

**Montreal Protocol
on Substances that
Deplete the Ozone Layer**

Distr.: General

21 July 2023

Original: English

**Open-ended Working Group of the Parties
to the Montreal Protocol on Substances
that Deplete the Ozone Layer
Forty-fifth meeting
Bangkok, 3–7 July 2023****Report of the forty-fifth meeting of the Open-ended Working
Group of the Parties to the Montreal Protocol on Substances
that Deplete the Ozone Layer****I. Opening of the meeting**

1. The forty-fifth meeting of the Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer was held at the United Nations Conference Centre, Bangkok, from 3 to 7 July 2023. The meeting was co-chaired by Ralph Brieskorn (Kingdom of the Netherlands) and Vidémé Amèh Djossou (Togo).
2. Mr. Brieskorn opened the meeting at 10.05 a.m. on Monday, 3 July 2023. Opening statements were delivered by Dechen Tsering, Regional Director and Representative for Asia and the Pacific, United Nations Environment Programme (UNEP), and Megumi Seki, Executive Secretary, Ozone Secretariat.
3. In her remarks, Ms. Tsering noted that the overall theme of the sixth session of the United Nations Environment Assembly of the United Nations Environment Programme, due to be held in early 2024, would be the consideration of effective, inclusive and sustainable multilateral actions to tackle climate change, biodiversity loss and pollution, and that the approach and work of the Montreal Protocol had much to contribute, as they addressed each element of the triple planetary crisis. The recovery of the ozone layer contributed to tackling nature loss and the return to safe UV-B levels helped to protect ecosystems and biodiversity; decreases in UV-B radiation led to a reduced net production of ground-level ozone, helping to counter the pollution crisis and benefitting human health; and the phasing down and phasing out of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), most of which were potent greenhouse gases, helped to tackle climate change. With regard to mitigating global warming in particular, she encouraged Parties that had not already done so to join the 150 Parties that had ratified the Kigali Amendment to the Montreal Protocol, as the planned phase-down of HFCs by 2047 could prevent the emission of up to 105 million tons of carbon dioxide-equivalent of greenhouse gases and, by 2100, up to 0.5°C of global temperature rise could be avoided. She further noted that the present meeting was taking place at a critical point, as parties operating under paragraph 1 of Article 5 (Article 5 parties) were striving to sustain their commitments for the phase-out of HCFCs while preparing for the HFC phase-down.
4. Turning to the refrigeration and air conditioning sector, she noted the sector's importance to society's well-being, in particular by preserving food and medicines, including vaccines, and providing cool living and working spaces, and to the global economy, for example through the employment of skilled workers. UNEP was therefore leading a Cool Coalition to support the presidency of the twenty-eighth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change in its call for parties to join the Global Cooling Pledge, which consisted of a range of policy actions, from nature-based solutions and sustainable cold chains to appliance efficiency policy and innovation investment, that allowed State and non-State actors to

enhance their commitments to climate mitigation, adaptation, resilience and investment towards sustainable cooling. Sustainable cooling was an opportunity to cut global warming, improve the lives of hundreds of millions of people, and realize huge financial savings. In closing, she encouraged all parties to strengthen their national legislation and policy frameworks related to the Montreal Protocol, and to facilitate the introduction of ozone and climate friendly technologies, including by addressing the challenges related to their market adoption.

5. Welcoming participants to the forty-fifth meeting of the Open-ended Working Group, Ms. Seki invited participants to observe a minute of silence in memory of Daniel Albritton, one of the first co-chairs of the Scientific Assessment Panel, who had died in April 2023. Ms. Seki recalled that he had steered the Panel successfully through several quadrennial assessments and had been an acclaimed atmospheric scientist and an amazing communicator who had been able to convey complex science to decision makers and the general public in simple language. He would also be remembered as having been a gentle person who treated everyone with respect, tolerance and kindness.

6. Turning to the agenda for the meeting, Ms. Seki drew attention to several key topics to be considered at the meeting. She noted first that the agenda item on strengthening Montreal Protocol institutions, including combating illegal trade, would be based on the key points from the rich discussions at the workshop on that theme, held on 2 July. The 2022 quadrennial assessment of the three assessment panels, as well as their synthesis report, which were due to be presented formally at the Thirty-Fifth Meeting of the Parties to the Montreal Protocol, in late 2023, were now available and would inform discussions on several agenda items at the present meeting. In addition, parties would start discussions at the present meeting on the terms of reference for the next quadrennial assessment, which was due to be completed in 2026. The strength of the assessment process and science-based decision-making approach of the Montreal Protocol were widely recognized as a useful model by other intergovernmental processes, including the ad hoc global assessments dialogue and the ad hoc open-ended working group on a science-policy panel to contribute further to the sound management of chemicals and waste and to prevent pollution. The co-chairs of the ad hoc open-ended working group had worked with the Ozone Secretariat to raise awareness and the visibility of the assessment process of the Montreal Protocol, including presenting lessons learned.

