



Distr.: General

3 April 2019

Original: English

**United Nations
Environment
Programme**

**Open-ended Working Group of the Parties to
the Montreal Protocol on Substances that
Deplete the Ozone Layer
Forty-first meeting
Bangkok, 1–5 July 2019
Items 3–12 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-first meeting

Note by the Secretariat

I. Introduction

1. The present note provides an overview of the issues on the provisional agenda for the forty-first meeting of the Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. Section II contains a summary of issues for discussion by the Open-ended Working Group. Section III contains information that will not be addressed by the Open-ended Working Group at its forty-first meeting but that is relevant to the Thirty-First Meeting of the Parties in November 2019, to the implementation of previous decisions by the parties or to the provisions of the Montreal Protocol itself.
2. Further information on a number of items on the agenda will be provided in an addendum to the present note (UNEP/OzL.Pro.WG.1/41/2/Add.1) once the relevant 2019 reports by the Technology and Economic Assessment Panel have been finalized (see para. 28 below). Reports of the Panel are anticipated for agenda item 3, on unexpected emissions of trichlorofluoromethane (CFC-11); agenda item 5, on the quadrennial assessment of the Montreal Protocol for 2018; agenda item 6, on the Technology and Economic Assessment Panel 2019 report, and its sub-items; and agenda item 7, on the access of parties operating under paragraph 1 of Article 5 of the Montreal Protocol (Article 5 parties) to energy-efficient technologies. The addendum will contain summaries of the reports of the Panel on those issues. The Scientific Assessment Panel is also expected to submit a preliminary report on unexpected emissions of CFC-11 for the meeting.
3. Issues that are not directly related to the implementation of decisions and related follow-up, but which may be of interest to the parties, will be addressed in an information note on issues that the Secretariat would like to bring to the attention of the parties (UNEP/OzL.Pro.WG.1/41/INF/2). That note will contain information for parties on initiatives undertaken by the Secretariat for the improved implementation of the Montreal Protocol and synergies with the United Nations Environment Programme (UNEP) and other United Nations bodies, including: outcomes of the fourth session of the United Nations Environment Assembly; the appointment of the Executive Director of UNEP; the Environment Management Group; the high-level political forum on sustainable development in 2019; discussions towards a global pact for the environment; activities under the Cool Coalition; cooperation

* UNEP/OzL.Pro.WG.1/41/1.

with the International Plant Protection Convention; the Strategic Approach to International Chemicals Management; the UNEP Big Data initiative – World Environment Situation Room; consultations with the International Maritime Organization; carbon offsetting in 2018; International Day for the Preservation of the Ozone Layer (World Ozone Day) in 2019; and the Secretariat's participation in relevant meetings.

4. Another issue that the Secretariat would like to bring to the attention of the parties is gender mainstreaming. The Secretariat has completed its initial review of gender mainstreaming in the work of the ozone treaties and has prepared a background document for the parties, which is available on the conference portal.¹ The document outlines the international context of gender mainstreaming, looks at the applicable United Nations and UNEP-specific policies, considers how different multilateral environmental agreements are addressing the issue and makes recommendations for action by the Secretariat and consideration by the parties. The Secretariat welcomes feedback from the parties on that document. The Secretariat will be participating from time to time in an informal network of gender practitioners across other multilateral environmental agreements to learn from their experience.

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

Agenda item 3

Unexpected emissions of trichlorofluoromethane (CFC-11) (decision XXX/3)

5. The issue of unexpected emissions of CFC-11 was discussed extensively in 2018 following the publication of a scientific study entitled, "An unexpected and persistent increase in global emissions of ozone-depleting CFC-11" in May 2018 in the journal *Nature*.² The study revealed that global emissions of CFC-11 had increased in the period after 2012 and indicated that the source of the emissions was Eastern Asia. The increase in emissions suggested that there had been unreported production of CFC-11 after the global phase-out from 1 January 2010.

6. At the Thirtieth Meeting of the Parties, held in Quito from 5 to 9 November 2018, parties adopted decision XXX/3 to address the serious concern about the increasing emissions of CFC-11. In the decision, the Scientific Assessment Panel was requested "to provide to the parties a summary report on the unexpected increase of CFC-11 emissions, which would supplement the information in the quadrennial assessment, including additional information regarding atmospheric monitoring and modelling, including underlying assumptions, with respect to such emissions; a preliminary summary report should be provided to the Open-ended Working Group at its forty-first meeting, a further update to the Thirty-First Meeting of the Parties and a final report to the Thirty-Second Meeting of the Parties" (para. 1). The Technology and Economic Assessment Panel was requested "to provide the parties with information on potential sources of emissions of CFC-11 and related controlled substances from potential production and uses, as well as from banks, that may have resulted in emissions of CFC-11 in unexpected quantities in the relevant regions; a preliminary report should be provided to the Open-ended Working Group at its forty-first meeting and a final report to the Thirty-First Meeting of the Parties" (para. 2). Accordingly, the Scientific Assessment Panel and the task force on CFC-11 that Technology and Economic Assessment Panel has established to respond to the decision are working to provide the requested reports to the Open-ended Working Group.

7. In the same decision, parties with any relevant scientific and technical information that might help to inform the reports of the Scientific Assessment Panel and Technology and Economic Assessment Panel were requested to provide that information to the Secretariat by 1 March 2019 (para 3). One party, China, submitted information to the Secretariat. The submission reviewed the action taken by China to fulfil the obligations of the Montreal Protocol and addressed the results of the surveys and research on the market consumption of CFC-11 substitutes, in particular in the manufacture of foams, for which CFC-11 was mainly used in China. The submission is also relevant to paragraph 7 of decision XXX/3, in which all parties were requested to take appropriate measures to ensure that the phase-out of CFC-11 was effectively sustained and enforced in accordance with obligations under the Protocol. The submission was forwarded to the two panels for their consideration.

8. At the initiative of the co-chairs of the Scientific Assessment Panel and in collaboration with the team of scientists working for the Stratosphere-Troposphere Processes and their Role in Climate

¹ <http://conf.montreal-protocol.org/meeting/oweg/oweg-41/presession/SitePages/Home.aspx>.

² <https://www.nature.com/articles/s41586-018-0106-2>.

(SPARC), the International Symposium on the Unexpected Increase in Emissions of Ozone-Depleting CFC-11 was convened in Vienna from 25 to 27 March 2019. The CFC-11 task force of the Technology and Economic Assessment Panel participated in the symposium.

9. The purpose of the symposium was to provide a forum for scientists and technologists to explore and present information on the potential causes of the increase in CFC-11 emissions. That information is expected to provide a firmer scientific basis for the discussions of the parties on the matter. The symposium provided the opportunity for deliberations on a range of CFC-11-related issues, including atmospheric measurements and the identification of potential emission sources; production processes and associated emissions; the role of interannual variability and transport; modelling studies and scenarios; and possible effects of the unexpected increase in CFC-11 on stratospheric ozone and the recovery of the ozone layer. The key outcomes of the symposium are expected to be reflected in the reports of the Scientific Assessment Panel and the Technology and Economic Assessment Panel to be submitted to the Open-ended Working Group for its consideration. The outcomes of the symposium discussions will also be presented in a SPARC newsletter that is expected to be issued in July.

10. In paragraph 6 of decision XXX/3, the Thirtieth Meeting of the Parties decided “to request the Secretariat, in consultation with the secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol, to provide the parties with an overview outlining the procedures under the Protocol and the Fund with reference to controlled substances by which the parties review and ensure continuing compliance with Protocol obligations and with the terms of agreements under the Fund, including with regard to monitoring, reporting, and verification, [and] to provide a report to the Open-ended Working Group at its forty-first meeting and a final report to the Thirty-First Meeting of the Parties”. Accordingly, the Secretariat has prepared a document that provides an overview of the requested information (UNEP/OzL.Pro.WG.1/41/3).

11. The Open-ended Working Group may wish to consider the reports of the two assessment panels and the document prepared by the Secretariat and discuss a way forward.

Agenda item 4

Terms of reference for the study on the 2021–2023 replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol

12. Since 1990, the Multilateral Fund has operated with a three-year funding cycle, and the parties accordingly adopted decisions on the replenishment of the fund in 1993, 1996, 1999, 2002, 2005, 2008, 2011, 2014 and 2017. The last replenishment decision, decision XXIX/1, covers the period 2018–2020. It has been the custom that in the year preceding the last year of each funding cycle, parties develop terms of reference for a study designed to estimate the funds necessary to enable parties to achieve compliance during the forthcoming replenishment period. In 2019, therefore, the parties may wish to consider the terms of reference for a study of the funding needed for the replenishment period 2021–2023.

