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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Twenty-fifth Meeting
Montreal, 29-31 July 1998

PROJECT PROPOSALS: CHINA

This document includes the comments and recommendations of the Fund Secretariat on the following project proposals:

Foam

- | | |
|---|------------|
| • Conversion of rigid and spray polyurethane foam manufacture from CFC-11 to HCFC-141b foam blowing agent at Victory Petroleum Organization Bureau | UNDP |
| • Conversion to HCFC-141b in the manufacture of rigid and spray polyurethane foams at Daqing Petroleum Organization Bureau | UNDP |
| • Conversion to LCD technology in the manufacture of flexible (slabstock) polyurethane foam at Jinling Petrochemical Co. Plastics Factory. | UNDP |
| • Conversion from CFC-11 to methylene chloride and forced cooling system in the manufacture of flexible polyurethane foam (slabstock) at Cangzhou New-Type Foam Decoration Material Plant | UNDP |
| • Elimination of CFC-12 in manufacturing of EPE foam packaging nets at 25 enterprises (umbrella project) | UNIDO |
| • Conversion of refrigerator manufacture in Foshan from CFC-11 to cyclopentane foam blowing agent in the production of PU insulation panels | World Bank |
| • Conversion of PU slabstock manufacture to forced cooling and methylene chloride at Wuxi New Type Raw Material Plant | World Bank |

Refrigeration

- | | |
|---|------------|
| • Conversion to cyclopentane and isobutane in the manufacture of domestic refrigerators at Hangzhou Household Electrical Appliance Industrial Corporation (HHEAIC) | UNDP |
| • Phasing out ODS at the refrigerator plant of Hefei Hualing Electronic Co. Ltd., China | UNIDO |
| • Conversion of refrigerator manufacture in Changhe Group to HFC-134a as refrigerant and cyclopentane as foam blowing agent | World Bank |
| • Conversion of refrigerator manufacture to cyclopentane foam blowing agent and HFC-134a refrigerant at Shanghai Haiou Electrical Appliance General Factory - Haiou | World Bank |

PROJECT EVALUATION SHEET **CHINA**

SECTOR: FOAM ODS use in sector (1996): 27,540 ODP tonnes

Sub-sector cost-effectiveness thresholds: Rigid US \$7.83/kg

Project Titles:

- (a) Conversion of HCFC-141b in the manufacture of rigid and spray polyurethane foams at Daqing Petroleum Organization Bureau.
- (b) Conversion of refrigerator manufacture from CFC-11 to cyclopentane foam blowing agent in the production of PU insulation panels at Foshan.
- (c) Conversion of rigid and spray polyurethane foam manufacture from CFC-11 to HCFC-141b foam blowing agent at Victory Petroleum Organization Bureau.

Project Data	Rigid		
	Daqing	Foshan	Victory
ODS phase-out (ODP tonnes)	186.46	120.5	80
Proposed project duration (months)	24	24	24
Incremental capital cost (US \$)	616,000	636,240	522,500
- including contingency (%)	10	10	10
Incremental operational cost (US \$)	1,560,580	592,180	600,200
Total project cost (US \$)	2,176,580	1,228,420	1,122,700
Local ownership (%)	100	100	100
Export component (%)	0	0	0
Amount requested (US \$) {Original}	1,313,980	942,000	563,760
{Revised}			
Cost effectiveness (US \$/kg)	7.83	7.83	7.83
National Coordinating Agency	State Environmental Protection Agency		
Implementing Agency	UNDP	World Bank	UNDP
Technical review completed?	Yes	Yes	Yes

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

- (a) Conversion of HCFC-141b in the manufacture of rigid and spray polyurethane foams at Daqing Petroleum Organization Bureau.
- (b) Conversion of refrigerator manufacture from CFC-11 to cyclopentane foam blowing agent in the production of PU insulation panels at Foshan.
- (c) Conversion of rigid and spray polyurethane foam manufacture from CFC-11 to HCFC-141b foam blowing agent at Victory Petroleum Organization Bureau.

1. The project document indicates that the Chinese foam industry consumed in 1996 27,540 tonnes CFCs based on the China country programme. CFC-11 was the dominant substance (21,500 tonnes), followed by CFC-12 (6,000 tonnes). No other ODS was used in significant amounts, although some methyl chloroform may be used in adhesive applications. Furthermore some methyl chloroform and CFC-113 may be used in mold release agents. Production is divided between larger state owned enterprises and smaller township or private enterprises. Production and process information from state enterprises is well documented. However information on the rest of the industry is less reliable. 16,000 tonnes of pipe insulation foam using 2,000 tonnes CFC and 8,000 tonnes of panel foam using 1,200 tonnes of CFC are expected to have been produced in that year.
2. The most recent information provided by the State Environmental Protection Administration (SEPA) in its progress of implementation of the country programme, however, indicates the consumption of CFC in the foam sector in 1996 as 20,870 tonnes.
3. SEPA and State Light Industry Bureau are agencies coordinating ODS phase out in the foam industry. They plan to phase out the use of ODS in extruded PS/PE by 2005 and phase out the use of ODS in polyurethane by 2010.
4. Letters of commitment from the enterprises indicating their agreement with the project and their commitment to provide necessary counterpart funding have been provided.
5. The use of HCFC-141b has been justified in the selection of technologies. All the companies have been informed about available substitute technologies and that no further funding can be provided for any subsequent conversions.

(a) Conversion of HCFC-141b in the manufacture of rigid and spray polyurethane foams at Daqing Petroleum Organization Bureau.

