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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
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**COST FOR CONVERSION OF COMPONENT MANUFACTURING VS. INCREMENTAL
OPERATING COST (DECISION 59/14)**

1. The Secretariat identified during the preparation for the 59th Meeting of the Executive Committee an issue related to the cost for conversion of component manufacturing vs. incremental operating cost.
2. The project for the conversion of HCFC-based air-conditioning equipment in Jordan, which had been submitted to the 59th Meeting, contained substantial incremental capital costs for conversion of one component of the air-conditioning unit, the heat exchangers. The same category of costs were also substantial in one project proposal submitted to the 60th Meeting for conversion of air conditioning equipment in China.
3. The related issue is two-fold namely, whether cost for the manufacturing of components is eligible versus a possible increase in incremental operating cost, and whether in particular the retooling of heat exchanger production would constitute incremental cost.

Manufacturing of components vs. increased incremental operating costs

4. The implementing agencies propose that the Multilateral Fund should fund the conversion of the manufacturing of components in cases where a producer of refrigeration and air conditioning projects manufactures such components in-house. This leads to the more generic issue of funding of cost increases for components of products manufactured with or containing ODS. The Executive Committee might either fund the conversion of the manufacturing of the components, or incremental operating costs (IOCs), for the manufacturers of the final products. Should the Executive Committee decide to fund the conversion of in-house component manufacturing, this might consequently lead to enterprises that only manufacture such components receiving support as well. Alternatively, the Executive Committee could fund IOCs for those manufacturers of refrigeration and air conditioning products that do not receive support for the conversion of component manufacturing, on the assumption that those would have to purchase their components on the open market. In this second case, in order to avoid double funding, the Executive Committee would have to establish barriers to avoid leakage of components manufactured in facilities converted as part of Multilateral Fund activities to enterprises that receive IOCs for these components as part of their funded conversion. Thus, three options are possible, differentiated by sub-sector: the funding of the conversion of only component manufacturing without paying IOCs for these components; the payment of IOCs for these components without funding of the component manufacturing; or, a combination of both with additional barriers to avoid double funding.
5. A similar issue in terms of component funding has already been discussed by the Executive Committee in the past, i.e. whether to fund IOCs for a key component, the compressors, or to fund the conversion of the compressor manufacturers. The Executive Committee had taken the related decision 26/36 in order to avoid double funding. The decision of that meeting differentiated between countries, which had both component manufacturers and equipment manufacturers – where equipment manufacturers would not receive IOCs if component manufacturers received conversion funding, and countries that had only equipment manufactures where IOCs would be paid.
6. The underlying assumptions of that decision appear to have been a limited export of compressors from Article 5 countries, and partial sourcing of components from non-Article 5 countries. However, in the eleven years since the 26th Meeting, the global exchange of goods has increased dramatically, and it is no longer possible to avoid double funding on the basis of national borders. In addition, one can assume that the predominant share of component manufacturing for air conditioning equipment is today located in Article 5 countries. Consequently, the Secretariat proposes that the Executive Committee revisits this decision, since a differentiation as provided for in the decision from the 26th Meeting appears no longer able to result in avoidance of double funding. The Multilateral Fund should either fund the cost increases of components through incremental operating costs or by covering the conversion costs of component manufacturers, and should aim at avoiding a mixture of the two concepts.

7. During the related discussion at the 59th Meeting of the Executive Committee, several Members spoke in support of funding component manufacturers and excluding downstream funding. Others felt that the criteria should not be changed. After some initial discussion the issue was deferred for consideration at the 60th Meeting as per decision 59/14.

Incremental cost of heat exchangers

8. As part of the review of project submissions, the Secretariat identified as one issue the question whether the conversion of heat exchanger production would be considered as an incremental cost. The following paragraphs attempt to explain the very technical aspects of the issue to enable the Executive Committee to take an informed decision on the matter.

9. The heat exchanger production referred to in this document relates to the production of refrigerant-to-air heat exchangers¹. These consist typically of a number of copper tubes with plate-like aluminium fins perpendicular to them, and there are usually several copper tubes through each fin. The manufacturing of the fins is done with complex dies which punch and form the fin using multiple hits. The external diameter of the tubes is minimally smaller than the diameter of the holes in the fins, so the fins can be aligned easily on a set of tubes. Typically, the tubes have been straightened previously and bent into a U-shape (“hairpins”), so that each tube goes twice through the heat exchanger; one heat exchanger can have numerous tubes. The tubes are laced into a stack of fins (up to several hundred) on a horizontal table. Once all of the hair pins have been placed into to the stack of fins, a rod with a precision ball tip slightly larger than the tubes inner diameter is pushed through the tube, enlarging the tubes interior and, therefore, outer diameter slightly, and so creating a fit between the tube and the fin. In high speed production all of the tubes are expanded at the same time. In very low volume production, the tubes are sometimes expanded one tube at a time. These heat exchangers are called tube-and-fin heat exchangers.