13. The Open-ended Working Group may wish to consider matters related to the 2021–2023 replenishment study, including the identification of an appropriate body to carry out the study, and to forward their views to the Thirty-First Meeting of the Parties for its deliberation and action.

14. For the parties’ convenience, the terms of reference for the 2017 study, adopted in decision XXVIII/5, are set out in annex I to the present note. Traditionally, the parties have requested the Technology and Economic Assessment Panel to carry out the replenishment study, and the Panel has established task forces to that end.

Agenda item 5

Quadrennial assessment of the Montreal Protocol for 2018 and potential areas of focus for the 2022 assessment

15. Article 6 of the Montreal Protocol calls for a review, at least once every four years, of the control measures provided for in Article 2 and Articles 2A–2J of the Protocol on the basis of available scientific, environmental, technical and economic information. Pursuant to Article 6 and in accordance with decision XXVII/6, the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the five technical options committees³ of the Technology and Economic Assessment Panel have

³ Flexible and Rigid Foams Technical Options Committee; Halons Technical Options Committee; Medical and Chemicals Technical Options Committee; Methyl Bromide Technical Options Committee; and Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee.

completed their quadrennial assessment reports. The report of the Technology and Economic Assessment Panel itself is expected to be ready in May 2019.

16. The full reports of the Scientific Assessment Panel⁴ and the Environmental Effects Assessment Panel⁵ have been posted on the Secretariat website. The reports of the technical options committees⁶ of the Technology and Economic Assessment Panel have also been posted. The highlights extracted from the report of the Scientific Assessment Panel and a brief summary by the Secretariat of key findings and highlights provided in the executive summary of the report of the Environmental Effects Assessment Panel are set out in annexes II and III, respectively.

17. The panels will present the key findings of their assessments to the Open-ended Working Group at its forty-first meeting. Parties may wish to use those findings in drawing up the terms of reference that contains the potential areas of focus for the next assessment. The Open-ended Working Group may wish to start discussing the terms of reference with a view to their adoption at the Thirty-First Meeting of the Parties, in November 2019.

18. The panels have jointly embarked on the preparation of a synthesis report that not only brings together the main components of each of their individual reports but synthesizes them to draw key conclusions. In decision XXVII/6, paragraph 2, the panels were specifically requested to present a synthesis report by 30 April 2019. However, owing to the heavy workload of the panels, the synthesis report is expected to be issued in September and presented to the Thirty-First Meeting of the Parties. Once it is available, parties may wish to consider the synthesis report in the discussions of the potential areas of focus for the next quadrennial assessment that will start at the forty-first meeting of the Open-ended Working Group.

(a) Ongoing reported emissions of carbon tetrachloride (UNEP/OzL.Pro.30/11, para. 225)

19. At the Thirtieth Meeting of the Parties, the three assessment panels gave a presentation on the progress they had made and the key issues emerging from their 2018 quadrennial assessments. One of the issues highlighted was that sources of significant carbon tetrachloride emissions, some previously unrecognized, had been quantified in the 2018 assessment. At least 25 Gg yr⁻¹ of emissions had been estimated, mainly originating from the industrial production of chloromethanes, perchloroethylene and chlorine. The global carbon tetrachloride budget was now much better understood and the previously identified gap between observation-based and industry-based emission estimates had been substantially reduced since the 2014 assessment.

20. In addition, during the discussion on the unexpected emissions of CFC-11, two parties asked about a paper by Mark Lunt in which he analysed carbon tetrachloride emissions in the atmosphere that had not been accounted for. Representatives of both the Scientific Assessment Panel and the Technology and Economic Assessment Panel said that they were aware of the paper, and the representative of the Technology and Economic Assessment Panel indicated that the Panel was taking the paper into account in the consideration of CFC-11 in its assessment reports. A Scientific Assessment Panel co-chair pointed out that large emissions of carbon tetrachloride had also been identified in previous assessments on the basis of atmospheric observations but the sources of those emissions had not been identified. In a 2016 report of the Stratospheric Processes and their Role in Climate, chloromethanes and perchloroethylene plants were identified as being a major source of inadvertent carbon tetrachloride emissions. The co-chair of the Scientific Assessment Panel also pointed out that Mr. Lunt, in his analysis, had used a technique that was very sensitive to regional emissions, allowing for a strong degree of confidence in the likelihood of locating regional emissions of CFC-11 in Asia.

21. During the discussion of the key issues emerging from the 2018 quadrennial assessments, a representative of one party said that his country was extremely concerned about the reported ongoing emissions of carbon tetrachloride. He suggested that a separate item be included on the agenda of the forty-first meeting of the Open-ended Working Group to allow for a more comprehensive discussion on carbon tetrachloride, which would also contribute to the development of a more holistic approach for coping more generally with deviations from the path to phasing out ozone-depleting substances.

22. The Open-ended Working Group may wish to discuss the issue further.

⁴ Available at <https://ozone.unep.org/science/assessment/sap>.

⁵ Available at <https://ozone.unep.org/science/assessment/eeap>.

⁶ Available at <https://ozone.unep.org/science/assessment/teap>.

(b) Relationship between stratospheric ozone and proposed solar radiation management strategies (UNEP/OzL.Pro.30/11, para. 214)

23. At the Thirtieth Meeting of the Parties, at the time of the adoption of the agenda of the high-level segment, a representative of the Federated States of Micronesia indicated that she planned to introduce a conference room paper prepared by a group of parties on the need to study the relationship between stratospheric ozone and solar radiation management, and asked that it be considered by the parties. As it was a new issue that had not been previously discussed by the parties or introduced during the preparatory segment of the meeting, and given the complexity of the issue and time constraints, the parties agreed to have a general discussion during the meeting but to defer the introduction of the conference room paper to a later meeting.⁷

24. During the discussion, several representatives also called attention to geoengineering technologies, expressing concern that the consequences of their use were not fully understood and that the risks could outweigh the potential benefits. They had serious concerns about how such technologies would be managed. Two of them stated that they and others were preparing a draft decision on the matter for consideration at the forty-first meeting of the Open-ended Working Group and a third said that his Government planned to submit a resolution on the matter to the United Nations Environment Assembly at its fourth session, in March 2019.⁸

25. The 2018 quadrennial assessment of the Scientific Assessment Panel discussed solar radiation management as one of the processes that might be important in addressing stratospheric ozone in the future.⁹ The report states that intentional, long-term geoengineering applications that substantially increase stratospheric aerosols with the aim of mitigating global warming by reflecting sunlight would alter the stratospheric ozone layer. The report further states that, although the estimated magnitude and even the signs of changes in ozone levels are uncertain in some regions, a significant increase of the stratospheric sulfate aerosol burden would delay the recovery of the Antarctic ozone hole. Moreover, less is known about the effects on ozone of geoengineering solutions that use non-sulfate aerosols. The quadrennial assessment of the Environmental Effects Assessment Panel also addresses the issue.¹⁰

26. The Open-ended Working Group may wish to discuss the issue further on the basis of any new information and proposals that the Federated States of Micronesia and other countries may submit to the meeting.

(c) Any other issues arising from the reports of the assessment panels

27. Parties may wish to raise other issues arising from the 2018 quadrennial assessment reports. Parties are requested to raise those issues at the time of the adoption of the agenda.

Agenda item 6

Technology and Economic Assessment Panel 2019 report

28. The Technology and Economic Assessment Panel 2019 report consists of the following volumes:

Volume 1: Technology and Economic Assessment Panel 2019 progress report

Volume 2: Methyl Bromide Technical Options Committee interim critical-use nominations assessment report

Volume 3: Decision XXX/3 task force report on unexpected emissions of CFC-11

⁷ The Secretariat received a request from the Federated States of Micronesia to include the issue on the agenda of the forty-first meeting of the Open-ended Working Group.

⁸ At the fourth session of the United Nations Environment Assembly, held in Nairobi from 11 to 15 March 2019, a draft resolution on geoengineering and its governance was submitted by a group of countries and discussed extensively but was eventually withdrawn by the proponents owing to a lack of consensus.

