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# PRIORITIZATION OF HCFC PHASE-OUT TECHNOLOGIES TO MINIMIZE OTHER IMPACTS ON THE ENVIRONMENT

1. In decision 55/43 (h) the Executive Committee decided to further analyse if an approach of the type outlined in document UNEP/OzL.Pro/ExCom/55/47 ("Functional unit approach") provided a satisfactory and transparent basis for the prioritization of HCFC phase-out technologies to minimize other impacts on the environment, including on the climate as originally envisaged in decision XIX/6 of the Nineteenth Meeting of the Parties, and to request the Secretariat to continue with its evaluation in order to report in a more detailed fashion at a subsequent Executive Committee Meeting.

2. This document provides a status report regarding this undertaking, and raises some issues the Executive Committee might wish to discuss in conjunction with the development and subsequent use of the indicator.

Background

3. Decision XIX/6 calls for the Parties "to promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate, as well as meeting other health, safety and economic considerations." It also provides direction to the Executive Committee that, when developing criteria for the selection of projects and programmes to be funded, it "gives priority to cost-effective projects and programmes which focus on *inter alia*, substitutes and alternatives that minimize other impacts on the environment, including on the climate, taking into account global warming potential, energy use and other relevant factors".

Interpretation of decision XIX/6

4. Given the specific wording of decision XIX/6, the Committee might wish to clarify whether effects on climate, specifically mentioned in the decision, will be in the focus of the Committee's attention. It should be recalled that local effects on the environment, usually controlled through local legislation, have in the past been fully taken into account on a project level, without the need to specifically formulate policies on that matter.

5. The nature of the term "gives priority" could allow for a number of interpretations, including priority in timing, in absolute technology selection or in funding provision. The Executive Committee has used in the past all three methods for giving priority, most notably given priority in time, that lead to the development of funding thresholds for sectors below which the projects would have a higher priority.

6. The decision provides, it would seem, equal footing for the climate effects related to energy and to those related to the Global Warming Potential (GWP), i.e. to the alternative substance used. While low GWP solutions technically exist for the majority of applications, there are presently limits in their broad availability and applicability; this is particularly true for the refrigeration sector. In addition, a number of technically available low GWP alternatives are not universally accepted in non-Article 5 countries, and are hardly used in Article 5 countries. This is particularly true for hydrocarbons in refrigeration and air conditioning; examples are the use in commercial refrigeration equipment and in room air conditioners.

7. Consequently, low GWP solutions are not universally available for Article 5 countries in the near future, i.e. in the next three to four years. One additional issue to be taken into account in this regard is also that the adaptation of technologies for conditions in Article 5 countries and proving their suitability for large scale introduction are time consuming. Traditionally, such technologies are first employed in demonstration projects, a process which delays full application of a technology under the Multilateral Fund often by another two years or more.

8. When considering incentives and giving priorities to substitutes and alternatives that minimize impacts on climate, it is also necessary to understand the existing incentives for beneficiaries regarding the choice of technology. The Secretariat wishes to particularly point out that the default choice is often

HFC technology, in particular in the refrigeration and air conditioning sector. HFC alternatives in that sector typically have a higher GWP than HCFCs, and tend to consume similar levels of energy in comparable equipment under the conditions prevailing in Article 5 countries. Some reasons for this are briefly listed in Annex I to this document. Incentives provided by the Multilateral Fund should to take into account that the decision of beneficiaries to use one or the other alternative technology is based on a broad set of incentives and might be difficult to influence.