1. Daqing Petroleum Organization Bureau is a state owned enterprise engaged in oil and gas exploration activities. It also produces spray foams and rigid pre-formed pipe sections for oil pipelines and power heating system. The organization consists of four production plants. In 1996, the four plants consumed 186.46 tonnes of CFC-11 as blowing agent. They have a total of 7 low pressure machines (two 12 kg/min machines and five 15 kg/min machines) and 4 low pressure spray foam machines. Under the project, Daqing will

replace CFC-11 with HCFC-141b foam system as an interim solution, until the ODS-free water-blown technology becomes fully developed. It is proposed to replace the seven low pressure machines with four high pressure machines at US \$400,000 and the spray foam machines with four high pressure machines at US \$20,000 each. Technology transfer, trials, and training costs amount to \$80,000. Incremental operational cost for two years resulting from this technology conversion and higher material costs amount to US \$1,560,580.

(b) Conversion of refrigerator manufacture from CFC-11 to cyclopentane foam blowing agent in the production of PU insulation panels at Foshan.

1. Foshan was established in 1976. It produces polyurethane sandwich panels and spray foam. 45,000 m² of panels using 815 tonnes of foam were produced in the past year consuming 120 tonnes of CFC. The factory operates one 1987 Cannon H200 high pressure machine, 1 Gusmer FF-600 and one locally made low pressure machines is used for "patch up".
2. The enterprise will phase out the use of CFC with cyclopentane. It is proposed to replace the existing high pressure machine and retrofit the presses and the production line to be compatible with the use of cyclopentane. The capital cost of conversion includes a new high pressure machine (US \$160,000), modification of presses (US \$40,000), premixer (US \$80,000), double wall underground tank and piping (US \$55,000), ventilation and other safety features (US \$153,400) and high pressure spray foam machines US \$60,000 for a total capital cost (including contingency) of US \$636,240. The incremental operating cost including 10% additional foam for insulation (US \$340,344) amounts to US \$592,180.

(c) Conversion of rigid and spray polyurethane foam manufacture from CFC-11 to HCFC-141b foam blowing agent at Victory Petroleum Organization Bureau.

1. Victory Petroleum Organization Bureau (Victory) is engaged in petroleum production and distillation. Its petroleum production in 1997 was 25 million tonnes.
2. Victory began its PU pre-insulated pipe production in 1985. It has five pipe plants serving transportation of oil in the area of 44,000 km² of Victory oil field. These five plants have six continuous pipe production lines and one discontinuous line, all for production of pre-insulated pipes. The six continuous lines are using the "standard" Chinese "one step" technology of which Victory still has the national patent. In this process, the low pressure Chinese made foaming machine which has an output of 12 kg/min injects foam between the steel pipe and PE casing extruded by an in line extruder. The discontinuous line is using a low pressure machine with a lance to pour the foam. The diameter of steel pipe ranges from 100mm to 430mm. In 1997, it produced about 1,350 km of pre-insulated pipes from 750 tonnes of foam and 80 tonnes CFC-11.

3. The enterprise will phase out CFC-11 by the use of HCFC-141b as an interim technology until commercial introduction of water-blown technology.
4. Victory proposed to rationalize the four plants into two and use two high pressure machines to produce all types of pipes ranging from 100 mm to 430 mm. Victory's engineers will develop the 141b formulation system in-house as they did before with CFC-11 formulation with the help of both local and international suppliers.
5. The capital cost includes two 200 l/min high pressure machines at the cost of US \$320,000, four high pressure mobile foaming machines for US \$100,000, civil works US \$10,000 trials, technology transfer and commissioning of US \$45,000. The incremental operational cost including 10% additional foam "to improve stability and insulation" (US \$308,763) amounts to US \$346,950.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

Daqing and Victory

1. With regard to Daqing and Victory projects the Secretariat drew attention to the inherent capacity increase in the proposed dispenser replacements. In the case of Victory it was pointed out that although its objective was save costs to both the company and the Multilateral Fund, the proposed rationalization would not be the most cost-effective since the overcapacity would result in increased project costs.

2. The following incremental capital costs were agreed:

	US \$
Daqing	478,500
Victory	324,500

3. An issue was also raised regarding the applicability to the two projects of incremental operational cost arising from additional foam for insulation and stability. The issue is still under discussion between the Secretariat and UNDP. The outcome will be communicated to the Sub-Committee on Project Review. More detailed information on the issue is provided in the Secretariat's Overview Paper.

Foshan

1. The Secretariat raised the issue of the use of cyclopentane instead of n-pentane in the project since generally n-pentane is cheaper and more readily available. The Secretariat drew attention of the World Bank to the business practice whereby foamers using hydrocarbon as blowing agent are advised to use n-pentane instead of cyclopentane in such sandwich panel

production where additional foam is required to increase thickness in order to improve insulation properties, as that makes sound business sense. The World Bank was also reminded of the requirement for adopting most cost-effective options whenever possible.

2. Issues were raised with some aspects of the capital costs including an additional spray foam dispenser replacement which is not supported by the baseline, and replacement of some of the dispensers rather than retrofit.
3. The incremental capital costs as well as the incremental operational costs are still under discussion.
4. The Project Review Sub-Committee will be informed of the outcomes of the discussions on the projects and the recommendations arising therefrom.

PROJECT EVALUATION SHEET CHINA

SECTOR: FOAM ODS use in sector (1996): 27,540 ODP tonnes

Sub-sector cost-effectiveness thresholds: Flexible Slabstock US \$6.23/kg
Extruded Polystyrene US \$8.22/kg

Project Titles:

- (a) Conversion from CFC-11 to methylene chloride and forced cooling system in the manufacture of flexible polyurethane foam (slabstock) at Cangzhou new-type foam decoration material plant
- (b) Conversion to LCD in the manufacture of flexible (slabstock) polyurethane foam at Jinling Petrochemical Co.
- (c) Conversion of PU slabstock manufacture to forced cooling and methylene chloride at Wuxi.
- (d) Elimination of CFC-12 in the manufacture of EPE Foam Packaging Nest at 25 enterprises (Umbrella Project).

