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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Sixty-second Meeting
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INCREMENTAL COSTS RELATED TO RETOOLING FOR MANUFACTURING HEAT EXCHANGERS (DECISION 61/45)

Pre-session documents of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol are without prejudice to any decision that the Executive Committee might take following issuance of the document.

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 versus incremental operating cost. Through decision 59/14 the Executive Committee decided to defer the discussion to the 60th Meeting and, subsequently, in decision 60/45 to defer it to the 61st Meeting.

2. At the 61st Meeting, the issues raised in the related document UNEP/OzL.Pro/ExCom/61/51 were discussed and resolved, except for the question of funding for the conversion of heat exchanger manufacturing. Consequently, the Executive Committee took decision 61/45 (c), requesting the Secretariat to prepare a document, based on the relevant sections of document UNEP/OzL.Pro/ExCom/61/51, on the level of incremental costs related to retooling for manufacturing of tube-and-fin heat exchangers to be considered by the Executive Committee at its 62nd Meeting.

Incremental cost of heat exchangers

3. As part of the review of project submissions, the Secretariat identified as one issue the question of 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.

4. The heat exchanger production referred to in this document relates to the production of refrigerant-to-air heat exchangers. These consist typically of a number of copper tubes with plate-like aluminium fins perpendicular to them.

5. The manufacturing of the fins is done with complex dyes 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 hairpins have been placed into the stack of fins, a rod with a precision ball tip slightly larger than the tubes inner diameter is pushed through each tube, enlarging the tubes interior and therefore its 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.

6. 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, more often, optimised for the manufacturer's model range and made on site. Typically the same external tube diameter would be used for units with a wide range of capacities. 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 CO_2).

7. According to technical experts consulted by the Secretariat, it is not necessary to reduce the diameter of the tube from the perspective of system performance when changing from HCFC-22 to HFC-410A or HFC-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 HFC-410A or HFC-32. This approach requires significantly less capital investment in equipment, and is therefore preferred by manufacturers for the initial conversion. 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, utilises certain benefits that the properties of HFC-410A offer over HCFC-22, and results in system miniaturization as well as weight and cost reductions. The cost savings are so significant that even better heat exchangers can be produced with still substantially lower operating costs. Project proposals received by the Secretariat show that the incremental savings can be above US $2/kg of HCFC-22.

8. However, as demonstrated in project submissions, the costs for the retooling of a smaller external diameter tube are very significant. Heat exchangers for CO_2 based systems would potentially need to use smaller diameter tubes because of the very high operating pressures of CO_2 systems and the different capacity per volume. Systems using flammable refrigerants (hydrocarbons and, to a smaller extent, HFC-152a and HFC-32) can reduce the refrigerant charge substantially by using smaller diameter tubing and thus enable the use of using flammable refrigerant in such refrigeration equipment with little additional safety requirements as compared to present HCFC systems.

9. 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 dyes for manufacturing of fins, the machines to bend the copper tubes, auto brazing equipment and the machines used to expand the tubes. For the production of consumer products (room air conditioners, etc.), all of these are usually fully automated precision production machines with relatively high modification or replacement costs. Commercial and industrial products are often manufactured with a lower degree of automatisation to allow for custom specific designs. However, the machines required are also high precision machines.

10. Companies are currently 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. In almost all cases brought to the attention of the Secretariat, the refrigeration and air-conditioning manufacturers produced their own heat exchangers in-house.

11. After the 61st Meeting, the Secretariat continued discussions with the agencies as well as with industry representatives during a mission to China. The concept of the Secretariat's paper was repeatedly explained. One agency, in particular, referred to the possibility of improving the energy efficiency of air conditioners through re-design and optimisation of the heat exchangers. Industry representatives referred to the examples from peer companies where the related conversions, in particular to HFC-410A, had taken place and where the heat exchangers had been also modified, and saw the conversion of the heat exchanger production as organically linked to the conversion of the manufacturing line.

12. In these discussions, the Secretariat referred in particular to the Executive Committee's decision 61/44, where the Secretariat was requested to maintain the established practice when evaluating component upgrades in HCFC conversion projects for the refrigeration and air-conditioning sectors, such that after conversion the defining characteristics of the components would remain largely unchanged or, when no similar component was available, would only be improved to the extent necessary to allow the conversion to take place. The Secretariat did not question whether or not the conversion of a heat exchanger line would be organically linked to the refrigerant conversion or not but whether, given the lack of technical need and the additional operating benefits, the conversion would need to be supported by the Multilateral Fund. While the technical content of the arguments provided by one implementing agency regarding energy efficiency is not disputed by the Secretariat, activities with the sole purpose of improvements in energy efficiency are not eligible under the Multilateral Fund. Should a beneficiary wish to convert the manufacturing to achieve energy efficiency benefits, this would require counterpart funding or co-financing.

13. It was suggested to all stake holders that entered into discussions with the Secretariat regarding this point to provide in writing any technical reason for the change of the external diameter of the tube, excluding those related to improvements in energy efficiency or cost. Despite providing clear deadlines and, in one case, sending out a reminder, the Secretariat has not received any contributions regarding this point.

Secretariat's recommendation

14. Based on the discussions reported above, and on decision 61/45, the Secretariat is proposing to the Executive Committee the same recommendation as those contained in document UNEP/OzL.Pro/ExCom/61/51 presented to the 61st Meeting, namely that the Executive Committee might wish to consider not treating as an incremental cost, in the case of conversion of refrigeration or air-conditioning systems from HCFCs to non-flammable HFCs, 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 technology upgrade.

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