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Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer
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Items 3, 8 (a) and 10 of the provisional agenda*

Issues for discussion by and information for the attention of the Open-ended Working Group of the Parties to the Montreal Protocol at its forty-fifth meeting

Note by the Secretariat

Addendum

I. Introduction

1. The present addendum to the note by the Secretariat on issues for discussion by and information for the attention of the Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer at its forty-fifth meeting (UNEP/OzL.Pro.WG.1/45/2) contains information that has become available since the preparation of that note. Section II of the addendum sets out new information provided by the Technology and Economic Assessment Panel in its 2022 quadrennial assessment report and its 2023 report in relation to items 3 and 8 (a) of the provisional agenda, respectively. It also includes information on a proposal submitted by Cuba to adjust the Protocol, in relation to item 10 (b) of the provisional agenda.

2. Further information, expected to be provided by the Technology and Economic Assessment Panel in relation to items 4, 6, 7 and 8 (b)–(f) of the provisional agenda, is included in a second addendum to the note by the Secretariat, along with any other issues of relevance for the parties' information.

3. The 2023 report of the Technology and Economic Assessment Panel consists of three volumes:[1]

(a) Volume 1: Technology and Economic Assessment Panel May 2023 Progress Report and its supplementary report: decision XXXIV/3 Energy Efficiency Working Group Report;

(b) Volume 2: Evaluation of 2023 Critical-Use Nominations for Methyl Bromide and Related Issues – interim report;

(c) Volume 3: Decision XXXIV/2 Task Force Report – terms of reference for the study on assessment of the funding requirement for the replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the period 2024–2026.

* UNEP/OzL.Pro.WG.1/45/1/Rev.2.

[1] Available on the portal for the forty-fifth meeting of the Open-ended Working Group at https://ozone.unep.org/meetings/45th-meeting-open-ended-working-group-parties/pre-session-documents.

II. Summary of issues for discussion by the Open-ended Working Group at its forty-fifth meeting

4. The issues covered in the present addendum are set out below in the order of the respective items on the provisional agenda of the meeting.

Agenda item 3

The 2022 quadrennial assessment of the Montreal Protocol (decision XXXI/2)

5. The full reports of the 2022 quadrennial assessments prepared by the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel and its technical options committees, in response to decision XXXI/2, are available on the Ozone Secretariat website on the corresponding panel portals[2] and on the portal of the forty-fifth meeting of the Open-ended Working Group.[3]

6. The highlights of the Scientific Assessment Panel report and the Environmental Effects Assessment Panel report are set out in annexes I and II, respectively, to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2). The overall key findings of the assessment of the Technology and Economic Assessment Panel are reproduced in the annex to the present addendum, as received by the Secretariat, without formal editing. In those findings, the Panel outlines its response to decision XXXI/2 and the main messages emanating from the assessments of its technical options committees, the executive summaries of which are also included in the assessment report.

7. In addition, in its quadrennial report, the Technology and Economic Assessment Panel includes responses to decisions of the parties on issues to be addressed under items 3 (b)–(d) and 3 (f) of the provisional agenda, as well as to decisions requesting the Panel to provide in its quadrennial reports updated information on issues related to process agent uses, and laboratory and analytical uses. Furthermore, the report contains updated information on destruction technologies for controlled substances and corresponding recommendations, outlined in this addendum under item 3 (g) of the provisional agenda. A summary of these responses is provided in paragraphs 8–43 below.

(a) Information on the consumption and production of hydrofluorocarbons not listed in Annex F (decision XXIX/12)

8. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 8–9), in decision XXIX/12, the assessment panels were requested to provide in their quadrennial reports to be presented in 2023, and every four years thereafter, information on the consumption and production of hydrofluorocarbons (HFCs) not listed in Annex F of the Protocol that have global warming potential no less than the lowest global warming potential (GWP) of the HFCs listed in Annex F, noting that this is only for information purposes.

9. A response to that decision is provided in the 2022 quadrennial assessment report of the Medical and Chemicals Technical Options Committee of the Technology and Economic Assessment Panel. Given that Annex F of the Montreal Protocol refers to 100-year GWP values from the 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change, the Committee notes that it has interpreted those values to constitute the basis for the GWP threshold mentioned in decision XXIX/12 as the lowest GWP of Annex F HFCs, that is, a GWP value of 53 for HFC-152 listed in Annex F.

10. In order to identify which HFCs have GWP greater than 53, the Committee used as a basis the 100-year GWP values included in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, which provides a number of HFCs, as well as hydrofluoroolefins (HFOs), that were not included in the Fourth Assessment Report. In doing so, the Committee notes that, even if HFOs are included within the scope of HFCs, most would have a GWP value lower than the GWP threshold of 53 defined pursuant to decision XXIX/12.

