UNITED
NATIONS

EP

United Nations
Environment
Programme

Distr.
LIMITED

UNEP/OzL.Pro/ExCom/22/73
29 April 1997

ORIGINAL: ENGLISH

Executive Committee of
the Multilateral Fund for the
Implementation of the Montreal Protocol

Twenty-second Meeting
Nairobi, 28-30 May 1997

INCREMENTAL OPERATING COSTS FOR DOMESTIC REFRIGERATION COMPRESSORS

This paper does not include the comments of the implementing agencies.

Introduction

1. This paper is submitted in response to decision 21/9 of the Executive Committee which states:

> "that incremental operating costs for the following projects, deferred at the Twentieth Meeting of the Executive Committee (decisions 20/22 and 20/27), would be considered at the Twenty-second Meeting, together with the policy paper on incremental operating costs for domestic refrigeration compressors: conversion of manufacturing facilities from CFC-11 foaming agents to cyclopentane and CFC-12 refrigerant to HFC-134a at Gansu Changfeng Baoan (China); conversion of compressor manufacture from CFC-12 to HFC-134a designs at Sanyo Universal Electric Co., Ltd. (Thailand); conversion of compressor manufacture from CFC-12 to HFC-134a, Phase 2, at Kulthorn Kirby Public Company Limited (Thailand). Incremental operating costs for the projects should be presented on the basis of the policies and guidelines currently available and also on the basis of the options arising from the policy paper."

Background

2. Seventeen domestic refrigeration compressor conversion projects have been approved by the Executive Committee since 1992 for nine Article 5 countries, with a total production level of 12 million compressors per year. Of this total, some 10.7 million per year will be used with HFC-134a refrigerant and the remainder with hydrocarbon refrigerant.

3. In particular, the Executive Committee approved capital costs of Phase 2 of two projects in Thailand at its 20th Meeting. Thus, the two phased conversion of compressor manufacture from CFC-12 to HFC-134a at Kulthorn Kirby Public Co. Ltd., was funded at a total sum of US $1,494,234 and conversion of compressor manufacture from CFC-12 to HFC-134a at Sanyo Universal Co. Ltd. was funded at a total sum of US $1,662,680, for the production of 1.2 million and 1.5 million units annually, respectively.

4. The Government of Thailand indicated that Thailand's strategy for the domestic refrigeration sector is to provide any eligible incremental operating costs for compressors to compressor manufacturers and not to refrigerator manufacturers.

5. Apart from the Thai compressor projects submitted to the 20th Meeting, no incremental operating costs were calculated or requested in any of the compressor conversion projects approved by the Executive Committee.

6. Thus, currently, there are no specific policies or guidelines upon which to base a determination of eligible incremental operating costs for conversion of domestic refrigeration compressors.

7. However, in connection with the projects in Thailand, the World Bank has proposed that incremental operating costs be paid by the Multilateral Fund on the basis of the incremental cost of the new lubricant required to be used with HFC-134a compressors intended for domestic use, calculated for a period of six months.

8. Using this methodology, taking the incremental cost of the lubricant proposed by the World Bank (US $1.54/compressor) and the annual compressor production figures intended for domestic use, the level of incremental operating cost for the two enterprises would be:

Sanyo:	US $577,500
Kulthorn Kirby:	US $457,050

9. If this methodology had been used in all previously approved projects for the production of HFC-134a compressors, and these costs had been claimed and approved, the additional funding which would have been provided from the Multilateral Fund for existing HFC-134a compressor conversion projects amounts to some US $8.26 million.

10. There are a number of significant uncertainties associated with calculating incremental operating costs on the basis of this methodology. They include:

(a) The costs of specialized commodities such as lubricating oil are difficult to confirm at the regional and enterprise level. The degree of variation present in this issue could potentially double the liability of the Fund for compressor incremental operating costs. It is to be noted that the World Bank estimated the cost of lubricant in the Thai projects to be US $1.54 per unit, while it used a cost of US $0.70 per unit in a project in Turkey;

(b) the number of compressors to be compensated for and the potential for double counting. In the case of Thailand, the Government has analyzed the sub-sector and determined an overall approach. However, there still exists a difference of over 72 per cent between the number of compressors proposed for compensation by the World Bank (2.025 million) and the eligible production level based on the use of compressors by Thai refrigeration manufacturers funded by the Multilateral Fund (1.18 million), as established by the Fund Secretariat;

(c) The difficulty in establishing to whom the costs should be paid. For example, the Sanyo compressor Company does not incur the cost for the lubricant since it is added to the compressor by the refrigerator manufacturer.

