tonnes = 2,935 ODP/tonnes. The consumption of 1,1,1 TCA which will be phased out as a result of this plan is 29 ODP/ tonnes, or about 87 percent of the remaining consumption of 33.5 ODP/tonnes.

Implementation Strategy

3. The national phase-out plan will use a series of instruments, like investment, non-investment, legislation and capacity building to manage the supply and demand of CFCs in order to achieve its goal. The strategy is to eliminate the CFC consumption in the manufacturing sector by 2005 and then gradually reduce the consumption of CFCs in the servicing sector to 0 ODP tonnes by 2010. The CFC consumption reduction schedule proposed is either in advance of or in compliance with the control schedule of the Montreal Protocol. There will remain a demand for CFC12 of approximately 287 ODP/tonnes after 2010, which according to the plan will be met either through recycled CFC or CFC imported before 2010 under the allowable import quota.

Components of the Plan

4. From the supply-side, the plan will rely on the application of import licensing to regulate the quantity of CFCs allowed into the country.

5. On the demand side, the plan will use a combination of measures to reduce the demand on a yearly basis to remain in balance with the supply of CFCs. These include policy measures like banning the use of CFCs in the manufacturing sector in 2005 and banning the use of CFCs in the servicing sector in 2010.

6. In addition, the plan will reduce demand by:

(a) completing the implementation of on-going projects;

(b) new investment activities;

(c) retirement of existing CFC-dependent equipment, including chillers and vehicles;

(d) new vehicle inspection system to prevent an increase in the existing stock of CFC-MAC vehicles.

Cost of the National Phase-out Plan

7. The total cost requested for the implementation of the national phase-out plan is US $14,922,947 and is detailed as follows:

		US $	US $
New investment activities			
	Technical assistance in MDI	57,200	
	CFC 113 phase-out in solvent cleaning	965,120	
	1,1,1 TCA phase out in garment and shoe industry	710,000	
	Technical assistance for phase out CFC113 use as contact cleaner	23,100	
	Technical assistance for the Garment Development Institute	166,100	
	Foam sector	3,985,167	
	Aerosol manufacturing	102,960	
	Sub-total		6,009,647
MAC servicing			
	Mandatory requirement for MAC inspection	1,237,500	
	Train-the-Trainer Program	319,000	
	Certification of MAC service technicians		
	Financial subsidy for purchasing MAC servicing equipment	3,025,000	
	Financial subsidy for purchasing MAC R&R equipment	822,800	
	Sub-total		5,404,300
Refrigeration servicing			
	Train-the-Trainer Program	319,000	
	Certification of refrigeration service technicians		
	Financial subsidy for purchasing refrigeration servicing equipment	1,485,500	
	Sub-total		1,804,500
Custom training			165,000
Implementation unit			1,540,000
Grand total			**14,922,947**

Implementation and Management of the Plan

8. The plan will be managed by the Government of Thailand through the NOU, with the assistance of the World Bank. The NOU will set up an implementation unit to be directly responsible for the execution of the project on a day-to-day basis. The unit will be financed from the project budget from 2002-2006 and will cease to function after that. NOU will resume full responsibility over the plan from then on.

Funding and Disbursement

9. The Government of Thailand seeks approval in principle, of the total requested funding, which will be disbursed in 9 tranches annually against a schedule of national CFC consumption targets which are either in advance of or in compliance with the Montreal Protocol schedule. The Government also requests maximum flexibility to utilize the approved funding to achieve the goals of the plan.

Independent Audit and Monitoring

10. The Government will be responsible for the monitoring of the plan and the implementing agency will conduct an independent performance audit to determine the achievement of the annual CFC reduction target, which will be the condition for releasing the annual funding.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

11. The national phase out plan of Thailand is developed with the same approach and methodology as that employed for the Malaysia national plan. All the comments of the Secretariat on the Malaysian plan are applicable to the Thailand plan. In addition, the following comments are specific to the Thailand plan.

Calculation of eligible incremental cost

(a) Costs for the aerosol, CFC 113 and foam sectors

12. The basis for the calculation of the eligible incremental cost is being discussed with the World Bank, which will have an impact on the total cost of the plan.

(b) Eligibility of the safety cost associated with the 1,1,1 TCA phase out

13. The plan includes a request for a total of US $710,000 for providing safety installations for the garment and shoe manufacturing plants which have already converted from TCA to trichloroethane (TCE), but without installing the necessary ventilation for the toxic TCE. This cost is not eligible under the Fund rules.

14. The agreement on the total eligible incremental cost of the plan will be communicated to the Executive Committee in due course.

RECOMMENDATIONS

15. Pending.

Thailand National CFC Phaseout Plan

September 10, 2001

Jointly prepared by Department of Industrial Works and the World Bank

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CHAPTER 1

INTRODUCTION

1. PROGRAM OBJECTIVE

The objective of this program is to assist the Government of Thailand to completely phase out its CFC consumption in accordance with the phase-out schedule stipulated by the Montreal Protocol. A total consumption of 3,568 ODP tons of Annex A, Group I chemicals as reported in 2000 to the Ozone Secretariat will be phased-out under this program.

To achieve this objective, the National CFC Phase-out Plan proposes to utilize a combination of policies, regulations, financial incentives - to subsidize the phase-out cost of the industrial sector, and to promote refrigerant recovery and recycling, training, and technical assistance activities to minimize and eventually eliminate import of CFCs and consumption of virgin materials. The national CFC phase-out program includes relevant technical assistance components for strengthening capacity of industry and the Government. It also proposes an innovative implementation modality and a monitoring program to ensure successful and effective implementation of this complete CFC phase-out program.

2. BACKGROUND

Thailand ratified the Montreal Protocol in 1989 and was classified as an Article 5 country as its consumption per capita of Annex A, Group I chemicals was less than 0.3 kg ODP per year. The 1999 freeze on production and consumption of Annex A, Group I chemicals, the first obligation under the Protocol that is applicable to all Article 5 countries, has only been effective since 1 July 1999. Like other Article 5 countries, Thailand is now entering into the compliance phase of the Montreal Protocol. It is a legally binding commitment for Thailand to comply with subsequent obligations (i.e., 50% consumption reduction in 2005, 85% reduction in 2007, and complete phaseout in 2010) in addition to this 1999 freeze requirement.

Thailand is not a producer of any substances controlled under the Montreal Protocol, nor of any substitutes of these chemicals. The total demand for Annex A, Group I chemicals has been met through imports. The average consumption level of all Annex A, Group I chemicals from 1995 – 1997 inclusive, is 6,082 ODP tons. According to the provisions of the Montreal Protocol, this average consumption level has been used as a baseline for establishing respective interim reduction targets during 1999 – 2010.

Based on 2000 data, the total import of Annex A, Group I chemicals was 3,568 ODP tons, which is significantly less than the freeze level. The total consumption of this group of chemicals is expected to decline to 2,905 ODP tons in 2004 when the full impact of all completed projects is realized. This suggests that the total demand for CFCs in 2005 would be less than the 50% reduction target of 3,041 ODP tons by 136 ODP tons. It

appears that with no additional intervention from the Government nor the Multilateral Fund, Thailand will narrowly meet the 50% reduction target but will have difficulty in meeting the subsequent interim phaseout targets.

Table 1.1 Projected Consumption of Annex A, Group I Chemicals from 2000 - 2005

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Max. consumption level allowed by the Montreal Protocol (ODP tons)	6,082	6,082	6,082	6,082	6,082	3,041
CFC phaseout from completed projects (ODP tons –direct impact)		30	306	97	230	
Consumption with no additional activity (ODP tons)	3,568	3,538	3,232	3,135	2,905	2,905

While it may appear that Thailand has already achieved its 1999 freeze and the 2005 50% reduction targets, Thailand cannot afford to be complacent. The achievement was assisted by the recent financial crisis which resulted in a decreased demand for products containing or producing with CFCs. It is known that a significant part of the production capacity of the Thai industry (about 50%) has been idle since the crisis. As no ban has been imposed on the use of CFCs in the manufacturing sector except the use of CFCs for manufacturing of domestic refrigerators, it is likely that the demand for CFCs could increase once the economy recovers. Moreover, as not all CFC-consuming enterprises have received assistance from the Multilateral Fund to convert their production facilities and no legal requirement for these enterprises to stop the use of these chemicals exists, this may create an unintended and unfair advantage for companies that are still using ODSs over those that have already converted to non-ODS technology.

Urgent action is required to level the playing field and to preempt back conversion by those enterprises that have already converted to non-ODS technology. It is imperative that the Government of Thailand continues its proactive measures to assist the remaining CFC-consuming enterprises to convert to non-ODS technology and, at the same time, to impose bans on the use of CFCs in the manufacturing sector as soon as possible. Failure to do so will undermine the achievement attained in the past and it can jeopardize Thailand's ability to comply with Montreal Protocol obligations.

It is obvious that based on the current consumption trends, Thailand will need to reduce at least 1,993 ODP tons during the period of 2005 – 2006 to ensure its compliance with the 85% reduction target in 2007. Basically, this reduction will have to be achieved in the servicing sector. To achieve significant and sustainable phaseout of CFCs in the servicing sector, a series of activities will have to be undertaken immediately. These include investment and non-investment activities aiming at changing behavior of end-users and service technicians. These types of activities require a long lead time before substantial reduction of CFCs can be achieved.

The rapid CFC consumption reduction achieved thus far has been a result of the investment and non-investment activities supported by the Multilateral Fund and DIW's own policy to reduce the import quota of Annex A, Group I chemicals by 10% a year since 1995. However, DIW is seriously considering whether the existing policy focusing primarily on the supply side should be continued. It appears that further reduction in the supply of CFCs could lead to illegal imports of CFCs. This has prompted DIW to develop an overall strategy to examine the actual demand of CFCs in the country to ensure that the demand will also be reduced in accordance with the reduction schedule on the supply side.

3. PROJECT SUMMARY

The National CFC Phaseout Plan will phase out the remaining consumption of 3,568 ODP tons of Annex A, Group I chemicals over the period of 2001–2010. To achieve this target, a series of investment, non-investment, technical assistance, and capacity building activities will be carried out. The National CFC Phaseout Plan will enable the Thai Government to ban the use of CFC in the manufacturing sector by 2005 and the use of CFC in the servicing sector by 2010. In addition, the proposed National CFC Phaseout Plan will also phase out 29 ODP tons of 1,1,1-TCA by 2005.

Considering this multi-faceted approach it is crucial that flexibility is given to the Thai Government to be able to adapt or modify its strategies during implementation of this plan as needs arise. Due to complex and dynamic nature of SMEs, some proposed strategies or approaches to deal with the CFC phaseout in this sector should be able to evolve over time. This is to ensure that the agreed phaseout targets will be met.

The Government of Thailand is requesting financial support of $14,922,947 from the Multilateral Fund to cover part of the phaseout costs to Thailand. This requested amount will be allocated to Thailand over a period of nine years. With 633 ODP tons to be phased out from the projects that have already been approved and funded by the MLF, this proposed funding request will phase out an additional 2,935 ODP tons of Annex A, Group I chemicals for a total phaseout of 3,568 ODP tons of Annex A, Group I chemicals and 29 ODP tons of 1,1,1-TCA in the consumption sector. Therefore, the overall cost-effectiveness of this National CFC Phaseout Plan is $5.03 per kg.

CHAPTER 2

ODS CONSUMPTION AND DISTRIBUTION BY SECTOR

1. SOURCES OF ODS SUPPLY

Thailand imported CFCs from Germany, France, United Kingdom, Italy, Netherlands, Greece, Japan, India and China. Major importers in Thailand are Dot-Bamboo, Aussini, Berli Jucker, East Asiatic, and Thai Asahi Chemical. There are very few cases where CFCs are imported directly by manufacturers of CFC products. The list of importers is included as Annex I.

2. ODS CONSUMPTION BY SECTOR

ODS consumption in MT as reported to the Ozone Secretariat is shown in Table 2.1. This table also provides estimates for ODS consumption in various sectors and the amount of ODS consumption captured by completed MLF-approved investment projects.

Table 2.1 ODS Consumption by Sector

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Reported ODS Annex A, group I consumption	8,426	9,702	8,222	7,063	8,314	5,619	4,486	3,811	3,655
Reported ODS Annex B, group II consumption	96	7	7	0	13	6	12	8	6
Reported ODS Annex B, group III consumption	6,947	7,934	4,688	2,948	2,236	1,141	1,043	847	455
ODS for the aerosol sector	N/A	N/A	N/A	N/A	600	445	445	445	194
ODS for the solvents sector	N/A	N/A	N/A	N/A	2,555	1,429	1,245	995	651
ODS for the foams sector	N/A	N/A	N/A	N/A	3,034	1,895	1,421	1,279	1,202
ODS for the refrigeration sector	N/A	N/A	N/A	N/A	4,374	2,997	2,430	1,947	2,054
Captured through MLF approved projects	N/A	N/A	N/A	215	185	131	937	397	724

A comprehensive survey of the end-use consumption by sector was carried out in 2000 as part of the preparation of this National CFC Phaseout Plan and to supplement data of the past years. The total consumption based on this survey is slightly different from import data collected by DIW and the Customs Department. The survey results are shown in Table 2.2.

Table 2.2 Import and Consumption Data by Sector for 2000

		MT by Sector	Total (MT)
CFC-11			
Import			*1,309.00*
Consumption			*1,287.00*
	Aerosol	5.00	
	Foam	1,055.00	
	Refrigeration (Manuf.)	97.00	
	Refrigeration (Servicing)	130.00	
	MAC (Servicing)		
CFC-12			
Import			*2,188.00*
Consumption			*2,054.00*
	Aerosol	25.00	
	Refrigeration (Manuf.)	106.00	
	Refrigeration (Servicing)	163.00	
	MAC (Servicing)	1,760.00	
CFC-113			
Import			*88.00*
Consumption			*84.00*
	Contact Cleaners	20.00	
	Compressor Manufacturer	46.00	
	Medical Products	2.50	
	Optical Lenses	4.00	
	Electronic Components	11.50	
CFC-114			
Import			-
Consumption			-
CFC-115			
Import			*1.54*
Consumption			*1.54*
	Refrigeration (Servicing)	0.82	
	Production of Thermostats	0.72	

While the total import of Annex A, Group I, chemicals in 2000 was 3,568 ODP tons (or 3,586.54 MT), the survey conducted during the preparation of this plan could account for 3,409 ODP tons. The small difference of 159 ODP tons between the two sets of data probably arises from the fact that normally there is a small inventory maintained by importers and/or chemical distributors. In a certain year, actual consumption may be higher than the amount imported within that particular calendar year. The difference was made up by last year's inventory. Similarly, actual consumption in a certain year may be slightly lower than the actual import. The difference represents the size of the inventory at the importer and wholesaler levels. No attempt was made to track down the inventory of various CFCs at the importer and wholesaler levels.

CHAPTER 3

POLICIES AND REGULATIONS ALREADY IMPLEMENTED

1. 1992 HAZARDOUS SUBSTANCES ACT

To carry out its obligations under the Montreal Protocol on Substances that Deplete the Ozone Layer, Thailand has already established a few regulations to control import/export of ODSs and to control the use of these chemicals. The 1992 Hazardous Substances Act classifies hazardous substances into four categories. The 1995 Ministerial Decree issued by the Ministry of Industry includes all ozone depleting substances controlled by the Montreal Protocol as Category III chemicals whose production and import must be approved by the Ministry of Industry. DIW has been designated by the Ministry of Industry to enforce the Hazardous Substances Act and other related decrees and regulations. This forms a basis of the import/export licensing system of Thailand.

Import of ODSs without a license can result in fine and imprisonment. Failure to comply with all conditions attached to import licenses can result in suspension or cancellation of import licenses. Import licenses can be suspended up to one year. If licenses are cancelled, importers will no longer be able to import that particular chemical until a new license is issued by DIW. An application for a new license for those importers whose previous licenses were revoked, cannot be made within five years after the date of cancellation of the previous licenses.

DIW has not issued import licenses to any new importers since 1995. An import quota system for CFC-12 was established in 1995. The import quota for each existing importer has been reduced by 10% a year up to 1999. Based on concerns raised by local importers that continuing pressure on the supply side, without due consideration on the demand side, may cause illegal imports of CFCs, DIW decided to slightly increase the 2000 import quota for CFC-12 in 2000 from the level allowed in 1999.

2. 1992 FACTORY ACT

Control of the use of ODSs in the manufacturing sector is carried out through the 1992 Factory Act. DIW has been assigned by the Ministry of Industry to enforce this Act and other related decrees and regulations. The existing Factory Control Act allows DIW to attach conditions pertaining to the use of raw materials in factory licenses. Failure to comply with such conditions can result in suspension or cancellation of the factory licenses. Without such licenses, factories will have to stop operations.

In 1997, the Ministry of Industry, based on the recommendations of DIW, issued a Ministerial Decree prohibiting the use of CFCs in the production of household or domestic refrigerators. To prevent imports of CFC domestic refrigerators, the Ministry of Commerce also issued a Ministerial Decree prohibiting imports of any CFC refrigerators into Thailand. Another Ministerial Decree was also issued in 1997 to prohibit any

expansion or new establishment of aerosol factories that intended to use CFCs in their operations.

DIW plans to recommend a similar Ministerial Decree to prohibit the use of CFCs in the production of commercial refrigerators after the on-going terminal umbrella project for CFC phaseout in the commercial refrigeration sector is completed.

CHAPTER 4

SECTORAL BASELINE INFORMATION

1. AEROSOL SECTOR

1.1. NON-MEDICAL PRODUCTS

There are approximately 44 major enterprises in the Thai aerosol industry, with only around 9 aerosol fillers. The consumption of CFCs in the aerosol industry has decreased steadily from about 600 MT in 1995 to 194 MT in 1999, and 30 MT in 2000.

Aerosol products include household aerosol products, pesticides, paint spray, and personal care products. At present, most aerosol products are already CFC free. HAPS (propane and butane) are commonly used as substitutes for CFC-11 and CFC-12. As alternative propellants are more economical than CFCs, most aerosol factories have already moved away from CFCs. Only a limited amount of CFCs is still used in the aerosol sector.

Thus far, six aerosol fillers have already received funding from the Multilateral Fund to phase out CFCs. These are Packserv, Sanit & Sons, P-Tech Manuchem, J.M.T. Laboratories, Standard Manufacturing, and Mary Manufacturing. Four of the six projects were completed at the end of 2000 while the other two projects were completed a few years earlier. Total funds approved for these six projects were $1.597 million with a total ODP phaseout of 504 ODP tons. The average cost-effectiveness of all aerosol projects approved for Thailand is $3.17 per kg ODP.

Table 4.1 Status of MLF Approved Projects in the Aerosol Sector

Status of MLF Approved Projects	No. of Projects	ODP Phaseout by Projects (MT)		
		CFC-11	CFC-12	Subtotal ODP
Completed Projects	6	265	239	504
On-going Projects	0	0	0	0
Cancelled Projects	0	0	0	0
Total	6	265	239	504

Based on the survey conducted under this study, it was discovered that there were about 5 MT of CFC-11 and 25 MT of CFC-12 being used in the three remaining CFC consuming aerosol factories in 2000 with a small quantity of CFC-11 used as an ingredient for the production of hair mousse. The three enterprises were established before July 1995.

Among the three aerosol manufacturers identified by the survey, Bangkok China Paint is the largest remaining CFC consuming aerosol factory. It used about 25 MT of CFCs in 2000 in the production of its specialized paint. The other two companies are Cosmonaut

and Vera Alline. Each of them used about 2.5 MT of CFCs in the production of their personal care products (hair mousse and perfume).

In 1997, the Ministry of Industry issued a Ministerial Order prohibiting establishment of new aerosol manufacturers using CFCs as propellants, and also prohibiting expansion of existing aerosol manufacturers that are still using CFCs as propellants. Because of this regulatory pressure, the remaining three aerosol manufacturers are being forced to convert to non-CFC technology. They have requested the Government to assist them in securing funding to support part of the conversion costs. Therefore, conversion of these three enterprises is included in the National CFC Phase-out Plan.

DIW agrees that the existing regulations only address or control the use of CFCs as propellants. Products containing CFCs as an ingredient, not propellant, are not controlled by the existing regulations. However, as the quantity of CFC-11 used in hair mousse is understood to be very small, DIW has decided to control the use of CFC-11 in this product through its existing CFC import control mechanism.

