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**Workshop for a dialogue on high-global-warming-potential  
alternatives to ozone-depleting substances**  
Geneva, 14 July 2009

## **Report of the workshop for a dialogue on high-global-warming-potential alternatives to ozone-depleting substances**

### **Introduction**

1. By decision XX/8, the Parties to the Montreal Protocol requested the Ozone Secretariat, with input, where appropriate, from the secretariat of the United Nations Framework Convention on Climate Change and its Kyoto Protocol to convene an open-ended dialogue on high-global warming potential alternatives for ozone-depleting substances among Parties, including participation by the assessment panels and the Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol, and inviting the Fund's implementing agencies, other relevant multilateral environmental agreement secretariats and non-governmental organizations, to discuss technical and policy issues related to alternatives for ozone-depleting substances, with a particular focus on exchanging views of the best ways of how the experience from the Montreal Protocol on Substances that Deplete the Ozone Layer could be used to address the impact of hydrofluorocarbons (HFCs), and also with a view to maximizing the ozone and climate benefits of hydrochlorofluorocarbon (HCFC) early phase-out under the Protocol. That dialogue took place on Tuesday, 14 July 2009 at the Geneva International Conference Centre.

### **I. Opening of the meeting**

2. The workshop was opened at 10.05 a.m. by Mr. Marco Gonzalez, Executive Secretary of the Ozone Secretariat, who welcomed representatives. He stressed that the Ozone Secretariat had worked closely with the secretariat of the United Nations Framework Convention on Climate Change to organize the workshop and welcomed the financial contribution of the Government of Sweden that had enabled key climate experts from developing countries to participate. He explained the workshop's structure, drew attention to the documentation and wished representatives fruitful discussions.

3. Mr. Florin Vladu, Manager, Adaptation, Technology and Science, secretariat of the United Nations Framework Convention on Climate Change, described the dangers posed by climate change, especially for the poorest and most vulnerable people, and warned that urgent action was required, particularly at the political level. He recalled that, at its recent summit, the Group of Eight had pledged to ensure further reductions in greenhouse gas emissions, recognizing the important activities of the Montreal Protocol in that regard. The fifteenth session of the Conference of the Parties to the Convention would take place in Copenhagen in December 2009, marking the culmination of intensive negotiations to produce a post-Kyoto Protocol environment regime. Time to achieve a successful

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outcome was short, however, with significant amounts of text remaining to be negotiated. He welcomed the involvement of the Ozone Secretariat in the negotiations.

4. Mr. Jukka Uosukainen (Finland), co-chair of the workshop, said that, with scarcely five months remaining until the Copenhagen meeting, representatives could indicate by their decisions at the current workshop the willingness of the climate community to work together. Such collaboration would be essential in bringing to a successful conclusion the discussions on the text remaining to be negotiated in Copenhagen.

5. Ms. Laura Berón (Argentina), co-chair of the workshop, said that the Montreal Protocol was recognized as an example of an excellent multilateral agreement. The current workshop was an opportunity to discuss new challenges and identify further synergies between the Montreal and Kyoto protocols.

## II. Scientific background

### A. Presentation

6. Mr. Akkihebbal R. Ravishankara, co-chair, Scientific Assessment Panel, gave a presentation on the effects of HCFC and HFC emissions on ozone depletion and climate.

7. He briefly summarized the findings of the 2006 ozone assessment and described some notable findings since that time. The 2006 assessment furnished even stronger evidence since the 2002 assessment that the Montreal Protocol was working successfully. Because of the phase-out of CFC usage, the production and use of HCFCs and HFCs were increasing. As anticipated, atmospheric abundances of CFCs were decreasing and those of HCFCs and HFCs were increasing. The production of HCFC-22 continued and its atmospheric abundance also continued to increase, as shown by data gathered subsequent to the 2006 assessment. Reported emissions of HCFC-22 were roughly consistent with estimates based on atmospheric measurements. Similar consumption and atmospheric data for HCFC-141b and HCFCs-142b showed that they were increasing in the atmosphere. There were some differences between reported consumption and emissions derived from the atmospheric observations of HCFC-141b and HCFC-142b but those differences could be due to various known processes such as retention in banks and consequent lag in emissions.

8. Recalling the awareness, since the mid-1980s, that ozone-depleting substances were strong greenhouse gases, he said that, since the adoption of the Montreal Protocol, all substitutes for ozone-depleting substances had been checked for their climate-friendliness. The 2005 joint interim report produced by the Intergovernmental Panel for Climate Change and the Technology and Economic Assessment Panel estimated the contribution of ozone-depleting substances to climate forcing was 7.5 gigatonnes equivalent of carbon dioxide in 1990. More recently, a report had quantified the extent to which the Montreal Protocol had helped to reduce global climate change to date. It had also estimated the savings made when compared to future estimated emissions of carbon dioxide and the potential savings from the recently proposed acceleration of the phase-out of HCFCs. Those savings were estimated at some 12–15 gigatonnes of carbon dioxide equivalent, if phased out HCFCs were replaced with low-global-warming-potential alternatives or reduced through conservation and recycling. The phase-out of HCFCs would significantly contribute to reducing the total atmospheric levels of ozone-depleting substances in the early twenty-first century.