11. The above uncertainties are present in the case of Thailand where there are only a small number of manufacturers and the Government has analyzed the sub-sector and determined a strategy. In larger countries, it is more difficult to determine the number of compressors which are eligible for compensation. For example, in regard to Gansu Baoan Industry Co. Ltd., China, the World Bank has requested incremental operating cost for new HFC-134a compressors at

US $5.42/unit which represents US $190,000. However, the Executive Committee has already approved US $5.1 million for conversion of compressor manufacturing facilities to HFC-134a technology in China This provides sufficient capacity to supply compressors to all refrigerator manufacturing facilities which will be committed to HFC-134a technology including Gansu Baoan Changfeng. Incremental operating costs were not requested in any of the approved compressor projects.

12. Similarly, other countries have both compressor manufacturing enterprises and refrigerator manufacturers, and projects for the conversion of some, but not all, of each group have already been funded. In some situations compressor conversion projects are going to be submitted at a later stage but full incremental operating cost for imported compressors are being requested now in refrigeration manufacturing projects. Thus is would be extremely difficult to establish the number of compressors which might be eligible for incremental operating costs on the basis of supply of compressors to individual enterprises in the same, or other Article 5 countries.

Modality for Funding Compressor Conversion

13. To overcome the disadvantages arising from the uncertainties outlined above the Fund Secretariat has attempted to develop a specific modality to address compensation for both capital and incremental operating cost for conversion of domestic refrigeration compressors. In considering a modality for compressor conversion, the following points might be borne in mind.

14. In almost all the cases, proposals for conversion of domestic refrigeration compressors were not submitted as part of a comprehensive strategy covering the entire domestic refrigeration sector. The absence of strategic planning and the extensive delay in implementation led the refrigerator manufacturers to import the requisite non-ODS compressors in order to complete implementation of the investment projects approved for them.

15. In order to prevent double counting, potentially involved in funding of an Article 5 country's conversion of both compressor and domestic refrigerator manufactures, the Executive Committee did not approve the incremental operating costs (US $3/compressor on average) associated with compressors in projects submitted in the domestic refrigerator sub-sector in such countries, except in few cases.

16. The Executive Committee has always approved all the eligible incremental capital costs requested for conversion of compressor manufacture. Incremental capital costs were requested for a variety of items which varied from project to project. Capital costs ranged from as low as US $0.5 million to as high as US $2.9 million per project. Production capacity ranged from 330,000 to 1.8 million units per enterprise per year.

17. The Executive Committee established at its 16th Meeting cost-effectiveness thresholds for all consumption sectors except that of mobile air conditioning and compressors. Thus, the Committee noted at that meeting that "it was difficult to determine cost-effectiveness thresholds

for the mobile air conditioner and compressor sub-sectors and therefore agreed that an amount of US $8,900,000 should be reserved for funding these projects in 1995." (UNEP/OzL.Pro/ExCom/16/20, para 32(f)).

18. Conversion of compressor manufacture entails change of the cleaning process which invariably results in savings. These savings were not reported in project proposals and were not considered in the calculation of the incremental cost of compressor projects.

ODS phase-out

19. Conversion of a compressor manufacturing facility does not phase out the refrigerant CFC-12 except when incorporated in a refrigeration system.

20. Thus, compressor conversion projects which are not implemented prior to the implementation of domestic refrigeration conversion projects will not contribute to the immediate phase-out of CFC-12 realized from the implementation of domestic refrigeration projects. It will, however, avoid the use of CFCs at a future date only.

Potential for double counting

21. The price of a HFC-134a compressor is currently about US $3.00 higher than a CFC-12 compressor. New HFC-134a compressors represent a new and more efficient generation of compressors. The increase in the price reflects development and capital recovery factor as well as cost of the lubricant which is more expensive. The detailed structure of price increase is very difficult to assess since it may include increased profit margin which entirely depends on the market situation. It is, however, expected that prices of a CFC-12 compressor may rise to that of a HFC-134a compressor in the near future.

22. The increase in the price of the CFC-free compressor has always been claimed as part of the incremental operating costs in domestic refrigeration conversion projects. On average, a cost of US $3 per compressor was paid for a period of 6 months to such enterprises in Article 5 countries where there is no indigenous compressor production. Generally, Article 5 countries with funded compressor conversion projects did not receive this part of the incremental operating costs in their domestic refrigerator projects.