Project Data	Flexible Slabstock			Extruded Polystyrene
	Cangzhou	Jinling	Wuxi	Umbrella Project
ODS phase-out (ODP tonnes)	67	81	231	1,146
Proposed project duration (months)	24	24	36	18
Incremental capital cost (US \$)	390,000	600,000	385,650	7,267,125
- including contingency (%)	10	10	10	
Incremental operational cost (US \$)	182,345	64,154	112,500	(190,470)
Total project cost (US \$)	572,345	535,846	488,150	7,076,655
Local ownership (%)	100	100	100	100
Export component (%)	0	0	0	0
Amount requested (US \$) {Original}	417,410	504,630	488,150	7,076,655
{Revised}				
Cost effectiveness (US \$/kg)	6.23	6.23	2.15	6.17
National Coordinating Agency	Ministry of Environment - MMA/PROZON			
Implementing Agency	UNDP			UNIDO
Technical review completed?	Yes	Yes	Yes	Yes

Secretariat's Recommendations:

Amount recommended (US \$)	Pending	504,630	Pending	Pending
Project impact (ODP tonnes)		81		
Cost effectiveness (US \$/kg)		6.23		
Implementing Agency support cost (US \$)		65,602		
Total cost to Multilateral Fund (US \$)		570,232		

PROJECT DESCRIPTION

- a) Conversion from CFC-11 to methylene chloride and forced cooling system in the manufacture of flexible polyurethane foam (slabstock) at Cangzhou new-type foam decoration material plant
 - b) Conversion to LCD in the manufacture of flexible (slabstock) polyurethane foam at Jinling Petrochemical Co.
 - c) Conversion of PU slabstock manufacture to forced cooling and methylene chloride at Wuxi.
 - d) Elimination of CFC-12 in the manufacture of EPE Foam Packaging Nest at 25 enterprises (Umbrella Project).
1. The project document indicates that the Chinese foam industry consumed in 1996 27,540 tonnes CFCs based on the China country programme. CFC-11 was the dominant substance (21,500 tonnes), followed by CFC-12 (6,000 tonnes). No other ODS was used in statistical significant amounts, although some methyl chloroform (MCF) may be used in adhesive applications. Furthermore some MCF and CFC-113 may be used in mold release agents. Production is divided between larger state owned enterprises and smaller township or private enterprises. Production is divided between larger stated owned enterprises and smaller township or private enterprises. Production and process information from state enterprises is well documented. However information on the rest of the industry is less reliable. 95,000 tonnes of flexible polyurethane foam using 5,400 tonnes CFC are expected to have been produced in that year.
 2. The most recent information provided by the State Environmental Protection Administration in its progress of implementation of the country programme, however, indicates the consumption of CFC in the foam sector in 1996 as 20,870 tonnes.
 3. State Environmental Protection Administration and State Light Industry Bureau are agencies coordinating ODS phase out in the foam industry. They plan to phase out the use of ODS in extruded PS/PE by 2005 and phase out the use of ODS in polyurethane by 2010.
 4. Letters of commitment from the enterprises indicating their agreement with the project and their commitment to provide necessary counterpart funding have been provided.
 - (a) **Conversion from CFC-11 to methylene chloride and forced cooling system in the manufacture of flexible polyurethane foam (slabstock) at Cangzhou new-type foam decoration material plant at Cangzhou.**
 - (b) **Conversion to LCD in the manufacture of flexible (slabstock) polyurethane foam at Jinling Petrochemical Co.**
 - (c) **Conversion of PU slabstock manufacture to forced cooling and methylene chloride Wuxi.**

1. Cangzhou Foam is a private Chinese enterprise established in 1993. It has a locally made vertifoam and a locally made boxfoam machines. Its output for 1996 was 1,440 tonnes using 67 tonnes CFC-11.
2. Wuxi was established in 1985. It uses a horizontal foaming line designed by Shanghai Light Industry Institute. The total output of foam in 1997 was 2,500 tonnes. 231 tonnes CFC-11 was consumed. Wuxi produces mainly low density foam.
3. Both companies will phase out CFC-11 through the use of methylene chloride and forced cooling in their continuous foam production. Cangzhou also proposes to use methylene chloride and forced cooling for its boxfoam production.
4. The capital costs include:

	Cangzhou US \$	Wuxi US \$
Forced cooling system for continuous line	120,000	160,000
Forced cooling system for boxfoam line	50,000	
MC storage and metering system	40,000	40,000
MC monitoring system	30,000	30,000
Ventilation	30,000	30,000
Safety facilities	30,000	30,000
Technology transfer, training and trials	30,000	30,000

5. Both Cangzhou and Wuxi projects incur incremental operational costs of US \$182,345, and US \$112,500 respectively based on CFC price of US \$1.2/kg.

d) Elimination of CFC-12 in manufacturing of EPE foam packaging nets at 25 enterprises (Umbrella Project).

6. State Environmental Protection Administration and State Light Industry Bureau are agencies coordinating ODS phase out in the foam industry. They plan to phase out the use of ODS in extruded PS/PE by 2005 and phase out the use of ODS in polyurethane by 2010.
7. PS extruded foam sheets and boards, polyethelene foamed net bags, PE sheets, pipes and sticks number 200 factories. 90 factories with 100 production lines produced PS extruded foam and consuming 3,600 tonnes CFC-12 in 1996, 70 factories with 150 production lines produced PE extruded foam net bags and consumed 2,000 tonnes of CFC-12 and 40 factories with 50 production lines produces PE extruded foam sheets and pipes consuming 400 tonnes of CFC-12.
8. The Government of China intends to phase out the consumption of CFC-12 from the 150 net bag production lines through several separate umbrella projects. The first group of 25

factories covering 46 production lines is submitted through this first umbrella project. 15 enterprises have one production line each, 3 enterprises have two each, 5 enterprises have 3 each and 2 enterprises have 5 each.