⁹ World Meteorological Organization (WMO). *Executive Summary: Scientific Assessment of Ozone Depletion: 2018*, Global Ozone Research and Monitoring Project – Report No. 58. (Geneva, WMO). Chapter 3: Update on Global Ozone: Past, Present and Future, P. Braesicke and J. Neu (2018); Chapter 6: Scenarios and Information for Policymakers, L. J. Carpenter and J. S. Daniel (2018). Available at <https://ozone.unep.org/science/assessment/sap>.

¹⁰ Environmental Effects Assessment Panel (2019). Interactive effects of changing stratospheric ozone and climate on tropospheric composition, air quality, and the consequences for human and ecosystem health. In *Environmental Effects and Interactions of Stratospheric Ozone Depletion, UV Radiation, and Climate Change: 2018 Assessment Report*. (Nairobi, UNEP). Available at <https://ozone.unep.org/science/assessment/eap>.

Volume 4: Decision XXX/5 task force report on access of Article 5 Parties to energy-efficient technologies in the refrigeration, air-conditioning and heat-pump sectors

The Panel is expected to finalize the volumes in May 2019.

29. Under agenda item 6, the Panel will present volumes 1 and 2 of its 2019 report, covering sub-items (a), (b), (d) and (e) of agenda item 6, as listed below:

- (a) Nominations for critical-use exemptions for methyl bromide for 2020 and 2021;
- (b) Stocks of methyl bromide (UNEP/OzL.Pro.30/11, paras. 73 and 77);
- (d) Process agents (decision XXIX/7 and UNEP/OzL.Pro.30/11, para. 86);
- (e) Any other issues.

The information and recommendations of the Panel relevant to the above-mentioned sub-items will be summarized in the addendum to the present note to be made available to the parties before the forty-first meeting of the Open-ended Working Group.

30. The Panel's report relevant to sub-item (c), on the development and availability of laboratory and analytical procedures that can be performed without using controlled substances under the Protocol, was presented to the Thirtieth Meeting of the Parties, in 2018.¹¹

31. The Panel will give separate presentations on emissions of CFC-11 (volume 3) and energy efficiency (volume 4) under agenda items 3 and 7, respectively.

(a) Nominations for critical-use exemptions for methyl bromide for 2020 and 2021

32. In 2019, two Article 5 parties (Argentina and South Africa) submitted two nominations each for critical-use exemptions for 2020, and two non-Article 5 parties (Australia and Canada) submitted one nomination each, for 2021 and 2020, respectively.

33. During its meeting held in Qingdao, China, from 10 to 14 March 2019, the Methyl Bromide Technical Options Committee reviewed, among other things, the critical-use nominations and additional information submitted by the nominating parties in response to the first round of questions from the committee. The interim recommendations on the quantities of methyl bromide eligible for exemption will be included in the report of the committee, to be made available in volume 2 of the Technology and Economic Assessment Panel 2019 report. The interim recommendations and associated information will be summarized in the addendum to the present note. Meanwhile, the parties that have submitted nominations for critical-use exemptions and the relevant quantities for 2020 and 2021 are listed in the table below.

Summary of the nominations for 2020 and 2021 critical-use exemptions for methyl bromide submitted in 2019 (tonnes)^a

<i>Non-Article 5 parties and sectors</i>	<i>Nomination for 2020</i>	<i>Nomination for 2021</i>
1. Australia		28.980
Strawberry runners		
2. Canada		
Strawberry runners	5.261	
Subtotal	5.261	28.980
<i>Article 5 parties and sectors</i>	<i>Nomination for 2020</i>	
3. Argentina		
Tomato (protected)	22.200	
Strawberry fruit (open field)	13.500	
4. South Africa		
Mills	1.500	
Structures	40.000	
Subtotal	77.200	
Total	82.461	28.980

^a Tonne = metric ton.

¹¹ Technology and Economic Assessment Panel, September 2018: Response to decision XXVI/5(2) on laboratory and analytical uses (volume 4). Available at <https://ozone.unep.org/science/assessment/teap>.

(b) Stocks of methyl bromide (UNEP/OzL.Pro.30/11, paras. 73 and 77)

34. At the Thirtieth Meeting of the Parties, during the discussion on critical-use nominations and exemptions, the parties raised the issue of existing stocks of methyl bromide and expressed a desire for a longer discussion on the topic. It was recommended that the issue be tabled for discussion at the forty-first meeting of the Open-ended Working Group. One representative stressed the importance of establishing stock levels and emphasized the need to consider the issue in 2019, and another called for heightened efforts to eliminate stocks of methyl bromide while recognizing that they could be scattered and difficult to secure.

35. Decision IX/6 specifies the criteria for permitting critical use exemptions of methyl bromide. One of them is that “methyl bromide is not available in sufficient quantity and quality from existing stocks of banked or recycled methyl bromide, also bearing in mind the developing countries’ need for methyl bromide” (para. 1 (b) (ii)).

36. The report of the Methyl Bromide Technical Options Committee on the initial evaluation of the critical use nominations, which is expected to be available in May 2019 (volume 2 of the Technology and Economic Assessment Panel 2019 report), is expected to include information on stocks of methyl bromide. The committee normally addresses the issue on the basis of the accounting framework information submitted by the parties that received critical use exemptions for the preceding year. The addendum to the present note will include relevant information provided by the committee.

37. The Open-ended Working Group may wish to discuss the matter further.

(c) Development and availability of laboratory and analytical procedures that can be performed without using controlled substances under the Protocol (UNEP/OzL.Pro.30/11, paras. 83 and 127)

38. At the Thirtieth Meeting of the Parties, the parties considered the report by the Technology and Economic Assessment Panel on its response to paragraph 2 of decision XXVI/5 on the global laboratory and analytical-use exemption for ozone depleting substances.¹² The report had been issued as volume 4 of the Panel’s September 2018 report. The Panel’s Medical and Chemicals Technical Options Committee analysed available alternatives to laboratory and analytical procedures that use controlled substances and are still part of the global exemption for laboratory and analytical uses. The Committee also provided an analysis of the known hydrochlorofluorocarbon (HCFC) uses in laboratory and analytical procedures. Hydrofluorocarbon (HFC) uses were not considered by the Committee. Information on trends in the global production and consumption of ozone-depleting substances for laboratory and analytical uses from 1996 to 2016 was also provided in the report. The Committee recommended nine specific laboratory and analytical procedures¹³ using methyl bromide, carbon tetrachloride and 1,1,1-trichloroethane for removal from the global essential-use exemption.

39. During the discussion, one representative noted that, at 151 tonnes, global production of ozone-depleting substances for laboratory and analytical uses in 2016 was insignificant in the light of the amount phased out since 1989, and the trend was that such uses were decreasing. The representative also drew attention to the Committee’s suggestion that excluding specific laboratory and analytical uses from the global exemption on a chemical-by-chemical basis could be confusing for practitioners and regulators, and therefore proposed that rather than engaging in detailed discussion on the recommended exclusions at the Thirtieth Meeting of the Parties, the parties wait until a future meeting to take a fresh look at how to continue to reduce the use of ozone-depleting substances in laboratory and analytical procedures without sacrificing clarity or introducing excessively complicated measures to address such a small quantity of the substances.

40. With regard to the laboratory and analytical procedures using HCFCs, one party proposed a draft decision that was discussed under the agenda item on adjustments to the control measures on HCFCs. The parties subsequently adopted the proposed decision as decision XXX/8, thus including HCFCs in the global laboratory- and analytical-use exemption under the same conditions and on the same timeline as set forth in decision XXVI/5. The parties also agreed to take up the question of

¹² TEAP September 2018: Response to Decision XXVI/5(2) on Laboratory and Analytical Uses (volume 4). Available at <https://ozone.unep.org/science/assessment/teap>.

¹³ The nine laboratory and analytical uses are as follows: (1) as a methylating agent; (2) as reaction solvents; (3) as a solvent for infrared, Raman and nuclear magnetic resonance spectroscopy; (4) in grease removal and washing of nuclear magnetic resonance tubes; (5) in iodine partition and equilibrium experiments; (6) in the determination of hydrocarbons in water, air, soil or sediment; (7) in the determination of moisture and water; (8) in the determination of the iodine index; and (9) in the determination of the bromine index.

laboratory and analytical uses in a more comprehensive manner at the forty-first meeting of the Open-ended Working Group.