The survey also reveals that there are still some small enterprises using 1,1,1-TCA in the production of mold releasing aerosol products. Various options to control the use of 1,1,1-TCA in these products have been considered. However, it was concluded that since these are not consumer products, regulation of the sales of these products may not be practical. DIW proposes to use its existing CFC import control and import quota allocation mechanism as a tool to curb the use of 1,1,1-TCA in these products. Registered importers will be required to provided DIW with names and addresses of their clients, and their intended uses.

1.2 METERED-DOSE INHALER

Thailand imported MDI products mainly from the United Kingdom, Australia, Belgium and Switzerland. At present, about 90% of all imported MDI products contain CFCs. About 10% are non-CFC MDI products, including HFC-134a MDIs and powder inhalers. It was reported that costs of non-CFC MDIs are only slightly higher than CFC products. Glaxo-Welcom is the major supplier of MDIs in Thailand with approximately 70-80% of the market share.

Based on interviews with the suppliers of MDIs, non-CFC MDIs have already been introduced in Thailand. The main driving force for the introduction of the non-CFC alternatives is mainly the corporate environmental policy of the MDI manufacturers in developed countries. It was reported, however, that non-CFC MDIs have not received favorable acceptance from asthma patients as non-CFC MDIs have a different taste and have a different cooling effect.

It was suggested that to successfully introduce non-CFC MDIs, the strategy should be focused on educating medical doctors who are prescribing these products. Moreover, as the Ministry of Public Health has established a list of approved prescription drugs and has a policy that all public hospitals should maintain and prescribe only drugs that are in this

list, this could be another constraint for doctors to introduce the use of new non-CFC MDIs. Moreover, most medical insurance policies will cover only the costs of drugs that are in the list of approved prescription drugs established by the Ministry of Public Health. It is, therefore, important to ensure that non-CFC MDIs are included in the list of approved prescription drugs of the Ministry of Public Health.

2. SOLVENT SECTOR

At the time of preparation of the first Country Program for ODS phase-out in Thailand, it was seen that in the solvent cleaning industry there were three main ODS user groups: electronics cleaning, metal/precision cleaning, and contact cleaning. In 1991, Thailand imported about 3,200 MT of CFC-113, about 7,100 MT of 1,1,1-TCA, and about 137 MT of CTC.

To reduce the consumption of CFC-113, 1,1,1-TCA and CTC, the Government of Thailand undertook both voluntary and mandatory measures as proposed in the original Country Program. These measures included the Board of Investment of Thailand's policy of not granting any investment privileges to any new investments that required the use of ODS, including the use of ODS in the solvent cleaning industry; and, DIW's Departmental Order requiring that all new applications for renewal of existing factory licenses from factories that used ODS as solvent cleaning agents should be supported by clear and definite plans for phasing out ODS uses. DIW, with the support of the Japanese Ministry of International Trade and Industry and the United States Environment Protection Agency, secured agreements from major multinational companies in Thailand to adopt the same phase-out schedule as adopted by their parent companies in Article 2 countries. This cooperation among the three countries contributed to a significant and rapid reduction of ODS consumption in the solvent cleaning industry.

For the Thai-owned enterprises, the Multilateral Fund has already provided about $5.57 million to support 11 investment projects to phase out the use of CFC-113 and 1,1,1-TCA with the average cost-effectiveness of $18.85/kg ODP for CFC-113 and $30.48/kg ODP for 1,1,1-TCA. Ten projects have already been completed, and one was cancelled. Consumption of about 100.5 MT of CFC-113 and 333 MT of 1,1,1-TCA has been eliminated by these projects. In addition to these investment projects, Thailand also has a bilateral agreement with the French Government to assist Thai SMEs in the electronic sector to replace ODS cleaning processes with no-clean technology.

Table 4.2 Status of MLF Approved Projects in Solvent Sector

Status of MLF Approved Projects	No. of Projects	ODP Phaseout by Projects (MT)		
		CFC-113	1,1,1-TCA	Subtotal ODP
Completed Projects	10	100.5	266	107
On-going Projects	0	0	0	0
Cancelled Projects	1	0	66.7	6.7

Total	11	100.5	332.7	113.7

Based on import data of DIW, Thailand imported about 88 MT of CFC-113, 335 MT of 1,1,1-TCA, and 6.5 MT of CTC, in 2000.

The survey results showed that 46 MT was used for cleaning parts at Thai Compressor Manufacturer. In addition, another 2.5 MT was used for the production of syringes at Challenge Medical Product. Another 11.5 MT was used as a cleaning agent at Alphatech for cleaning electronic components. About 20 MT of CFC-113 was used in aerosol formulations, primarily for contact cleaners at Lafa Thai and Pronet Inter. Another 4 MT of CFC-113 was used by Intergold Optical for cleaning plastic lenses. The remaining 4 MT of CFC-113 imported in 2000 was unaccounted for. It is believed that these remaining 4 MT of CFC-113 may be used in old dry cleaning equipment.

Current consumption of 1,1,1-TCA was reported to be in the following applications: metal cleaning industry, textile and garment industry, and plastic industry. As the use of 1,1,1-TCA is scattered among SMEs, only consumption in the larger users could be accounted for.

Table 4.3 1,1,1-TCA Consumption by Application

Application	**Quantity (MT of 1,1,1-TCA)***
Textile and Garment Industry	250
Metal Cleaning	20
Shoe Soles Cleaning	40
Mold Releasing Agent (Estimated)	25
Total	335

*2000 consumption data

The Garment Development Institute reported that 1,1,1-TCA had been used in the textile and garment industry for spot cleaning of garment products and for cleaning metal parts of weaving and sewing machines. It was reported that there were 1,424 garment factories in Thailand. In the past, all garment factories used 1,1,1-TCA for spot cleaning and metal cleaning. Due to the quota system imposed by DIW, the price of 1,1,1-TCA has increased by more than 4 times, from $1/kg to $5/kg. For spot cleaning of garment products, most factories have switched to other cleaning agent which is a blend between 1,1,2-TCE and other solvents. However, the replacement of 1,1,1-TCA as a metal cleaning agent is unclear. Many garment factories reported that they are no longer used any chemicals for cleaning parts of weaving and sewing machines. Based on the survey carried out by the Garment Development Institute, about 250 MT of 1,1,1-TCA were used in the textile and garment industry in 2000. This quantity is much higher than the level of consumption estimated in the 1993 Country Program.

It was also reported that about 6.24 MT of 1,1,1-TCA was used for cleaning metal components at Siam Zexel, a MAC system manufacturer. The company reported that a suitable alternative had already been identified. The company is in the process of

converting its cleaning process. In addition, it was reported that the Electricity Generating Authority of Thailand (EGAT) consumed about 13.5 MT per year for cleaning generator motors. At present, EGAT is not aware of any alternatives to 1,1,1-TCA. Technical assistance to help identify replacement for 1,1,1-TCA is urgently needed. With better understanding of the availability of non-ODS options, policy and investment strategies could, then, be developed.

It was also reported that 1,1,1-TCA was used as a mold releasing agent. It is estimated that about 25 MT of 1,1,1-TCA was used as a mold releasing agent in 2000. Efforts to identify producers of mold releasing products were not successful. DIW will continue to impose a requirement for importers to provide a list of end users and applications before approvals of import licenses. This approach, however, is expected to be able to identify only major users. This approach should be supported by technical assistance activities to: identify potential uses of this chemical in SMEs; develop a strategy to approach SMEs,; organize workshops to inform SMEs of available alternatives based on all applications identified in the country. After that, any needs for additional support from the Multilateral Fund in forms of investment and technical activities could be determined.

The survey conducted under this study identified that there are three major applications of CTC. These include the use of CTC for testing quality of activated carbon. There are two companies (CarboKarn and C-Gigantic Carbon) producing activated carbon in Thailand. The total consumption of CTC for this application was 3.25 MT in 2000.

It is anticipated that CTC is still required for this application as the existing international standard requires specifically that only CTC be used as a testing agent for low grade activated carbon. A new standard is expected to be adopted within the next few years. The two companies have agreed to start phasing out the use of CTC in their quality control process for higher grade activated carbon where a new testing standard using non-CTC technology is already available.

Another 750 kg of CTC was used in the pharmaceutical industry for coating medicine tablets. The Government Pharmaceutical Organization, one of the major drug manufacturers in Thailand, reported that it was investigating suitable alternatives to replace the use of CTC. It requested DIW to seek technical and financial assistance from the Multilateral Fund. The most urgent need is to identify the safest and most suitable replacement of CTC for this application.

It was reported by Italmar, CTC importer and distributor, that about 2.5 MT of CTC were used in university and industry laboratories in 2000. To phase out the use of CTC in laboratories, it is believed that it is too premature to apply a complete ban on the use of CTC for this purpose as complete understanding of this application is not available. It is proposed that DIW should impose a similar requirement on importers of CTC to provide a list of their clients and their applications. Once the list has been compiled, DIW with the assistance of international experts, should compile a list of suitable alternatives and a list of exemptions for those applications where alternatives are not available. More comprehensive study for this particular sector is needed before any proposal for investment activities can be made.

3. FOAM SECTOR

CFCs are used as blowing agents in the production of five types of foams in Thailand - appliance insulation, flexible foams, rigid construction insulating foams, polystyrene packaging and miscellaneous applications. Producers of foam products in Thailand used an average of 2,000 tons of CFCs from 1995 to 1997. CFC consumption in this sector has decreased to 1,202 ODP tons in 1999, and 1,055 ODP tons in 2000.

From 1991 through 2000, 59 investment projects in the foam sector (excluding foam used in the refrigeration sector) were funded by the Multilateral Fund of the Montreal Protocol. Alternative technologies employed by these projects include methylene chloride (MeCl), liquid carbon dioxide (LCD) and low index additive (LIA) for slabstock, and HCFC-141b or water-blown technology for other applications.

These approved projects, when completed, will result in a combined phase-out of 2,179.6 ODP tons/year of CFCs. These projects had approved grants totaling to US$ 11.79 million. The average cost-effectiveness of Thai investment projects in the foam sector is $5.34 per kg ODP. A detailed breakdown of the cost-effectiveness of Thai foam projects by sub-sector is shown in Table 4.4.

Table 4.4 Average Cost-Effectiveness of Thai Foam Projects by Sub-Sector

Sub-Sector	No. of Approved Projects	Approved Funds ($)	ODP Phaseout (ODP tons)*	Cost-Effectiveness
Slabstock Foam	9	1,657,620	522.5	3.17
Integral skin Foam	1	196,600	19.7	9.98
Multisectors	8	2,377,490	333.3	7.13
Polystyrene/ Polyethylene Foam	3	1,134,500	269	4.22
Rigid PU Foam	38	6,273,056	1,035.1	6.06
Total	59	11,639,266	2,179.6	5.34

*Net ODP reduction takes into account ODP of HCFCs.

Table 4.5 Status of MLF Approved Projects in Foam Sector

Status of MLF Approved Projects	No. of Projects	ODP Phaseout by Projects (MT)			
		CFC-11	CFC-12	CFC-114	Sub-total
Completed Projects	38	1,541.8	225	44	1,810.8

On-going Projects	19	412	-	-	412
Cancelled Projects	2	73.3	-	-	73.3
Total	59	2,027.1	225	44	2,296.1

At present, 38 projects have already been completed and resulted in elimination of about 1,810 MT of CFCs. The 19 on-going projects are scheduled to complete by 2003. The impact of ODP phaseout from on-going projects to the country's demand for CFCs for the next three years is shown in Table 4.6.

Table 4.6 Projected Impact of Remaining On-going Projects

	2002	**2003**	**2004**
CFCs to be phased-out from on-going projects	289.4	97.3	25

Based on the information provided by 15 chemical suppliers and 9 polyol suppliers in Thailand, it was found that there were 100 foam enterprises that had not been covered by any assistance from the Multilateral Fund. All of them are fully Thai owned. These 100 enterprises consumed about 643 of MT CFC-11 in 2000. The breakdown of these enterprises and their CFC consumption by sub-sector is as follows:

- There are 91 enterprises producing rigid polyurethane foam with CFC-11 as a blowing agent. The combined consumption of these 91 enterprises is about 465 MT;
- There are 6 enterprises producing flexible polyurethane foam with CFC-11 as a blowing agent. The combined consumption is about 173 MT;
- There are 3 enterprises producing CFC-11 blown integral-skin foam. The combined consumption is about 5 MT.

Table 4.7 CFC-11 Consumption in Remaining Foam Enterprises by Sub-Sector and by Application

Sub-Sector	**Application**	**CFC-11 Consumption**
Rigid Polyurethane Foam	Spray foam	150.18
	Thermoware	43.75
	Insulated Containers	47.50
	Refrigerated Trucks	47.18
	Insulation Panels	47.05
	Others	129.59
Flexible PU Foam	Box Foam	172.5
Integral Skin Foam	Furniture & Auto Parts	5.26
Total		643

Providing that there is no new use of CFCs in the foam sector and no growth in the demand of CFCs in the remaining 100 newly identified foam enterprises, the demand for CFCs in this sector will decrease to 643 MT after 2004.

The remaining CFC consumption in the foam sector is in the PU foam sub-sectors where production costs after conversion are normally higher. Without any legal requirements to prohibit the use of CFCs in these sub-sectors, those who are still using CFCs are encouraged to prolong their use of CFCs. Moreover, for those who have already phased out CFCs, they may be forced to revert to CFCs by the pricing pressure.

To attain complete phaseout of CFCs in the foam sector and to ensure sustainability of all converted projects, DIW finds it important to maintain a level-playing field. It proposes to prohibit the use of CFCs in foam production, and to prohibit sales of CFC pre-mixed polyol, and sales of CFCs to polyol suppliers or system houses by 1 January 2005. To support these policies of DIW, conversion of the remaining 100 foam enterprises and timely implementation of all on-going projects should receive high priority.

4. REFRIGERATION SECTOR

According to the 1993 Country Program, about 1,035 MT of CFCs (225 MT of CFC-11, 805 MT of CFC-12, and 5 MT of CFC-115) were used for the production and installation of new domestic and commercial refrigerators, chillers, and mobile air-conditioning systems (MACs). In addition, another 2,217 MT of CFCs (225 MT of CFC-11, 1,970 MT of CFC-12, 2 MT of CFC-113, and 20 MT of CFC-115) were used for servicing existing domestic and commercial refrigerators, chillers, and MACs. The total consumption of CFCs in the refrigeration and air-conditioning sectors in 1991 was 3,252 MT.

Due to the economic growth in early 1990's, the total consumption of CFCs in the refrigeration and air-conditioning sectors grew to 4,374 MT by1995. To curb the rising demand for CFCs in these sectors (mainly CFC-12), DIW established an annual import quota system for CFC-12 in 1995. As a result, the total import of CFC-12 in 1995 decreased to 3,300 MT in 1996. Since then, the total consumption of CFCs in the refrigeration and air-conditioning systems has declined continuously. In 1999, it was reported that the combined consumption of CFC-11 and CFC-12 in these sectors was about 2,050 MT of which, 1,845 MT was CFC-12.

In addition to the annual import quota system, regulations were introduced in 1996 to ban production and import of CFC-based domestic refrigerators starting from January 1, 1997. Further, with industrial cooperation, the MAC industry agreed to equip all new vehicles with HFC-134a MACs since 1 January 1996. For the chiller sector, most building chillers installed after 1993 were non-CFC. Through mandatory and voluntary measures, and through intervention in a form of investment projects by the Multilateral Fund, consumption of CFCs in 2000 in the refrigeration and air-conditioning sectors was reduced by approximately 50% since 1995.

As of December 2000, the Multilateral Fund approved funding to support 23 investment projects in the refrigeration sector (one in the chiller sub-sector, seven in the commercial refrigeration sub-sector, nine in the domestic refrigeration sub-sector, two in the MAC sub-sector, and the remaining for compressor manufacturers). All domestic and commercial refrigeration projects, except Sanden Refrigerator, adopted HCFC-141b as an alternative blowing agent for insulation foam.

Table 4.8 Status of MLF Approved Projects in Refrigeration Sector

Status of MLF Approved Projects	No. of Projects	ODP Phaseout by Projects (MT)		
		CFC-11	CFC-12	Subtotal ODP
Completed Projects	19	717	362.6	1,079.6
On-going Projects	3	99.4	153.0	252.4
Cancelled Projects	1	12	12	24
Total	23	828.4	527.6	1,356.0

4.1 REFRIGERATION MANUFACTURING SUB-SECTOR

At present, no CFC is used for the production of domestic refrigerators. In addition, there is no new installation of any new CFC chillers in Thailand. The remaining use of CFCs for manufacturing is in the commercial refrigeration sub-sector.

(a) Domestic Refrigeration

All producers of domestic refrigerators and freezers converted to primarily HFC-134a in the mid 1990's. DIW also introduced a ban on production and import of domestic refrigerators and freezers using CFCs on January 1, 1997. While no CFCs are being used for the production of domestic refrigerators in Thailand, it was recently reported that in 2000 about 720 kg of CFC-115 was used for the production of thermostats at one enterprise. The enterprise is in the process of replacing CFC-115 with HFC-134a. It plans to completely phase out the use of CFC-115 by 2004. The difference between the quantity of CFC-115 imported in 2000 and the quantity mentioned above is about 820 kg. This amount was imported as R-502.

(b) Commercial Refrigeration

Thai producers of standard unitary commercial refrigerators/freezers (plug-in type) have converted to HFC-134a/HFC-404A. The main company is Songserm Intercool having a market share of 80% for this type of equipment. Annual production volume of Songserm Intercool is around 70,000 units. The typical refrigerant charge for this type of appliance is 500 g.

For non-standard commercial refrigerators and display cabinets, DIW has already established a policy to ban production of new CFC units immediately after completion of

the terminal umbrella project for the commercial refrigeration sector which is being implemented with the cooperation of Kulthorn, the major compressor manufacturer and supplier in Thailand. The objective of this project is to provide technical and financial assistance to all non-standard commercial refrigerator manufacturers (most are SMEs) to phase out CFCs in their production facilities. This project is expected to be completed in 2003 at the latest. In addition, DIW will also prohibit production of any compressors intended for use with CFC. There are three compressor manufacturers in Thailand, which are Kulthorn Kirby, Sanyo Universal Electric, and Hitachi.

(c) Chiller

A survey carried out in 1999 identified approximately 1,400 chillers using CFC as a refrigerant in Thailand. Approximately 76% (1,060 units) had a capacity of 300 – 500 tons or more, and their age (based on installation dates) ranged from 6 – 37 years. About 42% (440 units) were used in textile and other industrial operations, 19% (200 units) in hotels, 18% (190 units) in department stores, 18% (188 units) in office buildings, and the remaining 3% were used in hospitals and buildings owned by state enterprises. Most CFC chillers were installed in the Bangkok Metropolitan area.

A chiller replacement demonstration project covering replacement of 24 chillers is on-going. Funding by means of a loan has been provided by MLF and GEF. The principle is that energy savings from chiller replacement will enable chiller owners to pay back their loans. The initial response from chiller owners is very promising and DIW is preparing for a second phase of the chiller replacement program which will cover up to 400 chillers. There is no production of chillers in Thailand. All chillers are imported from Carrier, Daikin, McQuay, Trane, York, and Ebara.

Under this project, it is required that suppliers comply with the Code of Good Practice jointly developed by all major chiller suppliers, DIW, the World Bank and UNEP. This Code of Good Practice is based on ASHRAE Guideline 3. This condition is made to promote proper handling of refrigerant in the chiller industry in Thailand. It is estimated that with this practice, about 1/3 of current CFC demand in this sector can be saved. With this project, future CFC demand for servicing remaining CFC chillers in Thailand will be met by CFCs recovered from the replaced units.

(d) Mobile Air-Conditioning

MACs are produced in Thailand where the major producers are Zexel and Denso (each having a market share of around 30%). Remaining production is basically with Thai Heat Exchange, Sanden and Formula. 90% of all MACs are installed by the car manufacturers. All have been using HFC-134a since 1996. The remaining 10% are installed at service stations and of these, around 60% use CFC-12.

(e) Transport Refrigeration

Currently there are no installations of any refrigerated trucks using CFCs. All installations use either HFC-134a or HFC-404A, with an average charge of 8 kg. Similarly, there is no production of refrigerated containers using CFCs in their refrigeration circuits. All new containers use HFC-134a. Average charge is about 5 kg.