9. Another issue of importance is that there are, broadly, two types of Article 5 countries: Those who consume HCFCs to manufacture goods as well as in the service of refrigeration and air conditioning equipment, and those which only use it in the servicing of such equipment. The second group consumes HCFCs to service a largely existing base of refrigeration and air conditioning equipment. Possible options are:

(a) Countries which manufacture goods can have a number of possibilities how to address HCFC consumption. They can convert the manufacturing facilities in the foam and/or the refrigeration sector to non-HCFC technology, and/or they can work on reducing their consumption in the service sector through, for example, better practices, recovery and recycling, and retrofit, plus an early ban on the manufacturing or importation of HCFC-containing refrigeration and air conditioning equipment, in order to gradually reduce the base of HCFC equipment in need of service; and

(b) Countries which consume HCFCs only in the service sector can only use measures such as better practices, recovery and recycling, and retrofit, plus an early ban on the importation of HCFC-containing refrigeration and air conditioning equipment. These countries are consequently dependent on the availability of non-HCFC refrigeration and air conditioning equipment, and their ability to reduce their consumption of HCFCs is strongly dependent on their existing base of HCFC refrigeration equipment.

10. There might be severe challenges for countries without a manufacturing sector to give priority to cost-effective projects and programmes that focus on, *inter alia*, substitutes and alternatives that minimize impacts on climate, since, at least in the next years, there might be insufficient technology choice, in particular regarding equipment based on low GWP alternatives.

11. It is possible for all countries to minimize climate impact by restricting importation of HCFC-containing refrigeration and air conditioning equipment in favour of equipment with a higher energy efficiency. The necessary infrastructure to achieve this in the country (customs training, test facilities), and the related cost might be described in an HPMP.

Possibilities uses of any indicator

12. Decision XIX/6 of the Meeting of the Parties requests the Executive Committee, *inter alia*, when developing criteria for the selection of projects and programmes, to give priority to projects and programmes which focus on substitutes and alternatives that minimize impacts on the climate. The assessment of such an impact can be performed using an indicator. The result of such an assessment does not by itself give priorities; instead, additional guidelines will need to address how to prioritise based on the results of an assessment.

13. The Executive Committee has in the past used a number of different ways to assign priorities and provide the related incentives. For example, by providing funding windows, introducing thresholds, limiting or broadening the eligibility of technologies or, in rare cases, avoiding to fund technologies (for instance when the technology proposed was not considered to be a proven one). Timely advice is needed by bilateral and implementing agencies as to what incentives might have to be taken into account when developing an HPMP.

Description of the indicator

14. Decision XIX/6 itself notes the need to take into account "global warming potential, energy use and other relevant factors". In assessing different possibilities for indicators, the Secretariat had been keen to develop an approach that is sufficiently robust to act as a basis for a funding assessment, while ensuring that it is sufficiently sensitive to make meaningful qualitative climate comparisons. This information had been presented in document UNEP/OzL.Pro/ExCom/55/47. Annex V of that document is enclosed as Annex II to this document.

15. Three basic methodologies have emerged:

(a) The adoption of a methodology based solely on global warming potential (GWP);

(b) The adoption of a methodology based in Life Cycle Climate Performance (LCCP); and

(c) The adoption of a 'functional unit' approach to life cycle evaluation.

16. In its initial review, the Secretariat did not consider that a methodology based solely on GWP would wholly address the mandate of decision XIX/6, since it would be unable to account for 'energy use' as required under the decision. In addition, the approach would need to account for differences in life-cycle containment practices and recovery options if it was to properly reflect a fair technology comparison. This would, by definition, bring it into the assessment of life cycle components.

17. As with all Life Cycle Assessment (LCA) processes, the development of a formal LCCP is data-intensive and requires the input of a substantial number of variables, not all of which might be known, either to the enterprise or a country, at the time of the funding application. Even if they were available, it would be a substantial and potentially impractical and resource heavy task for the Secretariat to cross-reference and verify that these assumptions were appropriate. The LCCP methodology is therefore seen as unsuitable as a basis for a funding assessment on a broad scale as foreseen here.

18. With the GWP and LCCP approaches representing the two extremes of the spectrum, the Secretariat has been assessing intermediate options which might overcome the disadvantages of each. This has resulted in the initial evaluation of a 'functional unit' approach which offers the robustness of a simplified and less data-intensive methodology, while ensuring that the key criteria outlined in decision XIX/6 (GWP, energy use and other relevant factors) can all be taken into account.