41. The Open-ended Working Group may wish to discuss the matter and develop a way forward.

(d) Process agents (decision XXIX/7 and UNEP/OzL.Pro.30/11, para. 86)

42. At the Thirtieth Meeting of the Parties, parties were asked to consider the three recommendations in the report of the Technology and Economic Assessment Panel on the process-agent uses of ozone-depleting substances, as contained in section 5.3.3.5 of volume 3 of the Panel's May 2018 report. The Panel's Medical and Chemicals Technical Options Committee had made the recommendations following its review of process agent information submitted by relevant parties on the quantities of ozone-depleting substances produced or imported for process-agent applications, on make-up, on levels of emissions and on containment technologies. The three recommendations were:

(a) To remove from the latest version of table A of decision X/14 (see decision XXIX/7, annex) the use of CFC-113 in the preparation of perfluoropolyether diols;

(b) To update the same table by removing the European Union from under the application "recovery of chlorine by tail gas absorption from chlor-alkali production";

(c) To reduce the quantities under "make-up or consumption" and "maximum emissions" that were set out in the latest version of table B of decision X/14 (see decision XXIII/7, annex) to take into account the process-agent uses and emissions currently reported.

43. During the discussion, several representatives said that it was important to continue to eliminate process-agent uses wherever possible and that, while they were not opposed to revising tables A and B of decision X/14, as recommended by the Committee, it would be beneficial to defer consideration of the revision of the two tables to the forty-first meeting of the Open-ended Working Group in order to enable parties to hold consultations with industry and other stakeholders on the relevant process-agent uses prior to revising the tables. One representative said that it would be better to update both table A and table B every two years at the same time. Another stressed that the parties had made great progress in taking applications no longer using ozone-depleting substances off the list of process-agent uses, which had been reduced from a peak of 44 to a low of 11 at present, stressing that the current framework ensured that emissions from process-agent uses were limited and had a minimal impact on the atmosphere. The parties agreed to defer further consideration of the issue to the forty-first meeting of the Open-ended Working Group.

44. The 2019 report of the Technology and Economic Assessment Panel is expected to contain further information regarding process agent uses of controlled substances, in response to decision XXIX/7. In that decision the parties requested the Panel to report to the Open-ended Working Group at its forty-first meeting on the industrial application of any alternative technologies employed by parties in the processes listed in table A of decision X/14, as updated in the annex to decision XXIX/7. The information provided by the Panel will be summarized in the addendum to the present report.

(e) Any other issues

45. The 2019 report of the Technology and Economic Assessment Panel is expected to contain other information and key messages, including on organizational and administrative issues relating to the work of the Panel and its technical options committees. The Secretariat will summarize in the addendum to the present note any other important issues raised by the Panel that may require the attention of the parties.

46. Under this agenda item, parties may also wish to raise issues of concern arising from the 2019 report of the Panel for discussion by the Open-ended Working Group. Parties are requested to raise such issues for inclusion in the agenda at the time of the adoption of the agenda.

Agenda item 7

Access of parties operating under paragraph 1 of Article 5 of the Montreal Protocol to energy-efficient technologies in the refrigeration, air-conditioning and heat-pump sectors (decision XXX/5)

47. It may be recalled that parties have adopted decisions on energy efficiency every year since 2016¹⁴ in recognition of the additional opportunities brought about by the Kigali Amendment to

¹⁴ Decision XXVIII/3 (2016) on energy efficiency; decision XXIX/10 (2017) on issues related to energy efficiency while phasing down HFCs; and decision XXX/5 (2018) on access of parties operating under

catalyse and secure improvements in the energy efficiency of appliances and equipment, in particular in the refrigeration, air-conditioning and heat-pump sectors.

48. At the Thirtieth Meeting of the Parties, the parties adopted decision XXX/5 on access of Article 5 parties to energy efficient technologies in the refrigeration, air-conditioning and heat-pump sectors. In paragraph 3 of the decision, the Technology and Economic Assessment Panel was requested “to prepare a report on the cost and availability of low-global-warming-potential technologies and equipment that maintain or enhance energy efficiency, inter alia, covering various refrigeration, air-conditioning and heat-pump sectors, in particular domestic air-conditioning and commercial refrigeration, taking into account geographical regions, including countries with high ambient temperature conditions”. In response to the request, the Technology and Economic Assessment Panel established a task force to assess the issue and prepare a report. The report is expected to be ready in May, and a summary of the report will be included in the addendum to the present report.

49. In the same decision, the parties also requested the Executive Committee of the Multilateral Fund to consider flexibility within the financial support provided through enabling activities for HFCs to enable Article 5 parties who wish to do so to use part of that support for energy efficiency policy and training support as it relates to the phase-down of controlled substances; to consider, within the context of paragraph 16 of decision XXVIII/2, increasing the funding provided to low-volume consuming countries to assist them in implementing activities related to energy efficiency policy and training (as outlined in paragraph 1 of decision XXX/5); to continue supporting stand-alone projects in Article 5 parties; to build on its ongoing work of reviewing servicing projects to identify best practices, lessons learned and additional opportunities for maintaining energy efficiency in the servicing sector, and related costs; to take into account the information provided by demonstration and stand-alone projects in order to develop cost guidance related to maintaining or enhancing the energy efficiency of replacement technologies and equipment when phasing-down HFCs; and, in dialogue with the Ozone Secretariat, to liaise with other funds and financial institutions to explore mobilizing additional resources and, as appropriate, set up modalities for cooperation, such as co-funding arrangements, to maintain or enhance energy efficiency when phasing down HFCs. The Executive Committee is expected to report on its progress with regard to these requests as part of its annual report to the Thirty-First Meeting of the Parties.

Agenda item 8

Linkages between hydrochlorofluorocarbons and hydrofluorocarbons in transitioning to low-global-warming-potential alternatives (UNEP/OzL.Pro.30/11, para. 89)

50. The issue of linkages between HCFCs and HFCs in transitioning to low-global-warming-potential alternatives was first introduced in 2017 at the Twenty-Ninth Meeting of the Parties. The representative of Saudi Arabia introduced the subject, with particular reference to paragraphs 6–8 of decision XXVIII/2. He explained that his concern was to avoid the need for industry to carry out a double transition, from HCFCs to high-global-warming-potential HFCs and subsequently to low-global-warming-potential alternatives. Many Article 5 parties had begun to phase out HCFCs on the understanding that HFCs would be an acceptable alternative, but, following the adoption of the Kigali Amendment, they faced the substantial costs of converting from HFCs in addition to converting from HCFCs. In paragraph 6 of decision XXVIII/2, the parties had recognized a need for flexibility if no other technically proven and economically viable alternatives were available. A mechanism was needed to put that principle into effect. Other representatives agreed with the position of Saudi Arabia and there was rich discussion on the issue, after which it was agreed that the issue would be included on the agenda of the fortieth meeting of the Open-ended Working Group.

51. The discussion continued at the fortieth meeting of the Open-ended Working Group. Saudi Arabia introduced the issue, referring to the challenges his country faced and calling for a review of the HCFC-related implementation schedule and for guidance from the Technology and Economic Assessment Panel in that regard. Several parties then described the specific experiences and challenges that their countries faced and agreed on the need to discuss the matter further and to obtain more information thereon. The need to avoid double conversions was emphasized and there was acknowledgement that the discussions and any action taken should build on decision XXVIII/2, taking into account decision XIX/6 on adjustments to the Montreal Protocol with regard to HCFCs. Other issues were raised as meriting further consideration, including energy efficiency; the cost of natural

paragraph 1 of Article 5 of the Montreal Protocol to energy-efficient technologies in the refrigeration, air-conditioning and heat-pump sectors.

refrigerants; related standards and norms; knowledge transfer for technicians and engineers; the adequacy of the supply of HCFCs; and stockpiles. In the contact group that was established, ideas raised for further discussion included measures to defer consideration of the compliance status of countries with high ambient temperatures in 2025 and 2026, with the possibility of the extension of the measure for an additional two years; extending that measure to other subsectors facing similar challenges; and, as a last resort, adjusting the HCFC phase-out schedules to avoid the need for double conversions. The group also suggested that for future discussions, it would be helpful to identify the anticipated scope and timing of the likely problems more precisely, and encouraged parties to discuss the matter with affected parties. Requests to the Technology and Economic Assessment Panel for more information on the alternative technologies available in different countries and regions were also discussed.

