UNITED
NATIONS

EP

United Nations
Environment
Programme

Distr.
GENERAL

UNEP/OzL.Pro/ExCom/61/50
3 June 2010

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Sixty-first Meeting
Montreal, 5-9 July 2010

# RELEVANT ASPECTS OF COMPONENT UPGRADE IN HCFC CONVERSION PROJECTS (DECISIONS 59/13(b) AND 60/43)

Introduction

1. At the 59th Meeting of the Executive Committee, the issue of eligibility of measures to improve the climate impact of the conversion from HCFCs was raised, and the Executive Committee decided to discuss the issue at its 60th Meeting. It requested in its decision 59/13 that the Secretariat prepare a document for the 60th Meeting providing information regarding the relevant aspects of component upgrade in HCFC conversion projects. The Secretariat prepared document 60/45 for discussion by the 60th Meeting, where the Executive Committee took decision 60/43, deferring the issue until its 61st Meeting; and requested the Secretariat to supplement the document on relevant aspects of component upgrade in HCFC conversion projects with examples of the possible consequences of each option, drawing on the experiences of the implementing agencies.

2. This document has been prepared in response to decision 60/43. In preparing the document, implementing agencies were contacted as requested. The Secretariat has received one reply from the World Bank; the content of the reply is included in Annex I to this document. The Secretariat has also, where appropriate, updated the information in the document.

Background

3. The Secretariat has so far received six project proposals for the conversion of manufacturers of refrigeration and air conditioning equipment from HCFCs to alternative technologies. Of those, five proposals contain cost elements related to components which strongly influence the energy efficiency, and have a major impact on the overall costs of the project.

4. The components mentioned are the heat exchangers and the compressor used in refrigeration and air conditioning equipment. When converting from HCFCs to an alternative substance, the heat exchanger might require changes depending on the alternative technology used. The compressor typically has to be modified or replaced by another model, often from a different manufacturer. Compressors are available in several performance levels, but the different levels are not standardised and not clearly distinguishable, in particular across different manufacturers.

5. As is implied by the information provided above, a conversion of the manufacturing of HCFC containing refrigeration and air conditioning products requires a redesign of the product to accommodate the change in components. Manufacturers that have already converted often used the opportunity to carry out a number of optimisations, using new technologies, better know-how and improved components to achieve a higher energy efficiency of their product; consequently, the products with alternative technology have often a better energy efficiency than the previous HCFC systems. This is particularly true for the "early adapter" products, i.e. products which champion the new technology ahead of the mainstream, because of their focus on a particular quality oriented customer group. Many of the optimisations carried out, however, would also have led to improvements in energy efficiency when applied to HCFC technology.

Relevant decisions of the Executive Committee and the Meeting of the Parties

6. The Meeting of the Parties, it its decision XIX/6 paragraph 11, requested the Executive Committee, when developing and applying funding criteria for projects and programmes, to give priority to cost-effective projects and programmes which focus on, *inter alia*, alternatives that minimize impacts on the climate, taking into account global-warming potential and energy use.

7. In its decision 18/25, the Executive Committee decided that costs associated with avoidable technological upgrades should not be considered as eligible incremental costs and therefore should not be funded by the Multilateral Fund. An upgrade in technology is defined as an improvement compared to the baseline, in this case the HCFC air conditioning equipment.

8. In order to assess incremental cost, a baseline for refrigeration and air conditioning equipment relating to energy efficiency needs to be defined. Any costs for improvements beyond this baseline would be seen as an avoidable technological upgrade.

Baseline

9. The Secretariat has developed a list of possible definitions for a baseline for refrigeration and air conditioning equipment, and has sorted it approximately according to increases in effort and, therefore, the resulting costs that each of these definitions would represent in a conversion project. A baseline could be defined as:

(a) The physical characteristics of the equipment as no more than the sum of the physical characteristics of its components, so that after a conversion the defining characteristics of the components would remain largely unchanged or only improved to the degree necessary where no similar component would be available ("component option");

(b) The energy efficiency of the equipment, so that after a conversion the energy efficiency would remain largely unchanged ("energy efficiency option");

(c) The climate impact of the equipment, so that after the conversion the climate impact would remain largely unchanged, taking into account its energy efficiency and any direct emissions related to the HCFCs ("climate impact option"); and

(d) The energy efficiency of competing products of a similar quality after their conversion ("peer quality option").

10. Each of the above options has certain consequences in terms of policy and practicality issues related to it. In the following paragraphs this document aims at highlighting some of the consequences in terms of policy and practicality.