19. At the 55th Meeting, the Executive Committee was presented this functional unit approach. Its scientific background has been explained in the above-mentioned document, and can be found in Annex II. In brief, the functional unit approach has the following characteristics:

(a) It provides a way of standardising the possible emission scenarios of greenhouse gases in a way that the climate impact of different alternatives vs. a baseline (e.g. HCFC) can be assessed; and

(b) It significantly limits through this standardisation, the amount of technical input-variables, and delivers as a result a good approximation sufficient for a qualitative assessment.

20. The functional unit approach is going to be used in two slightly differing ways. In both cases, the increment between HCFC technology to be replaced and the alternative technology is being determined. In order to determine this difference, case specific data will be used such as sector and sub-sector, type of HCFC used and its quantity, alternative substance and quantity used. A number of other data, such as an approximation of HCFC use pattern, emissions and changes in energy efficiency are part of the functional

unit and will not vary on a case-by-case basis. Additional data such as substance properties are also part of the model. Other variations are possible if measures are being taken to improve the climate impact of the alternative, such as further improvements in energy efficiency.

21. The results are being used in two ways:

(a) On the enterprise- or sub-project level, which is also the level on which data is being collected, the result of the functional unit approach is being compared to the most cost effective alternative which fulfils certain minimum baseline requirements. At present this requirement would be that the alternative has no higher climate impact than the HCFC technology being replaced. As a result, a cost effectiveness for activities in addition to HCFC phase-out is being defined using the unit "US $/tonne of $CO_2$ emission avoided"; and

(b) On the country level, the increments in climate impact of the technologies chosen are being aggregated, allowing to determine if the total climate impact caused by the alternative technologies has a different value from the climate impact caused by HCFC technology. Growth effects are not being taken into account in this calculation.

22. The indicators can be used for a number of purposes and in different ways. The tool will for example allow:

(a) the Executive Committee to ensure that the climate impact of an activity is lower or equal to a certain benchmark, e.g. the climate impact of the existing HCFC technology. This could be assessed on an aggregate basis, e.g. at country level, allowing a technology mix to be used;

(b) the Executive Committee to support the introduction of technologies to reduce the emission of GHGs beyond a baseline scenario, e.g. the conversion to the most cost effective alternative technology with a similar or lower climate impact to the HCFC technology replaced. Funding criteria for such an approach would need to be developed;

(c) Article 5 countries to understand the change in climate impact caused by the conversion to an alternative technology. This assessment provides information and benchmarking at the country level, and at the same time identifies the most cost-effective options for further activities to reduce the climate impact at the activity / sub-project level;

(d) beneficiaries and implementing agencies to more accurately assess the probability to receive co-funding for activities and plans beyond those to be funded from the Multilateral Fund; and

(e) other funding mechanisms to assess, with small effort, the costs and climate-related benefits of potential activities for piggy-backing on related activities and sub-projects of the Multilateral Fund;

23. A possible example for using the functional unit approach in this way, on an enterprise level, would be the conversion of an air conditioning manufacturer to non-HCFC technology, which might cost US $1,000,000. At the same time, the products could also be made much more energy efficient through redesigning components, and providing new manufacturing technology, at an additional cost of US $300,000. This energy efficiency would, in this example, reduce carbon emissions by 150,000 tonnes $CO_2$ emission per year. On the enterprise level, this would lead to a cost effectiveness of US $2/tonne of $CO_2$ emission abatement/year. Using this value, and comparing it with other opportunities, would allow for a good estimation as to whether support for an amendment to the project for energy efficiency would

be a meaningful decision. This relates both to the government concerned, and to funding mechanisms as well.

24. The Secretariat, with the support of several experts and the implementing agencies, is presently undertaking technical consultations to allow the development of mutually agreed functional units for the refrigeration and foam sector with clear and well defined characteristics. This will enable the use of the functional unit approach using a small number of easily determinable parameters and allowing equitable and fair assessment during project review, while at the same time ensuring that the functional units defined broadly represent reality. Solvents and other uses cannot at present be included in this undertaking, since there has so far been no consistent use pattern in those sectors that would allow for meaningful standardisation. The Secretariat intends to complete this process in time to report to the 58th Meeting.