52. At the Thirtieth Meeting of the Parties, parties highlighted the importance of the issue, in particular with regard to the phasing out of HCFCs such as HCFC-22 in the refrigeration and air-conditioning servicing sector, and recalled the valuable discussions held at the fortieth meeting of the Open-ended Working Group. Several representatives expressed the view that more time was needed for reflection before coming to a decision on the issue, and suggested therefore that further discussion be deferred until the forty-first meeting of the Open-ended Working Group, where it could be taken up on the basis of the discussions at the fortieth meeting, as summarized in the report of that meeting (UNEP/OzL.Pro.WG.1/40/7) and in paragraph 51 above. Given the importance of the issue, one representative encouraged all parties to participate in informal discussions intersessionally, with a view to taking a decision as soon as possible.

53. The parties may wish to discuss the issue and develop a way forward.

Agenda item 9

Safety standards (UNEP/OzL.Pro.30/11, para. 199)

54. In its decision XXIX/11 on safety standards, the Twenty-Ninth Meeting of the Parties requested the Secretariat to hold regular consultations with the relevant standards bodies with a view to providing, with regard to standards for flammable low-global-warming-potential refrigerants, a tabular overview of relevant safety standards, drawing on the 2017 report by the task force on safety standards established by the Technology and Economic Assessment Panel to respond to decision XXVIII/4 and the outcome of the consultations. The parties specified that the overview should include any relevant information submitted on a voluntary basis by parties or by national and regional standards bodies and should provide concise information on the scope, in terms of activities, appliances or products covered; the content, namely the safety and relevant technical aspects addressed; the responsible standards body and its subsidiary body in charge of the standard; and the status of the review. The parties also requested the Secretariat to make the information accessible on its website and to ensure an update of the tabular overview at least prior to each meeting of the parties up until the Thirty-Fourth Meeting of the Parties, when parties should consider whether to renew that request to the Secretariat.

55. At the Thirtieth Meeting of the Parties, the representative of the European Union explained that he had asked for safety standards to be included on the agenda in order to highlight the work of the Secretariat on the tabular overview of safety standards for refrigeration, air-conditioning and heat-pump systems and appliances. After some discussion, it was suggested that the parties further discuss the issue of safety standards at the forty-first meeting of the Open-ended Working Group, once they had had an opportunity to review the information provided in the tabular overview of safety standards prepared by the Secretariat. The parties agreed to include the sub-item on the agenda of the forty-first meeting of the Open-ended Working Group.

56. Since the Thirtieth Meeting of the Parties, the Secretariat has made further progress in the development of a tabular overview of safety standards. It has revised the tabular overview in the light of comments received from the European Union, updated information on the status of safety standards and developed a corresponding interactive online tool.¹⁵ The tool reflects the information included in the current version of the tabular overview and follows a similar format. It includes filtering and search functions to enable the extraction of specific information, as well as functions for exporting and downloading data fields. The tool will be expanded in the future to include information on any other standards that are submitted to the Secretariat. The revised tabular overview and further information on the online tool can be found in information document UNEP/OzL.Pro.WG.1/41/INF/3.

¹⁵ Available at <https://ozone.unep.org/system-safety-standards>.

57. The Open-ended Working Group may wish to discuss the matter further.

Agenda item 10

Review of the terms of reference, composition, balance, fields of expertise and workload of the Technology and Economic Assessment Panel (decision XXX/15)

58. At the Thirtieth Meeting of the Parties, discussions were held on the various issues related to the organization and procedures of the Technology and Economic Assessment Panel, its technical options committees and temporary subsidiary bodies, including their terms of reference, composition, balance, fields of expertise and workload. The parties adopted decision XXX/15, in which they requested the Ozone Secretariat “to prepare a document in consultation with the Technology and Economic Assessment Panel, for the Open-ended Working Group at its forty-first meeting, taking into account the ongoing efforts by the Technology and Economic Assessment Panel to respond to changing circumstances, including the Kigali Amendment, in relation to the following:

(a) Terms of reference, composition, and balance with regard to geography, representation of parties operating under paragraph 1 of Article 5 and parties not so operating, and gender;

(b) The fields of expertise required for the upcoming challenges related to the implementation of the Kigali Amendment, such as energy efficiency, climate benefits and safety”.

59. The requested document has been prepared and issued as document UNEP/OzL.Pro.WG.1/41/4. It provides an analysis of the current situation of the Panel, its technical options committees and temporary subsidiary bodies in terms of their size, balance and composition, and the nomination, appointment and terms in office of their members. The document addresses new challenges arising from the Kigali Amendment and how the Panel has organized itself to meet the requests of the parties regarding energy efficiency. The document includes a summary of key issues emerging from the analysis for consideration by the parties.

60. The Open-ended Working Group may wish to discuss the matter and develop a way forward.

Agenda item 11

Membership of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol (UNEP/OzL.Pro.30/11, para. 177)

61. The Executive Committee currently consists of seven parties from the group of Article 5 parties and seven parties from the group of non-Article 5 parties. Each group selects its Executive Committee members annually and they are formally endorsed by the Meeting of the Parties. The chair and vice-chair of the Executive Committee are selected from the fourteen members, and the office of chair is subject to rotation, on an annual basis, between the group of Article 5 parties and the group of non-Article 5 parties. The group of parties entitled to the chairmanship selects the chair from among its members on the Executive Committee, and the vice-chair is selected by the other group from among its members.

62. The terms of reference of the Executive Committee as amended by the Sixteenth Meeting of the Parties provide for the seven seats allocated to the group of Article 5 parties to be allocated as follows: two seats to parties of the African region, two seats to parties of the region of Asia and the Pacific, two seats to parties of the region of Latin America and the Caribbean, and one seat rotating among the regions referred to above and the region of Eastern Europe and Central Asia. The allocation of the seven seats reserved for non-Article 5 parties is not specified. However, since the establishment of the Executive Committee, Japan and the United States of America have each occupied one seat; Australia and Canada have rotated one seat between them; European countries excluding countries with economies in transition have occupied three seats; and countries with economies in transition have occupied one seat.

63. To broaden participation in the decision-making process, the Executive Committee introduced a representative constituency system allowing each of the 14 members to co-opt additional countries from the same region. At its thirty-fifth meeting, the Executive Committee decided that all comments, both oral and written, provided by members should be unified submissions delivered directly and solely in the name of the Executive Committee member (decision 35/62 of the Executive Committee).

64. At the Thirtieth Meeting of the Parties, during the discussion of membership in various bodies under the Montreal Protocol for 2019, a proposal was presented by the representative of Armenia, on behalf of the Eastern European and Central Asian group of parties, to increase the membership of the

Executive Committee to eight non-Article 5 and eight Article 5 members, including one place for a representative of the Eastern European and Central Asian group. The representative explained that the reason for the proposal was to establish balanced representation of regional groups. She further explained that because the Eastern European and Central Asian group was able to nominate a member of the Committee in only one out of every four years, the group was being denied the right of the parties to “develop and monitor the implementation of specific operational policies, guidelines and administrative arrangements, including the disbursement of resources, for the purpose of achieving the objectives of the Multilateral Fund under the Financial Mechanism”.¹⁶

65. A number of representatives agreed with the proposal, highlighting in particular the importance of balanced representation in implementing the requirements of the Kigali Amendment. A point was made in the discussion that when the Multilateral Fund was established, the regional group named “Eastern Europe and Central Asia” did not exist, as the region under the United Nations was “Eastern Europe”. However, in 2004, pursuant to decision XVI/38, which had established the rotating seat for Article 5 parties under the Executive Committee, the region of Eastern Europe and Central Asia was specifically included in the rotation. Other parties observed that there were other examples of imbalance in geographical representation, such as the situation of the Caribbean islands or that of the Pacific islands, which should not be overlooked. Some representatives suggested that a complete overhaul of the current membership structure of the Executive Committee would be needed to address the situation comprehensively. At the same time, other representatives cautioned against upsetting the delicate balance that was established when the Multilateral Fund was set up 25 years ago. It was also suggested that other potential solutions, such as changing the rules on co-options to the Committee or making other changes within the existing structure, could be explored.

66. Further informal discussions took place in the margins of the meeting, after which the following clarifications and additional information were provided regarding the Eastern Europe and Central Asian group:

(a) The group comprised both Article 5 and non-Article 5 parties.