9. 20 of the 25 enterprises were established in 1994, 3 were established in 1993 and the remaining two established in 1992 and 1958. The CFC-12 consumption of the enterprises range from 24 tonnes to 109 tonnes. The average consumption of a production line is 25 tonnes. The total quantity of CFC-12 to be phased out is 1,146 tonnes.
10. The enterprises will phase out the use of CFC-12 through the use of butane. The project capital cost is calculated based on one extruder (production line) and multiplied by the number of extruders for enterprises with more than one extruder, with adjustments to the cost of some items as necessary.
11. The total cost of the project (excluding 13% agency support cost) is US \$7,076,655. The items of capital cost to the Multilateral Fund of the production lines according to the number of extruders include:

	1 Extruder	2 Extruders	3 Extruders	5 Extruders
	US \$	US \$	US \$	US \$
Extruder retrofit	38,000	76,000	114,000	190,000
Foaming agent supply (butane tank, delivery system and molecular sieve)	65,500	107,500	147,500	232,500
Safety related modification	64,000	109,500	109,000	142,500
Certification	5,000	6,000	6,000	7,000
General consulting service	8,000	12,000	10,000	15,000
Contingency 5%	8,375			
Total	188,875	311,000	386,500	587,000

12. The incremental operational costs were calculated using the prices US \$1.30 for CFC-12 and US \$1.10 for butane. The incremental operational costs range from a cost of about US \$9,900 to a saving of about US \$28,000.
13. The attached list (Annex 1) provides a summary of the costs of the individual projects. UNIDO has provided project cover sheets and descriptions for all the individual projects.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

Cangzhou and Wuxi

1. The Secretariat raised the issue of the feasibility of the forced cooling process in view of the long delay in implementation of previously approved projects using this technology. With regard to its application to boxfoam the Secretariat pointed out that no boxfoam project has been approved for use with forced cooling.

2. Since the reason for the Chinese companies' selection of forced cooling with methylene chloride continues to be the lack of urethane grade methylene chloride, the Fund Secretariat drew the attention of the implementing agencies to the Executive Committee decision - requesting the Government of China and the implementing agencies to explore the possibilities of improving access of the flexible foam manufacturers who select the methylene chloride technology to foam grade methylene chloride in order to reduce costs of methylene chloride projects in the country. The Secretariat received a statement from the Government indicating that the Tianjin Polyurethane Plastics Factory has completed its demonstration project for forced cooling, methylene chloride and softening additives in 1996. Therefore the technology is now available in China and is being selected by interested enterprises. It also stated that there are not many chemical suppliers who have interest to develop urethane grade methylene chloride in China.

3. The Tianjin project was approved at the 10th Meeting of the Executive Committee by the Ministry of Light Industry as a demonstration plant for the dissemination of ODS technology in the manufacture of flexible polyurethane foam to demonstrate different technologies in China.

4. The Executive Committee also approved three projects at the 10th Meeting (June 1993) for the production of blended polyol at Shenyong, Lining Research and Wuxi. All the projects have been completed since 1995.

5. In view of the provision through the Multilateral Fund of indigenous forced cooling technology and the role of Tianjin in technology transfer, the cost of US \$20,000 charged for technology transfer in methylene chloride based flexible slabstock foam projects needs a review. Further, there is the need to assess the impact of the polyol production on polyol prices in foam projects.

Jinling

1. The capital costs have been agreed. The incremental operational savings were recalculated to conform to the methodology approved under Decision 24/58. The incremental operational savings recalculation resulted in the amount of US \$64,154 instead of US \$25,143.

2. The three flexible slabstock foam projects are still under discussion and the Sub-Committee on Project Review will be informed of the outcomes.

Umbrella EPE Project

1. This umbrella project, covering 25 enterprises with 46 production lines, submitted by UNIDO is the first proposal for an estimated 50 companies in the sub-sector which covers 70 enterprises with production lines. The targeted ODP phase-out for the EPE/EPs sector is estimated at about 6,000 ODP tonnes. The potential cost for the Multilateral Fund could be estimated at about US \$65 million. Given the importance of this sub-sector for ODP phase-out in China and the serious impact on the Fund, a clear strategy for phasing out the CFC from the sector should be developed.
2. The substitution of CFC-12 as a blowing agent would require about 4,600 tonnes of butane annually. A sectoral phase-out strategy would consider among others the issue of supply of a good substitute. The project proposes to use molecular sieves to clean butane at each individual production line. Rough estimates shows that this approach would result in US \$150,000 for the estimated 150 lines. The Secretariat reviewed advice from a sector expert that where the blowing agent has to be purified, then it is more economical to use LPG. This approach needs further investigation by UNIDO.
3. Capital costs are estimated on the basis of international costs and prices. However, the analysis of the project shows that many equipment items can be provided locally at lower cost.
4. UNIDO indicated in the project document that implementation of projects will be effected through national capabilities. However, the implementation strategy was not developed in details. Further work is needed to optimize the cost of technology transfer and training. It is indicated that the phase out of CFC-12 from the sector is expected to be completed by the year 2005. It may be possible that a strategy that considers issues including supply and delivery of equipment and materials would bring the target date forward.
5. The Secretariat drew UNIDO's attention to the fact that 20 of the enterprises covered under this project started production only in 1995, that the equipment is relatively new. UNIDO was requested to clarify whether production was continuous through the year given the nature of the product and their seasonal use. This has implications on the calculation of incremental operating costs.
6. The Secretariat and UNIDO have discussed issues relating to the costing of the requested equipment and prices of chemicals.
7. The Secretariat and UNIDO are still discussing the issues raised in the comments above. The Sub-Committee on Project Review will be informed accordingly.