7. The replenishment of the Multilateral Fund for the period 2024–2026 was another key issue to be discussed at the present meeting, with the replenishment task force of the Technology and Economic Assessment Panel providing the highest ever estimate of funding required, as a consequence of Article 5 parties beginning to implement HFC phase-down activities while still phasing out HCFCs. Energy efficiency and low- or zero-global-warming-potential (GWP) technologies would also be considered, on the basis of a progress report prepared by the Technology and Economic Assessment Panel, in conjunction with the issue of the illegal importation of inefficient cooling equipment. Furthermore, parties would consider the adjustment proposal put forward regarding the low HFC baselines, resulting from reduced economic activities during the coronavirus disease (COVID-19) pandemic, that would affect Group 1 Article 5 parties in particular, in view of the freeze in HFCs for those parties from 1 January 2024 onward.

8. In closing, she recalled that the Secretariat, in line with other United Nations entities, had recently established an environmental management system policy to reduce carbon emissions in its operations and events. The policy had been applied for the first time in 2022 to the forty-fourth meeting of the Open-ended Working Group and the Thirty-Fourth Meeting of the Parties and the sustainability scores of both meetings had been pleasingly high. The sound environmental policies of the United Nation Conference Centre in Bangkok coupled with the excellent conference support team provided the ideal setting for what she hoped would be a successful and fruitful meeting.

II. Organizational matters

A. Attendance

9. The following parties to the Montreal Protocol were represented: Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Bahrain, Bangladesh, Barbados, Belgium, Belize, Benin, Bhutan, Bosnia and Herzegovina, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Comoros, Cook Islands, Costa Rica, Côte d'Ivoire, Cuba, Czechia, Democratic Republic of the Congo, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, Eswatini, Ethiopia, European Union, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Grenada, Guatemala, Guinea-Bissau, Hungary, India, Indonesia, Iran (Islamic Republic of), Iraq, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Lesotho, Liberia, Malawi, Malaysia,

Maldives, Mali, Marshall Islands, Mauritius, Mexico, Micronesia (Federated States of), Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands (Kingdom of the), Nicaragua, Niger, Nigeria, Norway, Pakistan, Palau, Panama, Paraguay, Peru, Philippines, Portugal, Qatar, Republic of Moldova, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Islands, Somalia, South Africa, South Sudan, Spain, Sri Lanka, State of Palestine, Suriname, Sweden, Switzerland, Syrian Arab Republic, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Türkiye, Turkmenistan, Tuvalu, Uganda, Ukraine, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay, Viet Nam, Yemen, Zambia and Zimbabwe.

10. The following United Nations entities, organizations and specialized agencies were represented: secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol, United Nations Development Programme, United Nations Environment Programme, United Nations Industrial Development Organization, World Bank and the United Nations Office on Drugs and Crime.

11. The following intergovernmental, non-governmental, industry, academic and other bodies were represented as observers: A-Gas (Australia) Pty Ltd.; Air Conditioning and Refrigeration European Association; Air-Conditioning, Heating and Refrigeration Institute; Alliance for an Energy Efficiency Economy; Alliance for Responsible Atmospheric Policy; Asia Pacific Urban Energy Association; Association des Distributeurs, Conditionneurs, Récupérateurs et Retraiteurs de Réfrigérants (ADC3R); ATMosphere; Carrier Corporation; Carrier Global Corporation; Collaborative Labeling and Appliance Standards Program (CLASP); Cold Chain Innovation Hub; Council on Energy, Environment and Water; Daikin; Danfoss A/S (Denmark); Environmental Investigation Agency; European Chemical Industry Council; European Environment Agency; European Partnership for Energy and the Environment; GIZ Proklima; Global Policy Associates; Guidehouse; Gujarat Fluorochemicals Limited; Heat Pump and Thermal Storage Technology Centre; ICF International; iFOREST; Institute for Governance and Sustainable Development; International Finance Corporation; International Pharmaceutical Aerosol Consortium; Japan Refrigeration and Air Conditioning Industry Association; Korea Petrochemical Industry Association; Kulthorn Group; Lawrence Berkeley National Laboratory; Mobile Air Conditioning Society (MACS); Mebrom Corporation; Mexichem UK Ltd.; Mitsubishi Electric Corporation, MOON-TECH; National Resources Defense Council; Network of Women in Refrigeration; Nomura Research Institute Consulting and Solutions India Pvt. Ltd.; Ökorecherche; Overseas Environmental Cooperation Centre; Recoolit; Refrigerant Reclaim Australia; Refrigerants Australia; SilverLining; SRF Limited; TATA Motors Ltd.; Thai Samsung Electronics; The Energy and Resources Institute; Tradewater; Union of Associations of African Actors in Refrigeration and Air-Conditioning; World Customs Organization; and Yale Carbon Containment Lab.