9. He pointed out that, as HFCs did not contain chlorine, bromine or iodine, halogen-catalysed ozone destruction could not be caused by HFCs. Furthermore, it had been shown that catalytic ozone destruction due to other parts of the HFC molecules was not attested. HFCs could therefore be termed “ozone-safe” substitutes for CFCs and HCFCs. HFCs were, however, potent greenhouse gases. They were increasing rapidly in the atmosphere as the use of CFCs and some HCFCs were decreasing. For example, HFC-134a had reached 30 ppt in 2004 and was continuing to increase at roughly 4 ppt/yr. Globally averaged HFC-125 and HFC-152a were approximately 3.1 ppt in 2004 and were continuing to increase, respectively, by 23 per cent and 17 per cent per year. Another recent study showed that the increasing HFC levels, if left unabated, could lead to climate forcing that was 7–12 per cent of that of carbon dioxide by 2050. In addition, the majority of the increase in HFC emissions was expected to be from developing countries.

10. He also noted that the relatively short lifetimes of some HFCs (e.g., HFC-134a, with a lifetime of 14 years) meant that they would quickly respond to emission changes and that their build-up in the

atmosphere would not be as large as that of the long-lived carbon dioxide, or other longer-lived gases, for the same given emissions.

11. Lastly, he noted that some substitutes for longer-lived, high-global-warming-potential HFCs were being proposed for use. Substitutes included olefins such as  $\text{CF}_3\text{CF}=\text{CH}_2$  or  $\text{CF}_3\text{CF}=\text{CHF}$ . Those gases had extremely short atmospheric lifetimes, of the order of days, and they would be removed from the atmosphere rapidly if their emissions were curtailed. A few other potential environmental consequences of their use needed, however, to be studied and established. Those environmental issues included: potential formation of toxic atmospheric degradation by-products such as trifluoacetic acid; production of local ozone air pollution; potential production of longer-lived greenhouse gases via their atmospheric degradation; and potential formation of longer-lived, chlorine-containing ozone-depleting substances during their atmospheric degradation.

## **B. Questions and answers**

12. One representative said that, during domestic activities to provide training for technicians, substance identifiers were sometimes used, their results demonstrating that some gases were mixtures. He explained that, while a canister might be labelled as containing HFC-134a, other substances that formed a larger percentage than HFC-134a might be present. In response to his request for advice, Mr. Ravishankara said that only the HFC component of a mixture should be taken into consideration. He noted that other gases could be involved in the HFC-134a mixtures, as those were proprietary mixtures.

13. In response to a query about the reasons for the decreasing growth rate of HFC-141b, Mr. Ravishankara said that the Panel could provide no further information as to why the reported emissions and observed abundances did not balance.

14. Another representative asked, with regard to climate forcing, whether the Panel's prediction took into account other regulatory reforms, such as those envisaged under the Framework Convention on Climate Change. He also wondered whether it had considered future technological reforms, such as alternatives that could be produced naturally. Mr. Ravishankara offered to discuss the matter bilaterally.

15. In response to a question as to whether a comparison of potential HFC emission projections would be possible and what the condition of the environment would have been without the Montreal Protocol, Mr. Ravishankara said that the contribution of HFCs to climate forcing was estimated to be roughly 10 per cent in 2050. If, however, chlorofluorocarbons (CFCs) went unchecked, their contribution was likely to be much greater than 10 per cent, possibly in the range of 30–40 per cent. He added that, given that HFCs were short-lived gases, a change in measured atmospheric abundance would swiftly become apparent.

16. He confirmed one representative's understanding that the business-as-usual scenario for high-global-warming-potential CFCs was not beneficial to the climate. He added that, when looking at HFC substitutes, there was a need to be cognizant of other environmental issues that may be of concern, in addition to climate issues and ozone depletion.

17. In response to another question, he said that the substitution of longer-lived HFCs for short-lived HFCs would create a harmful situation and should be avoided.

## **III. Technological and economic issues**

### **A. Status of alternatives to hydrochlorofluorocarbons and hydrofluorocarbons, including use patterns, costs and potential market penetration of alternatives**

18. A presentation was given by the members of the Technology and Economic Assessment Panel's task force set up under decision XX/8.

19. The presenters focused on refrigeration and air conditioning in six presentations, and also on foams, fire protection, solvents and inhaled therapy. The domestic refrigeration presentation emphasized the significant market percentage and growing importance of isobutane, while that on commercial refrigeration mentioned that HFC blends remained important but that the future would be for machine-room units (and secondary loops), which would contain any type of refrigerant in much smaller quantities. The presentation on large-size refrigeration mentioned the importance of ammonia and carbon dioxide and placed less emphasis on HFCs. The unitary air conditioning presentation

mentioned R-410A as the important replacement, where there remained a significant amount of equipment manufactured using HCFC-22, particularly in Parties operating under paragraph 1 of Article 5. Final choices for low-global-warming-potential developments had yet to be made in that area in a genuine way, although propane had made its way into smaller units in some regions. Large chillers used HFC-134a and HCFC-123 and were intended to continue doing so, with smaller-size chillers using mainly HFC-blends, and small numbers using hydrocarbons and water.

20. The presenters pointed out that mobile air conditioning had three low-global-warming-potential candidates: carbon dioxide, HFC-1234yf and HFC-152a. The industry sector had expressed preferences and transitions could be made relatively quickly in principle, but no industry had made definite choices. Foam production was growing in all countries, with HFC applications declining and hydrocarbons continuing to mature in many applications. HCFCs were used in virtually all applications in Parties operating under paragraph 1 of Article 5. Transitions to high-global-warming-potential alternatives continued to occur in the extruded polystyrene sector. Maintaining and improving the performance of insulation applications presented a principal challenge. In fire protection, two important alternatives were carbon dioxide and HFCs, with a small percentage of halons remaining. Some applications would continue to need halons, HCFCs or HFCs. Options were available in the solvent sector to replace most HCFC, HFC and HFE applications, but a small number of uses would continue to rely on ozone-depleting substances. HCFC-141b continued to be used in large amounts as a solvent in Parties operating under paragraph 1 of Article 5. The inhaled therapy sector was expected to conclude its transition to HFC-based metered-dose inhalers by 2015 worldwide. Transition to HFC-free dry powder inhalers was, however, estimated to be possible in the future with competitive product pricing.