11. A comparison between the GWP values for HFCs (including for existing Annex F HFCs) and HFOs in the Fourth and Sixth Assessment Reports of the Intergovernmental Panel on Climate Change undertaken by the Committee is presented in table 2.18 of its assessment report, showing significant differences for some HFCs, owing partly to changes in the calculation of GWP values. The Committee's findings are presented in table 2.19, which lists 13 HFCs and one HFO with Sixth

[2] https://ozone.unep.org/science/assessment/sap; https://ozone.unep.org/science/assessment/eeap; https://ozone.unep.org/science/assessment/teap.

[3] https://ozone.unep.org/meetings/45th-meeting-open-ended-working-group-parties/pre-session-documents.

Assessment Report 100-year GWP values greater than the threshold GWP of 53, along with available information about their commercial use. Of these substances, there are six HFCs with known commercial use (HFC-245cb, HFC-245eb, HFC-52-13p, HFC-76-13sf, HFC-c447ef and cis-1,1,2,2,3,4-hexafluorocyclobutane).

12. In this regard, the Committee also points out that some HFCs listed in Annex F have not had significant commercial use, including HFC-134, HFC-143, HFC-236cb, HFC-245ca and HFC-152.

13. Furthermore, the Committee provides information on other fluorinated substances with known commercial use that are not HFCs but have GWP values above the decision XXIX/12 threshold of 53. These include hydrofluoroethers (HFEs) used as solvent replacements for controlled substances with Fourth Assessment Report GWP values between 59 and 580; and HFEs used as inhalation anaesthetics, where emissions are more likely to occur, with Sixth Assessment Report GWP values between 195 and 2,590. According to the Committee, anaesthetic gases are estimated to contribute up to 0.1 per cent of total greenhouse gas emissions and account for around 5 per cent of total health-care emissions.

(b) Information on the availability of hydrochlorofluorocarbons (decision XXX/2, para. 4)

14. As is mentioned in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 10–12), in paragraph 4 of decision XXX/2, parties requested the Technology and Economic Assessment Panel to provide, in its quadrennial reports to be presented in 2023 and 2027, information on the availability of hydrochlorofluorocarbons (HCFCs), including amounts available from recovery, recycling and reclamation, and best available information on country-level and total known stocks, as well as on the availability of alternative options for the applications described in Article 2F, subparagraphs 6 (a) and (b).

15. Subparagraphs 6 (a) and (b) of Article 2F provide that, after the HCFC production and consumption phase-out date of 1 January 2020 and up to 1 January 2030, parties not operating under paragraph 1 of Article 5 of the Montreal Protocol (non-Article 5 parties) may exceed the zero limit on HCFC consumption or production in any year by up to 0.5 per cent of the baseline consumption or production allowance, provided that such consumption or production shall be restricted to the following specific applications: (a) the servicing of refrigeration and air-conditioning equipment existing on 1 January 2020; (b) the servicing of fire suppression and fire protection equipment existing on 1 January 2020; (c) solvent applications in rocket engine manufacturing; and (d) topical medical aerosol applications for the specialized treatment of burns. Use of HCFCs for these applications can continue in non-Article 5 parties from recycled or stockpiled sources for as long as those sources remain.

16. Information on banks and stocks of controlled substances is provided in chapter 3 of the Panel's quadrennial report. Options for alternatives to HCFCs and, when feasible, the amounts available from recovery, recycling and reclamation for the applications described in subparagraphs 6 (a) and (b) of Article 2F are outlined in the assessment reports of the Fire Suppression Technical Options Committee, the Medical and Chemicals Technical Options Committee and the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee.

(i) Refrigeration and air-conditioning sector

17. As is mentioned in the 2022 assessment report of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee, the HCFC phase-out for refrigeration, air-conditioning and heat pump (RACHP) uses in non-Article 5 parties is essentially complete. HCFC-22 and HCFC-123 are currently used in legacy equipment that is mostly at the tail end of its lifetime. For servicing, easy retrofit solutions, for example, R-422D,[4] are used as a direct drop-in replacement for HCFC-22, when necessary.

18. Any remaining refrigerant consumption is sourced mainly from banks of recovered, recycled or reclaimed HCFCs. Estimates of the size of HCFC banks in the RACHP and foam sectors are reported in sections 3.2.3.3 through 3.2.3.5 of the Panel's 2022 assessment report. These are aggregated values, representing banks in both non-Article 5 and parties operating under paragraph 1 of Article 5 of the Montreal Protocol (Article 5 parties).

[4] R-422D is an HFC-hydrocarbon mixture (see the annex to chapter 3 of the 2022 assessment report of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee).