25. In this paper, the Secretariat raised two issues which the Executive Committee might wish to address in its deliberations:

(a) The question to what degree it is possible in countries without a manufacturing sector to give priority to cost-effective projects and programmes that focus on, *inter alia*, substitutes and alternatives that minimize impacts on climate; and

(b) The use of indicators assessing the climate impact on the country level and on the enterprise/sub-project level, and how incentives might be associated with such indicators in order to give the desired priority to projects.

Recommendation

26. The Executive Committee might therefore wish to:

(a) Take note of the present document UNEP/OzL.Pro/ExCom/57/59; and

(b) Decide to discuss issues related to the type of incentives to be associated with the indicators being developed, and other relevant questions relating to the indicators, no later than the 58th Meeting.

## Annex I

## POSSIBLE INCENTIVES FOR CONVERTING FROM HCFC TO HFC

1. A number of incentives for countries and enterprises are presently existing which are predominantly favouring HFC technology, in particular for the refrigeration and air conditioning sector; in several cases, the climate impact of these technologies is likely to be larger than that of HCFC. These incentives are, for example:

(a) The predominant non-ODS technology used in the refrigeration sector using presently HCFC are HFC. Other, low GWP technologies are hardly used on a large scale in those refrigeration and air conditioning sub-sectors where HCFC are or were prevalent. Out of a variety of reasons, the default technology choice of an enterprise facing a technology change is almost always the best established and most broadly used technology;

(b) The handling of HFC technology is in comparison very similar to HCFC technology, the differences are moderate – that is in particular the case for all kinds of service operations, and for the commercial refrigeration sector;

(c) HFC servicing capabilities have been established across the world, not the least through Multilateral Fund supported projects for CFC phase-out; this is by far not the same for low GWP alternatives.

(d) HFC technology in HCFC-using refrigeration and air conditioning sectors appears to be presently the least restricted HCFC alternative in industrialised countries;

(e) The commercial means of technology transfer and component distribution for HFC technology are better developed as compared to those of other technologies, partially due to its utilisation of very well established networks, which are typically the same which used to distribute HCFC information and equipment before. Without a significant focus on that challenge, enterprises will face difficulties in the access to specific expertise and to components used to built or repair equipment; and

(f) A number of approaches in carbon markets are supporting the replacement of, in particular, HFC by more climate friendly substances (see also document UNEP/OzL.Pro/ExCom/57/62). The potential financial gains from doing so can be significant. There appears to be frequently the perception that HFC based manufacturing has to be in place in order to be eligible for funds. The issue is in this case not only the factual situation, but also the perception as to how it will or might develop. Such perceptions might be perverse incentives regarding technology selection under the Montreal Protocol, suggest selection of HFC technology and would increase the overall cost for society of moving to low GWP solutions significantly[1].

(g) In projects supported by the Multilateral Fund, incremental operating cost for conversion to HFCs tend to be significantly higher than incremental operating cost for the presently used low GWP technologies.

[1] It should be noted that the political situation on HFC under CDM is fluent, and projects for HFC emission mitigation have come under significant pressure. However, there are also the different voluntary markets which might accept HFC projects.

# Annex II

## ENVIRONMENTAL ISSUES
## (previously Annex V of document UNEP/OzL.Pro/ExCom/55/47)

### V1. Characteristics of the 'functional unit' approach

1. One of the advantages of the 'functional unit' approach is a simplified and transparent derivation of lifecycle impacts. It should be noted that, in contrast to an LCCP approach, the purpose is not to calculate the precise climate impact for each and every application, but to characterise these impacts to the extent that they can be used for the purpose of comparing technologies. It is therefore desirable to fix as many of the potential variables as possible across a sector or sub-sector and only allow those which have clear localised character (e.g. average carbon loading of energy) to be modified routinely.