## **B. Presentation of updated data from the supplement to the Intergovernmental Panel on Climate Change and Technology and Economic Assessment Panel special report on ozone and climate**

21. A presentation providing updated data on banks and emissions was given by Mr. Lambert Kuijpers, Mr. Daniel Verdonik and Mr. Paul Ashford.

22. They said that the Task Force had provided significant data on banks and emissions in the fire protection, foams and refrigeration and air-conditioning sector, based on a business-as-usual scenario, with new data for 2020 compared to the data in the 2005 special report on safeguarding the ozone layer and the global climate system, jointly prepared by the Panel and the Intergovernmental Panel on Climate Change. HFCs were expected to receive increasing attention in fire protection, with halon banks and emissions decreasing. In foams, the CFC and HCFC banks were forecast to be large with increasing HFC banks; emissions were relatively small, however. The largest emissions were forecast to take place in the refrigeration and air-conditioning sector. In Parties not operating under paragraph 1 of Article 5, refrigeration and air-conditioning banks and emissions of HFCs were forecast to increase steeply during the period 2010–2020. Increases in HCFC banks and emissions were forecast in particular in Parties operating under paragraph 1 of Article 5, with gradual stabilization after 2015. HFC banks and emissions were also expected to grow in those Parties. HFC emissions in Parties operating under paragraph 1 of Article 5 in 2020 were expected to measure one third of the emissions in Parties not so operating, a situation which was not expected to change significantly after 2020. In the total emissions for the period 2002–2020 HCFC and HFC emissions from foams and fire protection were relatively small; CFC emissions would continue for a significant period, in particular from foams. Taking all fluorochemicals together – including CFCs – total emissions expressed in carbon dioxide were expected to decrease over the period 2002–2020. If HCFC plus HFC emissions were considered alone, however, the total was expected to continue to increase globally, with HCFC emissions to begin stabilizing around 2020, and HFC emissions likely to grow, with a share of 75 per cent in the total forecast for HFC emissions from Parties not operating under paragraph 1 of Article 5.

## **C. Questions and answers**

23. One representative asked whether the Technology and Economic Assessment Panel had any safety or other concerns relating to the technology used for hydrocarbon-based refrigerators that would make it necessary to use HFCs. Mr. Kuijpers responded that countries in the developed world, such as Canada and the United States of America, were using HFC-134a and beginning to consider using hydrocarbons. HFC-134a had also been an important alternative in developing countries.

24. The same representative said that it was stated in the Panel's report that the responsible use of HFCs was the near-term solution to achieving best life-cycle climate performance for unitary air

conditioners. While he did not disagree with that statement, he requested the Panel to elaborate, using measured rather than calculated data, on the assumptions supporting that statement. Mr. Kuijpers responded that that issue had been mentioned within the context of the absence of proven alternatives and agreed that leakages were possible in some types of equipment.

25. In response to questions from three representatives, Mr. Kuijpers said that the issue of the phase-out or phase-down of HCFCs and conversion to HFCs or other refrigerants in Parties operating under paragraph 1 of Article 5 needed careful consideration. Although it might be desirable to wait one or more years to identify a reliable means of doing so, it might ultimately prove impossible to avoid a second conversion at a later date as it was important to move promptly to identify industrial subsectors in which low-global-warming-potential alternatives could be introduced.

26. Regarding a question as to whether substitutes that had low- or zero-global-warming-potential had been identified outside the motor-vehicle sector, Mr. Kuijpers responded that the mobile air-conditioning sector was probably the sector in which the most testing had been undertaken, as in other sectors refrigeration engineers and developers had not yet accepted HFC-1234yf.

27. Concerning the high transition costs of reducing by an estimated 7,000 tonnes HFC use in the subsector of metered-dose inhalers and dry powder inhalers, Mr. José Pons Pons undertook to enlarge on the estimate in bilateral discussions with metered-dose inhaler experts.

28. One representative said that experts in States in West Asia and in States members of the Cooperation Council for the Arab States of the Gulf, where temperatures reached 52° C in the shade, had expressed concern that the performance of air-conditioning units in such high temperatures might suffer if R-22 was replaced with HFC-410A or HC-290, which had not been adequately tested in those temperatures and might currently perform adequately but might fail to do so in the future. That representative asked which alternatives might be available that would be both sustainable and environmentally friendly. Mr. Kuijpers responded that there might indeed be problems with some blends, but assured representatives that more information would be provided during the twenty-ninth meeting of the Open-ended Working Group, when a presentation on alternatives would be given.

29. In response to a question as to what alternative technologies might be available for conserving vaccines in refrigerated conditions in rural areas, given that ammonia, the dominant refrigerant used in the absorption technology currently in use in some countries, and spare parts were not readily available, Mr. Kuijpers responded that absorption technology worked in many countries because it would work with many primary heat drivers, such as liquid petroleum gas and electricity. Refrigerants other than ammonia might pose problems, which was why ammonia was used to refrigerate items such as vaccines. He could provide no alternative suggestions and doubted that the domestic refrigeration sector could do so. He suggested further discussion on a bilateral basis.