B. Adoption of the agenda

12. The Working Group adopted the following agenda on the basis of the provisional agenda set out in document UNEP/OzL.Pro.WG.1/45/1/Rev.2:

1. Opening of the meeting.
2. Organizational matters:
 - (a) Adoption of the agenda;
 - (b) Organization of work.
3. The 2022 quadrennial assessment of the Montreal Protocol (decision XXXI/2):
 - (a) Presentations and discussion on issues arising from the 2022 quadrennial assessment and synthesis reports of the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel;
 - (b) Information on the consumption and production of hydrofluorocarbons not listed in Annex F (decision XXIX/12);
 - (c) Information on the availability of hydrochlorofluorocarbons (decision XXX/2, para. 4);

- (d) Update to the report of the working group of the Technology and Economic Assessment Panel on information on alternatives to hydrofluorocarbons (decision XXVIII/2);
 - (e) Potential areas of focus for the 2026 quadrennial assessment;
 - (f) Future availability of halons and their alternatives (UNEP/OzL.Pro.WG.1/44/4, para. 140);
 - (g) Any other issues.
4. Report of the Technology and Economic Assessment Panel on the replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the period 2024–2026 (decision XXXIV/2).
5. Strengthening Montreal Protocol institutions, including for combating illegal trade (decision XXXIV/8):
 - (a) Outcomes of the workshop on strengthening the effective implementation and enforcement of the Montreal Protocol (UNEP/OzL.Pro.WG.1/45/6);
 - (b) Background documents prepared by the Secretariat in accordance with decision XXXIV/8 (UNEP/OzL.Pro.WG.1/45/5, UNEP/OzL.Pro.WG.1/45/5/Add.1 and UNEP/OzL.Pro.WG.1/45/5/Add.2).
6. Energy-efficient and low- or zero-global-warming-potential technologies:
 - (a) Report by the Technology and Economic Assessment Panel (decision XXXIV/3);
 - (b) Illegal import of certain refrigeration, air-conditioning and heat pump products and equipment (decision XXXIV/4).
7. Identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring:
 - (a) Report by the Secretariat (decision XXXIII/4);
 - (b) Report by the Technology and Economic Assessment Panel (decision XXXIV/5).
8. Technology and Economic Assessment Panel 2023 report, including issues relating to:
 - (a) Nomination for critical-use exemption for methyl bromide for 2024;
 - (b) Ongoing emissions of carbon tetrachloride (decision XXXIV/6);
 - (c) Quarantine and pre-shipment uses of methyl bromide for which alternatives are available (decision XXXIV/10, para. 4);
 - (d) Existing challenges and potential options for the future configuration and function of Panel technical options committees (decision XXXIV/11, para. 1);
 - (e) Panel membership changes;
 - (f) Any other issues.
9. Stocks of methyl bromide (decision XXXIV/10, para. 3).
10. Potential impacts of the coronavirus disease (COVID-19) pandemic on hydrofluorocarbon consumption for Group 1 parties operating under paragraph 1 of Article 5:
 - (a) Hydrofluorocarbons consumption data reported by relevant Group 1 parties operating under paragraph 1 of Article 5 (decision XXXIV/13, paras. 1 and 2);
 - (b) Proposed adjustments to the Montreal Protocol.
11. Other matters.
12. Adoption of the report of the meeting.
13. Closure of the meeting.

13. Under agenda item 3 (g), “Any other issues”, the Working Group agreed to consider very short-lived substances, including dichloromethane; feedstocks; emissions of HFC-23; changes to the list of approved destruction technologies; and management of the life cycle of refrigerants.

14. At the time of adoption of the agenda, a number of representatives delivered statements. Two of those statements are reproduced as delivered in annex III to the present report, without formal editing, and the summaries of three of the statements are set out in the same annex.

C. Organization of work

15. In response to a request from one representative for summaries of the discussions at side events to be provided to participants in the present meeting as promptly as possible, the representative of the Secretariat said that she would endeavour to accommodate the request, in particular for the benefit of small delegations. The request from one representative to bring forward the discussion on the proposed adjustments to the Montreal Protocol under agenda item 10 (b), owing to the sensitivity of the matter and the potential benefit of full consideration in a contact group, would also be borne in mind.

16. The Working Group agreed to the organization of work proposed by the Co-Chair, namely to establish contact and informal groups as necessary and to avoid, to the extent possible, the holding of contact or informal group meetings in parallel with each other or with plenary meetings. Morning plenary sessions would run from 10 a.m. to 1 p.m. and afternoon sessions from 3 to 6 p.m.

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

A. Presentations and discussion on issues arising from the 2022 quadrennial assessment and synthesis reports of the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel

17. Introducing the sub-item, the Co-Chair drew attention to the note by the Secretariat on issues for discussion by and information for the attention of the Open-ended Working Group at its forty-fifth meeting (UNEP/OzL.Pro.WG.1/45/2) and the addendum thereto (UNEP/OzL.Pro.WG.1/45/2/Add.1), which set out the highlights of the 2022 quadrennial assessment reports prepared by the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel and its technical options committees. He also highlighted the note by the Secretariat that contained, in its annex, in English only, a synthesis of the 2022 assessment reports of the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel (UNEP/OzL.Pro.WG.1/45/3).