(b) The Eastern European group was an official regional group of the United Nations. In 2004, Central Asian parties had requested that they be allowed to join the group for the purposes of the Montreal Protocol, as they felt they had more in common with Eastern European parties than they did with other parties in the Asia-Pacific region. That arrangement was recognized in decision XVI/38 on the need to ensure equitable geographical representation in the Executive Committee of the Multilateral Fund.

(c) At the Thirtieth Meeting of the Parties, the Eastern European and Central Asian group had received a similar request from Turkey. Turkey was the only Article 5 party within the group of Western European and other States, and for non-electoral purposes it also participated in the Asia-Pacific group. The Eastern European and Central Asian group had agreed to Turkey’s request and had nominated Turkey for one of its positions on the Implementation Committee for 2019.

67. The parties agreed to include the issue on the agenda of the forty-first meeting of the Open-ended Working Group.

68. The Open-ended Working Group may wish to further discuss and recommend a way forward on the matter.

Agenda item 12

Request by Azerbaijan to be included among the parties to which the phase-down schedule for hydrofluorocarbons, as set out in paragraphs 2 and 4 of Article 2J of the Montreal Protocol, applies

69. On 18 March 2019, the Government of Azerbaijan requested the Secretariat to place on the provisional agenda of the forty-first meeting of the Open-ended Working Group its request to be included among the parties that would follow the HFC phase-down schedule set out in paragraphs 2 and 4 of Article 2J.

70. In its letter, the Government of Azerbaijan stated that the adoption of the Kigali Amendment brought a new approach to the fulfilment of obligations under the Montreal Protocol. It further stated that according to decision XXVIII/2, the parties to the Montreal Protocol were split into four groups, each with a different baseline and phase-down schedule for HFCs. The inclusion of Azerbaijan in the

¹⁶ Paragraph 1 of the terms of reference of the Executive Committee. The terms of reference were adopted under decision IV/18 and modified by decisions IX/16 (1997), XVI/38 (2004) and XIX/11 (2007).

group that will implement paragraphs 2 and 4 of Article 2J, which currently consists of Belarus, Kazakhstan, the Russian Federation, Tajikistan and Uzbekistan, could assist in the timely implementation of HFC phase-down obligations by Azerbaijan. Azerbaijan is classified as a non-Article 5 party.

71. In accordance with the request, the issue has been placed on the agenda of the forty-first meeting of the Open-ended Working Group.

72. The Open-ended Working Group may wish to discuss the issue and propose a way forward.

III. Issues that are relevant to the Thirty-First Meeting of the Parties, including updates on the implementation of previous decisions

A. Ministerial round-table discussion at the Thirty-First Meeting of the Parties

73. The Secretariat is organizing the Thirty-First Meeting of the Parties, to be held in Rome, together with the host Government of Italy and the Food and Agriculture Organization of the United Nations (FAO), whose premises will be the venue of the meeting.

74. During the high-level segment of the meeting, a ministerial round table will be organized to discuss the contribution of the Montreal Protocol to a sustainable cold chain to reduce food loss. Each year, around one third of all food produced globally is either lost or wasted. Food loss and waste also amounts to a misuse of precious resources, such as land, water and energy and contributes to climate change. Eliminating food loss is a priority under the 2030 Agenda for Sustainable Development and is relevant to many of the Sustainable Development Goals. Food loss is detrimental to farmers' incomes and can be addressed with the establishment of a sustainable cold chain that consists of pre-cooling, refrigerated storage and refrigerated transport and ensures that farm produce reaches markets in good condition. Urbanization and the growing middle class are driving cold chain growth.

75. The Montreal Protocol, with its recent Kigali Amendment, has raised awareness of the need to develop sustainable solutions in the refrigeration and air-conditioning sector, including cold chain initiatives for food preservation. The fact that the Thirty-First Meeting of the Parties will take place at the headquarters of FAO, which works with a broad spectrum of stakeholders and partners to tackle food loss and waste, makes it an opportune time to explore the contribution of the Protocol to a sustainable cold chain to reduce food loss.

B. Online data reporting tool

76. The development of the long-promised online reporting system is nearing completion. The Secretariat will be testing the system until June 2019. During the forty-first meeting of the Open-ended Working Group, the Secretariat will convene a side event to demonstrate the online reporting system and give representatives of the parties an opportunity to try out the system. A detailed explanation of the system is provided in information document UNEP/OzL.Pro.WG.1/41/INF/4. Between July and December 2019, parties will be able to test the system by using it to submit data reports and provide feedback to the Secretariat. During that period, the Secretariat will run the system in parallel with its current data reporting and recording system to ensure consistency, accuracy and reliability. The expectation is that the online reporting system will be launched and in full use by early 2020.

C. Mixtures and blends

77. Under the Kigali Amendment, parties will report amounts of HFCs produced and traded, including in mixtures and blends of refrigerants, foam mixtures, blowing agents and fire extinguishing agents. In the instructions and guidelines for data reporting under Article 7, as updated and approved by the parties at the Thirtieth Meeting of the Parties, the common mixtures and blends that contain HFCs that are controlled under the Montreal Protocol are listed in section 11. Accuracy in the compositions of the mixtures is of great importance for the correct calculation of CO₂-equivalent production and the consumption of HFCs by the parties.

78. The Secretariat has produced an information document listing the most commonly used mixtures and blends containing HFCs, along with their compositions and their sources (UNEP/OzL.Pro.WG.1/41/INF/5). The Secretariat will update the document annually.

Annex I

Decision XXVIII/5: Terms of reference for the study on the 2018–2020 replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol

Recalling the parties' decisions on previous terms of reference for studies on the replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol,

Recalling also the parties' decisions on previous replenishments of the Multilateral Fund,

1. To request the Technology and Economic Assessment Panel to prepare a report for submission to the Twenty-Ninth Meeting of the Parties, and to submit it through the Open-ended Working Group at its thirty-ninth meeting, to enable the Twenty-Ninth Meeting of the Parties to adopt a decision on the appropriate level of the 2018–2020 replenishment of the Multilateral Fund;

2. That, in preparing the report referred to in paragraph 1 of the present decision, the Panel should take into account, among other things:

(a) All control measures and relevant decisions agreed upon by the parties to the Montreal Protocol and the Executive Committee of the Multilateral Fund, in particular those pertaining to the special needs of low-volume- and very-low-volume-consuming countries, in addition to small and medium-sized enterprises, and the decisions of the Twenty-Eighth Meeting of the Parties and the Executive Committee at its meetings, up to and including its seventy-eighth meeting, insofar as those decisions will necessitate expenditure by the Multilateral Fund during the period 2018–2020;

(b) The need to allocate resources to enable all parties operating under paragraph 1 of Article 5 of the Montreal Protocol (Article 5 parties) to achieve and/or maintain compliance with Articles 2A–2E, 2G, 2H, 2I and 2J of the Protocol;

(c) The need to allocate resources to enable all Article 5 parties to meet compliance obligations relevant in the replenishment period 2018–2020 in respect of Article 2F of the Protocol, providing support for a transition to low-global-warming-potential (GWP) or zero-GWP alternatives in hydrochlorofluorocarbon (HCFC) phase-out, taking into account decision XIX/6 of the Meeting of the Parties and the extended commitments made by Article 5 parties under approved HCFC phase-out management plans;

(d) Rules and guidelines agreed upon by the Executive Committee at all its meetings, up to and including its seventy-eighth meeting, for determining eligibility for the funding of investment projects and non-investment projects, including, but not limited to, institutional strengthening;

3. That the Technology and Economic Assessment Panel should provide indicative figures of the resources within the estimated funding required for phasing out HCFCs that could be associated with enabling Article 5 parties to encourage the use of low-GWP or zero-GWP alternatives and indicative figures for any additional resources that would be needed to further encourage the use of low-GWP or zero-GWP alternatives;

4. The need for additional resources to enable Article 5 parties to carry out initial activities related to the phase-down of HFCs listed under Annex F and controlled under Article 2J;

5. That in preparing the report the Panel should consult widely, including all relevant persons and institutions and other relevant sources of information deemed useful;

6. That the Panel should strive to complete the report in good time to enable it to be distributed to all parties two months before the thirty-ninth meeting of the Open-ended Working Group;

7. That the Panel should provide indicative figures for the periods 2021–2023 and 2024–2026 to support a stable and sufficient level of funding, on the understanding that those figures will be updated in subsequent replenishment studies.