## **IV. Policies and measures**

### **A. Activities to limit or reduce emissions of high-global-warming-potential alternatives for ozone-depleting substances under the United Nations Framework Convention on Climate Change and its Kyoto Protocol**

30. The representative of the secretariat of the United Nations Framework Convention on Climate Change gave a presentation on activities to limit or reduce emissions of high-global-warming-potential alternatives to ozone-depleting substances under the Convention and its Kyoto Protocol. He noted that HFCs were regulated under the Convention and its Kyoto Protocol and that there had been decisions taken by the Conference of the Parties to the Convention with regard to HFCs. Parties reported to the secretariat their activities to combat climate change through national communications, greenhouse gas inventories and the provision of supplementary information under the Protocol. Under the Convention, Parties were taking action on HFCs, including through the Clean Development Mechanism.

### **B. Policies and measures for hydrofluorocarbons and perfluorinated chemicals at the national and regional levels**

31. Presentations on measures at the national and regional levels were given by the representatives of the European Commission, Japan and the United States.

32. The representative of the European Commission presented the policy on HFCs and other fluorinated greenhouse gases which applied in the European Community, considered by many as a driving force for innovations leading to lower charges of fluorinated gases into equipment, better containment and substitution by low-global-warming-potential technologies. He described the background and context in which the policy on HFCs had been developed with a view to attainment of the emission reduction targets by which the Community and its member States were bound under the Kyoto Protocol. The legislation adopted in May 2006 ultimately comprised two elements: Directive 2006/EC/40 (MAC Directive), which related to emissions and the use of fluorinated greenhouse gases in air conditioning systems of certain motor vehicles, and Regulation (EC) No 842/2006 (F-Gas Regulation), which contained a series of measures covering all stages of the life cycle of those gases designed to reduce emissions of fluorinated greenhouse gases primarily in stationary applications. In addition, he noted that the 2009 revision of the European Union Emissions Trading Scheme covered, among other things, emissions of perfluorinated chemicals from primary aluminium production.

33. The representative of Japan said that, under the country's Kyoto Protocol target achievement plan, the emission of HFCs had been steadily reduced, through the measures characterized by voluntary actions. Various business sectors had pledged reduction targets and taken measures to that end, which the Government subsequently reviewed. While Japanese industries had advanced technologies, some subsectors, such as air conditioning, received government assistance for further research and development. Japanese legislation also included a mandatory system for the recovery and destruction of HFCs. It provided financial and technical assistance to developing countries to help them contribute to the global reduction of ozone-depleting substances and HFCs.

34. The representative of the United States said that her country used a combination of regulatory and voluntary approaches to reduce greenhouse gas emissions from ozone-depleting substances and their substitutes, including the significant new alternatives policy programme, refrigerant management programmes and voluntary partnerships. To date, the significant new alternatives policy programme had found acceptable some 400 substitutes for all major sectors. Its approvals often included use conditions that protected human health and the environment. The United States prohibited or greatly restricted the use of some high-global-warming-potential substances, and was currently evaluating additional alternatives, many of which had extremely low-global-warming potentials, to expand further the menu of safer alternatives. Another major regulatory effort, the national refrigerant management programme, reduced emissions. For example, the programme required HFCs that were used in motor vehicle air conditioning to be recovered and recycled, and prohibited intentional venting. The country's voluntary programmes targeted specific sectors such as supermarkets, tackled appropriate disposal at end-of-life for small appliances and partnered with affected sectors to create and encourage responsible use of high-global-warming-potential gases. In addition, the United States shared information about domestic legislation under consideration that treated HFCs separately from other climate-forcing gases.

### **C. Questions and answers**

35. In response to a question on the relative cost-effectiveness of the regulatory approach to HFCs and the approach based on the emissions trading scheme, the representative of the European Commission explained that a cost-effectiveness ranking had been undertaken in the past and would soon take place again as part of a review for which analytical capacity was being tendered. Originally, HFCs had not been considered to be covered by the trading scheme, which had begun on an experimental basis and was subsequently expanded to cover other gases.

36. He went on to clarify, in response to another question, that the end-of-life provisions mentioned in his presentation did not apply to the foams sector. In response to the question as to whether a single refrigerant had been considered for the motor vehicle sector, he said that it was the Commission's position to regulate towards a benchmark but to remain technologically neutral, leaving it to the market to decide upon the best solution. No single refrigerant would be imposed.

37. The representative of Japan answered, in response to the same question, that the Government had introduced a regulatory framework only for recovery and destruction. Individual efforts were left to the discretion of the manufacturer or business association. Another representative added that any refrigerant could be chosen, provided that it met the relevant threshold.

## V. Discussions

### A. Experience from the Montreal Protocol that may be used to address the impact of HFCs

#### 1. Experience of the Montreal Protocol that may be relevant

38. The representative of the Secretariat gave a short presentation on the above-mentioned topic. She said that the Montreal Protocol, which had near-universal participation, had succeeded in phasing out the production and consumption of more than 97 per cent of 96 ozone-depleting substances.