18. The Working Group then heard presentations on the main findings and conclusions of the 2022 quadrennial assessment reports. David Fahey, Bonfils Safari and Paul A. Newman, co-chairs of the Scientific Assessment Panel, described the Panel’s main findings. They were followed by Janet F. Bornman, Paul Barnes and Krishna Pandey, co-chairs of the Environmental Effects Assessment Panel, who presented the results of the Panel’s investigations. Summaries of the presentations by the co-chairs of the Scientific Assessment Panel and of the Environmental Effects Assessment Panel, as prepared by the presenters, are set out in section A of annex II to the present report, without formal editing.

19. Ashley Woodcock, co-chair of the Technology and Economic Assessment Panel, provided an overview of the Panel’s assessment report, including key messages, after which the following co-chairs of the technical options committees summarized the findings of the report: Paulo Altoé – Flexible and Rigid Foams Technical Options Committee; Adam Chattaway – Fire Suppression Technical Options Committee; Ian Porter – Methyl Bromide Technical Options Committee; Helen Tope – Medical and Chemicals Technical Options Committee; and Roberto Peixoto – Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee. Finally, Marta Pizano, co-chair of the Technology and Economic Assessment Panel, summarized the Panel’s findings on the impact of the phase-out of ozone-depleting substances on sustainable development. Summaries of the presentations, as prepared by the presenters, are set out in section B of annex II to the present report, without formal editing.

20. In the ensuing question-and-answer session, many representatives had specific questions on the quadrennial assessment, which members of the assessment panels proceeded to answer.
21. A number of questions related to CFC emissions, the uncertainty surrounding them and whether additional work was being done or should be done. Mr. Newman and Mr. Fahey both addressed the issue. From a scientific perspective, it was clear that ozone-depleting substances were declining in the atmosphere overall and across all the nations of the world, and ozone levels were increasing. Nevertheless, continued vigilance, including through ongoing monitoring, was needed: ozone was a fundamental gas for Earth's atmosphere and close attention had to be paid to it. Unexpected emissions of controlled substances had been found, and while they had subsequently declined, they had not yet all been accounted for. Furthermore, natural phenomena had also had an impact on the ozone layer, comparable to that of refrigerants: the water vapour from the Hunga Tonga volcano, for instance, was expected to cause a large change in the Antarctic ozone hole during the current season, the difference being that the volcano's impact would be short-lived, with the material leaving the atmosphere within a couple of years.
22. Whether additional work was called for was a policy question; various policy options in terms of further controls that could enhance the recovery of the ozone layer and lessen climate change were included in the Scientific Assessment Panel's 2022 assessment report.
23. Reacting to a comment on the imbalance in the distribution of the global monitoring network, Mr. Newman confirmed that there was an imbalance, which the Scientific Assessment Panel would be very keen to see corrected through an increase in the number of stations to cover the regions where there were gaps. He cautioned, however, that building the stations was a highly technical process.
24. Stephen Montzka of the Scientific Assessment Panel assured representatives that the scientific community was continuing to measure trichlorofluoromethane (CFC-11) and related substances by tracking their emissions and working with the Technology and Economic Assessment Panel to understand the magnitude of emissions from banks created from production before 2010 and newly produced banks. Scientists in the Scientific Assessment Panel continued their efforts to refine and improve methodologies and observational networks to enable more accurate and precise estimates of emissions from gases controlled under the Montreal Protocol.
25. Mr. Newman also addressed a question regarding the implication of the loss of satellites in terms of the ability to track changes in the stratosphere. Noting that instruments in space degraded over time, he confirmed that the Aura satellite with its microwave limb sounder had been orbiting since 2004 and was optimistically expected to continue taking measurements into 2025. The few missions that were in planning to make similar observations had not yet been approved and would not be operational before 2030 even if approved. There would therefore be a gap in the ability to monitor the stratosphere, particularly for specific chemicals that were involved with ozone depletion, including chlorine monoxide, hydrogen chloride and nitric acid, the latter being intimately involved with ozone depletion in the Arctic and the Antarctic. Observations of those important constituents would no longer be available, although there were satellites that would continue to make ozone profiles and aerosol profiles.
26. Regarding the recovery of the ozone hole to date, there was evidence of an increase in ozone over Antarctica as chlorine and bromine levels fell, although that recovery was currently not particularly large. Nevertheless, ozone levels were no longer declining and had recovered somewhat, and full recovery was forecast by around 2066.
27. Responding to a question regarding those emission reductions that would deliver the greatest gain in fighting climate change, Mr. Newman named carbon dioxide, methane and nitrous oxide: a 3 per cent reduction in anthropogenic nitrous oxide emissions on average over the period 2023-2070, for instance, increase global ozone by about a half a Dobson unit but would decrease radiative forcing by 0.04 watts per metre squared, which was fairly substantial. Those emissions were not controlled under the Montreal Protocol, however; with respect to controlled substances, phasing down very-high-GWP HFCs could yield very large gains, and eliminating banks would also yield a positive gain for climate.
28. Mr. Newman also addressed a number of questions on very short-lived substances. He began by noting that controlling dichloromethane would have a very rapid impact on ozone depletion because of its short lifetime. A fairly good reduction of ozone depletion would also result from controlling very short-lived chlorine. Regarding assignment of an ozone-depleting potential figure or range to very short-lived substances, he responded that it was very difficult to calculate because it depended on where the substance was emitted: a substance emitted in the tropics could enter the stratosphere easily, while a short-lived species emitted in the mid-latitudes was less likely to make it

out of the troposphere and into the stratosphere to cause ozone depletion. Consequently, there was no single value that could be put into the table.