RECOMMENDATION(S)

1. The Fund Secretariat recommends approval of the Wuxi project with the level of funding and associated support cost as indicated in the table below:

Project Title	Project Cost US \$	Support Cost US \$	Implementing Agency
(a) Conversion from CFC-11 to methylene chloride and forced cooling system in the manufacture of flexible polyurethane foam (slabstock) at Cangzhou new-type foam decoration material plant	Pending	Pending	UNDP
(b) Conversion to LCD in the manufacture of flexible (slabstock) polyurethane foam at Jinling Petrochemical Co.	Pending	Pending	World Bank
(c) Conversion of PU slabstock manufacture to forced cooling and methylene chloride at Wuxi.	504,630	65,602	UNDP
(d) Elimination of CFC-12 in manufacturing of EPE foam packaging nets at 25 enterprises (Umbrella Project)	Pending	Pending	UNIDO

2. Development of the flexible slabstock foam projects using methylene chloride technology should take account of the Tianjin technology demonstration facility.

Annex 1. UNIDO-China EPE foam projects summary

No.	Name	Location	No. of lines	Average			Capital cost, US\$		Incremental operating cost/(saving) calculated US\$	Incremental operating cost/(saving) requested US\$	Budget, US\$	Cost-effectiveness US\$/kg
				Production, MT	CFC-12 consumption, MT	CFC share, %	Total capital cost, US\$	Including 5 or 10% contingency				
1	Dangshan Factory	Dangshan, Anhui	5	433.4	108.5	20.0	643,500	56,500	(27,957)	(27,957)	615,543	5.67
2	Liquan Factory	Liquan, Shaanxi	5	365.3	93.5	20.4	643,500	56,500	(21,213)	(21,213)	622,287	6.66
3	Xinjiang Lihua Packaging Factory	Urumqi, Xinjiang	3	320.7	86.2	21.2	425,550	37,050	(25,572)	(25,572)	399,978	4.64
4	Xuzhou Factory	Xuzhou, Jiangsu	3	315.0	86.0	21.4	425,550	37,050	(26,330)	(26,330)	399,220	4.64
5	Pucheng Factory	Pucheng	3	312.4	83.9	21.2	425,550	37,050	(24,127)	(24,127)	401,423	4.78
6	Shijiazhuang Fact.	Shijiazhuang, Hebei	3	270.0	76.3	22.0	425,550	37,050	(22,179)	(22,179)	403,371	5.28
7	Xinfu Factory	Kuerle, Xinjiang	3	275.0	78.0	22.1	425,550	37,050	(23,411)	(23,411)	402,139	5.16
8	Xian No. 3 Factory	Xian, Shaanxi	2	168.0	47.0	21.9	339,750	29,250	(4,598)	(4,598)	335,152	7.13
9	Cangzhou Factory	Cangzhou, Hebei	2	200.0	54.0	21.3	339,750	29,250	(7,713)	(7,713)	332,037	6.15
10	Yuncheng Factory	Yuncheng, Shanxi	2	186.5	51.8	21.7	339,750	29,250	(7,373)	(7,373)	332,377	6.42
11	Tulufan Factory	Tulufan, Xinjiang	1	100.3	25.0	19.9	188,875	8,375	8,828	0	188,875	7.56
12	Kunming Factory	Kunming, Yunnan	1	106.0	26.5	20.0	188,875	8,375	7,894	0	188,875	7.12
13	Lingbao Factory	Lingbao, Henan	1	112.9	27.0	19.3	188,875	8,375	8,573	0	188,875	7.00
14	Tianshui Factory	Tianshui, Gansu	1	103.1	25.9	20.1	188,875	8,375	8,192	0	188,875	7.30
15	Talimu Factory	Tarim, Xinjiang	1	105.0	26.4	20.1	188,875	8,375	7,837	0	188,875	7.15
16	Tianshui Lihua Fact.	Tianshui, Gansu	1	103.1	25.5	19.9	188,875	8,375	8,640	0	188,875	7.39
17	Luochuan Factory	Luochuan, Shanxi	1	105.3	26.7	20.2	188,875	8,375	7,616	0	188,875	7.09
18	Panxi Factory	Xichang, Sichuan	1	102.3	24.4	19.3	188,875	8,375	9,941	0	188,875	7.73
19	Chengdu Factory	Chengdu, Sichuan	1	98.3	24.7	20.1	188,875	8,375	8,788	0	188,875	7.64
20	Qinhuangdao Fact.	Qinhuangdao, Hebei	1	100.9	25.3	20.0	188,875	8,375	8,567	0	188,875	7.47
21	Baishui Factory	Baishui, Shanxi	1	113.3	27.8	19.7	188,875	8,375	7,663	0	188,875	6.80
22	Binxian Factory	Bin County, Shanxi	1	94.9	23.9	20.1	188,875	8,375	9,226	0	188,875	7.90
23	Baoji Factory	Mei County, Shanxi	1	96.7	24.0	19.9	188,875	8,375	9,443	0	188,875	7.87
24	Xinyu Factory	Urumqi, Xinjiang	1	97.6	23.8	19.6	188,875	8,375	9,827	0	188,875	7.92
25	Wujiaqu Factory	Wujiaqu, Xinjiang	1	96.3	24.0	19.9	188,875	8,375	9,381	0	188,875	7.87
TOTALS and AVERAGES				4,382.4	1,146.3	20.7	7,267,125	511,625	(60,055)	(190,471)	7,076,654	6.17

PROJECT EVALUATION SHEET **THE PEOPLE'S REPUBLIC OF CHINA**

SECTOR: REFRIGERATION ODS use in sector (199): ODP tonnes

Sub-sector cost-effectiveness thresholds: Commercial US \$15.21/kg
Domestic US \$13.76/kg

Project Titles:

- (a) Conversion to HFC-134a as refrigerant and cyclopentane as foam blowing agent at refrigerator manufacturer, Changling Huanghe Group Co. Ltd. ("Changhe").
- (b) Conversion to cyclopentane and isobutane in the manufacture of domestic refrigerators at Hangzhou Household Electrical Appliance Industrial Corporation (HHEAIC).
- (c) Phasing out ODS at the refrigerator plant of Hefei Hualing Electronic Co. Ltd., China.
- (d) Conversion of refrigerator manufacturer to cyclopentane foam blowing agent and HFC-134a refrigerant at Shanghai Haiou Electrical Appliance General Factory ("Haiou").