23. Compressor manufacturers in Article 5 countries will potentially supply their compressors to local refrigerator companies. They also may export their product both to other Article 5 and non-Article 5 countries. Cost of compressor conversion funded from the Fund can be passed on to refrigerator manufacturers in other Article 5 countries. Funding for exports to non-Article 5 countries is regulated by the guidelines approved at the 15th Meeting of the Executive Committee. There is no regulation, however, of funding for export to Article 5 countries. Therefore, it is difficult to identify the final purchaser of compressors sourced from a specific compressor company which received funding from the Fund. Only in a few instances where

detailed information was provided on the source of compressors has it been possible for the Secretariat to identify and exclude such double counting.

The need for establishing cost-effectiveness thresholds

24. The funding so far approved for compressor conversion should be examined against the funding level of what would have been available to a country under the current rules and policies of the Executive Committee had there been no compressor projects funded, and all costs are provided through incremental operating cost for refrigerator manufacturers at international prices without considering cost-effectiveness threshold limits.

25. The Secretariat has examined all the projects approved by the Executive Committee for compressor conversion to HFC-134a technology. The total funding available to a country which manufactures compressors would exceed by a factor of 1.64 the level of funding which a similar country importing compressors would be eligible to receive.

26. Additionally, if incremental operating costs were paid to the compressor manufacturer for the new lubricant in the amount of US $ 1.0 per unit for a period of six months, the funding level of a country which manufactures compressors would exceed by a factor of 2 the funding level of a country which imports compressors.

27. The increase in cost of a non-ODS compressor is part of the eligible incremental operating cost of refrigerator manufacturing conversion projects, and is thus included in the cost-effectiveness calculations and capped by the threshold established in the domestic refrigeration sector. Compressor projects, however, are not subject to the cost-effectiveness criteria since no threshold limit exists for this sub-sector as was recognized by the Executive Committee at its 16th Meeting.

28. Cost-effectiveness is calculated as the amount of the eligible grant, comprising capital and operating costs, divided by the amount of ODS to be phased out in ODP tonnes. Since conversion of compressors does not lead to direct phase-out of ODS, a different methodology is proposed to establish cost-effectiveness threshold for this sector.

Method of calculation cost-effectiveness threshold in compressor projects

29. Annex I provides a table which gives a summary of all the relevant compressor conversion projects approved by the Executive Committee. The table indicates that the adjusted average of incremental capital cost is US $1.97 per unit per year, which is 33% higher than the average incremental operating costs associated with the ODS free compressors claimed by domestic refrigerator conversion projects for a six-month period in countries without indigenous compressor production.

30. To avoid the high degree of uncertainty in calculating the net incremental operating costs per unit, as well as the number of compressor units supplied for conversion of local refrigerator

production, it is proposed that a percentage of the eligible capital cost may be considered as a better assessment of incremental operating cost. It is to be recalled that a level of 10% of capital cost was decided as an option for compensating for incremental operating costs in the domestic refrigeration sector. It is, therefore, proposed that this method be used as a basis for compensation for incremental operating cost in HFC-134a compressor projects.

31. It is suggested that US $2.00 per unit per year be taken as the threshold value in compressor conversion projects. As a check on this figure, the 'percentile' methodology used to establish all other cost-effectiveness thresholds can be applied to already approved compressor conversion projects. Applying the 18th percentile, which was the figure used at the 16th meeting, would result in US $1.40 per unit as the threshold value for domestic refrigeration compressors. The figure of US $2.00 proposed above corresponds to the 47th percentile.

Recommendations

32. The Executive Committee is requested to consider the following recommendations:

(a) establish cost-effectiveness threshold value of US $2.00 per unit per year for compressor conversion projects;

(b) incremental operating costs calculated on the basis of 10% of capital costs could be paid, if requested, to enterprises converting to the production of HFC-134a compressors, provided that the threshold value of US $2.00 per unit is not exceeded;

(c) no incremental operating costs associated with the CFC-free compressors should be paid to refrigerator producers in Article 5 countries in which both conversion of compressor and refrigeration system are funded by the Multilateral Fund;

(d) in the case of the two Thai projects, incremental operating costs at a level of 10% of capital costs should be considered as eligible, subject to the proposed compressor sub-sector threshold of US $2.00, as detailed in Annex II;

(e) in the case of Gansu Changfeng Baoan project in China, no incremental operating cost for compressors would be payable as the enterprise is a refrigerator manufacturer and both conversion of compressor and refrigerator manufacturing are funded by the Multilateral Fund.