(f) Cold Store and Large Refrigeration Systems

With regard to CFC consumption in cold stores and large refrigeration systems, a series of interviews were made with the Thai Refrigeration Association, which is the only refrigeration association in Thailand. Members of this association are contractors, refrigeration servicing companies, manufacturers and distributors of refrigeration equipment, and chemical suppliers. It was reported that CFC-12, HCFC-22, HFC-134a, HFC-404A and R-502 were used in cold stores and large refrigeration systems. However, consumption of CFC-12 and R-502 was very small and their use was only limited to servicing old refrigeration units. Awareness of the ozone issue and the need to phase-out the use of CFCs is widespread among stakeholders in this sub-sector. This has resulted in early adoption of HCFC-22 and HFC-134a as substitutes for CFC-12 and HFC-404A for R-502.

4.2 REFRIGERATION SERVICING SUB-SECTOR

The survey result indicates that service provided to household and commercial refrigerators falls into three categories: (1) about 80% of all servicing jobs is related to failure in the refrigerant circuit; (2) about 15% is due to wear and tear; and (3) about 5% is related to the electrical wiring system. It was also found that the cause of failure in 50% of all refrigerators with failed refrigerant circuits was leakage in refrigerant piping circuits, 35% in compressor units, and another 15% due to clogging in refrigerant piping circuits.

When servicing household and commercial refrigerators, it is common for technicians to release remaining charges of CFC-12. Most service technicians obtained servicing techniques through on-the-job training. The skill level of service technicians varies significantly from one shop to another.

As servicing of HFC-134a units requires a higher skill level, most service technicians are not equipped with proper knowledge for handling the new lubricant for HFC-134a which is much more humidity-sensitive than mineral oil. In addition, the significant price differential between CFC-12 and HFC-134a has proven to be a major reason for service technicians to charge the repaired units with CFC-12 without any consideration as to whether the units were originally designed for CFC-12.

(a) Domestic Refrigerators

To establish CFC consumption in the domestic refrigeration servicing sub-sector, two approaches were used. First, the level of CFC consumption was established based on the number of domestic refrigerators produced and imported during the period from 1980 – 1996 and the assumption that the leakage rate is about 2% per year with the charge size of 100 g. All domestic refrigerators produced after 1996 were HFC-134a models. The second approach is to estimate CFC consumption based on the consumption reported by service shops.

Based on the first approach, it was estimated that there were about 12 million CFC domestic refrigerators for the 16 years. Therefore, the total CFC consumption in the domestic refrigerator servicing sector is about 24 tons of CFC-12.

The survey conducted through interviews with service shops and suppliers of refrigeration components suggested that there were about 1,000 service shops throughout the country that provided services for all refrigeration systems, including domestic refrigerators, display cabinets, water coolers, and commercial refrigerators. Each of these shops consumed about 82 kg per year of which 12 kg was for servicing domestic refrigerators. Therefore, the total CFC consumption for servicing domestic refrigerators in these 1,000 shops was about 12 tons of CFC-12.

There are an additional 300 shops that service domestic refrigerators only. For those service shops that are dedicated to domestic refrigerators, it was reported that the total CFC consumption of these shops was about 6 tons of CFC-12. In addition to 1,300 service shops, it was also found that there were 80 service stations associated with domestic refrigerator manufacturers. The survey indicated that the total CFC consumption of these service stations was about 2 tons of CFC-12.

In the hotel industry, the Thai Hotels Association reported that there were 303 hotels that were members of this association. The Thai Hotels Association classified its members into two groups: one with more than 200 guest rooms and another with less than 200 guest rooms. The survey conducted by the Thai Hotels Association suggested that only those hotels with more than 200 guest rooms (about 160 hotels) normally had their own in-house servicing teams. It was reported that in average each member hotel consumed about 72.5 kg of CFC-12 per year. Approximately 4% of this annual consumption (or about 0.46 tons of CFC-12) is for servicing domestic refrigerators. For hotels with less than 200 guest rooms, servicing was done by outside service shops. All hotels with more than 200 guest rooms were members of the Thai Hotels Association. Household and commercial refrigerators used in hospitals and restaurants were serviced mainly by outside service shops.

In conclusion, the survey conducted by interviewing servicing shops indicated that there were about 20.46 tons of CFC-12 used for servicing domestic refrigerators in Thailand. This amount is about the same as the amount calculated on the basis of the total inventory of CFC-12 domestic refrigerators produced within the past 20 years.

(b) Commercial Refrigerators

Based on the industrial survey, it was found that the average life of commercial refrigerators is about 7 years. The survey result also indicates that 15 % of all units required one service a year. As the annual production of commercial refrigerators is about 220,000 units per year, there is a stock of about 1,500,000 units already sold and in operations throughout the country. Approximately 300,000 units already in the market are running with HFC-134a. With the average charge of 0.6 kg/unit, the total CFC consumption in this sector is about 108 tons of CFC-12.

Based on the survey conducted under the Terminal Umbrella Project for the Thai Commercial Refrigeration sector, it was found that there are about 1,000 shops providing services for household and commercial refrigeration units. There are only 240 shops that manufacture, sell and service commercial refrigeration systems. 260 shops sell commercial refrigerators and provide maintenance services. The remaining shops render only maintenance and repair services. The survey results reveal that in average, each shop is consuming about 70 kg of CFC-12 per year for servicing. In addition, it was reported that major manufacturers of commercial refrigerators (e.g. Songserm Intercool, Siam Cooler, and Sahakarn Intercool) also consumed about 8.21 MT of CFC-12 per year for servicing CFC commercial refrigerators.

The Thai Hotels Association also reported that about 11 tons of CFC-12 per year are being used for servicing commercial refrigerators. In additional, the Thai Retailers Association also reported that about 3 tons of CFC-12 are being used in all chained supermarkets, mini-marts, and convenient stores.

The Thai Navy reported that it is still requiring about 6.7 tons of CFC-12 for servicing its existing refrigeration systems installed in all the Thai Navy ships. 70% of this amount is used for servicing cold rooms and 30% for servicing household and commercial refrigerators installed on board.

The total CFC consumption in the commercial refrigeration servicing sector as reported by service shops, and owners of these commercial refrigeration units, is about 94 tons of CFC-12 per year.

(c) Refrigerated Truck and Containers

With regard to CFC consumption in refrigerated trucks, the survey result confirms that at present, there is no installation of any new CFC-12 or R-502 refrigeration systems on pick-up trucks and 10-wheel trucks. CFC-12 has completely been replaced by HFC-134a in the new system while R-502 has been replaced by R-404a. The use of CFC-12 and R-

502 is limited to servicing of old units. It was reported that about 665 kg of CFC-12 and 109 kg of R-502 are being consumed in this sub-sector. For refrigerated ships, the most commonly used alternative is HCFC-22.

In the case of refrigerated containers, it was reported that two sizes of containers used for refrigeration purposes are the 20 and 40 foot models. Refrigerated containers using CFC-12 are more than 10 years old. All newer refrigerated containers are installed with HFC-134a and R-409 refrigerants. Thailand does not manufacture any refrigerated containers. Servicing of refrigerated containers is provided by four major contractors: S&T ConTemp, Container Care, Container Network, and CTS. These contractors reported that they consume about 25 tons of CFC-12 a year for servicing all CFC-12 refrigerated containers in Thailand.

The total CFC-12 consumption in the refrigerated trucks and containers is about 25.67 MT per year plus 109 kg of R-502 per year (or 55.6 kg of CFC-115 per year).

(d) Chillers

Based on information obtained through interviews with all chiller suppliers and some chiller service contractors in Thailand, it was concluded that about 130 tons of CFC-11 and 15 tons of CFC-12 are being used for servicing the existing 1,398 CFC chillers installed in Thailand. These 1,398 CFC chillers are being used in different industrial and commercial applications.

Table 4.9 Inventory of Existing CFC Chillers Installed in Thailand

Application	No. of Chillers Installed by Capacity and Year of Installation						Summary		
	>500 Tons		300 - 500 Tons		< 300 Tons				
	<15 Years	>15 Years	<15 Years	>15 Years	<15 Years	>15 Years	<15 Years	>15 Years	Total
Textile	83	34	106	66	9	41	198	141	339
Industry	43	10	73	29	34	27	150	66	216
Hotel	79	22	78	22	40	44	197	88	285
Hospital	2		20	6	9	14	31	20	51
Offices	63	17	89	19	39	41	191	77	268
Department Stores	64	20	84	24	7	14	155	58	213
State Enterprises	1	5	1		5	14	7	19	26
	335	108	451	166	143	195	929	469	1398

(e) MAC Servicing

The survey conducted during the preparation of this document reveals that 66% of all vehicles undergone repair work are subject to proper leak test while the remaining 34%

have their MAC charged with refrigerant without fixing any leaks. When servicing MACs, about 49% of the total units services are replaced with new or refurbished receiver dryers.

Receiver dryers are locally produced and some are imported from Taiwan. There are four major producers of receiver dryers in Thailand. These are Denso (Thailand), Siam Zexel, President Automobile, and Formula Industry. A large number of receiver dryers used in Thailand are refurbished units. Based on information provided by the four major CFC-12 receiver dryers, it is estimated that about 1,030,000 CFC-12 receiver dryers are used on an annual basis in the MAC sector in Thailand.

Information obtained through the on-going MAC recovery and recycling project indicates that in average, each MAC service shop in the Bangkok Metropolitan area is using approximately 64 kg of CFC-12 per month while each service shop outside the Bangkok Metropolitan area is using about 33 kg of CFC-12 per month. It was also reported that based on the amount of CFC-12 bought by the MAC service shops and the number of MACs coming for service, the total charge required for each repair job is about 0.8 kg. While the number of new MACs in private passenger cars that require any services is very small, the frequency of MACs coming in for services increases with the age of the units. In average, each MAC requires service once every two years.

Interviews conducted with seven major taxi companies that have their own service shops indicate that MACs installed in taxies require services about four times a year with an average consumption of CFC-12 of 0.8 kg for each servicing job. These seven taxi companies own 901 taxis of which, 715 taxis are installed with HFC-134a. The rest of the fleet is installed with CFC-12 MACs.

Two state-owned mass transportation enterprises: Bangkok Mass Transportation Organization, and State Transportation, reported that they have 1,000 and 130 CFC-12 air-conditioned buses, respectively, in their fleets. Air-conditioning systems of these buses undergo maintenance on a monthly basis. In average, CFC-12 consumption is about 1.86 kg/bus/month. However, receiver dryers only get replaced once a year. State Transportation has its own air-conditioning service center while the Bangkok Mass Transportation Organization has contracted out air-conditioning services to CoachAir (Thailand). For air-conditioned buses owned by the private sector, service is provided mainly by S. K. Tour and Service.

Based on input provided by distributors of CFC-12 and air-conditioning spare parts, it is estimated that there are about 2,750 service shops throughout the country of which, 1,750 shops are located in the Bangkok Metropolitan area.

The statistical data provided by the Land Transport Department shows that there were a total number of 3,124,944 registered vehicles (passenger cars, taxis, hotel limousines, pick-up trucks, minivans, and vans) that were manufactured before 1995 (all MACs installed after 1995 are CFC-free models). These vehicles were manufactured during the period from 1986 – 1995. Prior to 1986, the number of vehicles that are still registered

with the Land Transport Department amounted to less than 5% of the total vehicles registered in 1999. In addition, a very few percentage of those cars are equipped with MACs.

Based on the information provided by MAC manufacturers, 80% of the vehicles produced before 1995 were equipped with MACs. Therefore, approximately 2.5 million vehicles of the 3.1 million vehicles manufactured before 1995 and registered in 1999 are still running with CFC MACs. In addition, about 1,130 buses owned by the Bangkok Mass Transportation Organization and the State Transportation are also equipped with CFC MACs and are still in operation. From the Land Transport Department's statistical data, it also shows that there are more than 22,000 air-conditioned buses owned by private operators. These 22,000 buses were manufactured before 1995. The survey results indicate that about 90% of all privately owned buses (or 20,000 buses) are equipped with CFC MACs.

It was also reported that 46% of 8,640 tour buses manufactured before 1995 and registered with the Land Transport Department in 1999 are equipped with CFC MACs. Another 3,230 privately owned buses are also installed with CFC MACs. In addition, about 9,600 (5%) of the total number of 193,538 six- and ten-wheel trucks are equipped with CFC MACs.

Therefore, the total number of vehicles that are equipped with CFC MACs in 1999 is about 2.55 million vehicles.

Table 4.10 Estimated Breakdown of Vehicles Equipped with CFC MACs

Vehicle Type	**Number of Vehicles (1)**
Passenger Cars (2)	2,508,080
Buses owned by state enterprises (3)	1,130
Buses owned by private operators (3)	19,977
Tour Buses	3,974
Privately owned buses	3,230
Trucks	9,677
Total	2,546,068

(1) Number of vehicles registered with the Land Transport Department in 1999 and were produced before or in 1995.
(2) Including private passenger cars, taxis, hotel limousines, mini vans, vans and etc.
(3) Buses for mass transit purposes.

Total CFC consumption for the MAC servicing sector can, therefore, be calculated as follows:

(1) CFC consumption based on the number of receiver dryers sold:

Consumption = Number of Receiver Dryers * Replacement Frequency * Charge Size
= 1,030,000 *100/49 * 0.8
= 1,680,000 kg
= 1,680 tons

(2) CFC consumption based on the number of registered vehicles:

Table 4.11 Service Information of CFC MACs Installed in Vehicles in Thailand

Vehicle Type	**Number of Vehicles**	**Charge Size (kg)/service**	**Avg. No. of Service per year**	**CFC-12 Consumption (kg/year)**
Passenger Cars (excluding taxis)	2,467,448	0.4	1	986,979
Taxis	40,634	0.8	4	130,029
Buses owned by state enterprises [3]	1,130	1.86	12	25,222
Buses owned by private operators [3]	19,977	1.86	12	445,887
Tour Buses	3,974	1.86	12	88,700
Privately owned buses	3,230	1.86	12	72,094
Trucks	9,677	1.5	1	14,516
Total	2,546,070			1,763,425

Therefore, the total CFC consumption in the MAC servicing sector based on the number of registered vehicles is about 1,763 tons.

(3) CFC consumption based on the number of MAC servicing shops:

CFC Consumption = Average consumption per shop*Number of Servicing Shops
= (64 * 1,750 * 12) + (33 * 1,000 * 12)
= 1,344 + 396
= 1,740 tons

Based on the three calculation methods, CFC-12 consumption in the MAC sector appears to be in the range of 1,680 tons – 1,763 tons.

(f) Cold Store and Large Refrigeration Systems

In 2000, 1.6 MT of R-502 was imported to Thailand. This quantity was used for servicing existing cold storage and large industrial refrigeration systems. The end-users are three companies in the food industry, McDonalds (Thailand) and one major hotel in Bangkok. All existing R-502 refrigeration systems are more than 15 years old.

The Thai Navy reported that it consumed about 4.8 MT of CFC-12 for servicing its cold rooms. The total consumption in this sector is about 6.3 MT per year of which, 1.6 MT is R-502.

Based on data collected during program preparation with regard to the existing stocks of CFC equipment, experiences on service frequencies, and useful life of various refrigeration equipment items from other countries, ODS consumption for refrigeration and MAC systems was then estimated.

The consumption figures from this estimation and figures collected from the field are then compared. In most cases, the lowest figures are used as a basis for development of a phaseout plan in the later part of this document.

Table 4.12 Inventory of Refrigeration and MAC Equipment and Service Information

Type of appliance	Stock	Initial charge	Service demand	Lifetime
Domestic refrigerators and freezers	12,000,000	0.1 kg/unit	2% per year	20 years
Commercial refrigerating appliances	1,500,000	0.6 kg/unit	15% per year	5-7 years
Cold stores and larger systems	1,000	10 kg/unit	50% per year	20 years
Water chillers	1,400	400 - 500 kg/unit	20% per year	20-30 years
Refrigerated containers	10,000	5 kg/unit	50% per year	20 years
MAC and Bus AC	2,546,070	0.8 – 5 kg/unit	Section 4.2 (e)	8-10 years

Table 4.13 CFC Demand in the Refrigeration and MAC Sectors

Type of appliance	Stock	Share using ODS	ODS inventory in MT	Annual ODS service demand in MT
Domestic refrigerators and freezers	12,000,000	100%	1200	24
Commercial refrigerating appliances	1,500,000	80%	720	94*
Cold stores and larger systems	1,000	100%	10	5
Water chillers	1,400	100%	700	145
Refrigerated containers	10,000	100%	50	25
MAC and Bus AC	2,546,070	100%	4,686	1,760
Total			7,361	2,053

*A lower figure of 94 MT is used, instead of 108 MT.

CHAPTER 5

NATIONAL CFC PHASEOUT PLAN

1. INTRODUCTION

The study showed that without further action taken by the Government and without additional intervention from the Multilateral Fund, Thailand will just meet its 50% reduction target for Annex A, Group I chemicals in 2005. This conclusion is based on the assumption that no enterprises that have already been converted to non-CFC technology will revert to use of CFCs. With regard to meeting the 85% reduction target in 2007, Thailand will have to phase out an additional 2,000 MT of Annex A, Group I chemicals from the current trends in consumption. As Chapter 1 has shown, the progress made by Thailand in ODS consumption phaseout can be easily erased if no steps are taken in the critical years of the compliance period.

While the focus of the national CFC phaseout plan is to phase out Annex A, Group I chemicals, consideration was also made to partly further reduce the consumption of Annex B chemicals. Phaseout of Annex A, Group II chemicals is not addressed in this study as the phaseout of these chemicals (halons) is being done via a separate terminal umbrella project. No consideration was made of any chemicals in Annex B, Group I as none of these have been imported to Thailand.

2. PROPOSED POLICIES AND STRATEGIES

It is the policy of the Government of Thailand to impose bans on the use of CFCs in the manufacturing sector by January 2005, and to establish legal requirements to preempt back-conversion of non-CFC equipment as soon as possible. The latter is critical to the success of sustainable phaseout of CFCs in the servicing sector.

Based on the survey results, the total use of Annex A, Group I chemicals in enterprises in the manufacturing sector that are eligible but have not received any assistance from the Multilateral Fund is about 696.8 ODP tons. The Thai Government is seeking funding from the Multilateral Fund to support conversion at these enterprises. The Government plans to have conversions of these enterprises completed by the end of 2004. The Government plans to ban the use of Annex A, Group I chemicals for the manufacturing sector by 1 January 2005. This will lead to additional phaseout of 740.6 ODP tons (of which, 696.8 ODP tons is phaseout through the MLF support) of Annex A, Group I chemicals.

With the whole manufacturing sector eventually becoming CFC-free, the amount of Annex A, Group I chemicals to be imported from 2005 onwards will be for meeting the demand in the servicing sector only. To meet the 85% reduction target in 2007, an additional CFC phaseout of about 1,251 ODP tons must be accomplished within the next five years (from 2002 – 2006).

To reduce the demand of CFCs in the servicing sector, particularly in the MAC sub-sector, the Government plans to establish a regulatory system to prevent the use of CFCs in non-CFC MAC systems. The Government is also contemplating regulatory requirements to ban the use of CFC in all MAC and AC systems and other refrigeration systems by 2010.

As part of the National CFC Phaseout Plan, a series of ministerial decrees banning the use of CFC in the manufacturing sector will be issued by the end of 2003 in order to ensure sustainability of CFC phaseout in the manufacturing sector. The proposed bans will become effective from 1 January 2005. DIW will use the existing legislation: the Factory Control Act and the Hazardous Substances Act, as its major legal tools to ensure sustainable phaseout of CFCs.

3. IMPACT OF APPROVED PROJECTS AND NEWLY PROPOSED ACTIVITIES

Impact of various investment, technical assistance, and regulatory activities proposed under this National CFC Phaseout Plan is shown in Tables 5.1 to 5.4. In 2000, Thailand imported 3,568 ODP tons of Annex A, Group I chemicals. The survey conducted during the preparation of this plan determined that the total amount of all CFCs actually consumed by end-consumers is about the same as the amount imported. However, when comparing the amounts imported and consumed for each chemical, there are slight differences in the amounts of CFC-11 and CFC-12 imported and the amounts consumed in the same year. This difference could have arisen from the fact that not all imported CFCs are consumed within the same year. When calculating the impact of the interventions proposed in the National CFC Phaseout Plan, the identifiable consumption will be used as a basis of the analysis.

With no further intervention from the Multilateral Fund or from the Government, it is expected that the current consumption level of 3,568 ODP tons a year will decrease by 757 ODP tons in 2004 due to the completion of all remaining investment projects already approved by the Executive Committee of the Multilateral Fund and other supporting measures carried out by the Government.