19. In particular, in its assessment report, the Panel provides estimates of the active[5] bank of HCFC-22 (used mainly as a refrigerant) and HCFC-142b (used mainly as a foam blowing agent) during the period 1990–2014. Accessing these banks may enable further management, including recovery, recycling and reclamation. According to the estimates, the total HCFC-22 bank in the refrigeration, air-conditioning and foam sectors reached a peak of about 3,500 kilotonnes around 2010–2012, falling to approximately 3,000 kilotonnes in 2014, while the total HCFC-142b bank reached a peak of more than 700 kilotonnes between 2011 and 2014.

20. In the case of HCFC-141b, most of the active bank is in construction foams. Estimates of the active bank for the period 1989–2050 reveal that a peak of about 1,000 kilotonnes was reached in the mid-2010s, falling to around 600 kilotonnes in 2023 and projected to reach insignificant levels by 2050. Regarding the decommissioning of foams containing HCFC-141b, the timing of the global peak is estimated to occur in the next five years.

(ii) Fire suppression sector

21. The Fire Suppression Technical Options Committee notes that, while HCFCs are used for fire suppression in several different blends, it is not possible to estimate either the global bank[6] or emissions of HCFCs from fire protection uses, as all HCFCs have been used more extensively as refrigerants.

22. The Committee discusses alternatives and enduring uses of HCFCs (civil aviation, military, oil and gas sector and nuclear power plants), together with those for halons and HFCs, noting that, although research to identify potential new fire protection agents from existing candidates is continuing, it could take quite a long time before new alternatives could have a significant impact on the fire protection sector. This is due mainly to the lengthy process of testing, approval and certification, and market acceptance of new fire protection equipment types and agents. Halons are therefore still needed for several enduring uses.

23. In fixed systems, HCFCs (and perfluorocarbons) were used as initial alternatives to halons, followed closely by HFCs and inert gases, and more recently by a fluoroketone (FK). The HCFCs (and perfluorocarbons) are no longer used in new total flooding fire-extinguishing systems and their use is limited to supporting existing systems. The three types of in-kind alternatives to halons and HCFCs that are used in new fire-extinguishing systems today are high-GWP HFCs, zero-GWP inert gases and a low-GWP FK.

24. For portable (handheld) extinguishers, there have been several in-kind alternatives to halon 1211 commercialized in a sustainable manner over time, beginning with HCFC blends, followed by HFCs, then by FK-5-1-12 and, more recently, by 3,3,3 trifluoro-2-bromo-propene (2-BTP). From 1999 to date, HCFC Blend B has been employed in non-residential applications, as well as notable military applications for airport flight lines. However, these alternatives, including HCFC Blend B, do not have the fire-extinguishing performance of halon 1211, meaning that greater quantities of agent (and larger extinguisher units) are required to achieve an equivalent extinguisher rating.

25. The Committee notes that more information on fire protection alternatives to halons, HCFCs and HFCs will be provided in technical note A of its assessment report, which is currently under preparation.

(iii) Rocket engine manufacturing

26. Alternative options for solvent in rocket manufacturing in non-Article 5 parties are addressed in chapter 4 of the 2022 assessment report of the Panel's Medical and Chemicals Technical Options Committee. According to the Committee, aerospace and military applications may require small quantities of chlorofluorocarbons (CFCs) or HCFCs globally to service existing equipment (e.g., CFC-113, HCFC-122, HCFC-122a, HCFC-141b and HCFC-225) in non-Article 5 parties, which would be sourced from stockpiles. While such HCFC solvent uses are unlikely to exceed several hundred metric tonnes (i.e., several ODP-tonnes) annually for the period 2020–2030, stockpiled sources of controlled substances can become unsuitable over time for these critical precision cleaning

[5] Active or reachable banks are substances contained in equipment or products in use and thus potentially reachable or accessible for management upon entering the waste stream at end of life.

[6] The "global bank" is defined as all agents currently contained in fire equipment, as well as all agents stored, for example, at recycling centres, at fire equipment companies and at user premises – in other words, all agents that have been produced but have yet to be emitted or destroyed. The collection, reclamation, storage and redistribution of fire-extinguishing agents is referred to as "banking". These concepts apply to all fire suppression gases, including halons, HCFCs, HFCs and their alternatives.

uses owing to the formation of chemical impurities, which can compromise the safety of humans and vehicles.

27. It can also be difficult to prove the efficacy of replacement solvents under actual conditions of use as such solvent substitutions require, in some cases, full-scale testing under expected loads and use environments. While alternative chemicals (e.g., hydrochlorofluoro-olefins (HCFO)-1233zd) are qualified as replacements to date, the Committee notes that challenges remain, including the degradation of legacy systems designed for CFC and HCFC cleaning solvents when those are replaced by chemicals not controlled under the Montreal Protocol.

