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Executive Committee of
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Implementation of the Montreal Protocol

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Montreal, 16-18 October 1996

PROJECT PROPOSALS: ZIMBABWE

This document includes the Comments and Recommendations from the Fund Secretariat on the following projects:

Foam

- Conversion of production of CFC-11 polyol systems to HCFC-141b specific systems at Trinidad Industries World Bank

Refrigeration

- Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-22 refrigerant, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ref-air Refrigeration World Bank
- Conversion of CFC-12 refrigerator production to HFC-134a refrigerant and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Capri Refrigeration World Bank
- Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-22 refrigerant and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ajax Refrigeration World Bank

- Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-22 refrigerant, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Commercial Refrigeration World Bank
- Conversion of CFC-12 refrigerator production to HFC-134a refrigerant and CFC-11 to cyclopentane as the blowing agent for foam insulation at Imperial Derbi Refrigeration Ltd. World Bank

PROJECT EVALUATION SHEET **ZIMBABWE**

SECTOR: FOAM ODS use in sector (1994): 20 ODP tonnes

Sub-sector cost-effectiveness thresholds: Not applicable

Project Titles:

Conversion of production of CFC-11 polyol systems to HCF-141b specific systems at Trinidad Industries.

Project Data	
	Trinidad Industries
ODS phase-out (ODP tonnes)	2.26
Proposed project duration (Yrs)	Completed
Incremental capital cost (US\$)	62,764
Contingency (%)	N/A
Incremental operational cost (US\$)	0
Total project cost (US\$)	62,764
Local ownership (%)	100
Export component (%)	0
Amount requested (US\$) {Original	62,764
{Revised	
Cost effectiveness (US\$/kg)	27.80
National Coordinating Agency	Ministry of Environment & Tourism
Implementing Agency	World Bank
Technical review completed?	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	Pending

PROJECT DESCRIPTION

Conversion of production of CFC-11 polyol systems to HCF-141b specific systems at Trinidad Industries.

1. Trinidad has been producing CFC-11 based foam systems since 1981. A programme to make a polyol from local castor oil (xannol range of polyols) was started in 1993. The company both uses Polyol in-house to produce articles such as toilet seats and coffins, and supplies polyol to outside manufacturers where it is used in applications as diverse as refrigerator manufacture and tourist artifacts. Currently, Trinidad is experimenting with using the PU foaming system for building panel construction and roof insulation. These involve the use of PU foam in a sandwich with asbestos sheet and are intended as a building material for low cost housing.

2. The company developed and produced HCFC-141b specific polyurethane foam system and supplied quantities to its main clients for trials and testing following its own laboratory testing. A foam system with conductivity from 20-22 W-NK was produced.

3. The project costs over a period of three years (1993-1995), for which the company is requesting retroactive funding including:

• Research and development cost of 2,000 chemist hours/year (provided by 2 chemists)	US \$ 42,714
• Supervision and quality control/testing	4,271
• Production costs - cost of producing HCFC-141b polyol supplied to clients for trials and testing.	11,055
• Cost of raw materials (additional cost of raw materials resulting from the use of HCFC-141b)	4,724
TOTAL	US \$ 62,764

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

1. This is a research and development project for which the company is requesting retroactive funding of the cost of developing and producing for trials HCFC-141b-based systems. The company's costs do not include costs for equipment, but manhours for specialist work and cost of producing about 16.7 tonnes of polyol for testing and field trials.
2. Five projects from Zimbabwe in the commercial and domestic refrigeration sub-sectors converting to HCFC-141b are being recommended for blanket approval at the 20th Meeting. These projects are claiming operating costs arising from the use of HCFC-141b and the associated foam formulation.
3. The eligibility of the proposed project is in doubt since it could constitute double counting.

RECOMMENDATIONS

1. Pending.

PROJECT EVALUATION SHEET **ZIMBABWE**

SECTOR: REFRIGERATION ODS use in sector (1993): 200 ODP tonnes
 Sub-sector cost-effectiveness thresholds: Domestic US \$13.76/kg
 Commercial US \$15.21/kg

Project Titles:

- (a) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ref-air Refrigeration.
- (b) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Commercial Refrigeration.
- (c) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ajax Refrigeration.
- (d) Conversion of CFC-12 refrigerator production to HFC-134a, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Capri Refrigeration.
- (e) Conversion of CFC-12 refrigerator production to HFC-134a, and CFC-11 to cyclopentane as the blowing agent for foam insulation at Imperial Derby Refrigeration Ltd.