At present, there are 19 on-going foam projects with a total CFC-11 consumption of 412 ODP tons. These projects are scheduled to complete in 2001 – 2003. The impact of these projects would begin to be realized from 2002 onwards. The demand for CFC-11 in the foam sector will decrease by 289 ODP tons in 2002, 386 ODP tons in 2003 and 412 ODP tons in 2004.

In the refrigeration sector, there are three on-going investment projects which are the commercial refrigeration terminal umbrella project, the MAC recovery and recycling demonstration project and chiller replacement project. The commercial refrigeration terminal umbrella project is scheduled to be completed no later than 2003. Therefore, the full impact of this projects, reduction of CFC-11 demand by 97 ODP tons and CFC-12 by 106 ODP tons, will be realized by 2004.

The MAC recovery and recycling demonstration project is expected to be completed by the end of 2001 with the full impact of a permanent reduction of CFC-12 demand by 47 ODP tons a year to be fully realized in 2002.

With the on-going chiller replacement project whereby 24 CFC-11 chillers of an average size of 500 refrigeration tons will be replaced, will result in an additional reduction of 2.4 ODP tons of CFC-11. The impact of this project will be realized in 2002. The Government of Thailand intends to replace an additional 450 CFC chillers once the pilot phase has proven to be successful. It is expected that an additional 450 chillers will be replaced during the period of 2004 – 2010. Based on the chiller survey carried out in 1999, 469 out of 1,398 chillers were more than 15 years old. With an average life expectancy of 20 – 30 years, some of these older units will be replaced from 2003 onwards. Therefore, it is estimated that the impact of the replacement program to be carried out by the Thai Government and the retirement of old CFC chillers will result in a reduction of CFC-11 demand by 11 ODP tons in 2004 and reach a reduced level of 67 ODP tons in 2010. Similarly, it is expected that demand of CFC-12 in the chiller sector will be reduced by 1 ODP ton in 2004 to 8 ODP tons in 2010.

With the implementation of the Thai Code of Good Practice for the Chiller sector, it is expected that about 1/3 of the demand of CFC-11 and CFC-12 in this sector will be lowered.

Based on the industrial survey, it is estimated that in 2000 there is an existing stock of 12 million CFC-12 domestic refrigerators installed across the country, as Thailand has stopped production and import of CFC-12 domestic refrigerators since 1 January 1997. With a life expectancy of 20 years for domestic refrigerators, it is expected that all CFC-12 domestic refrigerators will be retired by 2016. That means from 2010 onwards when Thailand is no longer allowed to import any more CFCs, there will still be some CFC-12 domestic refrigerators that may require CFC for servicing.

It is estimated that during the period from 2010 – 2016, there may be about 400,000 CFC-12 domestic refrigerators that need servicing. However, early retirement of these units can be avoided through the refrigeration service technicians training programs. Therefore, while the analysis shows that there will still be a demand of 10 ODP tons of CFC-12 in 2010, this demand can be replaced through retrofitting. No compensation for retrofit is requested under this plan.

As the life expectancy of commercial refrigerators is about seven years and the current production level of about 220,000 units of non-standard commercial refrigerators, there are about 1.5 million commercial refrigerators installed across the country. 80% of the 1.5 million units are CFC-12 based units. The survey indicates that about 94 ODP tons of CFC-12 are being used for servicing CFC-12 commercial refrigerators. Since the Government of Thailand already has a policy to ban production and import of CFC commercial refrigerators after the commercial refrigeration terminal umbrella project financed by the Multilateral Fund is completed in 2003, the demand for CFC-12 in this sector will, therefore, start to decline from 2004 onwards.

The consumption of CFC-12 in the refrigeration container sub-sector was 25 MT in 2000. Since there is no production of CFC-12 refrigeration containers in Thailand, it is expected that the demand for CFC-12 in this sub-sector will gradually decline over the next ten years. At the time the survey was conducted, it was reported that most CFC-12 refrigeration containers were more than 10 years old. Therefore, it is expected that by 2010 all these units will be retired.

The impact of the proposed strategy for the MAC sector can be described as follows. First, a condition will be imposed that vehicles manufactured from 1 January 1996 will not have their registrations renewed if their MACs contain CFC as refrigerant. (All vehicles manufactured after 1 January 1996 were equipped with HFC-134a MACs.) This will discourage reverse retrofit of HFC-134a MACs and help prevent the demand of CFC-12 in this sector from increasing.

As the average life expectancy of vehicles is about 20 years, it is expected that by 2016 all vehicles that were equipped originally with CFC MACs will be retired. It is recognized that within the life span of the vehicles, vehicles' owners may need to have their MACs repaired. It is, however, expected that most owners of vehicles with CFC-12 MACs will replace the old CFC-12 units with another new or rebuilt CFC-12 unit.

It is estimated that retirement of vehicles that were originally equipped with CFC MACs will be done in the period of 2006 – 2015. Therefore, a significant decline of CFC demand in the MAC sector will start to be realized from 2006 onwards. By 2010, it is estimated there will still be about 1.5 million vehicles that were manufactured before 1996 and originally equipped with CFC-12 MACs in operation. However, with other supporting activities, including legal pressure created by a MAC annual inspection as discussed in the subsequent chapter, many owners of vehicles will replace their CFC-12 MACs with non-CFC systems when their original systems break down. The actual impact of early retirement of CFC-12 MACs is expected to be much less than 1.5 million units.

The training program to be provided to service technicians is expected to help minimize the current practice of topping up refrigerant without fixing the leak. The current rate of topping-up is about 34%. The training program is expected to reduce topping up by 300 ODP tons a year.

The National CFC Phaseout plan also proposes new investment activities in the manufacturing sectors in the aerosol, foam, solvent, refrigeration and MAC servicing sectors. New investment activities in the aerosol, foam, and solvent sectors will result in an additional reduction of 740.6 ODP tons in the demand of CFC-11, CFC-12, and CFC-113.

To phase out CFC-115, the manufacturer of thermostats will convert to non-CFC alternative by the end of 2004. No funding request is anticipated. The remaining use of

CFC-115 of about 820 kg a year, is in the refrigeration servicing sector. The Government will allow the import of CFC-115 at this level until 2009.

In addition to all the interventions mentioned above, CFC phaseout of an additional 228 ODP tons is still required in order to meet the 85% reduction target in 2007. It is proposed that a MAC recovery and recycling option be employed.

With the proposed plan, Thailand will be able to meet its 50% and 85% reduction targets in 2005 and 2007. In 2010, there will still be a demand for CFCs, mostly CFC-12, of approximately 287 ODP tons. This demand represents a large number of MACs and domestic refrigerators that have to be retired before the end of their useful life. However, with the train-the-trainer programs and certification programs included in this plan, Thailand will have infrastructure and service technicians that are capable of converting these equipment items to other non-CFC alternatives.

Table 5.1. CFC Phaseout by On-going and Newly Proposed Activities (MT)

Annex A, Group I	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
CFC-11 (Demand)	1,287	1,287	1,287	1,287	1,287	1,287	1,287	1,287	1,287	1,287	1,287
Impact of On-going Phaseout Activities											
Completion of On-going Projects: Foam		-	289	387	412	412	412	412	412	412	412
Completion of On-going Projects: Comm. Ref.					97	97	97	97	97	97	97
Chiller Replacement/Retirement			2	2	11	21	30	39	49	58	67
Code of Good Practice (Chiller)					35	32	29	27	24	21	18
Impact of New Phaseout Activities											
Investment Activities in the Aerosol Sector					-	5	5	5	5	5	5
Investment Activities in the Foam Sector					-	643	643	643	643	643	643
CFC-11 Reduction Schedule	1,287	1,287	995	898	732	77	71	64	58	51	45
CFC-12 (Demand)	2,054	2,054	2,054	2,054	2,054	2,054	2,054	2,054	2,054	2,054	2,054
Impact of On-going Phaseout Activities											
Completion of On-going Projects: Comm. Ref.					106	106	106	106	106	106	106
MAC R&R Demonstration Project		30	47	47	47	47	47	47	47	47	47
Chiller Replacement/Retirement					1	2	3	4	5	7	8
Retirement of CFC-12 Domestic Refrigerators		1	3	4	6	7	8	10	11	13	14
Retirement of CFC-12 Comm. Refrigerators				-	32	43	53	63	73	84	94
Retirement of CFC-12 Cold Stores						5	5	5	5	5	5
Retirement of CFC-12 Refrig. Containers	-	3	5	8	10	13	15	18	20	23	25
Retirement of Vehicles with CFC-12 MACs	-	0	0	0	0	0	176	352	528	704	880
Impact of New Phaseout Activities											
Investment Activities in the Aerosol Sector					0	25	25	25	25	25	25
New Vehicle Inspection Requirement Upgrading Capacity of Inspection Stations (To stop back-conversion)				10	21	31	41	52	62	72	83
Train-the-Trainer Program Certification of MAC Service Technicians (No Toppping-Up) Partial Grant to Finance Procurement of MACs Maintenance Tools				100	200	300	300	300	300	300	300
Financial Subsidy for R&R Machines				77	143	193	228	228	228	228	228
CFC-12 Reduction Schedule	2,054	2,020	1,999	1,808	1,489	1,283	1,047	844	643	442	239
CFC-113	88	88	88	88	88	88	88	88	88	88	88
Impact of New Phaseout Activities											
New Investment Projects for Remaining 4 Enterprises					0	64	64	64	64	64	64
Technical Assistance for Contact Cleaners					0	20	20	20	20	20	20
CFC-113 Reduction Schedule	88	88	88	88	88	4	4	4	4	4	4
CFC-114 Reduction Schedule	-	-	-	-	-	-	-	-	-	-	-
CFC-115 (Demand)	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54
Conversion at the Thermostat factories					-	0.72	0.72	0.72	0.72	0.72	0.72
Retirement of R-502 Cold Stores											0.82
CFC-115 Reduction Schedule	1.54	1.54	1.54	1.54	1.54	0.82	0.82	0.82	0.82	0.82	-

Table 5.2. CFC Phaseout Schedule Based on the Proposed Plan (ODP Tons)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Phaseout Schedule for Thailand	3,412	3,378	3,066	2,777	2,291	1,364	1,121	912	704	496	-
Interim Reduction Targets for Thailand	6,082	6,082	6,082	6,082	6,082	3,041	3,041	912	912	912	-
Required Additional Phaseout Activities	-	-	-	-	-	-	-	-	-	-	-

With no more R&R machines, Thailand will exceed the 85% reduction target in 2007 by 228 MT.
To have additional phaseout of 228 MT, additional 635 R&R machines must be in operation by 2007.

Table 5.3. 1,1,1-TCA Phaseout by On-going and Newly Proposed Activities

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1,1,1-TCA (Import, MT)	335	335	335	335	335	335	335	335	335	335	335
Impact of New Phaseout Activities											
Investment Activities for the Garment and Shoe Sole Industry (MT)			-	-	-	290	290	290	290	290	290
Additional phaseout due to the ban on the use of TCA in for manufacturing new products (MT)						6	6	6	6	6	6
1,1,1-TCA Reduction Schedule	335	335	335	335	335	39	39	39	39	39	39

Table 5.4. 1,1,1-TCA Phaseout Schedule Based on the Proposed Plan (ODP Tons)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Phaseout Schedule for Thailand	34	34	34	34	34	4	4	4	4	4	4
Interim Reduction Targets for Thailand				55	55	38	38	38	38	38	16
Required Additional Phaseout Activities				-	-	-	-	-	-	-	-

CHAPTER 6

ACTION PLAN

1. AEROSOL SECTOR

As of the end of 2000, all projects that already received funding from the Multilateral Fund, have been completed. There are only three remaining aerosol manufacturers that are still using CFCs in their production process. To completely phase out the use of CFCs in this sector by 2004, conversions have to be carried out at the three remaining enterprises: Bangkok China Paint, Cosmonaut, and Vera Alline. These three companies were established before July 1995. Products produced by these enterprises are for the domestic market and for export to neighboring countries (i.e., Lao, Malaysia, Cambodia, and Vietnam).

1.1 INVESTMENT COMPONENT

Based on the previously approved projects in the aerosol sector for Thailand, the average cost-effectiveness for Thai aerosol projects is US$3.17 per kg ODP. Thailand is requesting funding for phasing out the remaining consumption of 30 ODP tons at the same level of cost-effectiveness of the previously MLF approved projects. For Cosmonaut and Veera Alline whose CFC consumption is both less than 20 ODP tons per year, 150% of the average cost-effectiveness level is used for determining their levels of funding. This is in line with the principle laid out by Dec. 25/56 with regard to conversion projects for small- and medium-scale enterprises. Therefore, it is proposed that the total funding for this sector is US$ 102,960.

Table 6.1 Proposed Funding for Conversion Projects in Aerosol Sector

Enterprise	Type of ODS	Consumption (ODP tons)	Requested Funding (US$)
Bangkok China Paint	CFC-12	25	79,200
Cosmonaut	CFC-11	2.5	11,880
Veera Alline	CFC-11	2.5	11,880
Total		**30**	**102,960**

These three enterprises will be invited to submit proposals to DIW, not later than the end of 2003, to convert their existing facilities to CFC-free technology. Proposals must include a list of new equipment items and safety devices, and a specific completion date which cannot be later than December 2004. The conversion plan must include a plan and method to render the old equipment unusable.

1.2 TECHNICAL ASSISTANCE COMPONENT

With regard to MDIs, it is proposed that a MDI phaseout strategy be developed. The objective of the proposed strategy is to promote the use of non-CFC alternatives and to

formulate a proper transition plan taking into account the phaseout plan of major CFC MDI producers in both developed and developing countries.

The proposed MDI strategy will include a proposal to have non-CFC MDI alternatives included in the list of approved prescription drugs, and the strategy will include information dissemination programs targeting medical doctors and the management of public and private hospitals in order to raise their awareness pertaining to the need to phase out the use of CFC MDIs.

To develop a comprehensive strategy for phasing out CFC MDIs, DIW, in close consultation with the Ministry of Public Health, will contract a consulting firm to undertake preparation of this strategy. The preparation process will include stakeholder consultation workshops, development of a transition plan including information dissemination strategies, and recommendations to promote the use of non-CFC alternative MDIs. It is proposed that financial support of US$ 57,200 be provided by the Multilateral Fund to support this activity.

Table 6.2 Technical Assistance Component for MDIs

Description	US $
Workshops	25,000
Consultant Fees	15,000
Information Dissemination Materials for Health Care Industry	12,000
Sub-total	52,000
Contingency 10%	5,200
Total	**57,200**

1.3 REGULATORY COMPONENT

DIW will issue a ministerial decree banning the use of CFC in the production of all aerosol products. This includes products that use CFC as propellants or as an ingredient. In addition, a condition prohibiting the use of CFCs in the production of aerosol products will be attached to all import licenses. To preempt imports of CFC aerosol products, DIW will propose to the Ministry of Commerce to include aerosol products containing CFCs be included in the list of restricted products whose imports require reviews and approvals from DIW. Only CFC MDIs will be excluded from the list.

The regulatory component shall be completed by the end of 2003.

2 SOLVENT SECTOR

DIW intends to ban the use of CFC-113 in the manufacturing process by the end of 2004. The import quota for CFC-113 will be set at 4 MT a year from 2005 onwards and decrease to zero by 2010.

2.1 INVESTMENT COMPONENT

(a) CFC-113

To phase out CFC-113 in the manufacturing sector, DIW is seeking funding from the Multilateral Fund to support conversion processes at the following enterprises: Thai Compressor Manufacturer, Challenge Medical Product, Intergold Optical Lenses, and Alphatech. The total amount of 64 MT of CFC-113 will be phased out. With regard to the phaseout of an additional 20 MT of CFC-113 used in contact cleaner products, DIW is seeking technical assistance from the Multilateral Fund to assist Lafa Thai and Pronet Inter to identify new alternatives and new formulations. All these enterprises were established before July 1995 and are 100% Thai owned.

It is proposed that the funding level of $965,120 be provided by the Multilateral Fund in order to phase out 64 MT of CFC-113 (51.2 ODP tons) in the four remaining enterprises that are still using CFC-113 for their cleaning process. This requested funding level is made on the basis of the cost-effectiveness level of the previously approved CFC-113 phaseout projects for Thailand ($18.85/kg ODP).

Table 6.3 Proposed Funding for Conversion Projects in Solvent (CFC-113) Sector

Enterprise	Type of ODS	Consumption (ODP tons)	Requested Funding (US$)
Thai Compressor	CFC-113	36.8	693,680
Challenge Medical Product	CFC-113	2.0	37,700
Intergold Optical	CFC-113	3.2	60,320
Alphatech	CFC-113	9.2	173,420
Total		**51.2**	**965,120**

DIW will invite all remaining users of CFC-113 in the manufacturing sector to submit their applications for financial support to phase out CFC-113. In case there are additional enterprises that are not included in the above table and wish to receive financial assistance, phaseout costs of these additional enterprises will be covered by the above requested amount.

Enterprises are required to provide DIW with information pertaining to their proposed alternative technology, proper measures to ensure worker safety, and disposal plans. When converting to alternatives, enterprises are required to comply with other relevant environmental protection regulations in the country. All conversion projects must have a completion date not later than the end of 2004.

(b) 1,1,1-TCA

Blended solutions of 1,1,2-TCE and other non-ODS solvents are common replacements of 1,1,1-TCA in the textile and garment industry in Thailand. Many textile and garment factories have already stopped using 1,1,1-TCA for spot cleaning. There are about 400

factories that are still using 1,1,1-TCA in their operations. However, since 1,1,2-TCE is toxic, it is important that those factories that have already switched to a blended solution of 1,1,2-TCE, have proper ventilation systems installed in their work areas. With assistance from international experts, DIW will work with the Ministry of Public Health and the Ministry of Labor and Social Welfare to establish a maximum allowable exposure level for 1,1,2-TCE by mid-2003. This maximum allowable exposure limit will form a basis for a proper design of ventilation systems.

To manage the phaseout of the use of 1,1,1-TCA for spot cleaning, DIW will appoint the Garment Development Institute or another qualified institution to act as a project team. The project team will be in charge of disseminating information pertaining to the need to phase out 1,1,1-TCA, safety measures for using 1,1,2-TCE solutions as mentioned in the earlier paragraph, as well as other environmental friendly alternatives. Activities required for phasing out 1,1,1-TCA in the garment and textile industry in a sustainable and environmentally friendly manner include both investment and non-investment activities. The investment component will include a funding request of $700,000 to support the installation of proper ventilation systems (hoods, air ducts and blowers) at 1,400 garment factories.

At this level of funding, each garment factory will only receive financial support that is enough for installing one ventilation system. This support is deemed necessary for demonstrating to garment factories that proper design and installation of ventilation systems will help ensure worker safety based on the 1,1,2-TCE maximum allowable exposure limit to be agreed by the Ministry of Public Health and the Ministry of Labor and Social Welfare, as mentioned above.

This component along with the technical assistance component described below will be implemented by the project team. Enterprises seeking funding to support the costs of installation of a ventilation system must submit their request to the project team. Prior to disbursing any funds to enterprises, the project team will carry out a technical audit to ensure that the design and installation of such a ventilation system is in line with the guidelines adopted under this project.

As the shoe sole factory (Summit Footwear) that used about 40 MT of 1,1,1-TCA for its cleaning process in 2000 is also in a process of converting to 1,1,2-TCE, therefore, a similar ventilation systems would be required. An additional $10,000 is requested for providing a proper ventilation system (hoods, air ducts and blowers) at Summit Footwear.

The total funding to phase out 290 MT of 1,1,1-TCA in the garment and the shoe sole industries is $710,000, which is equivalent to a cost-effectiveness level of $24.48/kg ODP (the average of cost-effectiveness of previous projects approved for Thailand is $30.48/kg ODP).

As the remaining use of 1,1,1-TCA of about 45 MT is for metal cleaning and production of mold releasers, most users are small- and medium-scale enterprises, except Siam Zexel and EGAT. DIW will seek bilateral support from the Government of Sweden to develop

a comprehensive strategy to phase out this remaining use. Funding request for this bilateral support will be submitted separately.

(c) Carbon Tetrachloride (CTC)

Thailand is required to reduce its consumption of CTC by 85% by 2005. As the current import of CTC was 6.5 MT in 2000 and the baseline consumption (1998 – 2000) for Thailand is 6.83 MT, Thailand is required to reduce its import of CTC by 5.1 MT by 2005.

To phase out the use of CTC for testing the quality of activated carbon and for production of sugar coated medicine tablets, Thailand will seek bilateral support from the Government of Sweden to develop a strategy to phase out this use. Phasing out of CTC in these two applications will enable Thailand to reduce the consumption of CTC by 4 MT per year. Funding for this component will be submitted separately by the Government of Thailand and the Government of Sweden.