(iv) Medical aerosol applications

28. Consumption and availability of HCFCs for medical aerosols in non-Article 5 parties, where recycling and use from existing stockpiles may be ongoing in small quantities, and in Article 5 parties are discussed in chapter 9 of the assessment report of the Medical and Chemicals Technical Options Committee. According to the Committee, topical medical aerosol applications using HCFC-22 (as a propellant) and HCFC-141b (as a solvent) are available in the Russian Federation, sourced from stockpiles. The production of two very popular foam medical aerosol products by a company in the country requires the annual use of around 20 tonnes of HCFC-22 and HCFC-141b.

29. In addition, the Committee reports that HCFC-22 and HCFC-141b are used for aerosols in China by several large pharmaceutical companies and some smaller companies. After 2020, the use of these substances has been estimated to be around 100 tonnes per year. Flammability safety concerns with some economically feasible alternatives, such as dimethyl ether or liquefied petroleum gas, have been a barrier to their use in this application, while other potential technical alternatives, such as HFC-134a, may be expensive.

(c) Update to the report of the working group of the Technology and Economic Assessment Panel on information on alternatives to hydrofluorocarbons (decision XXVIII/2)

30. In response to paragraph 4 of decision XXVIII/2, and as outlined in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 13–18), in 2022, the Technology and Economic Assessment Panel established a working group to prepare a report containing information on alternatives to HFCs, using the criteria set out in paragraph 1 (a) of decision XXVI/9. The report of the working group was set out in volume 5 of the 2022 Panel report[7] and its executive summary was reproduced in annex II to the addendum to the note by the Secretariat for that meeting (UNEP/OzL.Pro.34/2/Add.1).[8] The report was presented for consideration to the Thirty-Fourth Meeting of the Parties, held from 31 October to 4 November 2022.

31. Information on alternatives to HFCs in the working group report was developed by the relevant four technical options committees of the Panel, namely, the Flexible and Rigid Foams Technical Options Committee, the Halons Technical Options Committee, the Medical and Chemicals Technical Options Committee and the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee. Each technical options committee provided its interpretation of the set criteria outlined in decision XXVI/9 of relevance to the sector that it considered and disaggregated the requested information into the different application sectors under its purview. The Panel also noted that the information provided might be further updated in the assessment reports of the technical options committees due for completion by the end of 2022.

32. In its 2022 assessment report, the Panel noted that the information that had been provided in the working group report was much the same as that provided in the 2022 assessment reports of the four technical options committees mentioned above. The working group report is also posted on the portal of the present meeting, for ease of reference.

33. In addition, the Panel reiterates its suggestion to align the preparation schedule of reports on HFC alternatives, as set out in decision XXVIII/2 (requesting a review in 2022 and every five years thereafter), with the timeline for the quadrennial assessment reports of the Panel. Such an alignment would take into consideration the workload of the Panel and avoid duplicative work, allowing it to respond better to other decisions of the parties during the same periods.

(d) Future availability of halons and their alternatives (UNEP/OzL.Pro.WG.1/44/4, para. 140)

34. At the forty-fourth meeting of the Open-ended Working Group, the parties considered the Technology and Economic Assessment Panel's updated response to decision XXX/7, on the future

[7] https://ozone.unep.org/system/files/documents/TEAP-Decision-XXVIII-2-HFC-%20Alternatives-report-sept2022.pdf.

[8] https://ozone.unep.org/system/files/documents/MOP-34-2-Add-1E.pdf.

availability of halons and their alternatives, contained in volume 1 of the Panel's May 2022 report (progress report).[9] In that decision, the parties had requested the Panel, through its Halons Technical Options Committee, to continue engaging with the International Maritime Organization and the International Civil Aviation Organization to better assess future amounts of halons available to support civil aviation and to identify relevant alternatives already available or in development; ways to enhance the recovery of halons from the breaking of ships; and specific needs, other sources of recoverable halon and opportunities for recycling.

35. At that meeting, the Halons Technical Options Committee, which was subsequently renamed the Fire Suppression Technical Options Committee in decision XXXIV/11 and will be henceforth referred to by that name, stated that it would provide updated information in its 2022 quadrennial assessment report. Recognizing that the issues of halon management remained of major importance, the Working Group agreed to defer further consideration of the item to its forty-fifth meeting and requested that an item on the issue be added to the agenda of the Thirty-Fourth Meeting of the Parties. The parties addressed the issue at the latter meeting and took note of the information provided by the Panel.

36. As was indicated by the Fire Suppression Technical Options Committee, a detailed account of issues related to halon availability and their alternatives is provided in the Committee's 2022 quadrennial assessment report. Following are the key messages:

(a) The expanded use of alternative refrigerants is worrying owing to their potential flammability and yet-to-be-determined effects on firefighting systems (e.g., agent effectiveness, by-products generated, etc.). The use of flammable refrigerants in system design, installation, and servicing requires additional training, particularly in Article 5 parties in the implementation of their HFC phase down. These issues are of particular concern to the military sector or other applications that may be subject to extreme environments. While new methods are being developed to address these concerns, support for capacity building in Article 5 parties would be important.