10. Refrigerant-to-air heat exchangers are very common in refrigeration and air conditioning systems, in particular in large scale production of systems. In cases of mass production the heat exchangers are either optimised for each model and purchased from an external supplier or optimised for the manufacturer’s model range and manufactured on site. Typically the same external tube diameter would be used for units with a wide range of capacities. In case of small scale production of refrigeration and air conditioning equipment, the heat exchangers are typically bought from a range of available models offered by a supplier. These heat exchangers do not substantially differ in their design or material between HCFC-22 technology and the various current HCFC-22 alternatives (except for ammonia and CO₂).

11. According to technical experts consulted by the Secretariat, it is not necessary to reduce the diameter of the tube when changing from HCFC-22 to R-410A or R-32; this is also the case for changes to HFC-407C and the hydrocarbons HC-290 and HC-1270. However, a small adjustment of the tube wall thickness is needed to increase the strength for the higher operating pressures of R-410A or R-32. This approach requires significantly less capital investment in equipment, and is therefore preferred by manufacturers. Another alternative is the use of specific, more expensive types of copper for the tubes that makes them more pressure resistant while having the same dimensions, or a combination of both. Reducing the external tube diameter, as requested in some project proposals, can result in system miniaturization and cost reduction. However, as demonstrated in project submissions, the costs for the re-tooling of a smaller external diameter tube are very significant. Coils for CO₂ based systems would potentially need to use smaller diameter tubes because of the very high operating pressures of CO₂ systems and the different capacity per volume.

¹ More precisely, air-to-refrigerant evaporators and refrigerant-to-air condensers

12. The machines for the production of heat exchangers are to some extent customized, in particular for the external tube size. A change in external tube size will lead to a replacement need for the equipment, in particular the dies for manufacturing of fins, the machines to bend the copper tubes, auto-brazing equipment and the machines used to expand the tubes. All these are usually fully automated precision production machines with relatively high modification or replacement costs.

13. In case of purchase of heat exchangers from external suppliers, the supplier will ask for some mark-up, and sometimes a supplier will not be able to meet high production volumes without making additional capital investments. Therefore large manufacturers will typically build their own heat exchangers while small manufacturers would find it more cost effective to purchase their heat exchangers from a specialty supplier. Should the supplier be flexible in its production set-up and able to supply heat exchangers with tubes of various external diameters a reduction in tube diameter, if desired, often might lead to the use of less copper in the production, which tends to reduce heat exchanger production costs and, therefore, market prices. In such cases, the refrigerant filling for the unit will also decrease, which leads to additional cost savings. However, as explained above, the Secretariat does not see these elements as related to the conversion from HCFC-22 to an alternative.

14. Companies are presently used to manufacturing their own heat exchangers in house, which provides them with a higher flexibility in designing and manufacturing larger air conditioning systems according to customers specification and might also yield some savings in operational costs. Consequently, due to the present lack of demand external manufacturers with sufficient capacity might currently not be available in acceptable proximity to all manufacturing facilities. In terms of transition times, independent of whether the manufacturing of heat exchangers is done within an air conditioner manufacturer or at a specialised supplier, the Secretariat would like to point out that equipment used to produce air conditioner heat exchangers is complex and available only from a small base of suppliers. The regular lead time to purchase this equipment can range from 12-24 months depending on the number of manufacturers that are purchasing equipment at a given time. Should the number of projects initiated by the Multilateral Fund accelerate the rate of orders, further delays are likely².

15. The Executive Committee might wish to consider the suggestion in sub paragraph (a) and, in addition, the suggestions contained in sub-paragraphs (b) to (e) establishing eligibility of the conversion of component manufacturing, or alternatively (f) as below, establishing eligibility of IOCs for components:

- (a) Not to treat as an incremental cost, in case of conversion of refrigeration or air conditioning systems from HCFC to a hydrocarbon or an HFC, the capital costs related to retooling for a change in diameter of the tubing within tube-and-fin heat exchangers, since these are considered to constitute an avoidable technical upgrade;

And

- (b) To discontinue funding of incremental operating cost for components, and instead fund conversions of component manufacturers and component manufacturing facilities in the production of air conditioning equipment;
- (c) Not to include any incremental operating cost in the funding provided for manufacturers of components; and

² As an example, there is anecdotal evidence that prior to the change in minimum efficiencies in the United States of America in 2006 which led to the necessity to change heat exchanger designs and, therefore, retool, the worldwide lead time for some heat exchanger manufacturing equipment increased to nearly 36 months.

- (d) To establish a list of components, the manufacturers of which might be viewed as eligible for funding, and to enclose in that list compressors;
- (e) To exclude facilities where less than 50 per cent of the production is for components for HCFC equipment, and for those with higher levels to deduct from the incremental cost the share of the non-HCFC components produced;

Or

- (f) To include incremental operating cost related to higher component costs within the definition of incremental operating costs, and not to allow funding for conversions of component manufacturers or a component manufacturing facility within an equipment manufacturer.