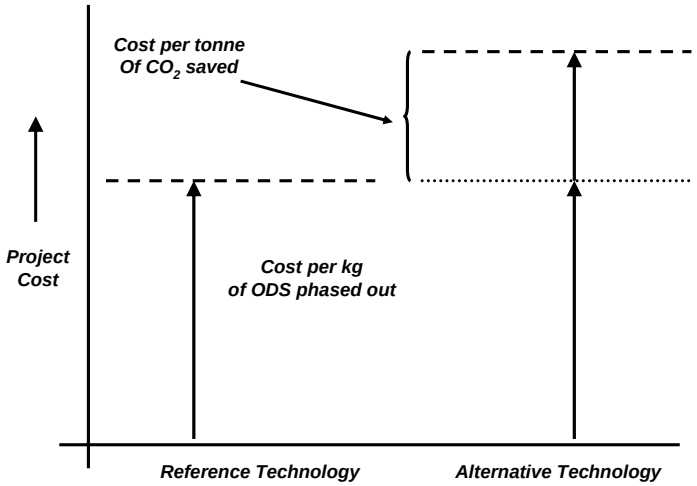
2. In practice, the primary output from any 'functional unit' approach would be a comparative assessment of lifecycle climate impacts taking into consideration the GWP of the ODS substitutes involved, the charge size, the energy used in operation, the emission functions through the various phases of the life-cycle and any efforts anticipated for recovery at end-of-life. The normal comparison would use the HCFC-based technology as the baseline, in order to assess whether the alternative technology offers better or worse climate performance

### V.2 Analysis made possible by the 'functional unit' approach

3. Carrying this approach forward into a practical analysis, some alternative technologies offer the capability of continuous adjustment. An example of such a technology would be HCFC-245fa-blown foams, co-blown with $CO_2$ (water). Since the level of co-blowing can, in theory, at least, be modified between 0 and 100 per cent, it is possible to envisage a range of climate impacts from 'low-to-high' associated with this range of technology options. At a certain point (in this case about 43.3 per cent co-blowing with $CO_2$ (water)) climate neutrality is reached with the HCFC-141b technology being replaced, based on the outputs of the 'functional unit' analysis. It is proposed that this technology is referred to as a "reference technology" for the transition and will be defined for each project or sector. Interestingly, the identity of the 'reference technology' is independent of the size of the enterprise being considered, since the analysis is based on a 'functional unit'.

4. In some sectors, it may not be possible to identify a technology capable of continuous adjustment. In such instances, the "reference technology" could be defined in terms of the closest such technology to climate neutrality. Although this could be defined as the closest either side of neutrality, some might prefer to see only those technologies with 'better than neutral' climate performance adopted as "reference technologies".

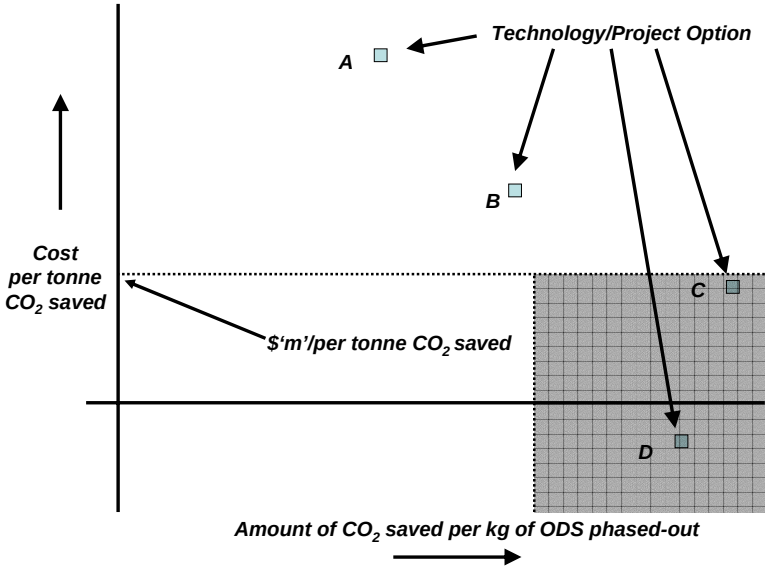
5. By evaluating the cost of implementing the "reference technology" using the existing Incremental Capital Cost (ICC) and Incremental Operating Cost (IOC) analysis, it is possible to derive the cost of an 'ozone only' transition, where the climate impact is broadly neutral. The analysis therefore delivers a cost per kilogramme of ODS phased-out (see graph below)




6. Against this benchmark any alternative technologies can be evaluated. In some instances the cost of alternative technologies may be less, even in cases where they deliver a climate benefit and there are no incremental costs. In other cases, such as that shown in the graph above, the alternative technology might be more expensive. In such circumstances, it is appropriate to consider the additional cost to be that required to achieve the additional climate benefit and a cost per tonne of $CO_2$ saved can be derived.