Project Data	Commercial			Domestic	
	Ref-air	Commercial Refrigeration	Ajax	Capri	Imperial Derby
ODS phase-out (ODP tonnes)	5.3	6.9	3.5	5.9	14.0
Proposed project duration (Yrs)	4	4	5	2	3
Incremental capital cost (US\$)	43,468	144,018	56,093	75,000	1,283,356
Contingency (%)	10	10	10	10	10
Incremental operational cost (US\$)	15,416	33,362	17,136	37,680	96,480
Total project cost (US\$)	58,884	177,380	73,229	112,680	1,379,836
Local ownership (%)	98	100	100	100	51.1
Export component (%)	0	0	0	0	0
Amount requested (US\$) {Original	51,975	177,380	73,229	112,680	705,096
{Revised	43,382	156,636	61,966	106,695	310,000
Cost effectiveness (US\$/kg)	8.18	22.7	17.7	18.08	14.39
National Coordinating Agency	MET	MET	MET	MET	MET
Implementing Agency	World Bank	World Bank	World Bank	World Bank	World Bank
Technical review completed?	Yes	Yes	Yes	Yes	Yes

Secretariat's Recommendations					
Amount recommended (US \$)	43,382	156,636	61,966	106,695	310,000
Project impact (ODP tonnes)	5.3	6.9	3.5	5.9	14.0
Cost effectiveness (US \$/kg)	8.18	22.7	17.7	18.08	14.39
Implementing Agency support cost (US\$)	5,640	20,363	8,055	13,870	40,300
Total cost to Multilateral Fund	49,022	176,999	70,021	120,565	350,300

PROJECT DESCRIPTION

- (a) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ref-air Refrigeration.
- (b) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Commercial Refrigeration.
- (c) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ajax Refrigeration.
- (d) Conversion of CFC-12 refrigerator production to HFC-134a, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Capri Refrigeration.
- (e) Conversion of CFC-12 refrigerator production to HFC-134a, and CFC-11 to cyclopentane as the blowing agent for foam insulation at Imperial Derby Refrigeration Ltd.

Commercial Refrigeration

1. ODS consumption in the refrigeration sector in Zimbabwe is about 200 MT. There are five main companies involved with assembling refrigeration equipment in the commercial sub-sector. A wide range of unitary and non-unitary equipment is produced by these companies. There is also a network of servicing shops using CFC-12, R-502 and HCFC-22 refrigerants.

2. This proposal covers conversion of three commercial refrigeration enterprises (Ref-air, Commercial and Ajax) from CFC-11 based foaming operation to HCFC-141b blowing agent and from CFC-12 to HCFC-134a refrigerant for medium temperature, and from R502 to HCFC-22 for low temperature installations. In the case of Ref-air, part of their production was converted from CFC-12 to ammonia absorption technology.

3. Conversion to HCFC-141b blowing agent has already been implemented by the three companies by modifying existing low pressure foaming machines, either at no cost or at very moderate cost. Where costs were incurred, they are being requested retroactively.

4. 5.9 ODP tonnes of CFC-11 have been phased out by the three companies, 9.8 ODP tonnes of CFC-12 will be phased out upon implementation of the conversion of the refrigeration system in the three companies.

5. Conversion of the refrigerant part requires replacement of charging units, leak detectors, gauges, retrofitting and replacement of vacuum pumps, purchasing recovery/recycling machines, testing and training.

6. Operating costs associated with higher cost of material and higher foam density are requested for six months duration.

Domestic Refrigeration

7. There are two major manufacturers of domestic refrigeration appliances, they are Imperial Derby and Capri. There are also smaller retailers who have integrated operations and are also engaged in limited assembly of new units.

8. The two projects cover phase out of 20.9 ODP tonnes by converting from CFC-11 to cyclopentane in Imperial Derby and HCFC-141b in Capri as a blowing agent, and from CFC-12 to HFC-134a as a refrigerant in both companies.

Imperial Derby Refrigeration

9. Imperial Derby Refrigeration is the largest domestic refrigerator manufacturer in Zimbabwe with 48.9% ownership by Derby and IFU, Denmark. Imperial's existing 12,000 units annual production will be increased to 50,000 in a new purpose built factory. The number of models will be increased from 7 to 13. The technology of choice for foaming operations is based on cyclopentane. Suitable foaming equipment has already been purchased and installed and is currently used for HCFC-141b foaming over a transitional period. About 10.5 of CFC-11 has been already phased out. The enterprise is in the process of purchasing safety related equipment to convert to cyclopentane.