Policy

11. Should the Executive Committee choose one of the above options, the dividing line between eligible and non-eligible activities will be established. This should also help to establish a clear understanding to what degree companies eligible under the Multilateral Fund can turn to carbon markets to fund activities beyond those eligible under the Multilateral Fund. Should the Executive Committee wish to establish a facility as discussed during this meeting, and should this facility be meant to address activities not eligible under the Multilateral Fund, including energy efficiency, agencies and countries could turn to the facility and apply for funding for increases in energy efficiency beyond the defined eligibility.

12. All presently available alternatives to HCFCs in the refrigeration and air conditioning sector, which are currently significant or have the potential to become so, use the same working principle and similar components. The energy efficiency therefore depends mainly on the substance, the quality of the components, and the engineering skills employed when designing the system out of the components. Significant improvements in any of the alternative technologies are possible as a function of the effort spent on components and on system design. In order to establish a comparable energy consumption, the use of components of similar quality is meaningful; this is also one of the underlying principles of the Multilateral Fund Climate Impact Indicator (MCII). The Executive Committee might wish to discuss whether the Meeting of the Parties referred in decision XIX/6 to energy efficiency as a typical characteristic of an alternative, rather than as an independent objective. Should the Executive Committee have the understanding that it is rather a characteristic of an alternative, then the Secretariat believes that the component option (a) would be the definition most accurately reflecting decision XIX/6 paragraph 11.

13. The energy efficiency option (b) would, in contrast, require that the Executive Committee would fund energy improvements in technologies with lower inherent energy efficiency, to achieve an improvement in the energy efficiency up to the level achieved with HCFCs.

14. The same point raised regarding the energy efficiency option (b) above also holds true for the climate impact option (c). In addition, while for all likely technology choices for a given application the energy efficiency of an alternative will show a limited deviation from the baseline, the situation is different for the climate impact. Since in many countries annual running hours of equipment are low, or electricity is produced with relatively small associated emissions of CO2, the climate impact indicator will be strongly influenced by the global warming potential (GWP) of the alternative substance. Even moderate increases in the GWP (for example from HCFC-22 to HFC-410A with an increase in GWP of about 15 per cent) would require measures to reduce the amount of refrigerant in the refrigeration cycle, i.e. possibly a change in heat exchanger tube diameter (see also document UNEP/OzL.Pro/ExCom/61/51 to achieve substantial increases in the energy efficiency. This might, in the view of the Secretariat, lead to the creation of false incentives by inflating project budgets for alternatives that are inherently less sustainable and less desired, at least in terms of climate impact, since substantial improvements in technologies that are inherently adverse to the climate would be eligible, while technologies more beneficial for the climate would, in comparison, receive significantly less funding.

15. The peer quality option (d) is in effect an extension of the previous option (b). The peer quality would be established in terms of energy efficiency of peer systems, and would create a moving benchmark for the energy efficiency aspect. However, choosing this option would, in the view of the Secretariat, stretch the intent of decision XIX/6 of the Meeting of the Parties and would probably constitute a technology upgrade.

Practicality

16. The scenarios above present a number of political considerations for the Executive Committee to consider. Another aspect is the issues related to the implementation of any decision taken. Any of the policies will lead to the need for the relevant implementing agency to incorporate related information into the project submission, and to the Secretariat having to review it. The following approaches appear possible:

17. The agency provides baseline information for each model or, in case of many models, for models manufactured in significant quantity. This baseline information could be:

(a) For the heat exchanger a similar air-side surface area providing a reasonable approximation of the performance that is easy to determine, calculate and monitor; and

(b) For the compressor the issue is more complicated. The Secretariat suggests comparing compressors of the same working principle except where a change would yield cost benefits without performance disadvantages. However, in particular when switching between manufacturers or between the model series of one manufacturer, considerable effort might be required to assemble the data and review the process, and will involve the determination of a comparative performance figure. The Secretariat will need to contract out the related work to a specialised service provider still to be identified.

18. The issue becomes more complicated still if increases in energy efficiency are required and related to the performance of the components, as is the case for the options energy efficiency (b), climate impact (c), and peer quality (d). Any refrigeration system is a balance between the different components, and if the performance of any component is increased the system will likely improve, but the rate of improvement will be depending on the system and its other components. The MCII could be used to

provide an indication of the result of component performance changes on the overall system; this could be used for the options (b), (c), and (d).