Annex II

Highlights¹

Scientific Assessment of Ozone Depletion: 2018

The Assessment documents the advances in scientific understanding of ozone depletion reflecting the thinking of the many international scientific experts who have contributed to its preparation and review. These advances add to the scientific basis for decisions made by the Parties to the Montreal Protocol. It is based on longer observational records, new chemistry-climate model simulations, and new analyses. Highlights since the 2014 Assessment are:

Actions taken under the Montreal Protocol have led to decreases in the atmospheric abundance of controlled ozone-depleting substances (ODSs) and the start of the recovery of stratospheric ozone. The atmospheric abundances of both total tropospheric chlorine and total tropospheric bromine from long-lived ODSs controlled under the Montreal Protocol have continued to decline since the 2014 Assessment. The weight of evidence suggests that the decline in ODSs made a substantial contribution to the following observed ozone trends:

The Antarctic ozone hole is recovering, while continuing to occur every year. As a result of the Montreal Protocol much more severe ozone depletion in the polar regions has been avoided.

Outside the polar regions, upper stratospheric ozone has increased by 1–3% per decade since 2000.

No significant trend has been detected in global (60°S–60°N) total column ozone over the 1997–2016 period with average values in the years since the last Assessment remaining roughly 2% below the 1964–1980 average.

Ozone layer changes in the latter half of this century will be complex, with projected increases and decreases in different regions. Northern Hemisphere mid-latitude total column ozone is expected to return to 1980 abundances in the 2030s, and Southern Hemisphere mid-latitude ozone to return around mid-century. The Antarctic ozone hole is expected to gradually close, with springtime total column ozone returning to 1980 values in the 2060s.

The Kigali Amendment is projected to reduce future global average warming in 2100 due to hydrofluorocarbons (HFCs) from a baseline of 0.3–0.5°C to less than 0.1°C. The magnitude of the avoided temperature increase due to the provisions of the Kigali Amendment (0.2 to 0.4°C) is substantial in the context of the 2015 Paris Agreement, which aims to keep global temperature rise this century to well below 2°C above pre-industrial levels.

There has been an unexpected increase in global total emissions of CFC-11. Global CFC-11 emissions derived from measurements by two independent networks increased after 2012, thereby slowing the steady decrease in atmospheric concentrations reported in previous Assessments. The global concentration decline over 2014 to 2016 was only two-thirds as fast as it was from 2002 to 2012. While the emissions of CFC-11 from eastern Asia have increased since 2012, the contribution of this region to the global emission rise is not well known. The country or countries in which emissions have increased have not been identified.

Sources of significant carbon tetrachloride emissions, some previously unrecognised, have been quantified. These sources include inadvertent by-product emissions from the production of chloromethanes and perchloroethylene, and fugitive emissions from the chlor-alkali process. The global budget of carbon tetrachloride is now much better understood than was the case in previous Assessments, and the previously identified gap between observation-based and industry-based emission estimates has been substantially reduced.

Continued success of the Montreal Protocol in protecting stratospheric ozone depends on continued compliance with the Protocol. Options available to hasten the recovery of the ozone layer are limited, mostly because actions that could help significantly have already been taken. Remaining options such as complete elimination of controlled and uncontrolled emissions of substances such as carbon tetrachloride and dichloromethane; bank recapture and destruction of CFCs, halons, and HCFCs; and elimination of HCFC and methyl bromide production would individually lead to small-to-modest ozone benefits. Future emissions of carbon dioxide, methane,

¹ Reproduced herein as printed in the 2018 quadrennial assessment report of the Scientific Assessment Panel and without formal editing by the Secretariat.

and nitrous oxide will be extremely important to the future of the ozone layer through their effects on climate and on atmospheric chemistry. Mitigation of nitrous oxide emissions would also have a small-to-modest ozone benefit.

Annex III

Brief summary of the key findings and highlights¹

Environmental Effects Assessment Panel: 2018 Quadrennial Assessment on the Environmental Effects and Interactions of Stratospheric Ozone Depletion, UV Radiation, and Climate Change: Contributions of the Montreal Protocol to a Sustainable Earth

A. Stratospheric ozone, climate change and ultraviolet radiation at the Earth's surface

1. Owing to the success of the Montreal Protocol, present-day increases in ultraviolet B (UV-B) radiation due to stratospheric ozone depletion have been negligible in the tropics, small (5–10 per cent) at mid-latitudes (30–60°) and large only in polar regions. With the predicted recovery of stratospheric ozone over the next several decades, new estimates of the ultraviolet index (UV index) for the end of the century relative to the current decade suggest a decrease of 35 per cent over Antarctica and up to 6 per cent over mid-latitudes, but with uncertainties arising from various factors, such as changes in cloud cover, aerosol concentrations and surface reflectivity, many of which are influenced by climate change.
2. The effect of ultraviolet (UV) radiation on organisms (including humans), natural organic matter, contaminants and materials depends on their exposure to the radiation, which is determined by several factors besides stratospheric ozone depletion, including the effects of climate change. Many of the environmental and health effects caused by exposure to UV-B radiation are also influenced, to varying degrees, by exposure to ultraviolet A (UV-A) and visible radiation, which is also affected by climate change. Climate change and its effects (e.g., drought; high temperatures; fire; the spread of pests and pathogens; increases in extreme weather events that increase the input of dissolved organic matter and sediments into coastal and inland waters and reduce the transparency of water; and melting of glaciers, snow and ice cover) are modifying vegetation cover, shifting the seasonal timing of critical life cycle events such as plant flowering, spring bud-burst in trees, animal emergence and breeding, and shifting geographical ranges for the migration of plant and animal populations and aquatic organisms. The combined effects of these changes are extremely complex.

B. Human health

3. Higher exposure to UV radiation increases the incidence of skin cancers and other UV-induced human diseases, such as cataracts and photosensitivity disorders. The exposure of individuals to UV radiation varies from one-tenth to ten times the average for the general population, depending on people's behaviour, including the time spent indoors versus outdoors and under shade structures. The exposure of the skin or eyes further depends on the use of sun protection. Warming temperatures and changing precipitation resulting from climate change will alter human behaviours in relation to sun exposure, but the direction and magnitude of the effect is likely to be highly variable across the globe. The dose of UV radiation to biological structures in the skin is mediated by skin pigmentation, with darker skin providing significant protection against skin cancers.
4. Increases in the incidence of skin cancer in the twentieth century can largely be attributed to changes in behaviour. Skin cancer is the most common cancer in many developed countries with predominantly light-skinned populations. For example, each year in New Zealand, there are over 90,000 new cases of skin cancers compared with around 3,000 new cases of colorectal cancer. Skin cancer is also the most expensive cancer to treat in many of those countries. The cost of treating cutaneous malignant melanoma in the United States of America was estimated at around \$457 million in 2011 and was predicted to increase to around \$1.6 billion in 2030. Exposure to UV radiation accounts for 60–96 per cent of the risk of developing cutaneous malignant melanoma in light-skinned populations. It is estimated that around 168,000 new melanomas in 2012 were attributable to “excess” exposure to UV radiation resulting from behaviour changes. Modelling studies show that, owing to the implementation of the Montreal Protocol, by 2065 the world can avoid the devastating effects of

¹ Prepared by the Secretariat from the “Key findings and highlights” section of the executive summary in the 2018 quadrennial assessment report of the Environmental Effects Assessment Panel.

UV radiation on human health, including large increases in skin cancer incidence in light-skinned populations resulting from high levels of UV radiation (i.e., UV index > 40) in the tropics.

5. Eye cataracts are the leading cause of vision impairment globally (12.6 million people blinded and 52.6 million people visually impaired in 2015 owing to cataracts). In low-income countries in particular, which often have high levels of ambient UV radiation, access to cataract surgery may be limited, making cataracts not only a major health concern but a major source of loss of livelihood and economic damage.

6. Concern about high levels of UV-B radiation due to stratospheric ozone depletion was an important driver in the development of programmes to promote sun protection in many countries. Sun protection programmes have been shown to be highly cost-effective in preventing skin cancers. Behavioural strategies need to be informed by the real-time level of ambient UV radiation and include controlling time outdoors, together with using clothing, hats, sunscreen and sunglasses to reduce exposure to UV radiation. Behavioural change can be facilitated by providing shade in public spaces such as parks, swimming pools and schools, and improving access to sunscreen.