2.2. TECHNICAL ASSISTANCE COMPONENT

(a) CFC-113

To phase out the use of 20 MT of CFC-113 (16 ODP tons) as a contact cleaner solution at Lafa Thai, and Pronet Inter, a technical assistance component to assist these two enterprises to identify alternatives and new formulations, is required. A grant funding of $23,100 is required to cover the costs of international consultants, and development and testing of alternative products.

Table 6.4 Technical Assistance Component for Phaseout of CFC-113 Use in Contact Cleaner Products

Description	US $
Expert	10,000
Travel and Per Diem	6,000
Trial and Testing	5,000
Sub-total	21,000
Contingency 10%	2,100
Total	**23,100**

(b) 1,1,1,-TCA

The Garment Development Institute, or other qualified institution, to be appointed by DIW, will act as a local executing agency/project team to manage the overall 1,1,1-TCA phaseout program for the garment industry. The whole program consists of the following components:

- Establishment of a national standard for the maximum exposure limit of 1,1,2-TCE. The project team will work closely with the Ministry of Public Health, the Ministry of Labor and Social Welfare, and the Ministry of Industry, to develop such a local standard.
- Development of guidelines for design and installation of proper ventilation systems for garment factories. A local consultant team comprising of toxicologists and engineers will be hired to assist about 20 selected garment factories of various sizes to design a proper ventilation system that meets the exposure limit for 1,1,2-TCE established by the Government.
- Newsletters informing garment factories of the Government's policy to phase out the use of 1,1,1-TCA by the end of 2004. The project team will issue eight newsletters, one for each quarter during 2003 – 2004. Newsletters will include information pertaining to the Government's effort to phase out 1,1,1-TCA, safety measures with regard to the use of 1,1,2-TCE, guidelines for design and installation of proper ventilation systems, and the funding availability to support installation of ventilation systems at garment factories.
- The project team will undertake technical audit at all 1,424 garment factories to ensure that they are no longer using 1,1,1-TCA after 2004. If 1,1,2-TCE is used as a substitute, a proper ventilation system in line with the guidelines developed by this project shall be required.

To support the above activities, a total funding of $166,100 is required.

Table 6.5 Technical Assistance Component for the Garment Industry

Description	US $
Development of national exposure limit for 1,1,2 TCE	4,000
Development of guidelines for design and installation of proper ventilation systems (with 20 demonstration sites)	15,000
Newsletters (6 issues with 1,500 copies of each issue)	12,000
Processing applications and allocations of funds for supporting installation of ventilation at 1,400 garment factories	20,000
Safety audit for 1,400 garment factories	100,000
Sub-total	151,000
Contingency 10%	15,100
Total	**166,100**

(c) Carbon Tetrachloride (CTC)

To meet the 85% reduction in 2005, Thailand is proposing a technical assistance program to identify the remaining use of CTC as well as to develop a list of exempted applications. Thailand will seek bilateral support from the Government of Sweden to

identify all laboratory uses of CTC in Thailand. Based on the list of identified laboratory uses, Thailand will develop a list of exempted applications in line with exemptions that the Montreal Protocol have already provided to non-Article 5 countries. Funding for this component will be submitted separately by the Government of Thailand and the Government of Sweden, at a later date.

2.3. REGULATORY COMPONENT

(a) CFC-113

The proposed ban for the use of CFC-113 in the manufacturing sector from 2005, will be announced by the end of 2003. In the meantime, DIW will impose a requirement for importers of CFC-113 to provide names of their clients. If more users of CFC-113 in the manufacturing sector are identified, conversion of all CFC-113 users in the manufacturing sector will be carried out within the funding level already provided by the ExCom.

From 2005 on, CFC-113 will only be allowed for servicing existing equipment. This end-use condition will be attached to the import licenses. Any importers failing to abide to this condition, will have their import licenses either suspended for one year or cancelled. If import licenses are cancelled, no new application can be made within five years after the cancellation date.

(b) 1,1,1-TCA

By 1 January 2005, DIW will prohibit the use of 1,1,1-TCA in the manufacturing sector, except 1,1,1-TCA used for metal cleaning and production of mold releasers. Import licenses for 1,1,1-TCA will be attached with a condition that imported 1,1,1-TCA can only be used for metal cleaning and for production of mold releasers. The import quota for 1,1,1-TCA will be maintained at 45 MT from 2005 onwards. The import quota will be revised after the strategy for phasing out the use of this chemical for metal cleaning and for the production of mold releasers, to be carried out separately, is completed.

This will enable Thailand to phase out the import of 1,1,1-TCA by 290 MT. DIW plans to have this program fully implemented and completed by the end of 2004. Therefore, the import quota for 1,1,1-TCA for 2005 onwards will be reduced to 45 MT.

3. FOAM SECTOR

3.1. INVESTMENT COMPONENT

As mentioned previously, there are 100 foam enterprises that are still using CFC-11 as a blowing agent and which have not received any assistance from the Multilateral Fund. DIW is requesting funding from the Multilateral Fund to phase out the use of CFC-11 in 89 eligible enterprises.

All these enterprises are 100% owned by Thais and their products are for the domestic market. The composition of these remaining 100 enterprises as reported by nine polyol suppliers can be presented as follows:

Table 6.6 CFC-11 Consumption in Remaining Foam Enterprises

Sub-sector	Established before July 1995		Established after July 1995	
	No. of Enterprises	ODP tons	No. of Enterprises	ODP tons
Rigid Polyurethane Foam				
Spray foam	17	150.18		
Thermoware	12	42.84	1	0.91
Insulated Containers	12	41.29	3	6.21
Refrigerated Trucks	11	22.75	4	24.43
Insulation Panels	16	35.19	3	11.86
Others	12	129.59		
Flexible PU Foam	6	172.50	-	-
Integral Skin Foam	3	5.26		
Total	89	599.60	11	43.41

Based on the previously approved projects in the foam sector for Thailand, the average cost-effectiveness values for relevant foam sub-sectors are:

Table 6.7 Average Cost-Effectiveness of Previously Approved Foam Projects for Thailand

Sub-sector	Average Cost-Effectiveness for the Thai Project ($/kg ODP)
Rigid PU Foam	6.06
Flexible PU Foam	3.17
Integral Skin Foam	9.98

For the rigid PU foam sub-sector, there are 72 out of 80 enterprises that consume less than 10 ODP tons of CFC-11 per year. Combined CFC-11 consumption at these 72 enterprises is about 222.08 ODP tons.

For the flexible PU foam sub-sector, 4 out of 6 enterprises are consuming less than 25 ODP tons of CFC-11 per year. Combined CFC-11 consumption at these 4 enterprises is about 82.50 ODP tons of CFC-11 per year. All three remaining enterprises in the integral skin foam sub-sector consume less than 10 ODP tons of CFC-11 per year.

Thailand is proposing to phase out the remaining consumption of 643 tons of CFC-11 in the foam sector by converting all the remaining foam enterprises that have already been identified. All conversion must be completed by the end of 2004. The funding level to support the phaseout in this sector is calculated on the basis of the ODP tons consumed

by the remaining enterprises that were established before July 1995 (599.60 tons, instead of the total 643 tons). In addition, the funding request is calculated on the basis of the average cost-effectiveness levels of foam projects in relevant foam sub-sectors that were previously approved for Thailand. For small foam enterprises that meet the condition of small- and medium-scale enterprises established by the ExCom (Dec. 25/56), 150% of the average cost-effectiveness levels are used for determining the funding levels.

Table 6.8 Requested Funding for Remaining Foam Enterprises

Sub-sector	ODP tons	Average C-E for Thailand ($/kg ODP)	Funding Request ($)
Rigid Polyurethane Foam			
Large enterprises	199.76	6.06	1,210,545
SMEs	222.08	9.09	2,018,707
Flexible PU Foam			
Large enterprises	90.00	3.17	285,300
SMEs	82.50	4.75	391,875
Integral Skin Foam			
Large enterprises			
SMEs	5.26	14.97	78,740
Total	599.60		3,985,167

All foam enterprises that are still using CFCs in their foam production will be invited by DIW to submit proposals to request funding from DIW to convert to non-CFC alternatives. Funding priority will be given to enterprises established before July 1995. All proposals must provide information pertaining to non-CFC alternatives, baseline equipment, and equipment disposal plans. All proposals must have conversion processes completed before the end of 2004 at the latest.

DIW will provide assistance to help foam enterprises prepare their proposals. The assistance will be delivered through the existing nine polyol suppliers. If it is found later that there are more foam enterprises that need to convert their production processes, costs of conversion at these additional enterprises will be covered by the funds already approved for this national CFC phaseout plan.

3.2. REGULATORY COMPONENT

DIW intends to prohibit the use of CFC-11 in foam production from 2005. A condition prohibiting the sales of CFC-11 for use as a blowing agent will be attached to the import licenses. All CFC-11 importers will be required to provide a list of end-users. In addition, DIW will ban the use of CFC-11 in the production of pre-mixed CFC-11 polyol, and the import of pre-mixed CFC-11 polyol. A task force comprising of chemical importers, polyol suppliers, major foam producers, and DIW, will be established. The main responsibility of this task force is to monitor distribution of CFCs and HCFC-141b in the foam sector. A list of foam enterprises that are buying only base polyol or polyol

mixed with additives will be developed. With this list, DIW will then be able to approach each of these enterprises to verify the types of blowing agents used in their processes.

4. REFRIGERATION SECTOR

The remaining use of CFCs in the refrigeration manufacturing sector will be phased out when implementation of the commercial refrigeration terminal umbrella project is concluded in 2003 at the latest. The following is the proposed strategy for dealing with the phaseout of CFCs in the refrigeration and air-conditioning servicing sectors.

4.1. DOMESTIC REFRIGERATION AND COMMERCIAL REFRIGERATION SERVICING SECTORS

As an average lifetime of domestic refrigerators and freezers is about 20 years, the last CFC domestic refrigerator units produced in 1996 will be out of service by 2016. Based on the survey results, about 24 MT of CFC-12 was used for servicing CFC domestic refrigerators in 2000. Assuming that the existing stock of CFC domestic refrigerators will decrease at a constant rate with a total depletion by 2016, the CFC demand for servicing domestic refrigerators will decrease to about 10 MT by 2010. It is expected that by 2010, there would still be about 4.94 million units of CFC domestic refrigerators and freezers remaining in operation. Based on the historical data that about 2% of the total fleet requires maintenance, it is expected that from 2010 to 2016 about 400,000 units of CFC domestic refrigerators and freezers may have to be retired early as no CFC-12 would be available for servicing these units.

The above scenario is based on the assumption that there are no reverse retrofits of HFC-134a domestic refrigerators to CFC-12. While the total production of domestic refrigerators was more than 1.1 million units a year, about 2/3 of the total production was for the domestic market. Due to the recent economic crisis, the total sales of domestic refrigerators have been stalled at about 730,000 units a year. By 2000, the stock of HFC-134a domestic refrigerators was about 2.9 million units. Assuming that the sales of domestic refrigerators remain unchanged, the total stock of HFC-134a domestic refrigerators will reach 10.2 million units by 2010.

Based on the survey results, about 94 MT of CFC-12 was used for servicing CFC commercial refrigerators in 2000. An average lifetime of commercial refrigerators is about 5-7 years. As the terminal umbrella project for the commercial refrigeration sector is scheduled for completion by 2003, the last CFC commercial refrigerator units produced in 2003 will be out of service by 2010. By 2010, the CFC demand for servicing commercial refrigerators will no longer exist. This scenario is based on the assumption that there are no reverse retrofits of HFC-134a commercial refrigerators to CFC-12. As the total production of commercial refrigerators was more than 170,000 units a year, the total stock of HFC-134a commercial refrigerators will reach 1.2 million units by 2010. Without any measures to preempt reverse retrofit of HFC-134a commercial refrigerators, the demand for CFC-12 may exceed 100 MT in 2010.

Most service shops repair both domestic and commercial refrigerators as technology and servicing procedures are quite similar. Therefore, it is proposed that implementation of the CFC phaseout strategy in the domestic refrigeration servicing sector should also cover the commercial refrigeration sector as the target group is the same.

Without a proper program to train service technicians on how to properly repair HFC-134a domestic refrigerators and commercial refrigerators, it is likely that a large percentage of this growing stock of HFC-134a units will be charged with CFC-12. Therefore, there is a need to establish a reeducation program for service technicians. Moreover, to ensure that there will be no more demand of CFC-12 from 2010 onwards, the reeducation program should also equip service technicians with the needed skill to carry out retrofits of CFC-12 domestic refrigerators to HFC-134a.

(a) Train-the-Trainer Program

A train-the-trainer program will be developed by international and local experts from domestic and commercial refrigerator manufactures and technical institutes. Training materials will be developed by using, to the extent possible, information already available in the country. All training materials will be prepared in the local language. The content of the training program should include how to properly repair CFC-12 and HFC-134a refrigeration systems, the need for proper labeling of all repaired units, and procedures for retrofitting CFC-12 refrigerators to HFC-134a. The duration of training should not be longer than 5 days.

Once training materials are available, DIW will invite potential training centers and technical institutes, including the training centers of the Ministry of Labor and Social Welfare, to submit a proposal to be "Authorized Training Centers" for this project component. Before submitting proposals, copies of training materials including the overall objectives of this project component will be given to all potential training centers.

Proposals submitted by training centers should provide information related to their staff members to be in charge of the training courses, descriptions of their existing facilities, proposed duration for its service technician training course (it should not be longer than 2 days), and how much they intend to charge service technicians. Based on this information, DIW will select 30 training centers across the country to be their authorized training centers for this project component.

The local experts who assist DIW in developing the training materials will carry out two five-days workshops to train 60 trainers, two from each of the 30 selected training centers. Training will include hand-on sessions. At the end of training, participants will be required to take an examination. Those who pass the examination will receive certificates from DIW. For those who fail they will be required to undertake make-up classes before certificates are given to them. The training centers will not receive basic equipment free of charge until all of their trainers have received certificates from DIW.

After completion of each training course, the authorized training centers are obliged to provide a list of all technicians who have passed their courses along with names and addresses of service shops that they are working with to DIW. A database containing names of certified technicians and names and addresses of service shops, will be developed by DIW.

It is proposed that two sets of basic equipment for training such as pressure gauges, vacuum pumps, refrigerant charging cylinder, leak detectors, and recovery and recycling machines be given to each of the participating training centers. The selected authorized training centers will use these equipment items for training and certifying service technicians for the next four years (2006 – 2009).

Table 6.9. Train-the-Trainer Program in the Refrigeration Servicing Sector

Description	**US $**
Development and Production of Training Materials	15,000
Training of trainers (2 five-days courses, 30 persons for each course) by local experts	5,000
Basic Equipment for 30 Training Centers (2 sets each)*	270,000
Sub-total	290,000
Contingency 10%	29,000
Total	**319,000**

*Based on a standard cost of $4,500.

It will take about 12 months to set up the above infrastructure.

(b) Certification of Service Technicians

There are about 1,300 shops providing services for domestic and commercial refrigerators of which, 300 shops are dedicated for domestic refrigerators only. In addition, the 160 major hotels, those with more than 200 rooms, have their own in-house servicing teams.

To reach out to this target group of more than 1,300 shops, DIW will conduct a public outreach program including articles in newsletters, trade magazines and radios. The objectives of the public outreach program are as follows:

- To inform service shops of the need to phase out CFCs;
- To inform service shops of the future plan of DIW to restrict the sales of CFCs only among those who have been trained on proper handling of CFCs;
- To inform service shops of the future import quotas of CFC-12;
- To provide service shops with information pertaining to how and where to obtain the training;

- To inform service shops of DIW's assistance to provide basic equipment (i.e. vacuum pumps, pressure gauges, and leak detectors) that is required for proper maintenance of HFC-134a refrigeration systems. Assistance in a form of a financial subsidy for the procurement of basic equipment will be given to the service shops at which at least one of their technicians has already received training from one of the authorized training centers.

At the same time, DIW will carry out a local shopping procurement process in order to identify qualified suppliers to provide basic equipment items for this project. Service shops that have at least one of their technicians trained and certified can contact one of the qualified suppliers in order to obtain the basic equipment. Qualified suppliers will ask for copies of training certificates, names of certified technicians, addresses and names of the service shops.

Prior to delivery of the products, qualified suppliers will provide this information to DIW. DIW will review this information against its database in order to verify whether technicians have indeed undergone proper training.

Lists of service shops with certified technicians and with basic equipment for proper maintenance of refrigeration systems will be given to chambers of commerce of respective provinces.

It is proposed that the train-the-trainer program starts in mid 2005, and training for service technicians should start from mid 2006.

4.2. MOBILE AIR-CONDITIONING SERVICING SECTOR

It is estimated that without any reverse retrofit of HFC-134a MAC systems to CFC-12, the current consumption of CFC-12 in the MAC sector for servicing 2.5 million vehicles with CFC-12 MACs, was about 1,760 MT in 2000. It is found that reverse retrofit of HFC-134a MAC systems is becoming a common practice among several taxi companies. To ensure that the CFC demand in the MAC servicing sector will continue to decrease over time as old vehicles are put out of service every year, and no new demand of CFC-12 is being created by reverse retrofit, a strategy addressing vehicle owners, service shops and supply of CFC-12, must be developed.

(a) Mandatory Requirement for MAC Inspection

The Land Transport Department (LTD), which requires that all vehicles more than seven years old must have an engine inspection on an annual basis, will expand its inspection requirements to include MACs. It is proposed that starting from 1 January 2004 all vehicles manufactured after 1 January 1996 will not pass the inspection if it is found that their MACs contain CFC refrigerant. From 2016 no vehicles will pass an inspection if their MACs contain CFC refrigerant. (However, the import of CFC-12 will be prohibited from 1 January 2010.) Failing this required inspection will result in not having vehicle registrations renewed. Vehicle owners should return to MAC shops that provided the last

service to their MAC systems in order to have their MACs filled with the proper refrigerant. In case service shops refuse to fix this problem, vehicle owners should report to DIW. Those service shops and their certified technicians will have names of their shops and certified technicians deleted from DIW's database of certified shops and technicians. The public will be informed of this policy by the end of 2002.

To implement the proposed requirement, the Land Transport Department and independent inspection stations must have capacity to identify different types of refrigerants contained in MAC systems. It is proposed that all independent inspection stations be equipped with refrigerant identifiers. There currently are about 600 independent inspection stations across 23 major cities in Thailand and another 80 inspection stations at Headquarters and provincial offices of the Land Transport Department.

To increase technical capacity of the existing vehicle inspection network, it is proposed that a manual describing procedures for determining the type of refrigerant in MAC systems be developed. All private and government-owned inspection stations will be invited to send their technicians for a half-day training. It is proposed that ten training sessions should be organized: five in the Bangkok Metropolitan Area and another five for other regions in the country. At the conclusion of the training, each participant from certified vehicle inspection stations will be given a refrigerant identifier which can identify CFC-12, HFC-134a, and hydrocarbons.

Independent vehicle inspection stations should follow the new requirement related to MAC systems proposed above. With failure to comply with this new requirement, independent vehicle inspection stations may have their licenses revoked. The Land Transport Department will monitor compliance of these inspection stations through its existing procedures for monitoring performance of the independent vehicle inspection stations.

To carry out this component, it is expected that the cost of development and production of the manual for inspecting MAC systems will be about $10,000. An additional amount of $35,000 is required for organizing ten training sessions for technicians of more than 600 vehicle inspection stations. For refrigerant identifiers, the budget of $1,020,000 (approx. $1,500 per unit, 600 stations + 80 owned by the LTD) will be required.

The Government will also require that all vehicles have a sticker identifying the refrigerant type in the MAC unit and the workshop that last worked on the system. The sticker will also inform the owner that adding CFC-12 to a HFC-134a system is illegal and may harm the vehicle. Requiring all vehicles to have a sticker is a very effective method of educating the public and the technicians about the Government's regulations. Such stickers are common in developed countries. As well as informing customers about legal requirements such stickers usually contain technician information such as type and amount of refrigerant and date last serviced.