39. She enumerated some specific features that had contributed to the Protocol's success. The Protocol's control measures allowed for stockpiling for future use, for exemptions for essential and critical uses, for basic domestic needs to be met and for trading in production rights; and those allowances ensured smooth phase-out without disrupting the functioning of the society. Trade measures were in place to encourage ratification and compliance. Parties operating under paragraph 1 of Article 5 and those Parties not so operating enjoyed equal voting rights and equal representation, yet the special situation of developing countries, and consequently the differentiated responsibility of Parties, was recognized. A science and technology review process enabled Parties to keep abreast of scientific advances and, based on such assessments, the control measures could be adjusted and amended. A flexible, country-driven approach to implementation and a supportive compliance regime helped countries in non-compliance to find amicable solutions. The Multilateral Fund financed incremental costs to enable Parties operating under paragraph 1 of Article 5 to comply with the control measures, and the compliance assistance programme, which included regional networks of national ozone units, assisted such Parties with implementation and compliance.

40. She pointed out, furthermore, that the Protocol benefited from successful global partnerships with Parties, industries, academic institutions, non-governmental organizations and the media. As implementation had progressed, Parties had pioneered new policies, learned useful working methods and developed a culture of trust and compliance. HFCs were the same type of chemical as ozone-depleting substances and used in the same industries. Parties were therefore familiar with such chemicals, their application, their phase-out and the phasing in of alternatives in the relevant industry sectors. The Protocol's proven methods could be applied in full or in part to dealing with HFCs, regardless of the legal instrument under which the substances fell.

#### 2. Financial mechanism: the institutional framework, capacity-building, key processes and procedures

41. The representative of the Multilateral Fund Secretariat gave a short presentation on the above-mentioned topic. The Fund was seen in a variety of forums as a key contributor to the Protocol's successful implementation. One key factor was the equal representation of developing and developed countries in the Fund's policymaking body, the Executive Committee, which contributed to the adoption of sound decisions. Trust among Parties had been built, which allowed for the prompt resolution of emerging issues, with the support of the Fund Secretariat, its implementing agencies and other bodies. Another key factor in that endeavour was the support given to national ozone units, which brought together stakeholders from Governments, industries, the servicing sector and the public, leading to a cost-effective and sustainable phase-out process. They had also assisted in developing regulations and licensing systems for controlling ozone-depleting substances. To ensure the efficacy of the regulations enacted, Customs officers had been continuously trained, which had helped to reduce illegal trade and assist compliance.

42. He remarked that the country-driven approach adopted for the implementation of phase-out plans was also an important factor: government participation had been strengthened and the active participation of all stakeholders throughout the affected sectors had been secured. That approach accorded full responsibility and control to Governments in meeting their compliance targets, which they often did in a timely manner. The Fund's robust business planning and monitoring process also contributed to its success. It enabled the compliance needs of all developing countries to be met within the limited funding available. The monitoring process enabled potential problems to be identified at an early stage so that corrective measures could be taken. Through the Fund, therefore, countries had established a significant basis that could be built on to tackle HFCs. The Fund's wealth of policies, decisions and guidelines could be considered as a model for any institution dealing with HFC controls.

The partnerships and expertise built up over many years could be extended to HFCs, as essentially the same stakeholders were involved.

### 3. Discussion

43. In the ensuing discussion, it was acknowledged that the combination of the various bodies and components was highly effective and represented a significant amount of expertise, including in sectors using HFCs, on which to draw when dealing with the phase-out of those substances. It was pointed out, however, that there was already an international policy framework in place for dealing with HFCs: the Framework Convention on Climate Change and its Kyoto Protocol. Many Parties had, therefore, already developed infrastructure on that basis. Nevertheless, some of the lessons learned in the Montreal Protocol could be applied: a successful funding mechanism was crucial; deployment of technology to Parties operating under paragraph 1 of Article 5, without technology dumping, would be vital; and partnerships between Parties operating under paragraph 1 of Article 5 and those not so operating would also be essential. The science-based approach, which enabled the Parties to take sound decisions, should also be emulated. It was suggested that there were lessons to be learned not only from the success of the Protocol, but also in terms of how matters might have been conducted more effectively under the Montreal Protocol.

44. It was pointed out that the Protocol's success was due in part to the targeted measures agreed for each substance and for each sector and that its focus on production and consumption phase-out, rather than on emissions control, had contributed to phase-out sustainability by altering the structure of the industries concerned. The step-by-step reductions provided predictability and certainty to countries in their search for alternatives: Governments and sectors could plan accordingly.

45. Representatives also commented that the Protocol's success could in part be explained by its limited scope and therefore could not be entirely replicated when dealing with climate change, which was a more complex issue. The Protocol's focus on all ozone-depleting substances had ensured that no ozone-depleting substance had been used as a substitute for another, with the exception of HCFCs for CFCs, given the lack of alternatives at the time. If HFC phase-out were dealt with solely under the Protocol, there was a risk that one greenhouse gas might be replaced with another.

46. It was noted that, although much progress had been made in phasing out ozone-depleting substances, Parties should not be complacent. Institutional capacity should be expanded in a way that ensured the Protocol's future success. There should be continued support for national ozone units. Since their establishment, their mandates had expanded: they had developed policies to reform legislation and they were the national reference points for coordination with other bodies, such as Customs authorities, to combat illegal trade. Institutional strengthening was therefore crucial, both for meeting obligations under the Montreal Protocol and for tackling climate change. The units were crucial for ensuring the sustainability of phase-out within a country and would, therefore, have a role to play in phasing out HFCs. The issues of ozone depletion and climate change could not be dealt with separately, and cooperation between national ozone units and national climate change focal points would be required for phasing out HFCs. Countries would need to be able to make HFC inventories, and national ozone units could provide that kind of information, which would give a clearer picture of production and consumption to enable baseline emissions to be established.