19. However, to implement the option of using peer quality (d) as a baseline, the peer quality would have to be established first. In order to determine the quality of peer systems in the market, the Secretariat would have to undertake, through a contractor, a market study of different types and sizes of air conditioning systems as well as subsequent updates, the latter probably about once every triennium. The resulting information on energy efficiency would form the basis for establishing energy efficiency targets for conversion projects.

20. Once the technical level of the components past conversion has been determined, the related incremental costs have to be established. This involves, in case of incremental capital cost (ICC), determining the cost of the conversion. While complex, the prices for the capital equipment items needed in a conversion can, with experience, be estimated with reasonable accuracy. While IOCs are possibly no longer a funding issue for most conversion projects based on decision 60/45 of the Executive Committee, they provide a clear indicator whether certain parts of the conversion are economically sustainable or if they make the product less competitive or margins smaller.

21. Should the Executive Committee decide on any of the options (b) to (d), potentially involving improvements in energy efficiency to meet the baseline, the Committee might wish to also consider how to ensure that the expected benefits actually arise. Any refrigeration or air conditioning product represents in its design an optimisation by the manufacturer of his manufacturing cost and the quality of the product the customer is expecting. In many cases the conversion will increase the manufacturing cost per unit, since the cost of HCFC-22 is presently very low compared to most alternative substances. A higher energy efficiency will increase manufacturing cost further. Depending on the market, the customer might be accepting a proportional increase in the unit price, or an even bigger increase, or might not be willing to pay as much. For the current products using HCFCs this optimisation has been carried out.

22. Should the Executive Committee provide funding for the energy efficiency upgrade of components, the potential for a subsequent reduction in the performance of components by the system manufacturer to yield per-unit cost benefits will increase. The wider the gap is between the current per-unit cost and the future ones, the more the Executive Committee will have to consider which assurances and, potentially, what monitoring activities are needed to ensure that any improvements agreed on are sustainably realised by the manufacturer. The Secretariat would like to point out that in cases where co-funding from carbon markets for energy efficiency improvements is being considered, monitoring will be required anyhow by the institutions issuing the carbon credits.

Examples provided

23. Decision 60/45 requests the Secretariat to provide examples of the possible consequences of each option. In the response to this requirement, the Secretariat prepared Annex II to this document. The Secretariat proposed four options, and, as explained above, it appears meaningful to differentiate between a flammable low-GWP substance and a non-flammable HFC, resulting in eight different cases to provide examples for. The Secretariat decided to assume for HFCs a conversion to HFC-410A, for hydrocarbons to HC-290 (propane) [1]. Based on the multiple permutations, a table format seems the most appropriate way to accommodate the resulting wealth of information. The Secretariat has for each example elaborated briefly on the basic reason for changes, information needs, needs for forecasts of, e.g., energy efficiency, as well as the impact on incremental capital and operating cost, differentiated by the manufacturing of systems, compressors and heat exchangers. The submission by the World Bank did not

[1] HFC-410A leads to a more costly conversion than HFC-407C; however, there are strong indications that HFC-410A will be, where HFC are selected, the refrigerant used almost universally in small and medium-sized air conditioning systems. For HFC-407C, the conversion costs for the component and energy efficiency options would have been lower than for HFC-410A. HC-290 will likely be the predominant choice for conversions to hydrocarbons, with some low-capacity commercial coolers potentially converting to HC-600a (iso-butane).

include an example, and no submission from any other agency was received. The table in Annex II is solely intended to provide the Executive Committee with an impression of the impact of different decisions on costs and process, and is only broadly indicative of the costs involved. The indications are based on the experience of the Secretariat at this time, and can presently not be quantified further.

24. It is important to note that with constant funding for IOCs as defined in decision 60/45, companies will increasingly be interested in technologies with a low IOC, since this translates into lower production costs and higher margins.

Submission by the World Bank

25. The concepts proposed in this document have not changed since the 60th Meeting. Consequently, the submission of the World Bank, based on the document as submitted to the 60th Meeting, provides an interesting reflection on these suggestions, and gives the opportunity to present the Executive Committee with a set of arguments and counter-arguments.