10. Conversion to HFC-134a refrigerant will involve replacement of charging boards, leak detectors, vacuum pumps, trials, testing and training. About 3.5 of CFC-12 will be phased out upon implementation of the conversion to a new refrigerant.

11. Capital costs of conversion have been calculated on the basis of pre-expansion of production. Operating costs due to higher density of cyclopentane based foam are requested for a six month duration also on the basis of pre-expansion output.

Capri

12. Capri is the second largest domestic refrigerator manufacturer in Zimbabwe. The annual production is about 8,000 units per year.

13. 4.5 ODP tonnes of CFC-11 have been phased out by converting from CFC-11 to HCFC-141b blowing agent. 1.4 ODP tonnes will be phased out resulting from conversion from CFC-12 to HFC-134a refrigerant.

14. Modification of existing low pressure foaming equipment to use HCFC-141b blowing agent has been already undertaken at the cost of US \$5,000.

15. Conversion to HFC-134a refrigerant entails replacement of vacuum pumps, leak detectors, charging units and service tools.

16. Operating costs associated with the higher cost of materials are requested for a six month duration.

Justification of the Use of Transitional Substances

17. The World Bank reported that cyclopentane would have been a very good choice for an ultimate solution for Ref-air, Commercial Refrigeration, Ajax and Capri enterprises, but was rejected as uneconomical and impractical, given the scope and nature of the companies' operation. There is no customer demand to convert to cyclopentane. Cyclopentane is not commercially available currently in Southern Africa and no potential source has been identified to date. Non-flammable zero ODP options are currently being trialed (e.g. HFC-245a), if successful, suppliers predict their availability towards the end of 1998. These will be "drop in" replacements for HCFC-141b and thus transition to these substances would be made without any significant further costs.

18. HCFC-22 was selected by Ajax, Ref-air and Commercial Refrigeration companies as the most suitable substitute for low temperature applications. HFC blend options are expensive and need the extra engineering not required to accommodate HCFC-22 on low temperature equipment. HCFC-22 is compatible with mineral oil. It is recognized that this is a transitional solution only. A zero ODS substitute such as an HFC based blend will be selected at a later date when a clear market leader has been established and more experience in their use has been accumulated in developed countries.

19. It should be noted that there is considerable resistance to the use of HFC blends to replace R-502 in Zimbabwe. It is also reported that about 70% of new low temperature refrigeration equipment in Europe is specified for either HCFC-22 or HCFC-22 based blends. Therefore, the refrigeration equipment manufacturers in Zimbabwe consider HCFC-22 as the most preferable option.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

1. The World Bank provided the justifications for choosing HCFCs as interim solution for all the enterprises except for one. The latter is to convert to cyclopentane. One of the justification provided for the use of HCFCs technology, stresses the lack of commercial availability of cyclopentane in Southern Africa. The World Bank did not explain how and when cyclopentane will be made available to enable conversion of Imperial Derby.

2. The Secretariat discussed with the implementing agency the eligibility and incrementality of all cost items. Cost of foaming equipment, cyclopentane storage and charging units have been reduced to reflect the standard prices for this type of equipment.

3. Operational costs have been adjusted to reflect the prevailing density of the foam system and prices of materials. Since, the price of cyclopentane used for calculation of operating cost is speculative given the fact that cyclopentane is not yet available in the Zimbabwe market, international price for cyclopentane has been used for the calculation of operating cost. Capital and operating costs in the project budgets have been adjusted accordingly.

4. The cost-effectiveness of four projects is above cost-effectiveness threshold value. Zimbabwe is a low ODS consuming country, therefore, the cost-effectiveness threshold has not been applied.

RECOMMENDATIONS

1. The Fund Secretariat recommends blanket approval of the project with associated costs at the funding level shown in the table below:

	Project Cost US \$	Support Cost US \$	Implementing Agency
(a) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ref-air Refrigeration.	43,382	5,640	World Bank
(b) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Commercial Refrigeration.	156,636	20,363	World Bank
(c) Conversion of CFC-12 commercial refrigeration equipment production to HFC-134a and HCFC-141b refrigeration, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Ajax Refrigeration.	61,966	8,055	World Bank
(d) Conversion of CFC-12 refrigerator production to HFC-134a, and CFC-11 to HCFC-141b as the blowing agent for foam insulation at Capri Refrigeration.	106,695	13,870	World Bank
(e) Conversion of CFC-12 refrigerator production to HFC-134a, and CFC-11 to cyclopentane as the blowing agent for foam insulation at Imperial Derby Refrigeration Ltd.	310,000	40,300	World Bank