29. Turning to a question on the emission reductions that could have the biggest short-term effect and magnitude in terms of reducing equivalent effective stratospheric chlorine, Mr. Newman suggested three measures to achieve at least a short-term effect: control or remove banks of ozone-depleting substances, which would have an immediate and long-term effect; eliminate anthropogenic, very short-lived chlorine substances, which could have a very immediate effect; and eliminate feedstock emissions, which could have a direct effect.

30. Returning to the topic of banks of ozone-depleting substances, Mr. Newman confirmed that a good understanding was needed of what banks existed and the rate at which they were emitting in order to understand atmospheric levels of ozone-depleting substances. He cautioned, however, that the instruments used for measurements were very sophisticated and precise – for every trillion molecules they had to be able to detect one molecule of ozone-depleting substance – and measurement had to be done by highly technical personnel.

31. Also on the topic of banks, Ms. Tope responded to a question regarding transboundary movements of waste and a concern around dumping, explaining that the related recommendation to parties was to consider how the Montreal Protocol could work with other international treaties to facilitate transboundary movement of end-of-life ozone-depleting substances and HFCs. While the Panel recognized the importance of countries managing waste and avoiding inappropriate transboundary movements of waste, it had wanted to bring to parties' attention the fact that some of the administrative aspects of that process could create a barrier to recovery, recycling and environmentally sound destruction of end-of-life ozone-depleting substances and HFCs, and thus lead to emissions at end of life rather than environmentally sound management. The intention had been to encourage the Meeting of the Parties and other international treaty bodies to get together, talk about the issues and the various policy objectives, and perhaps try to facilitate and encourage recovery, recycling and environmentally sound destruction.

32. Several representatives asked for additional clarity on unexplained emissions of carbon tetrachloride and HFC-23, and in particular on discrepancies between bottom-up and top-down atmospheric observations, as well as feedstock uses. Providing context on the matter, Mr. Newman said that good progress had been made in understanding the imbalance between the bottom-up and top-down estimates of carbon tetrachloride. For HFCs, however, a fairly large discrepancy remained: reporting under the United Nations Framework Convention on Climate Change only accounted for 31 per cent of HFC-23 emissions when this was included in the analysis of the global total CO₂ equivalent emissions derived from observations. Hence there remained a scientific problem in matching the bottom-up estimates that the Technology and Economic Assessment Panel provided to the top-down estimates derived from atmospheric observations.

33. Also speaking on the matter, Ms. Tope noted that a report to be provided to the Meeting of the Parties in response to decision XXXIV/7 would cover bottom-up estimation of HFC-23 emissions and might help to provide some perspective. For the current assessment, new information on non-chloromethane production had been available on the inventory of bottom-up emissions of carbon tetrachloride, such as identification of the vinyl chain production process as a new potential source of emissions.

34. Asked what had led the Scientific Assessment Panel to recalculate the lifetime of carbon tetrachloride, leading to an increase in the gap between top-down and bottom-up estimates, Mr. Newman explained that the lifetime estimates had changed not because of any change in the calculated rate of breakdown of carbon tetrachloride in the stratosphere but because the Panel had also taken into account loss of carbon tetrachloride to the oceans, a complex process to estimate. There had nevertheless been great improvements in solving the budget of carbon tetrachloride in the last 20 years, and there was overlap at the edges of the top-down and bottom-up emissions estimates.

35. With respect to questions on feedstock uses, their management and the possible need to monitor them, Ms. Tope drew attention to sections in both the assessment report and the progress report on best practices in controlling emissions of controlled substances that were products, co-products, intermediates or feedstocks. Those sections outlined the range of good practice approaches that industry could take to minimize emissions of feedstocks. The topic was also relevant to the discussion of the response to decision XXXIV/5 and gaps in monitoring.

36. Also responding to specific questions on HFCs used as etchants in the semiconductor industry, which some countries reported as feedstock applications and others as emissive applications, Ms. Tope explained that the Technology and Economic Assessment Panel did not currently have much

information on conversion and recovery rates and their impact on emissions and would welcome information from parties on such emissions. The Panel had looked at semiconductor manufacturing for the first time in the context of the current assessment and had wanted to bring the inconsistency in the way parties were treating such HFC use to the parties' attention. She clarified that when HFC-23, for instance, was used as an etching gas, it was combined with silicon as the substrate to be etched. In the plasma process, the HFC-23 formed ions and radicals, and then fluorine radicals reacted with the silicon substrate to create the silicon fluoride coating. How that should be treated for the purposes of Article 7 reporting was not clear. She said that, from her perspective, it was not a traditional feedstock-type use, which was more likely to be the combination of two chemicals to create a new chemical and then having that chemical isolated. While that was her understanding of a feedstock use, the matter had been brought to the parties' attention because it probably required clarification.