### V.3 Possible funding mechanisms arising from the 'functional unit' approach

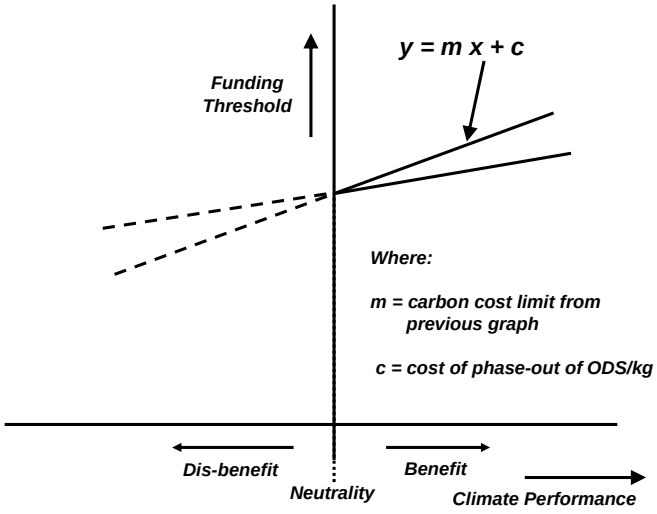
7. The Executive Committee might like to evaluate the output of such analyses on a number of different technology options for a project or programme in order to decide whether it is appropriate to provide funding for additional climate benefits over and above the reference scenario. To facilitate such an evaluation, there is a need to plot the unit cost of the saving in carbon terms against the 'potency' of the measure (i.e. the amount of $CO_2$ saved per kg of ODS phased-out). The following graph illustrates what this analysis might look like.



8. Using this approach, Executive Committee members could make decisions on the criteria for investment in additional climate benefits in terms of potency and climate benefit (as defined by the shaded area). In the example shown above, Technology A might be a blowing agent technology delivering poorer thermal performance, although being based on a low GWP blowing agent, whereas Technology C might be a similar low GWP technology delivering better thermal performance. It is useful to note, that this analysis would also take into consideration the size of the project envisaged. Therefore, Technology C might be situated in the shaded area for a 50te/yr plant, but outside of the shaded area (higher in terms of cost per tonne of $CO_2$ saved) for a 10te/yr plant.

9. Executive Committee members would have the ability to define these criteria by sector and region, with the additional ability to cross-reference the cost of the savings against other climate measures adopted by their own governments.

10. Having considered all aspects, the Secretariat believes that it would provide best use of Multilateral Funds to retain the existing ICC and IOC approaches in assessing the overall cost of a project or programme rather than reward climate benefits through market-based mechanisms based on carbon itself. However, it could be possible to use the upper bound of the permitted investment ($'m'/ per tonne $CO_2$ saved) to drive cost effectiveness thresholds, as shown in the diagram below:




11. Such an approach would not only provide an incentive, in terms of funding threshold, for climate benefits, but could also be used to determine lower thresholds for technologies creating climate dis-benefits against those offered by the "reference technology". However, the Executive Committee would need to satisfy itself that such an approach would still meet the obligations of the Multilateral Fund in terms of phasing out the relevant HCFC consumption targeted under decision XIX/6

12. As noted in earlier paragraphs, the 'functional unit' needs further evaluation across a wider range of sectors to provide assurance that the basic methodology can be applied more widely. The Secretariat therefore seeks the mandate to continue this work on the current path, or as revised by the Executive Committee in order to present a more concrete set of proposals at a future Meeting of the Executive Committee.

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