47. Several representatives were of the view that there was not always a technically and economically viable alternative to HCFCs and that there were none without high-global-warming potential. Safety-related concerns and lack of incentives for industry also posed potential obstacles to phase-out. HFCs might therefore initially have to be used as alternatives to HCFCs. The Multilateral Fund Secretariat was urged to maintain its dialogue with Parties operating under paragraph 1 of Article 5 to solve some of the issues related to funding the phase-out of HCFCs and HFCs. There were significant grey areas regarding options for replacing HCFCs, and Parties were encouraged to approach the matter with an open mind.

48. It was suggested that there remained more questions than answers with regard to phasing out HFCs. The Executive Committee of the Multilateral Fund was currently discussing issues related to HCFC phase-out, such as the mobilization of co-funding; the choice of technology; the climate impact of those technologies; related institutional strengthening at the national and international levels; and appropriate levels of financing from the Fund. All those issues would equally apply to HFC control measures.

49. Another representative suggested that there should be a detailed assessment of the effects of HCFC phase-out on industry, as it would require technical support in that regard. That could be given within a framework drafted jointly by the Technology and Economic Assessment Panel and the Intergovernmental Panel on Climate Change.

50. The representative of a non-governmental organization said that scientists were warning that humanity was running out of time with regard to climate change. He was glad to see that the Parties had finally begun to tackle that important issue. He suggested that the very industries affected by the phase-out of ozone-depleting substances could be required to contribute to funding destruction of stockpiles of such substances by the levying of an environmental fee on their products. He also suggested the following: the introduction of HFC phase-out into the agreement that it was hoped would be signed in Copenhagen; the involvement of the Montreal Protocol in any such phase-out measures; and the amendment of both the Kyoto and Montreal protocols to reflect that. He also stressed the need to focus on HFC-free alternatives such as natural refrigerants and to strengthen the Technology and Economic Assessment Panel with representatives from the natural refrigerant sector.

## **B. Maximizing the ozone and climate benefits of early HCFC phase-out**

### **1. Technical options and their feasibility and energy efficiency**

51. A member of the Technology and Economic Assessment Panel made a short presentation on the above-mentioned topic. He said that, in most economies, buildings and the equipment in them accounted for 40–50 per cent of anthropogenic carbon dioxide emissions. Key ozone-depleting substances and HFC-replacement technologies affected energy consumption in those buildings. Some had relatively long product life cycles and thus the energy impact of the technologies could be highly significant. Furthermore, carbon intensities varied worldwide, depending on levels of hydroelectric, nuclear and renewable energy.

52. He explained that energy efficiency requirements were becoming more demanding. He recalled that decision XIX/6 required global-warming potential and energy efficiency to be considered when prioritizing alternatives. The functional unit approach being developed under the Multilateral Fund was a methodology that collectively considered energy-related carbon dioxide emissions and other direct emissions in a way that made technology comparison possible at the enterprise level. Over-emphasis on either energy-related or direct emission aspects could thereby be avoided.

### **2. Progress on the ground**

53. The representative of the United Nations Development Programme (UNDP), made a brief presentation on the above-mentioned topic. She said that UNDP was involved in the preparation of HCFC phase-out management plans in 40 countries, including 22 low-volume-consuming countries. Inception workshops and stakeholder consultations on HCFC phase-out management plans had been held, focusing on technologies. Progress was being made in integrating adjusted HCFC controls in national legislation. Awareness was being raised among local industry and industry associations with regard to links between ozone-layer protection and climate change mitigation. Local industry was open to innovative approaches and partnerships had been established. There remained challenges, however, which included the accounting and financing of climate benefits; guidance on policy and costs; tackling more than one sector simultaneously to meet obligations; dealing with the servicing sector in large countries; and the ease of availability and favourable cost of HCFCs in the absence of production controls.

54. She said that, in the foams sector (rigid foams in insulation applications and integral skin foams in automotive, furniture and microcellular applications), validation and pilot projects had been approved by the Executive Committee of the Multilateral Fund for Brazil, Egypt and Mexico. For methyl formate, formulation development for some applications had been completed and optimization was in progress. Initial results were expected in the last quarter of 2009. Methylal and fully formulated hydrocarbon-based polyols pilot projects had been approved at the fifty-eighth meeting of the Executive Committee. Options with zero ozone-depleting potential and low-global-warming potential existed, at acceptable costs, but challenges remained with regard to performance, usability and safety.

55. Noting that, in the refrigeration and air-conditioning sector (domestic, commercial and industrial refrigeration manufacturing; residential, commercial and industrial air-conditioning manufacturing; and servicing), there were no perfect substitutes, she suggested that energy efficiency would be one of the driving forces in HCFC phase-out. Strategic partnerships with industry associations had been established and local manufacturing industries were being proactive. Links with energy-efficiency

programmes and standards had been established, but alternatives were costly and many had an associated global-warming potential.

56. Lastly, she explained that the UNDP portfolio of Global Environment Facility energy-efficiency projects amounted to some \$186 million. UNDP was not simply designing projects with the Global Environment Facility team, but also reviewing portfolios with regard to life-cycle project opportunities and funding. Furthermore, in Ghana, UNDP and the Global Environment Facility had devised an integrated plan that dealt with energy efficiency, climate mitigation and the reduction of ozone-depleting substances.

### 3. Discussion

57. In the ensuing discussion, some representatives from developing countries said that the main issue was, in their view, how their countries' fragile economies could afford to phase out climate-hostile ozone-depleting substances, as the alternatives tended to be more expensive than the substances that they were replacing.