Table 6.10. Mandatory Requirement for MAC Inspection

Description	US $
Development of a standard inspection manual	10,000
Development and printing of pamphlet explaining new laws on MAC systems	30,000
Development and printing of LTD approved label for vehicles	30,000
Training of 700 Technicians from all Existing Inspection Stations (10 sessions)	35,000
Refrigerant Identifiers for 680 stations	1,020,000
Sub-total	1,125,000
Contingency 10%	112,500
Total	**1,237,500**

The above measure will start taking effect in 2004 when the first vehicles produced after 1 January 1996 are required to undergo an annual inspection. However, in the meantime, certified independent inspection shops which carry out this annual inspection for the Land Transport Department, will identify refrigerant for all vehicles equipped with MACs that are coming for annual inspection from 2003 onwards. This will help raise awareness of vehicle owners of the types of refrigerants (CFC-12, HFC-134a, or hydrocarbons) which are being put into their MAC systems.

(b) Train-the-Trainer Program

A train-the-trainer program will be jointly developed by international and local experts from major MAC manufacturers and technical institutes. Training materials will be developed on the basis of the training materials being used for the Thailand MAC Recovery and Recycling Project. All training materials will be prepared in the local language. The objectives of this training program are to educate MAC service technicians on how to properly handle CFC-12 and how to properly repair non-ODS MACs. The training course should provide service technicians with knowledge to retrofit CFC MACs to non-ODS alternatives. Service technicians will be trained not to top up refrigerants without fixing leaks, and the need for proper labeling of all repaired units. They will also be informed of the potential commercial viability of the use of recovery and recycling machines. The duration of training should not be longer than five days.

Once training materials (code of good practice) are available, DIW will invite potential training centers and technical institutes, including the training centers of the Ministry of Labor and Social Welfare, to submit proposals for having their institutes become authorized training centers for this project component. Before submitting proposals,

copies of training materials including the overall objectives of the project will be given to all potential training centers.

Proposals submitted by training centers should provide information regarding their staff members to be in charge of the training courses, descriptions of their existing facilities, proposed duration for its service technician training session (it should not be longer than 2 days), and how much they intend to charge service technicians. Based on this information, DIW will select 30 training centers across the country to be their authorized training centers.

These training centers are obliged to provide DIW with a list of all technicians who have passed their course along with names and addresses of service shops that they are working with. A database containing names of certified/trained technicians and names and addresses of service shops, will be developed by DIW.

It is proposed that two sets of basic equipment for training such a, pressure gauges, vacuum pumps, leak detectors, and recovery and recycling machines be given to each authorized training center. The selected authorized training centers will use these equipment items for training and certifying service technicians for the next four years (2003 – 2006).

The expert teams that assist DIW in developing the training materials will carry out two five-days workshops to train trainers from the 30 selected training centers. Training will include hands-on sessions. At the end of training, participants will be required to take an examination. Those who pass the examination will receive certificates from DIW. For those who fail they will be required to undertake make-up classes before certificates be given to them. Training centers will not receive a set of basic equipment, mentioned above, free of charge until all of their trainers have received certificates from DIW.

Table 6.11. Train-the-Trainer Program in the MAC Servicing Sector

Description	**US $**
Development and Production of Training Materials	15,000
Training of trainers (2 five-days courses, 30 persons for each course) by local experts	5,000
Basic Equipment for 30 Training Centers (2 sets each)*	270,000
Sub-total	290,000
Contingency 10%	29,000
Total	**319,000**

*Based on a standard cost of $4,500.

Work on this project will begin immediately after funds are allocated. It will take about 12 months to set up this infrastructure.

(c) Certification of Service Technicians

There are about 2,750 MAC service shops throughout the country of which, about 1,750 shops are located in the Bangkok Metropolitan area. To reach out to this target group of more than 2,750 shops, DIW will conduct a public outreach program including articles in newsletters, trade magazines and radios. The objectives of the public outreach program are as follows:

- To inform service shops of the need to phase out CFCs;
- To inform service shops of the future plan of DIW to restrict the sales of CFCs only among those who have been trained on proper handling of CFCs and CFC MACs;
- To inform service shops of the proposed requirement from the Land Transport Department;
- To provide service shops with information pertaining to how and where to obtain the training;
- To inform service shops of DIW's assistance to provide basic equipment (i.e., vacuum pumps, pressure gauges, and refrigerant identifiers) that is required for proper maintenance of non-ODS MACs. Assistance in a form of a financial subsidy for the procurement of basic equipment will be given to the service shops at which at least one of their technicians has already received training from one of the authorized training centers. This financial subsidy will be offered to service shops through qualified equipment suppliers.

At the same time, DIW will carry out a local shopping procurement process in order to identify qualified suppliers to provide basic equipment items for this project component. Service shops that have at least one of their technicians trained and certified can contact one of the qualified suppliers in order to obtain the basic equipment. Qualified suppliers will ask for copies of training certificates, names of certified/trained technicians, addresses and names of service shops.

Prior to delivery of the products, qualified suppliers will provide this information to DIW. DIW will review this information against its database in order to verify whether technicians have indeed undergone proper training.

Lists of MAC service shops with certified technicians that are equipped with basic equipment for proper maintenance of MAC systems, will be given to chambers of commerce of respective provinces. Unscheduled visits will be made by DIW to service shops in this area to ensure that certified technicians are still working there and that they are practicing the code of good practice trained by the above certified training centers.

The code of good practice should require that service shops attach a label to each of the MAC systems they repair. The label should contain information pertaining to refrigerant type and names of service technicians and service shops.

It is proposed that the train-the-trainer program starts in 2002, and training of service technicians on proper maintenance of MAC systems (code of good practice) as well as distribution of basic equipment should start from 2003. Service shops associated with major auto manufacturers will be urged by DIW to have their technicians trained and start employing the code of good practice in their service work by mid-2003.

4.3. FINANCIAL SUBSIDY FOR FINANCING PROCUREMENT OF REFRIGERATION AND MAC MAINTENANCE TOOLS

To ensure that trained service technicians strictly follow the code of good practice when servicing refrigeration and MAC systems, it is important that financial assistance to enable service shops to purchase necessary equipment be provided to them. Various financial assistance options, including full grants, partial grants, and concessional loans, have been considered.

While the concessional loan option was considered by the Thai Government as the most cost-effective option, it is uncertain as to whether this option will be practical for this sector. Due to a large number of transactions and the small size of each loan, transaction costs are expected to be very high. High transaction costs make this option unattractive. It was agreed that a partial grant approach should be used.

The partial grant option is selected as it will incur less transaction costs. In addition, by requiring service shops to pay part of equipment costs, it will ensure that equipment will be given to only those service shops that really need it.

For determining the funding level to be requested from the Multilateral Fund and the level of subsidy for the partial grant option, the concessional loan option will be used. Based on the funding level determined by this approach, a level of subsidy based on a partial grant option will be determined. The level of subsidy for the partial grant option should ensure that the available funds will be sufficient to provide the same number of maintenance tools to service shops for both the MAC and refrigeration servicing sectors. Funding of the two sectors will be done in a phased approach, whereby the most important sector, in terms of ODP impact, will be addressed first.

(a) <u>MAC Servicing Sector</u>

As the CFC consumption in the MAC servicing sector is approximately 1,760 ODP tons, the phaseout of CFC consumption in this sector will have a direct impact on Thailand's ability to meet its 50% and 85% reduction targets in 2005 and 2007. As mentioned previously, the total CFC consumption in the domestic and commercial refrigerator servicing sectors is approximately 100 ODP tons. The phaseout of this consumption may not have significant impact to the country's ability to meet its 50% and 85% reduction targets. However, the phaseout of this consumption is needed for Thailand to meet its 100% phaseout in 2010. It is agreed that phaseout activities in the MAC servicing sector should get a higher priority.

To determine the funding level for this project component, let assume that a grant funding of $4.1 million be used for establishing a revolving fund to finance CFC phaseout in the MAC servicing sector. This fund would be lent out to qualified equipment suppliers with no interest. The qualified equipment suppliers/borrowers will then provide credits to service shops to buy a basic set of tools that are necessary for properly repair non-ODS MACs.

To start the process, at the beginning of 2003, the total credit line of $4.1 million will be distributed among all qualified suppliers based on their financial capacity and market shares. While the term of credit to be given to service shops should be no longer than 24 months, suppliers are required to settle their accounts in full by the end of 2004. During the loan settlement, suppliers can claim for a loan forgiveness rate of up to 30% (which is the average rate of non-performing loans in Thailand). To reinvest the remaining funds, credit lines will be redistributed to suppliers. The level of the credit lines will depend on suppliers' past performance. Priority will be given to suppliers that sell more equipment to service shops in the previous round and to those that request a lower loan forgiveness rate. By the end of 2006, all suppliers are required again to resettle their accounts. The remaining funds at the end of 2006 after discounting the loans forgiven rate of up to 30% will then be used for financing the procurement of basic tools for repair CFC-12 and non-CFC refrigeration systems.

Table 6.12. Cash-flow for the Revolving Fund for Purchasing MAC Service Tool Kits

Period	Begin Balance of the Revolving Fund	Ending Balance of the Revolving Fund	Number of Service Tool Kits Purchased*
2003 – 2004	$4,100,000	$2,870,000	1,640
2005 - 2006	$2,870,000	$2,009,000	1,148
Total			2,788

*Based on an estimate cost of $2,500 per set.

According to this model, by the end of 2006 there will be approximately $2 million available in the revolving fund. This resource will be reused for financing procurement of maintenance tools for service shops in the domestic and commercial refrigeration servicing sector.

(b) Refrigeration Servicing Sector

It is estimated that a grant funding of $2 million will be required for financing CFC phaseout in the refrigeration servicing sector.

A similar concessional loan model is used for determining the level of funding required by this project component. Let assume that the available resource of $2 million be invested in the refrigeration servicing sector starting from 2007. This fund will be lent out to qualified equipment suppliers with no interest. The qualified equipment

suppliers/borrowers will then provide credits to service shops to buy a basic set of tools that are necessary for proper repair of CFC-12 and non-CFC refrigerators.

To start the process, at the beginning of 2007 the total credit line of $2 million will be distributed among all qualified suppliers based on their financial capacity and market shares. The term of credit to be given to service shops should be no longer than 24 months, and suppliers are required to settle their accounts in full by the end of 2008. During the loan settlement, suppliers can claim for a loan forgiveness rate of up to 30%. To reinvest the remaining funds, credit lines will be redistributed to suppliers. The level of the credit lines will depend on suppliers' past performance. Priority will be given to suppliers that sell more equipment to service shops in the previous round and to those that request a lower loan forgiveness rate. By the end of 2010, all suppliers are required again to resettle their accounts.

Based on this scheme, it is anticipated by 2010 at the latest, all service shops will have basic equipment to maintain non-CFC refrigerators. Lack of capacity will no longer be a factor driving service shops to reverse retrofit refrigerators that come in for repair. This also sets up an infrastructure to support retrofits of the remaining CFC domestic and commercial refrigerators in order to avoid early retirement of a large number of domestic refrigerators.

Table 6.13. Cash-flow for the Revolving Fund for Purchasing Refrigeration Service Tool Kits

Period	Begin Balance of the Revolving Fund	Ending Balance of the Revolving Fund	Number of Service Tool Kits Purchased*
2007 - 2008	$2,009,000	$1,406,300	803
2009 - 2010	$1,406,300	$984,410	562
Total			1,365

*Based on an estimate cost of $2,500 per set.

In addition to the high transaction costs, another constraint of this model is timing for delivering these service tool kits to all service shops. To ensure that expected repayments are collected at certain dates, it is important that the purchase of service tool kits must be done in one batch at the beginning of each lending cycle. For example, with the lending term of 24 months, all 800 refrigeration service tool kits must be purchased at the beginning of 2007 in order to have the ending balance of the revolving fund equals to $1.4 million at the end of 2008. In reality, the purchase of the service tool kits will probably span over a longer period.

It is, therefore, proposed that a funding request of $4.1 million should be made to the Multilateral Fund. The $4.1 million will then be given to 2,750 MAC and 1,300 refrigeration service shops. Funding to be provided by the Multilateral Fund will cover part of the costs of the equipment. In average, the level of subsidy will be approximately 40% of the equipment cost. It is also proposed that flexibility should be given to the

country to work out in details the actual subsidy scheme. Thailand may consider to employ a sliding-scale on the level of subsidy. That is, to attract participation of service shops at the beginning of the program a higher level of subsidy (more than 40%) can be offered to service shops. However, the level of subsidy will decrease for those shops that decide to join the program at a later date. The following is the financial plan to support this partial grant option.

To be qualified for a subsidy from this plan, service technicians must undergo training at the authorized training centers as mentioned in Sector 4.2.(c). Vouchers for purchasing service tools will be given to all certified service technicians. Values of the vouchers will be determined by DIW. Service technicians can use these vouchers to pay for part of the costs of the service tools at any qualified suppliers agreed by DIW. The balance will have to be paid by technicians' own funds. After delivery of the service tools, qualified suppliers will submit vouchers to the financial intermediary to be appointed by DIW in order to get their reimbursement.

Table 6.14. Financial Plan for Purchasing Refrigeration and MAC Service Tool Kits

	2003	2004	2005	2006	2007	2008	2009	Sub-total
Resource Allocation	900,000	800,000	700,000	350,000	500,000	500,000	350,000	4,100,000
Contingency (10%)	90,000	80,000	70,000	35,000	50,000	50,000	35,000	410,000
Total	990,000	880,000	770,000	385,000	550,000	550,000	385,000	4,510,000

4.4. FINANCIAL SUBSIDY FOR FINANCING PROCUREMENT OF 635 R&R MACHINES

A similar approach described in Section 4.3 will be used for determining the level of funding for supporting the procurement of 635 recovery and recycling machines for the MAC servicing sector.

To start the process, at the beginning of 2003, the total credit line of $748,000 will be distributed among all qualified suppliers based on their financial capacity and market shares. The term of credit to be given to service shops should be no longer than 24 months. Suppliers are required to settle their account in full by the end of 2004. During the loan settlement, suppliers can claim for a loan forgiveness rate of up to 30%.

To reinvest the remaining funds, credit lines will be redistributed to suppliers. The level of the credit lines will depend on suppliers' past performance. Priority will be given to suppliers that sell more equipment to service shops in the previous round and to those that request a lower loan forgiveness rate. By the end of 2006, all suppliers are required to resettle their accounts and no reinvestment will be undertaken.

Table 6.15. Financial Plan for Purchasing Approximately 635 MAC R&R Machines

Period	Begin Balance of the Revolving Fund	Ending Balance of the Revolving Fund	Number of R&R Machines Purchased
2003 – 2004	$748,000	$523,600	374
2004 – 2006	$523,600	$366,520	261
Total			635

It is proposed that a funding request of $748,000 should be made to the Multilateral Fund. The $748,000 will then be used for supporting the purchase of 635 MAC recovery and recycling machines on a partial grant basis. In average, the level of subsidy will be approximately 60% of the equipment cost. It is also proposed that flexibility should be given to the country to work out in details the actual subsidy scheme. Thailand may consider to employ a sliding-scale on the level of subsidy. That is, to attract participation of service shops at the beginning of the program a higher level of subsidy (more than 60%) can be offered to service shops. However, the level of subsidy will decrease for those shops that decide to join the program at a later date. The following is the financial plan to support this partial grant option.

Table 6.16. Financial Plan for Purchasing 635 MAC R&R Machines

	2003	2004	2005	2006	Sub-total
Resource Allocation	254,000	214,000	164,000	116,000	748,000
Contingency (10%)	25,400	21,400	16,400	11,600	74,800
Total	279,400	235,400	180,400	127,600	822,800

4.5. COLD STORE AND LARGE REFRIGERATION SYSTEMS

The Thai Refrigeration Association reported that the use of CFC-12 and R-502 is very small and limited to servicing old refrigeration units. Based on information provided by its members, combined consumption of these two refrigerants in 1999 was only a few tons. Due to awareness of the ozone issue and the need to phase out the use of CFCs, all members of the Thai Refrigeration Association have switched to HCFC-22, HFC-134a and HFC-404A since early 1990s. Since the life expectancy of these systems is about 20 years, by 2010 all CFC cold storage and large refrigeration systems will be retired.

Therefore, the Government's policy for this sub-sector is to allow the import of a small quantity of R-502 for servicing the remaining units until 2009.

It was concluded that no intervention is required for this particular sector.

4.6. REFRIGERATED TRUCKS AND CONTAINERS

For refrigerated trucks, it has been confirmed that there is no new installation of any CFC-12 and R-502 refrigeration systems on pick-up trucks and 10-wheel trucks. The use of CFC-12 and R-502 is limited to servicing of old units. Combined consumption of these two refrigerants in 2000 was less than 1 MT.

There are four major contractors that provide services for refrigerated containers. These are S&T ConTemp, Container Care, Container Network, and CTS. The combined CFC-12 consumption of these four contractors was about 25 MT in 2000.

As all CFC-12 refrigerated containers are older than 10 years, it is anticipated that by 2010 the demand for CFC-12 in this sector will disappear. It is reported that no reverse retrofit takes place in this sector as almost all containers are owned by multinational shipping industry.

It is, therefore, concluded that no intervention is required for this sector.

4.7. CHILLERS

At present, the chiller sector requires about 145 MT of CFC-11 and CFC-12 for servicing. By 2010, approximately 469 chillers will be more than 25 years old and may all be retired. Therefore, the requirement for CFC-11 and CFC-12 in this sector will decrease to about 96 MT per year.

The Government's strategy is to have 470 CFC chillers (1/3 of the existing stock) replaced by 2010. Not later than 2004, the evaluation of the pilot chiller replacement project which is jointly funded by MLF and GEF will be available. With a successful pilot project, the Government will allocate an additional $30 million to set up a revolving fund to replace additional chillers to achieve the above target. With this program, the demand for CFCs for this sector will decrease to 51 MT per year. With proper recovery and recycling practices, replacement and retirement of 948 CFC chillers will render a stock of refrigerants of 470 MT. This amount of CFC will be sufficient to meet the needs of the chiller sector for almost 10 years. By that time, most CFC chillers will end their useful life. Therefore, the economic burden will be very minimum.

To ensure that suppliers and contractors take proper measures to recover and recycle CFCs when they replace old CFC chillers with new non-CFC units, DIW and the chiller industry in Thailand have already established a code of good practice whereby recovery and recycling of CFC refrigerants is mandatory. Only contractors and suppliers that implement this code of good practice are allowed to participate in the pilot chiller replacement project. DIW will also ensure that when implementing a larger scale project (replacement of additional 450 chillers), this similar requirement will be imposed on contractors and suppliers.

It is, therefore, concluded that no additional intervention from the MLF is required.

4.8. CAPACITY BUILDING AND TECHNICAL ASSISTANCE ACTIVITIES

In addition to technical assistance activities that are sector-specific, it is proposed that two additional capacity building and technical assistance activities be included in the national strategy. These are:

- Project Implementation and Monitoring Activity;
- Customs Training.

(a) Project Implementation and Monitoring Activity

The national CFC phaseout plan entails CFC phaseout activities in the manufacturing sector, implementation of safety measures in the garment industry, and training of a large number of small- and medium-scale service shops. In total, this overall plan will involve CFC phaseout activities in more than 5,000 private enterprises, in addition to a series of activities to establish a policy and regulatory framework to support sustainable CFC phaseout.

Implementation of this proposed plan will involve a significant amount of administrative work to facilitate the development of the policy and regulatory framework, database of CFC users, public awareness activities, and other activities. Implementation of this plan requires a project implementation and monitoring unit with full-time staff.

The following activities, but not limited to, will be managed or carried out by the Project Implementation and Monitoring Unit:

Regulations

The project management team will assist the NOU to undertake the following:

- Issue a ministerial order banning the use of CFC in the production of aerosol products from 2005 onwards. This includes products that use CFCs as propellants or as an ingredient;
- Include aerosol products containing CFCs and 1,1,1-TCA in the list of restricted products whose imports require review and approvals from DIW, from 2005 onwards;
- Issue a ministerial order banning the use of CFC-113 in the manufacturing sector from 2005 onwards;
- Impose a legal requirement for importers of CFC-113 to provide names of their clients and end uses;
- Issue a ministerial order prohibiting the use of 1,1,1-TCA in the manufacturing sector from 2005 onwards, except 1,1,1-TCA used for metal cleaning and production of mold releasing agents;
- Issue a ministerial order prohibiting the use of CFC-11 in the foam production from 2005 onwards;

- Attach a condition prohibiting the sales of CFC-11 for the use as a blowing agent, to all import licenses issued from 2005 onwards;
- Issue a ministerial order banning the use of CFC-11 in the production of pre-mixed CFC-11 polyol;
- Include pre-mixed CFC-11 polyol in the list of restricted products whose imports require review and approvals of DIW, from 2005 onwards;
- Propose to include MAC inspection as part of the annual vehicle inspection requirement of the Land Transport Department;
- Propose to the Land Transport Department that from 1 January 2004 any vehicles manufactured after 1 January 1996 will not have their registrations renewed if CFC is found in the MAC systems;
- Propose to the Land Transport Department that from 1 January 2016 any vehicles that have CFC in their MAC systems will not have their registrations renewed;
- Issue a revised schedule for import quotas for each chemical in Annex A, Group I of the Montreal Protocol for 2002 – 2010.