ANNEX I

Compressor Projects in the Domestic Refrigeration Sector

No.	Project	Production Unit/yr	Cost Approved US $	Cost per Unit US $/unit
1	Kirloskar, India	56,800	547,900	9.65
2	Elgin, Brazil	180,000	460,339	2.56
3	Andinos, Colombia	330,000	313,648	0.95
4	PEG Profilio, Turkey	400,000	170,395	0.43
5	Facosa, Mexico	421,425	584,000	1.39
6	Shriram, India (Phase 1)	488,000	685,000	1.40
7	Shanghai, China	800,715	1,280,000	1.60
8	Arcelic, Turkey	500,000	1,500,000	3.00
9	Dongbei, China	516,000	899,030	1.74
10	Comesa, Mexico	592,000	1,884,724	3.18
11	Xian, China	412,685	1,599,000	3.87
12	Jiaxipera, China	1,077,592	1,490,000	1.38
13	ZEL, Tiajing, China*	1,199,621	834,300	0.70
14	Kulthorn Kirby, Thailand	1,200,000	1,494,234	1.25
15	Sanyo, Thailand	1,500,000	1,662,680	1.11
16	Wanbao, China	1,250,198	2,250,000	1.80
17	MCMC, Egypt	1,800,000	2,100,000	1.17
	TOTAL:	12,725,036	19,755,250	37.17
	Adjusted average **			1.97

* Submitted for blanket approval by the 22nd Executive Committee Meeting

** Calculated without outlyers (Kirloskar and Profilio projects) and without Shriram project which was approved for Phase 1 only.

ANNEX II

Presentation of Incremental Operating Costs for Conversion of Compressor Manufacture from CFC-12 to HFC-134a Designs at Sanyo Universal Electric Co., Ltd.; Conversion of Compressor Manufacture from CFC-12 To HFC-134a, Phase 2, at Kulthorn Kirby Public Company Limited (Thailand) for Projects on the Basis of the Policies and Guidelines Currently Available and also on the Basis of the Options Arising from the Policy Paper.

1. Decision 21/9 requests presentation of the operating costs of the two Thai and the Chinese projects on the basis of the current guidelines and policies and on the option arising from this policy paper.

Kirby and Sanyo Projects

2. The two companies produce 2.7 million compressors per year of which 2,025,000 units are for domestic use.

3. Four domestic refrigerator manufacturers source their compressors from Kirby and Sanyo. The level of production of those manufacturers eligible for incremental cost compensation is estimated at 1.18 million refrigerator units per year. However, the amount of the compensation will have to be capped at the level allowed by the threshold value.

4. The following Table gives a comparison between the amounts requested by the World Bank, and those estimated by the Secretariat according to the current rules. In this comparison two estimates are used for the incremental lubricant costs, i.e., US $0.70 and US $1.54 per unit.

Refrigerator Enterprises using Sanyo and Kulthorn Kirby Compressors	Eligible Production level (Unit/yr)	Local Ownership %	IOC/6 months	
			US $0.7/kg lubricant	US $1.54/kg lubricant
Kang Yong	115,000	60	24,150	53,130
Thai Toshiba	204,245	54.5	38,959	85,709
Sanyo Electric	740,000	65	168,350	370,370
AP National	121,418	55	23,372	51,418
TOTAL:	1,180,663		254,831	560,627

5. Allocations already provided to Kang Yong company for capital equipment exceeded the total funding available under the cost-effectiveness threshold applicable to the sector. No additional funding can be provided to this company. Therefore, the total eligible incremental costs

for lubricant for two compressor companies will be the sum of the entitlements of the other three companies i.e., US $230,681 at US $0.7/kg cost of lubricant or US $507,627 at US $1.54/kg cost of lubricant.

6. It might be noted that the Sanyo compressor company does not incur the cost for lubricant. The lubricant is added to the compressor at the Sanyo refrigerator plants.

7. Calculation of eligible operating cost for Kulthorn Kirby and Sanyo Compressor conversion projects in Thailand on the basis of options arising from the policy paper are:

Kulthorn Kirby

Total funding at US $1,494,234 has been approved for Phase 1 and Phase 2 conversion. The reported production level is 1,200,000 units per year. Incremental operating costs calculated at 10% of total capital cost will be US $149,423.

Total cost of the project is US $1,643,657.

Sanyo Project

Total funding at US $1,662,620 has been approved for Phase 2 and Phase 1 conversion. The reported production level is 1,500,000 units a year. Incremental operating costs calculated at 10% of total capital costs will be US $166,268.

Total cost of the project is US $1,828,948.