37. Turning to a question on trifluoroacetic acid (TFA) and HFC production from HCFC-22 and associated emissions of HFC-23 and PFC-318, and whether more work could be done on the topic, Ms. Tope said that more accurate data would be needed from parties. The Panel did not have accurate information on possible emission factors or current abatement levels, which it would need, nor did it have information on whether those processes currently required incineration – thermal oxidation – to destroy those emissions, which it would be grateful to receive.

38. Members of the Environmental Effects Assessment Panel were also asked about TFA, its accumulation and phytotoxic effects and possible ways to remove it. Ms. Bornman, while cautioning that very few studies had been done and the conclusions of those that had been done were not always robust, responded that the most important thing would be to look at the concentration in oceans, which was 200 nanograms per litre – noting that one nanogram was extremely small. The Panel had only found two studies on aquatic plants tested so far and there was no observed effect at very high concentrations in a laboratory setting. For smaller amounts in water, a study had been done in Germany on rainwater samples, at an average concentration of 703 nanograms per litre. In a laboratory rat experiment, rats had been given TFA salts in drinking water at very high concentrations, up to 600 milligrams per litre, with no significant effects at 30 milligrams and a few potential impacts on enzyme activity in the liver at 120 and 600 milligrams. For animals, including humans, the most important message seemed to be that, although there was a lot of TFA that could accumulate in the environment, it was water soluble and therefore did not accumulate, which was often forgotten. That said, the full story of potential biological effects of TFA was not yet known, and the Panel encouraged continuous monitoring and assessment of any potential effects.

39. Regarding information suggesting that HFC-23 emissions had abated considerably while atmospheric measurements suggested otherwise, Mr. Montzka confirmed that HFC-23 global emission magnitudes and trends derived from atmospheric measurements contrasted with expectations of a substantial increase in abatement of HFC-23 emissions. The source of that abatement information was cited in the Scientific Assessment Panel's report as being reports of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, and more specifically estimated effects of relevant national regulations.

40. Representatives also had a number of questions relating to low-GWP alternatives. Responding to a question on supply shortages related to supply chain and logistics issues, raw material shortages, manufacturing issues and severe weather, Helen Walter-Terrinoni, co-chair of the Flexible and Rigid Foams Technical Options Committee, acknowledged that a mismatch between available capacity or supply of next-generation foam blowing agents had been exacerbated by several events, including the COVID-19 pandemic and weather events that had affected the operation of several facilities. There had since been some easing in that regard, with new capacity recently coming on line. The same problem could recur, however, if more capacity was not developed or other steps were not taken.

41. Turning to a question on refrigerant charge reduction for HFC systems or equipment, covered in section 7.3 of the same assessment report, she said that the two main strategies for charge reduction related to equipment design, and more specifically to heat exchanger design using new architectures like microchannels or small diameter tubes, and the design and volume of the compressor.

42. Also on the same general topic, Omar Abdelaziz, co-chair of the Refrigeration, Air Conditioning and Heat Pump Technical Options Committee, addressed a question on hydrofluoroolefin (HFO) technology for air conditioning in cars and related risks, such as flammability. He explained that the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee had looked at safety considerations and the impact of updates in safety standards and had described any updates on the safety standards, as well as new refrigerant charge limits, for each technology sectors. In certain specific applications or specific conditions, the Committee's 2022

assessment report also described how parties could cope with new higher charges in terms of maintaining safety for users.

43. Mr. Abdelaziz also provided clarifications regarding the key messages in the 2022 assessment report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee. Regarding the difference between direct versus indirect impacts of high-GWP refrigerants, he said that one factor could not be addressed without addressing the other one. In general, most industrialized countries were moving towards higher-energy-efficiency products but were also working with lower-GWP refrigerants. For building energy efficiency, the answer was integration and synergy: if cooling demand could be reduced and energy efficiency improved, then the required capacity and system charge could be reduced.

44. In terms of the accessibility of alternatives and how it hindered the implementation of the Kigali Amendment, there was a dual responsibility between importing and exporting countries, the problem being that importing countries often did not have the regulatory framework needed to only allow in energy-efficient equipment with lower-GWP refrigerants, which created a disparity.

45. Mr. Peixoto addressed a question about the limits for the use of natural refrigerants, saying that the choice of refrigerant was based on weighing a set of criteria, covering environmental issues, suitability of the application, a safety assessment and regional and national regulations, as was mentioned in one of the key messages of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee. Energy efficiency, or energy consumption, was also one of the criteria. A CO₂ transcritical system, for instance, was a natural refrigerant installation that had not been used in warmer climates because of the energy penalty, but with technological developments such as multi-ejector, parallel compression, transcritical CO₂ systems were now also used in warmer countries. Technology was thus changing the limits of the use of natural refrigerants.