Project Implementation

The project management team will undertake the following activities under supervision of the NOU:

- Prepare standard implementation procedures for eligible enterprises that would like to seek funding from the resources provided by the Multilateral Fund;
- Assist eligible CFC consuming enterprises prepare proposals to obtain financial support from the funds provided by the Multilateral Fund to phase out their use of CFCs;
- Arrange technical support, on a need basis, to assist enterprises to identify appropriate non-ODS technology;
- Review and approve proposals submitted by eligible enterprises;
- Coordinate the establishment of the networks of authorized training centers for the refrigeration and MAC servicing sectors;
- Facilitate the selection of qualified suppliers to supply tools and equipment for MAC and refrigeration servicing sectors to service shops;
- Provide DIW with recommendations on the level of subsidy for MAC and refrigeration servicing tools and R&R machines;
- Develop and maintain a database of refrigeration and MAC certified technicians including names and addresses of service shops that already have their technicians trained;
- Assist the Land Transport Department to train their independent vehicle inspection stations to identify various refrigerant types in the MAC systems;
- Provide advice and recommendation on the allocation of annual import quotas of all Annex A, Group I, chemicals to DIW;
- Prepare an annual progress report of the overall implementation of the national CFC phaseout plan in accordance with any ExCom procedures for this task;

Public Awareness

The project management team will undertake the following tasks under supervision of the NOU:

- Disseminate information related to the Government's policy to phase out CFCs in the manufacturing sector in 2005;
- Inform the industry of the availability of funds provided by the Multilateral Fund to support CFC phaseout in Thailand;
- Raise public awareness of the environmental and economic impact of ozone layer depletion to the public via newsletters, news articles, seminars, radio spots;
- Organize a promotional program to encourage the public to have their refrigeration and MAC systems repaired by certified technicians;
- Undertake the public outreach programs for the refrigeration and MAC servicing sectors as described in the previous sections.

Monitoring

The project management team will assist NOU to carry out the following tasks:

- Establish a foam task force to monitor distribution of CFCs and HCFC-141b in the foam sector;
- Set up a web site with a list of importers, their annual quotas, and the actual amount already imported within the current calendar year;
- Update the information on the actual amount of imported CFCs with the Custom Department on a quarterly basis;
- Monitor import of HFC-134a, HCFC-22, and HCFC-141b;
- Inspect warehouse of CFCs, HCFCs, and HFC-134a importers;
- Report any incidents of illegal import of CFCs;
- Carry out safety and technical audits of all projects undertaken under this plan.

Table 6.17. Project Implementation and Monitoring Unit (2002 – 2006)*

Description	**US $**
Regulatory and Policy Support	50,000
Project Implementation and Management (including expert's fees)	450,000
Public Awareness	600,000
Monitoring Activities	300,000
Sub-total	1,400,000
Contingency 10%	140,000
Total	**1,540,000**

*After 2006, remaining tasks will be carried out by the Ozone Protection Unit

(b) Customs Training Program

To strengthen the effectiveness of the import control systems for CFCs, it is proposed that a train-the-trainer program be provided to the Customs Training School of the Custom Department. A training program should focus on the issue of ozone layer depletion, countries' obligations under the Montreal Protocol, the Government's policy on CFC phaseout and all the relevant legislation, techniques to identify the types of refrigerants, the regional and global distribution networks of CFCs, current requirements of DIW pertaining to import licenses.

A training program will be developed jointly by local and international experts, particularly those that are familiar with illegal trafficking of CFCs. Training materials will be developed in 2003 and the actual training will follow in 2004. The first two trainings will be carried out by both national and international experts. For subsequent training sessions, training will be conducted by trainers from the Customs Department and experts from DIW. This training course will, then, be included as part of the curriculum of the institute.

As well as the provision of training, it will be important to provide portable CFC detection equipment. It is envisaged that field officers will use hand held equipment and, where there is doubt about the legitimacy of a refrigerant the Customs will send samples to a central laboratory for testing. The training providers should also assist with the development of policies for sampling of all shipments of refrigerant gases as it can be dangerous working with pressure vessels and gases under pressure.

To strengthen the enforcement capacity of the custom officials, it is proposed that two refrigerant identifiers be given to each of the 29 major port/entry points across the country and the training institute of the Custom Department. It is also important to ensure that there is at least one laboratory in Thailand that can carry out a legally valid test to determine what any gas suspected might be. This testing can be done by most analytical testing laboratories. It will not be necessary to establish a dedicated facility. There may be some costs to establish calibrations for testing equipment at an existing laboratory. These are estimated at US$10,000.

Estimated costs for initial "train the trainers" workshops, development of training course and sampling procedures are US$50,000. In addition, each port/entry point will require a hand held testing device that can distinguish between various refrigerant types. Each of the 29 major port/entry points across the country and the training institute of the Custom Department will be allocated two detection devices which are estimated to cost around $US1,500 each.

Table 6.18. Custom Training Program

Description	US $
Development of Training Course and Sampling Procedures	20,000
International Expert (Fees, Travel, Per Diem)	20,000

National Expert	10,000
Refrigerant Identifiers (2x30x$1,500)	90,000
Calibrations for Testing Equipment at an Existing Laboratory	10,000
Sub-total	150,000
Contingency 10%	15,000
Total	**165,000**

CHAPTER 7

JUSTIFICATION FOR SELECTION OF ALTERNATIVE TECHNOLOGY

1. AEROSOLS

The following alternatives will be considered under this Plan:

Hydrocarbon aerosol propellants have been the principal alternatives to CFC-12 and CFC-11/12 blends employed worldwide. They are approved by the 1996 UNEP Technical Options Report on Aerosols Sterilants and Miscellaneous Uses and Carbon Tetrachloride. At this time they are the major acceptable alternate for substituting CFCs as aerosol propellants.

Aerosol grade hydrocarbon propellant (HAPs) is not available in Thailand, but the LPG that is available can be cleaned with molecular sieves for use with most products if a gas is available to lower the pressure.

Dimethyl ether (DME) is a liquefied gas propellant. The advantages of DME include high solvency and ease of reformulation to water-based products. Environmental, health, and safety disadvantages include its flammability, which requires the retrofit or redesign of filling lines and storage facilities, and the fact that it is a volatile organic compound (VOC). DME corrodes tinplate and aluminum cans if water is also present and therefore requires the addition of special corrosion inhibitors. In addition, DME may dissolve can linings. Finally, the use of DME as a propellant requires the sue of butyl rubber or neoprene valve gaskets.

While DME propellant formulations may present a lower potential for fire hazards to workers and fire fighters than do hydrocarbon formulations, the flammability of the total aerosol product must be considered. Therefore, the same fire safety and explosion prevention precautions should be taken in DME filling and storing operations as with hydrocarbon aerosol propellants. In addition, retrofitting or redesign of filling lines and storage facilities will be necessary.

2. FOAM

The presently available ODS phaseout technologies for *rigid polyurethane insulating foams* are:

CLASSIFICATION	LIQUID TECHNOLOGY	GAS TECHNOLOGY
LOW ODP TECHNOLOGIES ("INTERIM")	HCFC-141b HCFC-141b/22	HCFC-22, -142b HCFC-22/142b
NON-ODS TECHNOLOGIES ("PERMANENT")	(CYCLO)PENTANE, WATER, HFC-365, HFC-245fa	HFC-134a

The selection of the alternative technology is governed by the following considerations:

a) Proven and reasonably mature technology
b) Cost effective conversion
c) Local availability of substitute, at acceptable pricing
d) Support from the local systems suppliers
e) Critical properties to be maintained in the end product
f) Meeting established standards on environment and safety

The following is a discussion of the mentioned technologies:

HCFC-141b has an ODP of 0.11. Its application is proven, mature, relatively cost-effective and systems that fit the enterprise's applications are locally available. HCFC-141b can, however, be destabilizing in higher concentrations, being a strong solvent, which would lead to the need to increase the foam density. Being an interim option, its application would only be recommended if permanent options do not provide acceptable solutions.

HCFC-22 has an ODP of 0.05 and is under ambient conditions a gas. It is not offered in the applicable regional area as a premixed system and would require an on-site premixer. It is not suitable for spray foam/slabstock applications. Its insulation value is somewhat less than with HCFC-141b.

HCFC-141b/HCFC-22 blends can reduce the solvent effect of HCFC-141b alone and therefore allow lower densities while maintaining acceptable insulation values. The blends are, however, not available in Thailand or neighboring countries. On-site blending would significantly increase the one-time project costs. In addition, the technology is not proven for spray foam applications. Being an interim option, the same restrictions as for HCFC-141b would apply.

(CYCLO-)PENTANE meets all selection criteria, except that of local availability. The use of hydrocarbons is a preferred solution when feasible from a safety and cost effectiveness standpoint. The relatively high investments for safety costs tend to limit pentane use to relatively large CFC users. In addition, the use of pentane is limited to those enterprises whose facilities can be adapted to meet safety requirements, and can be relied on to maintain safe operations. While it may be applicable—albeit connected with high investments and density limitations—for the slabstock operation, it cannot be used—and never has been used—for (on-site) spray foam applications, where ever-changing ambient conditions never could provide for the required safety.

WATER-BASED systems are an alternative in cases where pentane is not feasible due to safety concerns, cost efficiency or availability. Water-based systems are, however, more expensive (up to 50%) than other CFC-free technologies due to reductions in insulation value (requiring larger thickness) and lower cell stability (requiring higher densities). They are also currently not available in the regional area. Water-based formulations tend to be most applicable in relatively less critical applications, such as in situ foams and thermoware. In sprayfoam, while in principle feasible, it is reported that the current

technology does not allow for overhead spraying and is therefore limited. For boxfoam, the technology is not applicable as it would lead to an unacceptably high increase in the reaction temperature, leading to severe scorching and even spontaneous combustion.

LIQUID HFCs do not meet requirements on maturity and availability. However, trials show that systems based on these permanent options would be feasible in sprayfoam as well as slabstock.

HFC-134a is under ambient conditions a gas. It is not offered in the applicable regional area as a premixed system and would require an on-site premixer. It is not suitable for sprayfoam applications. It is also less energy efficient, and expensive compared to most other technologies.

The following technologies have been considered for the *flexible polyurethane foam* conversion:

The use of methylene chloride has been for long the standard replacement technology for the use of CFCs in flexible PU slabstock/box foam. Its use has been only limited by regulatory restrictions based on its perceived toxic character and processing problems when used in large amounts.

Recently more regulatory restrictions have emerged on the emissions of MC as well as on allowable workplace concentrations, leading to active searches for replacements. In slabstock, the emergence of liquid carbon dioxide (LCD) is quickly replacing any residual CFC use as well as MC in most developing countries. This technology does not yet apply to boxfoam, where the recent introduction of low index/additive (LIA) technology shows some promise for, at least a partial, replacement of CFCs/methylene chloride.

Enterprises will be informed by the sector expert of the available technical options. If methylene chloride is selected as an alternative technology, enterprises will be required to implement necessary safety measures to ensure occupational health safety of workers.

The following technologies have been considered for the *integral skin foam* conversion:

Accepted ODS phaseout technologies for integral skin molded foam are:

CLASSIFICATION	**TECHNOLOGY**
LOW ODP TECHNOLOGIES ("INTERIM")	HCFC-141b, HCFC-22
ODS-FREE TECHNOLOGIES ("PERMANENT")	PENTANE, ALL WATER BLOWN, HFC-134a, HFC245fa

The selection of the alternative technology would be governed by the following consideration:

a) Proven and reasonably mature technology;
b) Cost effective conversion;
c) Local availability of substitute, at acceptable pricing;
d) Support from the local systems suppliers;
e) Critical properties to be maintained in the end product;
f) Meeting established standards on environment and safety.

HCFC-22 and HCFC-141b are interim solutions, and as such are regarded as intermediate steps to a final solution. Companies may use HCFC-141b, where necessary, as an interim since it is commercially available and reasonably priced.

In the permanent solutions, pentane is a technologically feasible alternative, but would require extensive and costly safety modifications to implement. The use of pentane, in the case, would be prohibitive from the safety cost standpoint. Gaseous HFC's are used in the United States extensively for shoe soles and steering wheels. Economically, water-blown foams are a more attractive option than systems employing either HCFCs or HFCs, even though water-blown is more costly than CFC-11 blown foams. In addition, carbon dioxide, the resulting blowing agent from the water-blown technology, has no ODP, making water blown the most favorable final solution.

It should be noted that in some individual cases, methylene chloride has been utilized as an effective solution, but due to processing concerns, it cannot be seen as an overall permanent solution.

3. SOLVENT

Selection of alternatives for solvent cleaning applications will be determined during the implementation of the National CFC Phaseout Plan. The report of the Solvents, Coatings, and Adhesives Technical Options Committee will be used as a guidance for selecting alternatives. All proposed alternative technologies will be reviewed by the OORG experts before any project activities in this sector can proceed. This is to ensure that all environmental, health, and safety requirements are adequately addressed.

4. GOVERNMENT'S STATEMENT ON THE USE OF HCFCS AS INTERIM SOLUTIONS

Thailand is fully aware of the ExCom requirements pertaining to the use of HCFC. The National Ozone Unit will review the use of HCFC during the implementation of this national CFC phaseout plan. Thailand has a preference for non-ODS substances and will enforce the general policy when possible.

CHAPTER 8

COSTS OF NATIONAL CFC PHASEOUT PLAN

Activities	No. of Enterprises	ODP tons	Total Costs US$	Requested Amount US$
CFC phaseout in the aerosol manufacturers	3	30	128,700[1]	102,960
Technical Assistance Component for the MDI sector			57,200	57,200
CFC-113 phaseout in the solvent cleaning process	4	51.2	965,120	965,120
1,1,1-TCA phaseout in the garment industry and shoe sole industry	1,425	29	710,000	710,000
Technical Assistance for phaseout CFC-113 use as contact cleaners	2	16	23,100	23,100
Technical Assistance for the Garment Development Institute	1,424		166,100	166,100
CFC phaseout in the foam sector • Rigid PU foam • Flexible PU foam • Integral skin foam Total	 80 6 3	 421.84 172.50 5.26	 4,744,246[2]	 3,229,252 677,175 78,740 3,985,167
Train-the-Trainer Program in the Refrigeration Servicing Sector (2 persons each from 30 centers)	30		319,000	319,000
Certification of Refrigeration Service Technicians (1,300 shops * 2 technicians/shop * $50 per person)			130,000	
Financial Subsidy for Purchasing Refrigeration Servicing Equipment	1,300	118	3,712,500[3]	1,485,000
Mandatory Requirement for MAC Inspection	680		1,237,500	1,237,500
Train-the-Trainer Program in the MAC Servicing Sector (2 persons each from 30 centers)	30		319,000	319,000
Certification of MAC Service Technicians (2,750 shops * 2 technicians/shop * $50 per person)			275,000	

[1] In average funding provided to previously approved aerosol projects was 80% of the total costs of conversion.
[2] In average funding provided to previously approved foam projects was 84% of the total costs of conversion.
[3] Level of subsidy requested from the MLF is 40% of the total costs.

Financial Subsidy for Purchasing MAC Servicing Equipment	2,750	1,547	7,562,500[4]	3,025,000
Financial Subsidy for Purchasing MAC R&R Machines	635	228	1,371,300[5]	822,800
Project Implementation and Monitoring Unit	1		1,540,000	1,540,000
Custom Training Program	30		165,000	165,000
Total	8,403	2,619	**23,426,266[6]**	**14,922,947**

[4] Level of subsidy requested from the MLF is 40% of the total costs.
[5] Level of subsidy requested from the MLF is 60% of the total costs.
[6] Not including any costs related to early retirement of existing CFC refrigerators and MACs.

CHAPTER 9

NATIONAL CFC PHASEOUT SCHEDULE FOR THAILAND

The Government of Thailand will announce an import schedule for Annex A, Group I, chemicals for 2002 – 2010 within 12 months after funding for this national CFC phaseout plan has been approved by the ExCom. No import licenses will be given to new importers. The proposed annual quota will be distributed among existing importers (the full list of importers that are currently imported CFCs to Thailand is included in Annex I).

Table 9.1. Import Quota for Annex A, Group I Chemicals

Import Quota	**2002**	**2003**	**2004**	**2005**	**2006**
Annex A, Group I (ODP tons) or	3,066	2,777	2,291	1,364	1,121
Annex A, Group I (MT tons)	3,084	2,795	2,310	1,365	1,122

Import Quota	**2007**	**2008**	**2009**	**2010**	**2011**
Annex A, Group I (ODP tons) or	912	704	496	0	0
Annex A, Group I (MT tons)	913	705	498	0	0

Table 9.2. Import Quota for Annex B, Group III Chemicals

Import Quota	**2002**	**2003**	**2004**	**2005**	**2006**
Annex B, Group III (ODP tons) or	34	34	34	4	4
Annex B, Group III (MT tons)	335	335	335	39	39

Import Quota	**2007**	**2008**	**2009**	**2010**	**2011**
Annex B, Group III (ODP tons) or	4	4	4	4	4
Annex B, Group III (MT tons)	39	39	39	39	39

CHAPTER 10

IMPLEMENTATION AND MONITORING

1. INTRODUCTION

The national CFC phaseout plan employs a phaseout strategy based on a combination of policy and regulatory support, investment and non-investment activities, including public awareness and other supporting measures. Instead of a traditional approach where enterprises are identified and individual projects prepared for each individual enterprise, the national CFC phaseout plan requires enterprises to be proactive and apply for funds based on rules and guidelines established as part of this program, consistent with MLF funding principles.

To attain proactive participation from the industry, the national CFC phaseout plan proposes to utilize various incentive structures, including financial and regulatory incentives. These incentive structures are designed with the aim of ensuring permanent and sustainable reduction of CFC phaseout. In addition, public awareness activities are also built into this national CFC phaseout plan to ensure that the whole industry is fully informed about the phaseout plan, the short-term and long-term implications of the global CFC phaseout efforts, and the possibility for obtaining funding to cover part of the phaseout costs.

The national CFC phaseout plan covers a number of sectors and sub-sectors with different profiles. Phaseout approaches are sector and sub-sector specific. The national implementation modality for the different sectors and sub-sectors has been agreed by DIW and the relevant industry sectors. The national CFC phaseout plan also sets specific milestones to be achieved before MLF funds can be provided to Thailand.

2. NATIONAL IMPLEMENTATION AND FINANCING MODALITIES

The agreed implementation modalities for various sectors and sub-sectors are as follows:

2.1 GRANT FUNDING BASED ON AVERAGE COST-EFFECTIVENESS OF PREVIOUSLY MLF APPROVED PROJECTS FOR THAILAND OF RESPECTIVE SECTOR AND SUB-SECTOR

The following implementation and financing modalities will be applied to investment projects in the aerosol, solvent (CFC-113), and foam sectors.

- Advertising and promotion of the MLF funding and CFC phaseout program will be done through workshops, national newspapers and trade magazines. All enterprises in these three sectors will be invited to attend the project preparation workshops. At these workshops, the project management unit (to be appointed by DIW) will provide training to enterprises on how to prepare project proposals;
- For enterprises that require technical assistance to identify suitable non-ODS alternatives, they should submit their request to DIW. Sector experts will be

contracted by DIW through its project management unit. Sector experts will assist these enterprises to select appropriate non-ODS alternatives;

- All enterprises are invited to submit requests for funding based on existing guidelines of the MLF (no production expansion nor technology upgrade, funding requests must exclude export components). Priority will be given to the most cost-effective proposals. In case, phaseout costs requested by enterprises exceed the funding approved by the MLF, funding will be capped at the average level of cost-effectiveness of previously MLF approved projects in respective sectors or sub-sectors. In case there are savings, the remaining funds will be used for financing additional enterprises that are not included in this plan;
- Enterprises are required to submit their proposals before the end of 2003;
- Funding priority should only be given to enterprises that were established before July 1995. After the deadline for submission of proposals, if the total funding request for all eligible projects is less than the amount approved, savings can be used for assisting those enterprises established after July 1995;
- Each enterprise is required to provide detailed information regarding baseline situation and CFC consumption. Before signing contracts, information provided by enterprises will be verified by the project management team.