Project Data	Domestic			Commercial
	Changhe	Hangzhou	Hefei	Haiou
ODS phase-out (ODP tonnes)	138.8	247.8	82.81	63.3
Proposed project duration (months)	36	24	24	36
Incremental capital cost (US \$)	1,772,600	2,671,680	675,702	826,200
- including contingency (%)	10	10	10	10
Incremental operational cost (US \$)	356,800	544,513	137,802	402,400
Total project cost (US \$)	2,129,400	2,973,313	813,504	1,228,600
Local ownership (%)	100	100	90	100
Export component (%)	0	0	0	0
Amount requested (US \$) {Original}	2,129,400	2,708,986	1,251,280	961,000
{Revised}			813,504	
Cost effectiveness (US \$/kg)	11.53	7.11	13.37	15.21
National Coordinating Agency	The World Bank	UNDP	UNIDO	The World Bank
Implementing Agency	State Environmental Protection Agency (SEPA)		National Environmental Protection Agency	State Environmental Protection Agency (SEPA)
Technical review completed?	Yes	Yes	Yes	Yes

Secretariat's Recommendations:				
Amount recommended (US \$)			785,984	
Project impact (ODP tonnes)			82.81	
Cost effectiveness (US \$/kg)			9.49	
Implementing Agency support cost (US \$)			102,177	
Total cost to Multilateral Fund (US \$)			888,162	

PROJECT DESCRIPTION

Background for domestic refrigeration sub-sector in China

1. In 1993 ODS consumption in the domestic refrigeration sub-sector was estimated at 8,320 ODP tonnes in the Country Programme approved at the 9th Meeting of the Executive Committee in March 1993. The Executive Committee approved 24 projects in the domestic refrigeration sub-sector phasing out 7,903 ODP tonnes. The growth rate in annual production of domestic refrigeration appliances was estimated 16% per annum. The target for complete phase out of CFC consumption in the domestic refrigeration sub-sector in China is 2005.

- (a) **Conversion to HFC-134a as refrigerant and cyclopentane as foam blowing agent at refrigerator manufacturer, Changling Huanghe Group Co. Ltd. ("Changhe").**
 1. The proposal contains the following statement: " The approval of this project will contribute to China's ODS phase out actions to meet 1999 freeze of ODS consumption."

 2. The proposal covers conversion of two plants (#24 located in Baoji City and #30 located in Xi'an City) under Changling Huanghe Group (Changhe) which was established through a merger of Changling Group Co. Ltd. and Huanghe Mechanical and Electronic Co. Ltd. in November 1996. Two projects have been approved for Changling at the 13th and 18th Executive Committee Meetings. One production line was excluded by the World Bank and China from the Changling project because this line was established in 1993 after China joined the Montreal Protocol. The project approved for Changling at the 18th Meeting stated that no additional funds will be requested to complete the ODS phase out at Changling.

 3. Two production lines of Huanghe installed at plants #24 and # 30 have been added after the merge with Changling. The capacity of these two lines is not known. The actual production was 40,100 units in 1995, 91,000 units in 1996 and 146,200 units in 1997. Changhe has already started the conversion of its CFC based production. Part of foaming production equipment was replaced in 1996. A portion of the requested funding is claimed retroactively.

 4. The description of the baseline equipment is not complete. Information is lacking in relation to the date of establishing the CFC-based production in Huanghe, number of units produced by Huanghe in 1993 and 1994 (years preceding its merger with Changling) and the date of installation of new equipment.

 5. The project is to phase out 138.8 tonnes of ODP (CFC-11 and CFC-12) in the production of domestic freezers by switching to the use of cyclopentane and HFC-134a.

6. Project inputs include replacement of OMS high pressure machines, retrofitting of existing production equipment, and provision of safety equipment, training and technology transfer, testing and pilot scale production. One recycling machine is requested to handle HFC-134a refrigerant
 7. Incremental operating cost are calculated on the basis of 1997 production level at 146,200 units and are requested for six months. Incremental operating costs for compressors are calculated on the basis of US \$ 3.93/unit but not requested in this proposal pending decision of the Executive Committee.
 8. All replaced equipment will be disposed before the commissioning of the project.
- (b) Conversion to cyclopentane and isobutane in the manufacture of domestic refrigerators at Hangzhou Household Electrical Appliance Industrial Corporation (HHEAIC).**
1. The project document indicates that implementation of HHEAIC project by the end of 1999 will make a significant contribution to China's ODS elimination programme. However, the proposed project duration is 24 months.
 2. Hangzhou Household Electrical Appliance Industrial Corporation produced 176,218 freezers in 1996. The production is organized in two factories on six foaming lines and seven refrigeration assembly lines. Some of these lines are working under low output. The project proposes consolidation of production by reducing the number of refrigeration production lines from seven to two and rationalization of foaming operation which would lead to reduction in the number of foaming machines, and improvements in safe handling of flammable substitutes. The capital costs for the refrigeration part are calculated for two production lines taking into account the proposed consolidation. However, the capital costs related to the foam part, however, do not reflect the rationalization as proposed in the project description.
 3. Under this project, HHEAIC will eliminate the consumption of 247.8 ODP tonnes of CFC-12 and CFC-11 by switching to the use of R600a (isobutane) as refrigerant and cyclopentane as blowing agent, respectively. Funds requested will be used to convert the existing production lines, new appliance design and prototype, testing, pre-production trials, training as well as incremental operating costs (6 months) resulting from the conversion to the new technology.
 4. Conversion of CFC-11 to cyclopentane requires the replacement and retrofitting of existing foaming system, pentane storage and pump, safety measures, handling mixing, dispensing cyclopentane and foam chemicals. Conversion of CFC-12 to isobutane requires redesign of the refrigeration system, ventilation, charging and leak detection.