(b) Halon emissions may be higher than those predicted by the Committee's models. For halon 1301, the Committee needs further information on emissions from feedstock production and use, and location of emissions. For halon 1211, emissions derived from atmospheric concentrations are near or above reported global produced amounts. For halon 2402, further information is needed on emissions from decommissioning activities in Asia.

(c) Many halon applications have transitioned to alternatives, some of which are high-GWP HFCs. Halons are still needed for several enduring uses such as in the growing civil aviation and other sectors e.g., oil and gas, nuclear power plants and military.

(d) Most available in-kind halon and high-GWP alternatives are considered to be per- and poly-fluoroalkyl substances (PFAS) in some definitions and are being proposed for a complete phase-out in some regulations. Such alternatives may therefore be curtailed or prohibited, leaving halons (with high ODP and GWP), HFC-23 (with very high GWP) and potentially trifluoroiodomethane (CF3I, with toxicity and potentially ODP issues) as the only viable alternatives.

(e) The run-out date of halon 1301 is now estimated to be 2030 to 2049, depending on the modelling scenario used. This time period is 2-5 years sooner than the period that had been estimated in the 2018 Assessment Report (2032 to 2054) due to the availability of less halon 1301 to support enduring uses.

(f) HFC phase-down regulations in non-A5 parties are having a bigger impact on the cost and availability of HFC fire suppressants than initially anticipated by the Committee. As the supply of newly produced HFCs for fire protection decreases in response to phase-down regulations, recycling becomes even more important as an alternative supply source and is likely to increase in the future.

(g) Destruction of halon 1301 for carbon credits to be traded in the voluntary carbon market is of concern as it could contribute to global shortages/regional imbalances of halon 1301 to support long-term enduring uses.

(h) Recovered, recycled or reclaimed fire suppressants represent a viable alternative to newly produced agents which would serve to greatly reduce emissions and production. Destruction should only be employed as the final disposition option when halons, HCFCs, HFCs, and their alternatives are too contaminated and cannot be reclaimed to an acceptable purity. Awareness programmes to re-establish the detected loss in institutional memory on issues surrounding the use, recycling, and banking of halons, HCFCs, HFCs, and their alternatives would be important.

[9] https://ozone.unep.org/system/files/documents/TEAP-Progress-report-may2022.pdf.

(e) Any other issues

37. As is mentioned in paragraph 7 of the present addendum, in addition to the decisions discussed above, the assessment reports of the Technology and Economic Assessment Panel and its technical options committees address decisions on issues related to process agent uses (decision XXXI/6), laboratory and analytical uses (decision XXXI/5), and destruction technologies for controlled substances (decisions XXX/6 and XXX/15). On the last issue, the Panel makes specific recommendations for updating the list of approved destruction technologies. A summary on this issue, which would fall under sub-item 3 (g) of the provisional agenda should parties wish to discuss it, is provided in paragraphs 38–43 below.

38. Under the Montreal Protocol, parties have taken several decisions to approve technologies used for the destruction of controlled substances. Consequently, the list of approved destruction technologies has been updated over the years. The most recent list of such technologies was adopted by decision XXX/6 in 2019 and is set out in annex II to the report of the Thirtieth Meeting of the Parties.[10]

39. In the same decision, the Technology and Economic Assessment Panel was requested to assess the destruction technologies that were listed as not approved or not determined, as well as any other technologies, and to report to the Open-ended Working Group prior to the Thirty-Third Meeting of the Parties, in 2021, with the understanding that if further information is provided by parties in due time, in particular regarding the destruction of HFC-23 by cement kilns, the Panel should report to an earlier meeting of the Open-Ended Working Group.

40. Furthermore, in paragraphs 2 and 5 of decision XXX/15, the Panel was requested to provide a review of destruction technologies, if new compelling information became available.

41. In 2021, the Panel and its Medical and Chemicals Technical Options Committee reported that an assessment in response to decision XXX/6 would be included in the Committee's 2022 assessment report, based on available information. The Committee also outlined preparations for its assessment of destruction technologies under that decision in its 2020 and 2021 progress reports, including suggested guidance on the type of relevant information needed for assessment, and invited parties to submit such information in response to paragraph 3 of decision XXX/6 no later than January 2022 to allow time for assessment.

42. In chapter 8 of its assessment report, the Committee notes that it is not currently aware of new test data relating to already approved destruction technologies or new technologies that would allow an assessment. It also observes that several mainstream destruction technologies continue to lack specific data on demonstrated destruction removal efficiency for Annex F HFCs and raises issues regarding already approved technologies for the consideration of parties.