2.2. PARTIAL GRANT FINANCING FOR PURCHASING OF REFRIGERATION AND MAC SERVICING TOOLS AND MAC R&R MACHINES

This financing modality will be applied to all refrigeration and MAC service shops. Partial grant funding approach will be employed. Possibly, a sliding scale of the level of subsidy will be used. For those participate early, a higher subsidy level will be provided to assist them in purchasing service tools for proper maintenance of CFC-12 and non-CFC refrigerators and MACs, and MAC recovery and recycling machines.

- The project management team will undertake a selection process to identify qualified suppliers for providing service tools and MAC recovery and recycling machines.
- Public outreach program including articles in newsletters, newspapers, trade magazines, radios, and workshops will be carried out by the project management team. This program intends to inform service shops of the need to phase out CFCs, future plans of DIW to restrict the sales of CFCs only among those who have been trained on proper handling of CFCs, information about the authorized training centers, and the availability of financial assistance to support the procurement of basic tools for proper maintenance of non-CFC and CFC-12 refrigeration and MAC systems.
- To be qualified for financial assistance, service shops must have at least one of their technicians trained and certified at one of the training centers authorized by DIW. Training centers will provide a list of certified technicians to DIW. DIW will include names of certified technicians and service shops that they associate with into DIW's database.
- Financial assistance should only be given to certified technicians.

2.3 FULL GRANT FINANCING FOR TECHNICAL ASSISTANCE AND CAPACITY BUILDING COMPONENTS

This financing modality will be applied to technical assistance components, capacity building components, such as train-the-trainer programs, technical capacity building for vehicle inspection stations, Customs training, and other activities.

3. IMPLEMENTATION SCHEDULE

Table10.1. Implementation Schedule

Task	2001				2002				2003				2004				2005				2006				2007				2008				2009				2010			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Investment Projects in the Aerosol Sector																																								
(i) Contract signed									x	x																														
(ii) Equipment delivered										x	x	x	x																											
(iii) Test and trials													x	x	x																									
(iv) Announce ban on CFC use in the aerosol production												x																												
(v) Activity Completed																x																								
Technical Assistance for MDI Sector																																								
(i) Selection of Consultant							x																																	
(ii) Consultation process								x	x	x																														
(iii) Development of MDI strategy											x	x																												
Investment Projects for CFC-113																																								
(i) Contract signed									x	x																														
(ii) Equipment delivered										x	x	x	x																											
(iii) Test and trials													x	x	x																									
(iv) Announce ban on CFC use in the solvent sector												x																												
(v) Activity Completed																x																								
Technical Assistance for Electronic Contact Cleaners																																								
(i) Selection of Consultant									x																															
(ii) Identification of Alternatives										x																														
(iii) Test and trials											x	x																												
(iv) Activity Completed													x																											
Investment Projects for 1,1,1-TCA																																								
(i) Contract signed									x	x	x	x																												
(ii) Equipment delivered										x	x	x	x	x																										
(iii) Test and trials											x	x	x	x	x																									
(iv) Announce ban on TCA use in the garment and shoe-sole industries												x																												
(v) Activity Completed																x																								
Technical Assistance for Garment Development Institute																																								
(i) Appointment of the Project Team							x																																	
(ii) Development of Local Exposure Limit								x	x																															
(iii) Development of Guidelines for Proper Ventilation Systems									x																															
(iv) Information Dissemination							x		x		x		x		x		x																								
(v) Processing Applications from Garment Factories									x	x	x	x	x	x	x	x																									
(vi) Safety Audit										x	x	x	x	x	x	x	x																								
(vii) Activity Completed																	x																								

Investment Projects in the Foam Sector																																								
(i) Contract signed									x	x	x	x																												
(ii) Equipment delivered										x	x	x	x																											
(iii) Test and trials													x	x	x																									
(iv) Announce ban on CFC use in the foam sector												x																												
(v) Activity Completed																x																								
Mobile Air-Conditioning Servicing Sector																																								
(i) Development of a Standard Inspection Manual							x	x																																
(ii) Training for Vehicle Inspection Technicians									x	x	x	x																												
(iii) Procurement of Equipment									x	x	x	x																												
(iv) Equipment Delivered										x	x	x																												
(v) Mandatory Inspection													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
(vi) Train-the-Trainer Program							x	x	x	x																														
(vii) Certification of Service Technicians									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																
(viii) Procurement of MAC Service Tools									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																
(ix) Procurement of MAC R&R Machines									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																
Refrigeration Servicing Sector																																								
(i) Train-the-Trainer Program																			x	x	x	x																		
(ii) Certification of Service Technicians																					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
(iii) Procurement of Refrigeration Service Tools																					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
Project Management Unit																																								
(i) Implementation Assistance					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																
(ii) Public Awareness Activities					x	x	x	x	x	x	x	x																												
(iii) Regulatory Support					x	x	x	x	x	x	x	x																												
(iv) Monitoring													x	x	x	x	x	x	x	x																				
(v) Activity Completed																								x*																
Customs Training Program																																								
(i) Development of a Training Course							x	x	x																															
(ii) Train-the-Trainer Program										x	x																													
(iii) Procurement of Equipment											x	x																												
(iv) Enforcement													x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

*After 2006, remaining tasks under the project management unit will be carried out by the Ozone Protection Unit.

4. FINANCIAL PLAN

Table 10.2. Cash-flow for the National CFC Phaseout Plan for Thailand

Description	Total Request (US$)	2001	2002	2003	2004	2005	2006	2007	2008	2009
Investment Projects - Aerosols	102,960			102,960						
TA for MDIs	57,200		57,200							
Investment Projects - CFC-113	965,120			965,120						
Investment Projects - 1,1,1-TCA	710,000			360,000	350,000					
TA for contact cleaners	23,100			23,100						
Technical Assistance: Garment	166,100		166,100	-	-					
Investment Projects - Foam	3,985,167			2,000,000	1,985,167					
Train-the-Trainer - Ref.	319,000					180,000	139,000			
Certification of Ref. Technicians										
Financial Subsidy for Purchasing Refrigeration Servicing Equipment	1,485,000							550,000	550,000	385,000
MAC Inspection Requirement	1,237,500		400,000	837,500						
Train-the-Trainer - MAC	319,000		180,000	139,000						
Certification of MAC Technicians										
Financial Subsidy for Purchasing MAC Servicing Equipment	3,025,000			990,000	880,000	770,000	385,000			
Financial Subsidy for Purchasing MAC R&R Machines	822,800			279,400	235,400	180,400	127,600			
Project Implem. And Monitoring U.	1,540,000	540,000	200,000	200,000	200,000	200,000	200,000			
Custom Training	165,000		82,500	82,500						
Total	14,922,947	540,000	1,085,800	5,979,580	3,650,567	1,330,400	840,000	550,000	550,000	385,000

5. KEY PROJECT IMPLEMENTATION MILESTONES

Table 10.3 Key Project Implementation Milestones

(To be finalized with the Thai Government)

Milestone	Performance Target	Amount (US$)
1st Tranche (2001)	The national CFC phaseout plan approved by ExCom.	$540,000
2nd Tranche (2002)	Import control policy in place and operational.	$1,085,800
3rd Tranche (2003)	Announcement of the national CFC phaseout plan and phaseout schedule/ import quota for CFCs from 2002 – 2010; Criteria and procedures for seeking financial support for investment projects completed and distributed to eligible enterprises.	$5,979,580
4th Tranche (2004)	Announcement of the Land Transport Department of its MAC inspection requirement; Ban on the use of CFCs in the manufacturing sector in 2005 is in place.	$3,650,567
5th Tranche (2005)	Annual MAC inspection requirement is operationalized; All CFC phaseout activities in manufacturing sectors completed.	$1,330,400
6th Tranche (2006)	Database of trained technicians in the MAC sector is functional.	$840,000
7th Tranche (2007)	CFC import in the previous year is within the respective limit proposed under this plan.	$550,000
8th Tranche (2008)	CFC import in the previous year is within the respective limit proposed under this plan.	$550,000
9th Tranche (2009)	CFC import in the previous year is within the respective limit proposed under this plan.	$385,000

ANNEX I

List of Importers

No.	Name of Importer	CFC-11	CFC-12	CFC-113	CFC-114	CFC-115	1,1,1-TCA	CTC
1	Kulthorn Engineering Co., Ltd.		x			x		
2	Coolman Corporation Co., Ltd.		x					
3	Chemical Specialties Corporation	x	x					
4	Sun Ta Trading Co., Ltd.	x	x					
5	Supercon (Far East) Part., Ltd.	x		x				
6	South City Universal Co., Ltd.	x						
7	DOT BAMBOO (Bangkok)	x	x					
8	Tomen (Thailand) Co., Ltd.	x						
9	Thasco Chemical Co., Ltd.	x	x				x	
10	Thai Osnor Co., Ltd.	x						
11	Numthai Equipment Co., Ltd.		x					
12	Berli Jucker Specialties Co., LTd.	x	x					
13	Pacific Unitrade Co., Ltd.	x	x					
14	Pan Technical Part Co., Ltd.						x	
15	Union Trading & Industries	x	x					
16	Refrigo Equipment Co., Ltd.	x	x					
17	Lee Gardens International	x	x					
18	Industrial Trade Co., Ltd.	x	x					
19	Ossini Co., Ltd.		x					
20	I.C.P. Chemicals Co., Ltd.		x					
21	East Asiatic (Thailand)	x	x				x	
22	Carbokarn Co., Ltd.							x
23	C. Gigantic Co., Ltd.							x
24	V.I.V. Interchem Co., Ltd.						x	
25	Italmar Co., Ltd.							x

Annex II

List of Enterprises Using CFCs in the Manufacturing Sector

Table II. 1 List of Enterprises in the Aerosol Sector

No.	Company	Application	Type of ODS	Quantity (MT)
1	Bangkok China Paint	Specialized Paint	CFC-12	25.00
2	Cosmonaut	Perfume and Hair Mousse	CFC-11	2.50
3	Veera Alline	Perfume and Hair Mousse	CFC-11	2.50

Table II.2 List of Enterprises in the Solvent Sector

No.	Company	Application	Type of ODS	Quantity (MT)
1	Thai Compressor Manufacturer	Metal Cleaning	CFC-113	46.00
2	Challenge Medical Product	Medical Products	CFC-113	2.50
3	Intergold Optical	Optical Lense Cleaning	CFC-113	4.00
4	Alphatech	Cleaning of Electronic Comp.	CFC-113	11.50
5	Garment Industry	Spot Cleaning	1,1,1-TCA	250.00
6	Summit Footwear	Shoe Soles Cleaning	1,1,1-TCA	40.00
7	Lafa Thai	Electronic Contact Cleaner	CFC-113	10.00
8	Pronet Inter	Electronic Contact Cleaner	CFC-113	10.00

Table II.3 List of Enterprises in the Foam Sector

No	Company	Application	Baseline Equipment (No. of equipment)				Date established		CFC-11 Consumption
			HP Foam injection	LP Foam injection	Premixer	No Baseline Equipment	Before July 1995	After July 1995	Blended (30:70) Preblended (35:100)
1	Sahafarm Co., Ltd.	Rigid PU/Spray Foam	1				/		8.71
2	Bangkok Insulated Co., Ltd.	Rigid PU/Spray Foam	1				/		13.74
3	Rotto Foam Co., Ltd.	Rigid PU/Spray Foam				/	/		0.05
4	Apply Foam Industry Co., Ltd.	Rigid PU/Spray Foam		11			/		13.50
5	Loxley Newtech Co., Ltd.	Rigid PU/Spray Foam		6			/		13.50
6	LDL International Co., Ltd.	Rigid PU/Spray Foam		4			/		10.00
7	Siltech Polymer Co., Ltd.	Rigid PU/Spray Foam		2			/		6.50
8	Vinsulator Co., Ltd.	Rigid PU/Spray Foam		1			/		6.50
9	S.M.D. Product Co., Ltd.	Rigid PU/Spray Foam	3				/		5.19
10	PUR Industry Co., Ltd.	Rigid PU/Spray Foam		1			/		6.48
11	West Service Co., Ltd.	Rigid PU/Spray Foam	1				/		0.17
12	AC Insulation Co., Ltd.	Rigid PU/Spray Foam	1				/		0.57
13	Roof Insulation Co., Ltd.	Rigid PU/Spray Foam	1				/		0.17
14	Mr. Viroj	Rigid PU/Spray Foam		2			/		2.10
15	Poly Rigid Insulation Co., Ltd.	Rigid PU/Spray Foam		1			/		4.00
16	A.P. Foam Co., Ltd.	Rigid PU/Spray Foam		1			/		40.00
17	PSP Marine Co., Ltd.	Rigid PU/Spray Foam		1			/		19.00
18	A.S.A. Pattana Co., Ltd.	Rigid PU/Spray Foam				/	/		2.50
19	Jee Seng Marketing Co., Ltd.	Rigid PU/Thermoware				/	/		5.00
20	Pioneer Industrial Co., Ltd.	Rigid PU/Thermoware		1			/		6.00
21	Chokchai Seri Plastic Co., Ltd.	Rigid PU/Thermoware				/	/		2.79
22	Namthawi Plastic Co., Ltd.	Rigid PU/Thermoware				/	/		0.21
23	Taksin Thermoware Co., Ltd.	Rigid PU/Thermoware				/	/		1.71
24	JCJ International Co., Ltd.	Rigid PU/Thermoware				/	/		1.71
25	T.A.T. Plastic Co., Ltd.	Rigid PU/Thermoware				/	/		8.57
26	Nipapol Limited Partnership	Rigid PU/Thermoware				/	/		0.05
27	Standard Plastic Co., Ltd.	Rigid PU/Thermoware				/	/		8.25
28	Pornsiam Co., Ltd.	Rigid PU/Thermoware				/	/		2.00

29	Pitak Sakorn Limited Partnership	Rigid PU/Thermoware				/	/		4.04
30	Samutprakarn Container Co., Ltd.	Rigid PU/Insulated Containers				/	/		20.57
31	P.C.S. Container Co., Ltd.	Rigid PU/Insulated Containers				/	/		2.50
32	Cosmo Contziner Co., Ltd.	Rigid PU/Insulated Containers				/	/		2.50
33	Pramualchai Co., Ltd.	Rigid PU/Insulated Containers				/	/		2.14
34	ROTO Plastic Co., Ltd.	Rigid PU/Insulated Containers				/	/		2.14
35	P.E.C. (Thailand) Co., Ltd.	Rigid PU/Insulated Containers				/	/		0.86
36	Chor Wassana Co., Ltd.	Rigid PU/Insulated Containers		1			/		0.10
37	UPE Container Co., Ltd.	Rigid PU/Insulated Containers	1				/		5.45
38	Packo Axis Co., Ltd.	Rigid PU/Insulated Containers				/	/		1.65
39	Narong Industry Co., Ltd.	Rigid PU/Insulated Containers	1				/		0.97
40	P.E. Products Co., Ltd.	Rigid PU/Insulated Containers	1				/		0.51
41	Hitech Industry Co., Ltd.	Rigid PU/Insulated Containers	1				/		1.88
42	J. Theparak Karnchang Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		0.21
43	Niwat Mahachai Industry Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		5.00
44	Sahasil Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		2.50
45	Thepthari Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		2.50
46	Chern Yong Panich Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		2.50
47	Eakachai Karnchang Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		2.57
48	I.X.L. Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		1.29
49	Thai Auto Works Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		5.14
50	Thawatchai Rotyen Co., Ltd.	Rigid PU/Refrigerated Transportation	1	1			/		0.19
51	Por Karnchang Co., Ltd.	Rigid PU/Refrigerated Transportation		1			/		0.28
52	Mutcom Co., Ltd.	Rigid PU/Refrigerated Transportation				/	/		0.57
53	Siam Panel Co., Ltd.	Rigid PU/Cold Store Panel				/	/		5.00
54	Thai Iso Wall Co., Ltd.	Rigid PU/Cold Store Panel				/	/		1.71
55	B.H.G. Limited Partnership	Rigid PU/Cold Store Panel				/	/		0.78
56	VP Structural Panel Co., Ltd.	Rigid PU/Cold Store Panel				/	/		0.86
57	Satian AST Limited Partnership	Rigid PU/Cold Store Panel				/	/		1.71
58	Colding Industry Co., Ltd.	Rigid PU/Cold Store Panel				/	/		2.57
59	S.E. Technology Co., Ltd.	Rigid PU/Cold Store Panel				/	/		0.52
60	Insulation Technology Co., Ltd.	Rigid PU/Cold Store Panel				/	/		6.48
61	Perfect Wall Co., Ltd.	Rigid PU/Cold Store Panel		1			/		0.87
62	New Design Fiber Co., Ltd.	Rigid PU/Door Insulation				/	/		1.81
63	Siam Navapan Co., Ltd.	Rigid PU/Door Insulation				/	/		5.00
64	One Steel Door Co., Ltd.	Rigid PU/Door Insulation				/	/		2.50
65	Door Insulated Co., Ltd.	Rigid PU/Door Insulation	1	1			/		2.17
66	Leeco Co., Ltd.	Rigid PU/Door Insulation				/	/		2.45

67	Bangkok Steel Co., Ltd.	Rigid PU/Door Insulation				/	/		0.57
68	Siam Engineering Co., Ltd.	Rigid PU/Door Insulation	1				/		0.19
69	Envitrade Engineering Co., Ltd.	Rigid PU/Others				/	/		2.50
70	Starmart Manufacturing Co., Ltd.	Rigid PU/Others	1				/		0.65
71	T.C.K. Furniture Co., Ltd.	Rigid PU/Others	1	1			/		1.43
72	Siam Furniture Co., Ltd.	Rigid PU/Others	1	1			/		0.02
73	F.N.T. Co., Ltd.	Rigid PU/Others				/	/		1.29
74	Super Furniture Co., Ltd.	Rigid PU/Others				/	/		0.17
75	Cobra International Co., Ltd.	Rigid PU/Others				/	/		20.00
76	South City Group (Supplier)	Rigid PU/Others				/	/		102.86
77	Thai Asia Industry Co., Ltd.	Rigid PU/Wood Imitation		1			/		0.34
78	House and Garden Co., Ltd.	Rigid PU/Wood Imitation	1	1			/		0.11
79	World Pack Co., Ltd.	Rigid PU/Wood Imitation		1			/		0.17
80	Solco Thai Co., Ltd.	Rigid PU/Wood Imitation		1			/		0.06
81	Win Fong Adhesive Manufacturing	Flexible PU Foam		1			/		45.00
82	Wale Industry Co., Ltd.	Flexible PU Foam				/	/		45.00
83	C.S.A. nterprise Co., Ltd.	Flexible PU Foam				/	/		22.50
84	Pagofoam Factory Co., Ltd.	Flexible PU Foam				/	/		22.50
85	Essential Synthetic Co., Ltd.	Flexible PU Foam				/	/		22.50
86	Ocean Foam Co., Ltd.	Flexible PU Foam				/	/		15.00
87	Thai PU Autopart Co., Ltd.	Integral Skin Foam		1			/		0.26
88	Polymer Co., Ltd.	Integral Skin Foam				/	/		2.50
89	Kamol trading Co., Ltd.	Integral Skin Foam				/	/		2.50

ANNEX III

Standard Costs

The following standard costs are applied to the national CFC phaseout plan:

Recovery and Recycling Equipment:

- Recovery and Recycling machine $ 2,000

MAC and Refrigeration Servicing Equipment for Training Centers:

• Vacuum pump	$ 800
• Manifold and gauges	$ 300
• Hoses	$ 100
• Portable leak detector	$ 500
• Refrigerant charging cylinder	$ 800
• Recovery and Recycling Machine	$ 2,000
Total	$ 4,500

MAC and Refrigeration Servicing Equipment for Servicing Shops:

• Vacuum pump	$ 800
• Manifold and gauges	$ 300
• Hoses	$ 100
• Portable leak detector	$ 500
• Refrigerant charging cylinder	$ 800
Total	$ 2,500

Equipment for Vehicle Inspection Stations and Customs Department

- Refrigerant Identifier $1,500

ANNEX IV

Environmental Assessment

All project components proposed under the National CFC Phaseout Plan will employ alternative technologies that are recommended by UNEP Technical Options Committees for the relevant sectors. All applicable government environmental, health and safety regulations will be conformed with.

All project components proposed under the Plan will enable existing enterprises to convert to non-ODS alternatives. Therefore, no job loss or any adverse social impact is envisaged.