26. The World Bank suggested in its submission, to use in effect, the same energy efficiency as a baseline (option (b)), but with the caveat that this would have no influence on the funding level. The suggestion is to have a constant funding level, i.e. probably to pay on a basis of kg HCFC phased out, possibly with a certain increase in funding for decreasing project size. The company would be given the task to produce equipment which is at least as energy efficient as the HCFC-22 equipment. In response, the Secretariat would like to point out that requests for a beneficiary for certain product characteristics are inconsequential if not monitored and, possibly, enforced. Independently, if this were done on the level of the agency or the Multilateral Fund it would in any case require monitoring through repeated visits, and a product comparison. In the past, such detailed oversight was the exception, not the rule, and the Secretariat is concerned about creating additional administrative requirements for undertakings which are, in the end, not related to the phase-out of ODS. However, without monitoring such a requirement is obsolete, and companies will produce their products according to what is required by the market for a certain price. The Secretariat is also sceptical about the concept of fixed costs for conversion out of a variety of reasons, such as: deviation from the principle of incremental cost; inability to account for changes in conversion cost over time; difficulty to adequately address small and medium-sized enterprises; inability to provide adequate funding to new technologies early on, so leading to an increased advantage for established technologies; lack of differentiation between different countries and regions.

27. One might understand the submission of the World Bank to imply a technology bias on the side of the Secretariat. The Secretariat wishes to note that equitable treatment of the different technology options needs to apply; and that several technology options, including hydrocarbons and HFC, will play a role in the replacement of HCFC.

Conclusions

28. The Secretariat has provided above policy and operational considerations regarding four different options to define the baseline for funding of the conversion of refrigeration and air conditioning equipment. All four options can be implemented, and the document shows what steps would be necessary. However, the Secretariat would like to suggest that consideration is only given to the options component (a) and energy efficiency (b). The option of climate impact (c) has, in the view of the Secretariat, the disadvantage of providing false incentives, while the option of peer quality (d) would suggest that considerable funds might have to be diverted to covering energy efficiency improvements.

29. The component option is the easiest one to implement, and will allow a fair and simple project review and costing process. Since some alternatives tend to have a lower energy efficiency than the baseline technology if there is no additional optimisation, the component option might lead to systems with a lower energy efficiency being introduced as compared to the HCFC baseline technology. The

energy efficiency option (b) would address this concern. However, assuming that the compressor is purchased externally (which is typically the case), energy efficiency is largely related to operating cost increases, and the Executive Committee, in its decision 60/45, has established a fix set of IOCs; following that decision, there are few little means for the Executive Committee to provide a differentiation in funding between options (a) and (b) despite a difference in actual cost. Given this decision taken during the 60th Meeting of the Executive Committee, the Secretariat recommends option (a).

Secretariat's recommendation

30. The Executive Committee might wish to consider defining as a baseline for currently manufactured equipment in the refrigeration and air conditioning sector, against which funding is provided for the conversion of manufacturing facilities, the physical characteristics of the equipment to be no more than the sum of the physical characteristics of its components, so that after a conversion the defining characteristics of the components would remain largely unchanged or only improved to the degree necessary where no similar component would be available.

**Annex I**

**COMMENTS SUBMITTED BY THE WORLD BANK DATED 23 MAY 2010**
(extracted from e-mail communication)

[…]

The Secretariat raises an interesting point in the interpretation of Decision XIX/6, para. 11. Decision XIX/6, para. 11 states that when phasing out HCFCs, consideration should be given to substitutes that minimize impacts on the environment, including on the climate, taking into account global-warming potential, energy use, and other relevant factors. Based on this statement, the Secretariat raised the question whether substitutes and alternatives would have to have either, both low GWP and low energy use or, only one of the two.

These two distinctions are the basis for options (a) and (b) of the Secretariat's paper (UNEP/OzL.Pro/ExCom/60/45). The Bank agrees that options (c) and (d) could make consideration of funding eligibility too complex. Hence, the consideration should focus on options (a) and (b) only.

It is our understanding that for option (a), conversion costs may be limited to the replacement of the same types of components. Therefore, incremental operating costs would only arise from different lubricating oil, refrigerant, and modification of compressors in case hydrocarbon is selected. The Secretariat suggested that this option is preferable as it would avoid a perverse incentive for enterprises to select refrigerants that may have lower thermal efficiency. This statement is made on the assumption that hydrocarbon refrigeration and air-conditioning equipment will have superior energy efficiency than high GWP system (i.e., R-410A).

If the consideration focuses on just the technology aspect without taking into account the current market however, decisions of enterprises to convert their HCFC refrigeration and air-conditioning products could be delayed. For example, R-410A is a predominant refrigerant used in non-ODS air-conditioning equipment in both Europe and the US. Conversion to hydrocarbon may not be an option. One may argue that equipment for the domestic market could be converted to hydrocarbon. However, this would make the cost of production much higher as enterprises would have to operate two separate production lines, and have two inventories of raw materials and components.