43. Addressing possible updates to the current list of approved destruction technologies, the Committee makes the following recommendations:

(a) To consider removing the category "Portable Plasma Arc" as a separate approved technology, as this employs a small-scale nitrogen plasma arc process that is already included in the list and the Committee finds unnecessary the approval of a smaller scale technology version as a separate category;

(b) To consider including cement kilns as an approved destruction technology for dilute sources of ozone-depleting substances and Annex F, Group 1, HFCs, as cement kilns have already demonstrated that they meet destruction removal efficiency for concentrated sources of a range of ozone-depleting substances and Annex F, Group 1, HFCs (99.99 per cent versus 95 per cent for dilute sources), which would qualify them for destruction of dilute sources.

44. The Working Group may wish to consider the information provided in the quadrennial assessment reports of the Technology and Economic Assessment Panel and its technical options committees.

Agenda item 8

Technology and Economic Assessment Panel 2023 report and related issues

45. Under item 8 of the provisional agenda, the parties will consider information provided by the Technology and Economic Assessment Panel in volumes 1 and 2 of its 2023 report. The Panel's progress report (vol. 1) is expected to include progress reports by its technical options committees and

[10] https://ozone.unep.org/system/files/documents/MOP-30-11E.pdf.

the Panel's responses in relation to sub-items 8 (b)–(e) of the provisional agenda. The interim report of the Methyl Bromide Technical Options Committee (vol. 2),[11] available on the meeting portal, provides information on the evaluation of a 2023 critical-use nomination for methyl bromide and associated issues in relation to sub-item 8 (a).

46. A summary of the issues addressed in volume 2 of the Panel's report is presented in paragraphs 47–55 below.

Nomination for critical-use exemption for methyl bromide for 2024

47. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 50–51), the Methyl Bromide Technical Options Committee evaluated one nomination for critical-use exemption, submitted in 2023 by Canada for 2024. Two parties (Australia and South Africa) that had submitted critical-use nominations in 2022 did not do so in this round.

48. According to the Committee, the nomination submitted by Canada for 2024 was attributed to environmental conditions and regulatory restrictions that did not allow partial or full use of alternatives that have been used successfully for this sector in other countries, difficulties in the scale-up of substrate technologies and associated economic costs.

49. The Committee has recommended the approval of the full amount nominated by Canada for 2024, taking into consideration that this represents a significant (17 per cent) decrease in the amount that had been approved for 2023, and that the party has made a policy decision, producing a step-down plan to reduce the nominated amounts over the next few seasons with the intention of phasing out methyl bromide use by 2026.

50. The nomination submitted by Canada for 2024 and the interim recommendation by the Committee are listed in the table below.

Nomination for 2024 critical-use exemption for methyl bromide submitted in 2023 and the interim recommendation of the Methyl Bromide Technical Options Committee

(Metric tons)

Party	*Nomination for 2024*	*Interim recommendation for 2024*
Non-Article 5 party and sector		
Canada Strawberry runners	3.857	[3.857]
Total	**3.857**	**[3.857]**

51. In addition to the interim recommendations on the critical-use nomination of Canada, in its report, the Committee recalls the reporting requirements under relevant decisions and includes information on trends in methyl bromide critical-use nominations and exemptions for all nominating parties to date, as well as on the reported accounting frameworks for critical uses and stocks of methyl bromide.

52. Pursuant to paragraph 9 (f) of decision Ex. I/4 on conditions for granting and reporting critical-use exemptions for methyl bromide, each party that has been granted a critical-use exemption is requested to submit its accounting framework information together with its nomination. In accordance with that provision, Canada submitted in 2023 its accounting framework for 2022, reporting no available stocks at the end of 2022.

53. The Committee also notes that, while reported stocks for controlled uses in non-Article 5 parties are now small, in Article 5 parties there is no reporting mechanism for pre-2015 stocks and it is possible that there are substantial unreported amounts globally (approximately 1,000 metric tons). Furthermore, there is confusion in some parties as to whether stocks held at the national level are for quarantine and pre-shipment uses or not.

54. The final report of the Committee will be available prior to the Thirty-Fifth Meeting of the Parties.

55. The Working Group may wish to consider the report and interim recommendations of the Methyl Bromide Technical Options Committee.

[11] https://ozone.unep.org/system/files/documents/TEAP-CUN-interim-report-may-2023.pdf.

Agenda item 10

Potential impacts of the coronavirus disease (COVID-19) pandemic on hydrofluorocarbon consumption for Group 1 parties operating under paragraph 1 of Article 5

Proposed adjustments to the Montreal Protocol

56. Under sub-item 10 (b) of the provisional agenda, the Working Group is expected to consider a proposal for adjustments to the Montreal Protocol submitted pursuant to paragraph 9 of Article 2 of the Protocol. In accordance with the procedure specified in the Protocol, any proposals for adjustments must be submitted six months prior to the meeting at which they are to be considered. The deadline for the submission of adjustment proposals to be considered at the Thirty-Fifth Meeting of the Parties, which is scheduled to begin on 23 October 2023, was therefore 23 April 2023. As at 23 April 2023, one proposal for adjustments had been received by the Secretariat, namely, the proposal by Cuba (UNEP/OzL.Pro.WG.1/45/7, annexes I and II), available on the portal of the forty-fifth meeting.