5. The project includes a list of the baseline equipment. No statement is made about the disposal of replaced equipment.
- (c) **Phasing out ODS at the refrigerator plant of Hefei Hualing Electronic Co. Ltd., China.**
1. The proposal does not contain information on how the implementation of the project would contribute to the 1999 freeze in China.
 2. This project will phase out the use of CFC-11 and CFC-12 in the production of 162,300 domestic refrigerators and freezers at Hualing Electronic Co. Ltd., Hefei. CFC-11 will be replaced by cyclopentane, while CFC-12 by HFC-134a. The project includes the redesign of all refrigerator models and the conversion of the production facilities. The model redesign element of the project covers all prototyping, testing, trial manufacture and reliability tests. The conversion of CFC-12 to HFC-134a requires the replacement of charging boards, new leak detector, new evacuation system, redesign and testing.
 3. Incremental operating costs (IOC) are requested for 6 months. IOC for HFC-134a compressors are not requested in this proposal pending decision of the Executive Committee.
 4. The project includes a list of the baseline equipment and the disposal plan of replaced equipment. The company has furnished UNIDO with a commitment letter to provide the counterpart funding if necessary.
- (d) **Conversion of refrigerator manufacturer to cyclopentane foam blowing agent and HFC-134a refrigerant at Shanghai Haiou Electrical Appliance General Factory ("Haiou").**

Background for commercial refrigeration sub-sector in China

1. ODP consumption of CFC-11 and CFC-12 is estimated in the proposal at 39,740 tonnes in the commercial refrigeration sector in China. The strategy on phasing out of CFC-12 in commercial refrigeration subsector was developed by the Government of China. The strategy provides that the total consumption of 13,000 MT of CFC-12 in the commercial refrigeration subsector will be achieved through the funding of conversion of 24 compressor production plants in China. The Executive Committee, noting China's strategy for the commercial refrigeration subsector provided for consolidation of the existing compressor manufacturing industry approved 17 investment projects for conversion of compressor manufacturing facilities and four technical assistant projects to facilitate the phase out of CFC-12 in the commercial refrigeration sector in China. The Government of China is to provide the necessary resources to convert the manufacturers of new commercial refrigeration equipment and the servicing subsector affiliated with the commercial refrigeration equipment.

2. This project will phase out 63.2 tonnes of ODP at Shanghai Haiou Electrical Appliance General Factory ("Haiou"), a 100% private owned Chinese enterprise. Under the project, Haiou will eliminate the use of CFC-11 and CFC-12 in the production of commercial freezers, insulated boxes and panels by switching to the use of cyclopentane blowing agent and HFC-134a refrigerant.
3. Project inputs include replacement or retrofitting of existing production equipment such as high pressure machines, vacuum pumps, charging machines, leak detectors, and provision of safety equipment, training and technology transfer, testing and pilot scale production, and incremental operating cost of six months. Haiou will implement the project under the supervision of SEPA and CIB. Haiou will cover the difference between the total cost and MLF funding.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

(a) Conversion to HFC-134a as refrigerant and cyclopentane as foam blowing agent at refrigerator manufacturer, Changling Huanghe Group Co. Ltd. ("Changhe").

1. The Secretariat requested additional information from the World Bank on the date of establishing the CFC-based production in Huanghe, number of units produced in 1993 and 1994 (years preceding its merger with Changling) and the date of installation of new production equipment. Additional information was provided by the World Bank.
2. The production in Huanghe was established in 1994 - 1995, a year before it was taken over by Changling Group, itself a recipient of two Multilateral Fund grants approved in 1994-1995. Huanghe's baseline at the time of takeover consisted of second hand foaming and refrigeration equipment mainly of 1986 vintage. The company produced an insignificant number of units in 1994 and actual production began in 1995 (40,100 units and was reported to have reached 146,200 units in 1997).
3. The World Bank has included a request for retroactive funding of two Cannon high pressure machines which replaced the two old OMS machines. The Secretariat requested the World Bank to provide the serial numbers of the OMS machines in order to track its source from the OEM for the purpose of ensuring that the machines were not sourced from a conversion project supported by the Multilateral Fund. The World Bank was unable to provide the information. Cannon informed the Secretariat that one foaming machine was shipped from Italy in May 1995 and another one in September 1996. Cannon clarified also that time for delivery and installation takes about 2 months. The company also installed Cannon premixing equipment in 1995 which was requested for funding. Serial numbers of this equipment provided by the World Bank do not correspond to Cannon codification system. Therefore, it was not possible to establish the date of installation of those production equipment. Other production equipment (pre-heating

oven, door foaming jigs, vacuum pumps) are reported to be installed in 1995. However, the exact date of installation of this equipment is not known.

2. Incremental operating costs are calculated on the basis of 1997 production level (146,200 units). This level of production was achieved using some of equipment which was installed after July 1995.