58. It was noted that Parties already working on phasing out HCFCs were about to come under additional pressure to replace their alternatives, namely HFCs. While it was necessary to seek technologies that were friendly both to the environment and to the ozone layer, the costs of such technologies tended to be high, and the Multilateral Fund should support developing countries when they selected more sustainable technologies.

59. The representative of a regional economic integration organization said that the organization was committed to providing funding to meet all the incremental costs arising out of the accelerated phase-out schedule for HCFCs. There was a need to take into account both the global-warming potential and the energy use of environment-friendly alternatives to HCFCs. Furthermore, the best available technologies must be transferred to Parties operating under paragraph 1 of Article 5 under favourable conditions. His organization had serious doubts about the suggestion that life-cycle climate change performance could be a successful measure as a replacement for global-warming potential. He sought the opinions of the representative of the Technology and Economic Assessment Panel on that issue.

60. One representative observed that energy efficiency was a major factor for small island developing States. Renewable energies and efficiency were important to capacity-building and to the promotion of alternative energy sources. Implementing such forms of energy would call for intense cooperation with other multilateral environmental agreements that also dealt with energy efficiency.

61. It was observed that any replacement option selected must be at least as energy-efficient as the original being phased out, but that that alone was an insufficient criterion. The issues to be considered also included environmental protection and safety. The latter factor had been underestimated, and should be considered in greater detail. For example, the use of ammonia as a refrigerant had been proposed, but owing to ammonia's toxicity additional safety measures would be needed to permit its use. That in turn had a financial impact on the choice of alternatives, and the Parties should take that safety cost into consideration. As a general principle the same level of consideration should be given to all technical options, including those labelled as "natural" or "hazardous".

62. One representative said that his country, as a low-lying State, was already observing the effects of sea-level rise, which would shortly affect the coastal tourist industry, a major source of the Government's revenues. He therefore strongly supported the proposal to regulate HFCs under the Protocol.

63. Many representatives applauded the success of the Multilateral Fund, several of them citing the reasons for that success, such as that it had strong institutions, it relied upon strong scientific and technical advice and it enjoyed a record of cooperation.

64. One representative, while commending the Secretariat and the Executive Committee of the Fund on their work over the years, said that the decisions taken at a Meeting of the Parties were not necessarily reflected within the Executive Committee. That deterred some Parties operating under paragraph 1 of Article 5 from becoming too deeply involved in the deliberations. He suggested that some form of working arrangement should be set up to consider how to establish a better relationship and flow of ideas between the Meeting of the Parties and the Executive Committee. He also observed that, when examining the Panel's sterling work, Parties should be more proactive. Technologies were available, for example, to phase out HCFCs, but the long time that it took to transfer such technologies to Parties operating under paragraph 1 of Article 5 was a problem. There was a need for a structure to ensure that such technologies were not only available to Parties so operating but were also affordable.

65. The representative of an intergovernmental organization observed that refrigerants were the subject of a long-running debate, but that in many applications it was already possible to replace HFCs with low-greenhouse-gas alternatives. He predicted that the needs of the refrigeration and air-conditioning sector would continue to grow. The equipment in that sector had a working life of at least 20 years, entailing high replacement costs and high expenditure on training with the new equipment. His organization stood ready to assist; such assistance did not need to be expensive.

66. The representative of the Technology and Economic Assessment Panel, responding to remarks about the safety of alternative substances, observed that some safety issues could be a pre-qualifier, with a risk assessment being used to show whether potentially hazardous materials could be used safely.

67. With regard to the question as to the choice between global-warming potential or life-cycle climate change performance as a measure to be applied, he considered that the choice was not simply between one or the other. The life-cycle approach would need to take account of the global-warming potential and the energy efficiency of chemicals under consideration.

68. The co-chair pointed out that, even as countries strove to maximize climate benefits, they remained within the Montreal Protocol structure, which meant that Parties operating under paragraph 1 of Article 5 would nonetheless have to comply with Montreal Protocol control measures.

## C. Policy options to tackle hydrofluorocarbons

### 1. Update on continuing negotiations under the United Nations Framework Convention on Climate Change

69. The representative of the secretariat of the United Nations Framework Convention on Climate Change gave an overview of the continuing negotiations concerning HFCs. He explained that HFC-related considerations were currently being considered by three bodies of the Convention: the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol and the Subsidiary Body for Scientific and Technological Advice.

70. In the negotiations under the first Ad Hoc Working Group, one major theme of the work was to learn from the Montreal Protocol. Relevant ideas and proposals by Parties included: taking into account experiences in the Montreal Protocol context; supplementing the Intergovernmental Panel on Climate Change reports with annual reports from technical committees representing key sources, sinks and sectors; disaggregating the climate problem by source, sink or sector, as was the practice under the Montreal Protocol; establishing national climate change committees for adaptation, similar to national ozone units, which could enhance coherence in national policies for adaptation; creating funding mechanisms following the model of the Montreal Protocol's Multilateral Fund to ensure the rapid diffusion and absorption of technologies needed for mitigation and adaptation.

71. Based on those ideas and proposals, a negotiating text had been prepared by the Chair of the Working Group, containing a paragraph on HFCs. During the Working Group's most recent session, Parties had provided general comments on the structure and content of the text, stated reservations and objections, and proposed additions and modifications. That had resulted in a revised negotiating text also containing a paragraph on HFCs, in line with those contributions. The paragraph in the revised negotiating text stated:

144. [[A four-year programme of work on] [Parties should take advantage of] opportunities for rapid, near-term climate mitigation [shall be established as a precautionary measure] to complement ongoing measures to mitigate climate change over the medium and long-term, with the goal of achieving significant near-term results through, for example, reducing emissions of substances that are short-lived in the atmosphere such as black carbon (soot), promoting the phase-down of hydrofluorocarbons (HFCs) and biosequestration. {An arrangement shall be established to reduce emissions of HFCs}.]