57. The adjustment to the Montreal Protocol proposed by Cuba seeks to make the selection of baseline years for HFCs for Article 5 parties more flexible. The main reason for the proposal is the concern that during the COVID-19 pandemic there was economic contraction and reduced imports of refrigerant gases compared with pre-pandemic years.

Annex*

2022 Assessment Report of the Technology and Economic Assessment Panel

Overall key findings

1. Since the 2018 TEAP Assessment Report, important technical developments have taken place to meet key ODS production and consumption phase-out milestones under the Montreal Protocol. The Kigali Amendment has created new challenges and additional milestones to phase down certain HFCs. Regular assessments by TEAP highlight the technical and economic challenges and provide useful information to transition to alternatives and technologies across the various sectors of use. The key sector and technology-specific challenges include phase-out of remaining uses of ODS in specific sectors, the phase-down of HFCs, uncontrolled and growing ODS uses, responsible management of banks and stocks of controlled substances, and emerging options for the use of more climate-friendly alternatives.

1. Significant technical progress

2. Actions under the Montreal Protocol support continued progress in consumer, commercial, industrial, agricultural, medical, and military sector, with ODS no longer used in many applications worldwide, e.g., no longer likely used in sterilisation. The phase-out of HCFC-22 in non-A5 parties is essentially complete and progressing in A5 parties. Under the Kigali Amendment, parties are progressing with national regulations to phase down HFCs, which is spurring market demand for lower-global warming potential (GWP) alternatives and simultaneously improving efficiency of equipment, stimulating innovative technologies and creating solutions to address new challenges for some applications.

3. Ultralow-, low-, and/or medium-GWP alternative refrigerants are available for all refrigeration, air conditioning, and heat pump (RACHP) applications and are being widely applied in some RACHP applications and regions. Most ultralow-, low-, and medium-GWP refrigerants have different flammability classes (lower flammability, flammable, and higher flammability). The RACHP sector continues to update the relevant safety standards to enable their use.

4. Significant progress has been made to phase-out the use of hydrochlorofluorocarbons (HCFCs) in foams. There are foam blowing agents (FBAs), that are not controlled substances, in use commercially today in nearly every foam sector.

5. Phase-out of controlled uses of methyl bromide (MB) is virtually complete. Parties report that greater than 99.8% of the baseline consumption of 66,428 tonnes for these controlled non-Quarantine and Pre-shipment (QPS) uses has been phased out by 1 January 2023.

6. Technically and economically feasible alternatives to controlled substances are commercially available for all aerosols, although not all alternatives are suitable across all aerosol applications in all locations. Parties may wish to consider the advantages of reducing the use of HFCs in the aerosol sector, where that is technically and economically feasible. Given that aerosols are totally emissive, any action taken would provide rapid reduction in HFC consumption and emissions.

7. Successful collaboration of experts across the Assessment Panels has supported the work of parties under the Montreal Protocol. The recent identification of unexpected increase in chlorofluorocarbon (CFC)-11 emissions between 2013 and 2018 led to coordinated research and analyses. In reports in 2019 and 2021, analysis by the TEAP Task Force on Unexpected Emissions of CFC-11 indicated that emissions from the CFC-11 banks alone could not explain the unexpected increase in emissions and indicative of unreported CFC-11 production and use in this period, most likely for use in closed-cell foams. Unreported production would also seem to have been occurring earlier in the period from 2007 to 2012. While this was a successful demonstration of scientific and technical collaboration providing answers on sources of unexpected emissions, it also highlighted the continuing challenge of compliance under the Montreal Protocol and the need for vigilance and continued support by parties.

* The annex has not been formally edited.

2. Continuing challenges

8. The planned HFC phase-down under the Kigali Amendment, as well as national and regional regulations, are driving industry towards lower-GWP HFC alternatives or not-in-kind technologies, particularly in refrigeration, air conditioning, and foam applications. However, the range of new, lower GWP products creates challenges in finding the best solution for each application, considering factors such as flammability, toxicity, availability, and operating conditions.

9. Supply shortages of low-GWP alternatives in some sectors are understood to have started in 2020 due to COVID-19 related supply chain and logistics issues, raw material shortages, manufacturing issues, and severe weather, at the same time as increasing global demand. While these supply issues are less severe now, these will need careful monitoring as extended shortages in supply could delay transition away from HFCs across the various sectors of use.