46. A number of the refrigerant-related questions were addressed in the 2022 assessment report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee. Thus, in response to questions regarding options for high temperature heat pumps above 90°C, Mr. Peixoto noted that district heating alternative systems had been implemented using ammonia, but he mainly drew attention to chapter 10 of the report, which dealt with industrial refrigeration and large installations and presented several refrigerant alternatives, including details on their properties. For questions on the energy efficiency side of the equation, Mr. Abdelaziz referred parties to the dedicated sections on energy efficiency within each chapter of the report.

47. Ms. Walter-Terrinoni responded to queries about the supply of alternative foam-blowing agents, saying that several years earlier, the Flexible and Rigid Foams Technical Options Committee had reported that for alternatives, including HFOs and hydrocarbons, specifically cyclopentane, supply was insufficient to meet demand, based on reports from several companies. Additional capacity had come on line in recent years, and the same companies now reported that the situation had eased somewhat, and supply had increased.

48. A number of questions were posed on aerosol injection, or solar radiation management, its impact on the ozone layer and recent developments and findings. Responding, Mr. Fahey began by speaking about timing in terms of effects on the ozone layer, explaining that injection of stratospheric aerosols that caused a meaningful change of global temperatures would almost certainly have a meaningful effect on stratospheric ozone within a year. Such changes had been seen in the case of volcanos causing explosive injections of aerosols into the stratosphere, a good example being the Hunga Tonga volcano, which was expected to increase the Antarctic ozone hole in the current season, although, as mentioned previously, this would not be long-lived. Discussion on the possibilities of conducting stratospheric aerosol injection in order to cool the planet had recently increased. From a scientific perspective, that could be seen as an indication of the urgency of providing the scientific foundation for any decision on whether to conduct climate intervention, and, as the Panel had pointed out in the 2022 assessment, there were substantial uncertainties with regard to the effects on stratospheric ozone, and on the environment more broadly. As more theoretical studies were conducted on the topic, there was increasing detail and comprehension of the potential unintended effects of such climate interventions. A global legal framework was lacking and did not appear imminent, but scientists would welcome the opportunity to carry out a comprehensive international scientific assessment on the topic to support a future legal framework.

49. Mr. Montzka addressed a question on emissions of methyl bromide, saying that its atmospheric abundance had varied between 6.5 and 6.9 parts per trillion over the period 2016–2020, with no systematic trend or change over that period but rather year-to-year variability, consistent with the known anthropogenic production and emission changes over the period. He also confirmed that the

pre-industrial atmospheric level for methyl bromide was 5.5 parts per trillion, based on measurements from air trapped in snow and ice in Antarctica.

50. Several questions on the topic of halons were addressed by Mr. Chattaway and Daniel Verdonik, co-chair of the Fire Suppression Technical Options Committee. Regarding the reported destruction of some halons, Mr. Chattaway confirmed that halon 1301 had been destroyed under a carbon credit system to satisfy corporate environmental sustainability goals. The halon had been recovered from a fire suppression system and had been perfectly usable. The company had proceeded with the destruction despite being requested not to. The Fire Suppression Technical Options Committee was concerned that the move could set a precedent and lead to further destruction of good halon, which would deplete the bank and could lead to a need for future production.

51. Mr. Chattaway also addressed questions about alternatives to halon. He began by noting that there were many listed in the 2022 assessment report of the Technology and Economic Assessment Panel, but that the Fire Suppression Technical Options Committee was not aware of any new fire suppression agents at an advanced development stage. The time scale for development and approval of a new agent was long, certainly in excess of ten years, and it was safe to assume that no new products were imminent. In terms of uptake of the available alternatives, with the exception of civil aviation, meaning aircraft engines and cargo compartments, none of the new halon system fire suppression systems used halon 1301. There were, however, several enduring or legacy uses, including military, oil and gas, and nuclear power plants, where a retrofit of the original halon system was not practical or feasible, for reasons such as available space, the weight of the system and temperature requirements. There were still some fixed systems protecting, for example, telecom suites and some marine uses. Those were typically decommissioned at the end of life of the asset and the halon was recovered and recycled into the available 1301 bank to support other enduring uses such as civil aviation. In terms of halon 1211, the only significant use remaining was portable extinguishers in civil aviation. All new aircraft were fitted with a halon replacement called 2-BTP, and for the existing aircraft fleets, halon 1211 was gradually being replaced; however, 2-BTP could be considered a per- and polyfluoroalkyl substance (PFAS) under some definitions, including the definition used by the Organisation for Economic Co-operation and Development.