144.1 Parties shall establish an arrangement to reduce emissions of HFCs.

72. In the context of the current negotiations under the Kyoto Protocol working group, proposals by Parties had included amendments to Annex A to the Kyoto Protocol to include lists of HFCs, which would be covered by the Protocol in the second commitment period.

73. Negotiations were also in progress under the Subsidiary Body for Scientific and Technical Advice. They involved consideration of the implications of the establishment of new HCFC-22 facilities seeking to obtain certified emission reductions for the destruction of HFC-23; and collaboration with relevant international organizations, including the Ozone Secretariat.

74. In conclusion, he said that the concerns over HFCs were that emissions therefrom were growing, that they had high global-warming potential, and that rapid and significant action was needed. Parties had reported on and were already undertaking activities to tackle those emissions, but more action was needed. There too were lessons to be learned from the experience of the Montreal Protocol.

75. The co-chair observed that the presentation could serve to mainstream the discussion on climate, with a focus on how developed countries could adopt new policies and how developing countries could contribute to the process.

## 2. Proposal to amend the Montreal Protocol to regulate HFCs

76. The representative of Mauritius, speaking also on behalf of the Federated States of Micronesia, introduced a proposal to amend the Montreal Protocol to control HFCs. The rationale for the proposal was that, if not controlled, HFC emissions would reach the level of 5.5 to 8.8 gigatonnes of carbon dioxide equivalent per year by 2050. That amount would represent as much as 28–45 per cent of total carbon dioxide emissions by 2050 under a 450 ppm carbon dioxide stabilization scenario and would accelerate adverse climate impacts, including sea-level rise, desertification and water shortages.

77. The proposal was for Parties not operating under paragraph 1 of Article 5 to phase down HFC production and consumption and for Parties that did so operate to establish HFC control measures, with a grace period. The Multilateral Fund would be called upon to provide incremental-cost funding to implement the HFC phase-down and, when implementing HCFC phase-out, would have to give preference to alternatives other than the high-global-warming-potential HFCs. For all Parties, HCFC-22 production would have to meet efficiency requirements to minimize HFC-23 emissions. Parties operating under paragraph 1 of Article 5 would be eligible for funding from the Multilateral Fund in that respect. Existing HFC-23 destruction projects under the Clean Development Mechanism remained open for consideration. In conclusion, he drew attention to the climate benefits of the Montreal Protocol, as it currently stood and with the proposed amendment.

78. In the ensuing discussion, most representatives expressed appreciation for the proposal, regarding it as an interesting initiative meriting serious consideration. It gave material for a robust discussion, even if much information remained needed to consider the question fully. One of the key issues to be resolved was that there were not, in fact, alternatives for all HFC applications. It was also suggested that the proposal suffered from a lack of specificity for Parties operating under paragraph 1 of Article 5. In addition, the topic of by-product emissions needed further discussion.

79. It was pointed out that phase-out of HFCs had its own complexity, covering not only technical complications but also the need for funding, among other matters. At the time of decision XIX/6, which had accelerated the phase-out of HCFCs by 10 years, the Parties had also decided that most technically-proven alternatives to HCFCs consisted of HFCs. There were some limited possibilities for the use of alternatives such as ammonia, carbon dioxide and other chemicals, in addition to other options under development. It might not, however, be possible fully to replace HCFC-22. One representative suggested that there was a need to emphasize the concept of responsible use rather than changing the list of covered chemicals every year.

80. The same representative sought clarification as to the legal implications of amending the Montreal Protocol to cover HFCs, a class of chemicals that were not ozone-depleting substances. That raised the issue of whether other changes could be made to the Protocol to cover other chemicals.

81. The representative of a regional economic integration organization said that his organization was concerned at the rapid increase in HFC emissions resulting from the phase-out of HCFCs. Action needed to be taken, such as an arrangement whereby HFCs would remain in the basket of gases regulated by the United Nations Framework Convention on Climate Change, but would additionally be controlled under the Protocol. His organization was looking into the mechanisms that would permit such a two-pronged approach.

82. Several representatives said that, as action taken under the Protocol was contributing to the growth in emissions from HFCs, the Parties to the Protocol had a responsibility to act. There was tension between seeking a solution in the context of the Convention and seeking one under the Protocol, tension that paralleled that between the use of HCFCs and the use of HFCs.

83. Some representatives agreed with the suggestion that, rather than a phase-out, there should be a well-designed phase-down of HFCs, enabling them to be used as replacements for HCFCs when no alternatives were available. That would give a more predictable phase-out of HFCs, without prejudging the final choice of solutions.

84. One representative said that, while the growth in global greenhouse gas emissions was alarming, agreement on resolving the problem would have to be found at the fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change. She pointed out that the scenario assumed in the presentation, of carbon dioxide stabilization with unchecked growth of HFCs, was inconsistent with the Kyoto Protocol, which covered all greenhouse gases. Parties to the Framework Convention were already taking actions to restrict emissions of any greenhouse gases, not simply carbon dioxide or any other gas in isolation.

85. Following closing remarks, in which he commended participants on the rich debate, the co-chair declared the meeting closed at 6 p.m.

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