In addition, while hydrocarbon has a superior thermodynamic property than R- 410A, it cannot be assumed automatically that conversion to hydrocarbon would yield higher energy efficiency. Due to safety requirements, reduction of the refrigerant charge size for the hydrocarbon system may be required depending on relevant national regulations and product standards. Such measures could compromise energy efficiency significantly. Therefore, in such cases low GWP alternatives would not minimize climate impacts.

While it is correct to say that the climate impact depends largely on the type of refrigerants for colder climates, it is different for tropical climates where avoiding high GWP refrigerant would be just a fraction of the potential total climate benefits to be gained from changing to alternatives.

Therefore, the World Bank has the view that neither options (a) nor (b) can fully address the objectives of Dec. XIX/6 para. 11 as the benefits are influenced by several factors. It might be useful instead to consider a fixed cost-effectiveness threshold and a condition that the final products after conversion must maintain the baseline energy efficiency level. This would give flexibility to the enterprises to determine which options would be the most optimal and which find a balance for the enterprises between the total conversion costs to be incurred and retaining market competitiveness.

[…]

**Annex II**

**QUALITATIVE INDICATIVE COMPARISON OF THE IMPACT OF DIFFERENT OPTIONS FOR BASELINE DEFINITION ON THE INCREMENTAL COST OF CONVERSION FOR TWO DIFFERENT TECHNOLOGIES**

| | | Component option | | Energy efficiency option | | Climate impact option | | Peer quality option | |
|---|---|---|---|---|---|---|---|---|---|
| | | HFC | HC | HFC | HC | HFC | HC | HFC | HC |
| **Remarks** | | Status quo | | Changes necessary since less efficient without changes | Changes necessary since slightly less efficient without changes | Negative climate impact compared to HCFC-22 because of emissions and energy efficiency issues - needs compensation | Positive climate impact compared to HCFC-22 because of emissions, to small extent offset by energy efficiency issues | Relates likely to high energy efficiency standards, suggests strongly technological upgrade | |
| **Information needs** | | Baseline information | | Energy efficiency before conversion (exact) or MCII (approximate) | | Energy efficiency before conversion, leak rate and repair occurrence (exact) or MCII (approximate) | | Definition of "peer group", collection of energy consumption data | |
| **Forecast needs** | | - | | Modelling of options to reach same energy efficiency post-conversion (exact) or MCII (approximate) | | Modelling of different options to reduce leak rate, reduce filling and reach a pre-determined energy efficiency post-conversion (exact); or MCII (approximate) | | Modelling of options to reach a pre-determined energy efficiency post-conversion | |
| **Incremental cost indication** | | | | | | | | | |
| **Conversion manufacturing** | **Capital** | Medium: Charging, testing | Medium: Safety, testing, charging | Medium: Charging, testing | Medium: Safety, testing, charging | Medium: Major redesign | Medium: Safety, testing, charging | Medium: Major redesign | Medium: Safety, testing, charging |
| | **Operating** | Low: Refrigerant | Low: Safety | Low: Refrigerant | Low: Safety | High: Refrigerant, probably inverter, smart controls… | Low: Safety | High: Refrigerant, probably inverter, smart controls… | High: Safety, probably inverter, smart controls… |
| **Conversion heat exchanger** | **Capital** | Low | Medium: Filling reduction | Low, possibly medium: Efficiency upgrade | Medium: Filling reduction | High: Filling reduction, efficiency upgrade | Medium: Filling reduction | High: Filling reduction, efficiency upgrade | High: Filling reduction, efficiency upgrade |
| | **Operating** | Constant | Savings: Less copper | Constant | Savings: Less copper | Savings: Less copper | Savings: Less copper | Savings: Less copper | Savings: Less copper |
| **Conversion compressor** | **Capital** | Medium: Pressure, testing equipment | Medium: HC safe testing equipment | Medium: Pressure, testing equipment, energy efficiency | Medium: HC safe testing equipment, energy efficiency | Medium: Pressure, testing equipment, energy efficiency | Medium: HC safe testing equipment | Medium: Pressure, testing equipment, energy efficiency | Medium: HC safe testing equipment, energy efficiency |
| | **Operating** | Low: Oil | Low: Safety | Medium: Oil, motor | Medium: Motor, safety | High: Oil, motor, compressor | Low: Safety | High: Oil, motor, compressor | High: Motor, safety, compressor |