3. The eligibility of the project is questionable since it was not possible to establish the compliance with Decision 17/7 in which the Executive Committee decided "not to consider any projects to convert any ODS-based capacity installed after July 1995" and Decision 20/20 in which the Executive Committee confirmed that "installation date" should be interpreted strictly as the date on which equipment was on site and ready for utilization.

4. The Secretariat discussed also with the World Bank capital costs associated with replacement of high pressure machines, acquisition of HFC-134a recycling machine, as well as the cost of cyclopentane storage and piping, cost of technology transfer, trials and training, capacity and cost of replacement of existing refrigerant charging units as well as cost of components and prices of chemicals in the requested operating costs..

(b) Conversion to cyclopentane and isobutane in the manufacture of domestic refrigerators at Hangzhou Household Electrical Appliance Industrial Corporation (HHEAIC)

1. The Secretariat discussed with UNDP issues in relation to rationalization of foam operations in Hangzhou, specifically the number and eligible incremental cost of foaming machines, and associated safety costs. UNDP clarified that the inclusion of rationalization the project was a mistake since the company did not accept it. However, a letter from the company to UNDP suggested that the company accepted the proposal (appendix 1).

2. The Secretariat considers that the costing of conversion of the foam lines should be based on the most cost-effective option which would also facilitate the better containment of the flammable blowing agent. The difference in cost of the two options is about US \$ 200,000

3. UNDP has requested to incorporate into the budget the cost of two power generators which were not part of the submitted proposal. Back-up power generators may be needed in the conversion to cyclopentane to provide power for ventilation and control system in case of power supply interruption. Usually, enterprises which experience regular power interruptions have back-up power generators in the baseline. The request for incorporation of two back-up power generators was not substantiated with the necessary references to the baseline conditions. furthermore, the Secretariat cannot accept additions to the proposed budget after the project has officially been submitted for the review by the Secretariat.

4. The Secretariat is seeking guidance of the Executive Committee on the issues of the consolidation of production and the incorporation of costs of two back-up power generators in the project.

4. The Secretariat discussed also the cost of civil works, the cost of trials and testing, and the cost of production equipment for isobutane refrigerant operation based on quotations received from international suppliers. Capital costs have been adjusted accordingly.

(c) Phasing out ODS at the refrigerator plant of Hefei Hualing Electronic Co. Ltd., China

1. The Secretariat discussed with UNDO the incremental capital and operating costs, in particular, the cost of modification of foaming jigs, capacity and cost of the cyclopentane storage, cost of nitrogen supply system, the eligibility of antistatic floor. The requested costs have been adjusted accordingly.

2. Incremental costs associated with HFC-134a compressors have been excluded from the calculation of IOC pending decision of the Executive Committee on this matter.

(d) Conversion of refrigerator manufacturer to cyclopentane foam blowing agent and HFC-134a refrigerant at Shanghai Haiou Electrical Appliance General Factory ("Haiou").

1. The proposal for Shanghai Haiou is the first commercial refrigeration project submitted for China. The proposal includes conversion of refrigerant part from CFC-12 to HFC 134a

2. The Secretariat discussed with the World Bank the eligibility of the cost of conversion of the refrigerant part in the project in light of China's strategy for CFC-12 phase out in the commercial refrigeration subsector. It was recognized that cost associated with the refrigerant part is ineligible for funding from the Multilateral Fund.

3. The Secretariat recommended to exclude the consumption of CFC-12 refrigerant from the calculation of the cost-effectiveness of Haiou project since phase-out of CFC-12 would be accounted for when the implementation of commercial compressor conversion projects approved for China will be completed, as is indicated in the China ODS Phase-out Strategy in the commercial refrigeration sub-sector. The World Bank agreed to exclude capital and operating costs related to the conversion of the refrigerant part from the project but it did not accept the Secretariat's recommendation to exclude the consumption of CFC-12 from the total ODP to be phased-out in the calculation of the cost-effectiveness.

4. The Secretariat proposed also to reclassify the project as a rigid foam project since it covers only the foam production operations. Two conversion projects are submitted to the 25th Meeting (Crios - Brazil and Rodriguez - Mexico) which are for foam production in commercial refrigeration application and which have been classified as rigid foam projects. This recommendation was not accepted by the World Bank.

5. The Secretariat is seeking guidance from the Executive Committee on the issues of accounting for the phase-out of CFC-12 when it takes place and reclassification of the project as a rigid foam project.

6. The Secretariat requested additional information from the World Bank on the baseline equipment. The Secretariat discussed with the World Bank the required capacity and the cost of cyclopentane storage. Subsequently, the cost for this item was reduced. Incremental operating costs have been recalculated to reflect the prevailing chemical prices in China.

RECOMMENDATIONS

1. The Secretariat recommends blanket approval of the project Phasing out ODS at the refrigerator plant of Hefei Hualing Electronic Co. Ltd. with the funding levels and associated support costs indicated in the table below.

Project Title	Project Cost US \$	Support Cost US \$	Implementing Agency
Phasing out ODS at the refrigerator plant of Hefei Hualing Electronic Co. Ltd., China.	785,984	102,177	UNIDO

2. Given the uncertainties on compliance of the project Conversion of HFC-134a as refrigerant and cyclopentane as foam blowing agent at refrigerator manufacturer Changling Huanghe Group Co. Ltd. (Changhe) with Decisions 17/7 and 20/20, the Secretariat cannot recommend the project for approval by the Executive Committee.

3. The guidance of the Executive Committee is sought on the issues described above in relation to the two projects:

- Conversion to cyclopentane and isobutane in the manufacture of domestic refrigerators at Hangzhou Household Electrical Appliance Industrial Corporation (HHEAIC)
- Conversion of refrigerator manufacturer to cyclopentane foam blowing agent and HFC-134a refrigerant at Shanghai Haiou Electrical Appliance General Factory ("Haiou")