7. The benefits of UV exposure include the production of vitamin D in the human body, which is critical to healthy bones, in particular during infancy and childhood. There is growing evidence of a range of other benefits of exposure to UV radiation through both vitamin D and non-vitamin D pathways, including in relation to systemic autoimmune diseases (such as multiple sclerosis), the prevention of myopia and the reduction of non-cancer mortality.

8. Gaps in our knowledge prevent calculations of the amount of UV radiation necessary to balance the risks with the benefits, in particular given that it likely varies according to age, sex, skin type and location. Projected changes in climate will alter the balance of risks versus benefits for human populations living in different regions.

C. Air quality

9. UV radiation drives photochemical reactions in many emitted chemical compounds, generating secondary pollutants, including ground-level ozone and some types of particulate pollutants. Modelling studies for the United States of America indicate that reductions in UV radiation due to stratospheric ozone recovery will lead to decreased ground-level ozone in some urban areas but slight increases elsewhere. A number of recent international assessments have concluded that poor air quality is a significant global health issue and is estimated to be the largest cause of deaths globally due to environmental factors (for example, exposure to fine particulate matter (PM_{2.5}) caused 4.2 million deaths in 2015). Because large populations are already affected by poor air quality, even small relative changes in UV radiation can have significant consequences for public health.

D. Agriculture and food production

10. There is little evidence to suggest that modest increases in solar UV radiation have any substantial negative effect on crop yields and plant productivity. How food production would have been impacted by the absence of the Montreal Protocol is unclear. One analysis for high latitudes concluded that a 20 per cent increase in UV radiation, equivalent to a 10 per cent reduction in stratospheric ozone, would reduce plant production by only about 6 per cent (i.e., a 1 per cent reduction in growth for every 3 per cent increase in UV radiation). To what extent this relationship would hold for even higher levels of UV radiation is uncertain and represents an important knowledge gap.

11. Climate change factors such as drought, high temperatures and rising carbon dioxide levels can modify how UV radiation affects crop plants, but those effects are complex and often contingent on growth conditions. Understanding the various UV-climate-change interactions can inform the agricultural practices of crop growers and animal breeders in the face of increasing environmental change. The beneficial effects of UV radiation on plants are often mediated by specific photoreceptors that regulate plant growth and development, and lead to changes in the nutritional quality of food and in plant resistance against pests and pathogens. Decreased exposure to UV radiation resulting from changes in stratospheric ozone levels and climate or changing agricultural practices may reduce plant defences and affect food security in ways other than just the direct effects on yield.

E. Water quality and fisheries

12. Changes in exposure to UV radiation and mixing depths are altering the fundamental structure of aquatic ecosystems and consequently their ecosystem services (e.g., water quality and fishery productivity) in regionally-specific ways. The larvae of many commercially important fish species are clear-bodied and sensitive to damage induced by UV radiation. The distribution of those larvae in

surface waters with high UV exposure has the potential to reduce the survival of fish and the harvests from those fisheries. Reduction in the transparency of clear-water lakes, which impedes the penetration of UV radiation, may increase the potential for invasions by UV-sensitive warm-water species that can negatively affect native species. The “browning” of many inland and coastal waters from heavy precipitation and the melting of glaciers and permafrost is leading to the loss of the valuable ecosystem service by which solar UV radiation disinfects surface waters by killing parasites and pathogens. Region-specific increases in the frequency and duration of droughts have the opposite effect, increasing water clarity and enhancing solar disinfection, as well as altering the depth distribution of the plankton that provide critical food resources for fish.

F. Biogeochemical cycles, climate system feedbacks and biodiversity

13. Changes in stratospheric ozone and climate affect biogeochemical cycles that are driven by sunlight and, in turn, greenhouse gases and air and water quality. Exposure to solar UV and visible radiation can accelerate the decomposition of natural organic matter (e.g., terrestrial plant litter, aquatic detritus and dissolved organic matter) and the transformation of contaminants. Photodegradation of natural organic matter results in the emission of greenhouse gases, including carbon dioxide and nitrous oxide. Increases in droughts, wildfires and the thawing of permafrost soils driven by climate change have the potential to increase photodegradation, thereby creating a positive feedback loop that fuels global warming. The scale of that effect remains an important knowledge gap.

14. Species of aquatic and terrestrial organisms differ in their tolerances to UV radiation, and those differences can lead to alterations in the composition and diversity of ecological communities under conditions of elevated UV radiation. Presently, ozone-driven changes in regional climate in the southern hemisphere are threatening the habitat and survival of some species that grow in the unique high-elevation woodlands of the South American Altiplano, as well as mosses and other plant communities in Antarctica, but enhancing the reproductive success of some marine birds and mammals. Losses in species diversity in aquatic ecosystems are known to be linked to high exposure to UV radiation and can cause declines in the health and stability of ecosystems and the services they provide to humans.

G. Contaminants and materials

15. UV radiation is a key factor that influences the biogeochemical cycling of contaminants and their degradation through direct and indirect photoreactions. The likely effects of climate change, such as increases in heavy precipitation or droughts, also have a large impact on the photodegradation of contaminants. Those effects depend on local conditions, posing challenges for the prediction and management of the effects of contaminants on human health and the environment. On the one hand, exposure to UV radiation increases the toxicity of contaminants such as pesticides and polycyclic aromatic hydrocarbons to aquatic organisms; on the other hand, it transforms the most toxic form of methylmercury into forms that are less toxic, thereby reducing the accumulation of mercury in fish. These impacts are further affected by underwater exposure to UV radiation.

16. Sunscreens are in widespread use, including in cosmetics, for sun protection for humans. However, it is now recognized that sunscreens wash into coastal waters and potentially affect aquatic ecosystems. The toxicity of artificial sunscreens to aquatic organisms has led some governments to ban or consider banning certain sunscreens. Microplastics (plastic particles < 5 mm) are now ubiquitous in the world’s oceans and pose an emerging serious threat to marine ecosystems, with many organisms now known to ingest them. Microplastics are formed by the UV-induced degradation and breakdown of plastic products and waste exposed to sunlight, which is accelerated by higher temperatures and UV radiation. Microplastic pollutants are found in more than 20 per cent of fish marketed globally for human consumption, but their toxicity is unknown.

17. Exposure to solar UV radiation damages the functional integrity and shortens the service lifetimes of organic materials used in construction. Due to the trend towards “green” buildings, the use of natural materials such as wood in place of plastics has increased. Some of those natural materials are more vulnerable to accelerated aging owing to increased exposure to UV radiation. Efforts to identify and develop novel, safer, effective and “greener” additives for plastic materials and wood coatings are also moving forward.

18. Substances controlled under the Montreal Protocol and some of their substitutes are known to degrade to trifluoroacetic acid in the atmosphere and in surface water. Trifluoroacetic acid has multiple anthropogenic sources and it is also produced naturally. Currently, the amounts of trifluoroacetic acid are small and not expected to pose a risk to humans or the environment.

H. Conclusions and knowledge gaps

19. Quantification of many of the benefits deriving from the successful implementation of the Montreal Protocol remains a major challenge, and future trends in UV radiation exposure remain uncertain considering climate change and the extent of the human response thereto.

20. Improved quantification of the environmental effects of future changes in stratospheric ozone requires addressing several significant gaps in current knowledge that would support improved scaling and modelling of the effects of stratospheric ozone depletion and climate change on living organisms and their ecosystems and on materials such as paint, plastics and wood. As a result of shifting geographic ranges and changes in the seasonal timing of life cycle events due to climate change, it is apparent that many organisms, including human populations, will experience differing and interacting combinations of UV radiation and other multi-factor environmental changes. Quantifying those effects on humans and ecosystems is extremely challenging, where many of the outcomes are also contingent on human behaviours and societal responses that are difficult to predict.

21. Unexpected increases in emissions of CFC-11 that have been recently reported are expected to have only small effects on stratospheric ozone depletion, and thus on human health and the environment. New threats might include “geoengineering” activities that have been proposed to combat the warming caused by greenhouse gases, which could have consequences for UV radiation reaching the Earth’s surface. Injecting sulfuric aerosols into the stratosphere could accelerate stratospheric ozone loss if substantial amounts of ozone-depleting substances remain in the atmosphere. The combination of changes to the absorption of UV radiation by ozone and its scattering by sulfates would have spectrally complex consequences for the transmission of UV radiation to ground level, and the ratio of direct to diffuse UV radiation would be systematically greater.