10. In RACHP applications which use more than 90% of all HFCs, the HFC phase-down schedule focuses on addressing direct greenhouse gas (GHG) emissions by reducing HFC production and consumption. However, indirect GHG emissions from RACHP applications are equally or potentially more impactful to climate change. Some new low GWP RACHP equipment is more efficient by design, and reduces national energy demand. This will have a greater impact on climate change mitigation through synergy with reduced demand in high-performance buildings and cold-chain, and reduced carbon intensity of the electricity network.

11. In most A5 parties, but especially in low- and very low-volume consuming countries (LVC and VLVCs), the majority of ODS and HFC refrigerants is used for servicing. Cold food chains require a systematic approach, and are especially vulnerable, with a scarcity of trained personnel along supply chains delaying their implementation. Establishing proper servicing, described in codes and applied by trained and certified technicians, would reduce direct emissions of ODS/HFC refrigerants, and reduce the loss in energy efficiency in RACHP equipment over time.

12. In specific foam applications, some challenges remain, particularly for smaller enterprises in some A5 parties. These include shortage of supply and cost of alternatives, especially hydrocarbons and hydrofluoroolefins (HFOs). The proportion of fluorocarbons (FCs) used as foam blowing agents declines with each transition and is predicted to eventually be around 20% of total foam blowing agent use. However, fluorocarbon foam blowing agents will still be needed long term in some applications, to mitigate fire risk.

13. The overall increase in ODS feedstock uses through the last decade has been mostly due to the increase in feedstock uses of HCFCs, while uptake of HFOs is driving a more recent increase in carbon tetrachloride (CTC) feedstock use. In 2020, the proportions of the largest ODS feedstocks were HCFC-22 (48% of the total mass quantity), CTC (20%), and HCFC-142b (11%). HCFC-22 is by far the largest feedstock used, with 713,536 metric tonnes reported in 2020. It is important to monitor the increasing use of controlled substances as feedstock, as these contribute to overall global emissions.

14. Global consumption of HFCs for electronics manufacturing (HFC-23, HFC-32, HFC-41) and magnesium production (HFC-134a) is relatively small, although increasing for electronics manufacturing. Alternatives to HFC use include other fluorinated gases, many of which have higher GWPs.

15. Pressurised metered dose inhalers (pMDIs) for asthma and COPD contain HFC-134a and HFC-227ea as propellants. Lower GWP HFC-152a and HFO-1234ze(E) are under development as replacement propellants. DPIs and SMIs, where available, affordable and suitable, have much lower carbon footprints than pMDIs with high GWP propellants. Complex considerations are necessary when patients and healthcare professionals make an informed choice about a patient's inhaled therapy. Transition away from high GWP HFC pMDIs is a major undertaking with serious potential public health risks unless it is carefully managed. Parties may wish to consider the range of technical and economic issues associated with the transition from high GWP HFC pMDIs to ensure adequate supplies of pMDIs and other inhalers during HFC phase-down.

16. All aircraft continue to depend on halon from stocks for most of their fire protection applications, even though research and development has been ongoing for many years. The updated, estimated timeframe of between 2030 and 2049, when halon would be no longer available to civil aviation (or other fire suppression applications), means that the civil aviation industry (and others) must look either to their own stockpiles of halon or to the limited amounts of recycled halon available on the open market to avoid grounding aircraft because of a lack of appropriate fire protection. New aircraft designs in the military sector may only be able to use halon or a high-GWP HFCs to meet stringent design requirements.

17. In 2021, 100% of reported MB production was for QPS purposes, and MB production for controlled uses was reported to be zero, although a small amount is still used under the critical use exemption. Consumption for QPS uses remain at an average of 10,000 tonnes per year. Alternatives are available for most pre-shipment uses and if adopted, could result in replacing 30-40% (i.e. 3,000-4,000 tonnes) of the total QPS MB. Technical alternatives to both Q and PS purposes are becoming increasingly available, with new chemicals such as ethane dinitrile and hydrogen cyanide showing good efficacy against pests. Controlling emissions from QPS uses can be managed through use of recapture technologies.

18. The largest banks overall are currently in non-A5 parties and will rapidly reach end-of-life in the next decade. While ODS banks have been more concentrated in non-A5 parties, HFC banks are currently more evenly distributed between non-A and A5 parties. Banks in A5 parties are growing rapidly and will dominate global banks volumes by the early 2030s, resulting from declining banks in non-A5 parties and the rapid uptake of HFC-containing equipment in A5 parties. With quantities potentially available for recovery and management expected to increase in A5 parties, timely efforts to establish effective end of life (EOL) management capacity to prevent HFC emissions would have a significant impact, given the predicted size and growth of these banks in larger industrialised A5 parties. Addressing the barriers to the transboundary movement of EOL ODS/HFCs will be important in supporting preferential recovery/recycling and environmentally sound destruction of EOL ODS/HFCs, thereby minimising their emissions. Parties may wish to consider how relevant international treaty bodies can work together to facilitate transboundary movement of EOL ODS/HFCs.