52. Mr. Verdonik responded to a question regarding uncertainties over the possible run-out date for halon 1301 available from banks. He indicated that the 19-year window provided was based on uncertainties essentially in two different areas. First, every time the Fire Suppression Technical Options Committee performed the analysis there was more halon being tied up in so-called enduring uses, with life extensions of legacy systems to keep them in existence for longer than originally anticipated. Better information on how much was really tied up in such existing systems and a better understanding of the future of those systems would be helpful in reducing the uncertainty. The second area was how much halon was coming out of the non-enduring uses, such as ship breaking, which was generating significantly less halon than had been projected. It was not clear whether the halon was no longer in the ships being broken due to end of life, or whether it was being diverted earlier in the ship-breaking process. Clarity on that would help reduce uncertainty. In addition, halon emission estimates based on atmospheric abundances were greater than expected based on a bottom-up approach, which the Fire Suppression Technical Options Committee thought might not be coming from the fire protection bank but rather from feedstock production and use; greater insight into what the actual feedstock production and use emissions were would greatly reduce the uncertainty and would provide a much better idea of whether the emission estimates from the Committee's model were accurate.

53. After the question-and-answer session, a number of representatives delivered statements. All the representatives who spoke thanked the assessment panels for their hard work, and particularly complimented the Scientific Assessment Panel on its publication entitled "Twenty Questions & Answers about the Ozone Layer".

54. One representative of an Article 5 party said that his Government was advising stakeholders in his country not to purchase equipment using HFCs, given the approaching phase-down targets. His Government was also doing its best to reduce the use of methyl bromide for quarantine and pre-shipment applications, though this was proving to be challenging, not least because illegal trade in methyl bromide had been observed.

55. Other representatives drew a number of conclusions from the presentations of the assessment panels, including that early and fast action to transition away from the use of controlled substances would deliver the best outcomes for the ozone layer and the climate. There was good news in the panels' assessments, including on the evidence for the recovery of the ozone layer and the halting of unexpected emissions of CFC-11.

56. They expressed their concern, however, at some of the panels' findings, including the high levels of emissions from feedstock and its by-products, including HFC-23, and the fact that some emissions remained unexplained due to limitations in global monitoring networks. Other matters of concern included increasing concentrations of minor CFC species, the failure of atmospheric concentrations of carbon tetrachloride to fall, and the emissions of very short-lived substances such as dichloromethane. They looked forward to being able to discuss those issues further during the meeting.

57. One representative drew attention to the risks posed by the accumulation of trifluoroacetic acid in the environment, including in fresh water and in trees, from the breakdown of HFCs and HFOs. She considered that given its persistent nature, its release into the environment should be minimized. She also expressed her concern at the increasing use of PFAS, many of them as alternatives to substances controlled under the Montreal Protocol. She believed that parties needed to take into consideration all the potential consequences for the climate and environment when assessing the use of alternatives to controlled substances.

58. Another representative highlighted the fact that the future of atmospheric ozone levels depended partly on emissions of substances such as water, hydrogen, methane or nitrogen oxides, whether from new aircraft fleets, rockets, volcanic eruptions or intentional injections of sulphate aerosols into the stratosphere to reduce global warming. In the light of the Scientific Assessment Panel's information on the matter, and of the "One Atmosphere" report published by UNEP in February 2023, her delegation was considering submitting a draft decision at the present meeting designed to alert the global scientific community to the need to factor in the effects on the recovery of the ozone layer of stratospheric aerosol injection activities aimed at solar radiation management.

59. Subsequently, the representative of Australia presented a conference room paper containing a proposed draft decision prepared by her delegation and by Canada on stratospheric aerosol injection and the protection of the ozone layer.

60. The Working Group agreed to forward the draft decision proposed by Australia and Canada, as set out in section A of annex I to the present report, to the Thirty-Fifth Meeting of the Parties for further consideration and encouraged further consultations thereon to take place during the intersessional period.

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

61. Introducing the sub-item, the Co-Chair recalled that, at the Twenty-Ninth Meeting of the Parties, in decision XXIX/12 on the consideration of HFCs not listed as controlled substances in Annex F to the Protocol, the parties had requested the assessment panels to provide in their quadrennial reports, in 2023 and every four years thereafter, information on the consumption and production of HFCs not listed in Annex F of the Protocol which had a GWP no lower than the lowest GWP of the HFCs listed in Annex F. A response to that decision was provided in the 2022 quadrennial assessment report of the Medical and Chemicals Technical Options Committee and a summary of the information was provided in an addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.1, paras. 8–13).

62. All the representatives who spoke, including one speaking on behalf of a group of parties, thanked the assessment panels for the comprehensive nature of the information provided.

63. Several representatives requested further information regarding the HFCs and the HFO identified as exceeding the GWP threshold (GWP 53), including on the extent and expected growth of commercial use of those substances. In addition, one representative requested further information regarding the implications for the implementation of the HFC phase-down by parties, in particular Article 5 parties, of the identified substances, and one representative, speaking on behalf a group of parties, supported the continued monitoring of three HFCs in particular, as identified in the report. One representative expressed concern regarding the commercial use of fluorinated substances, including hydrofluoroethers and perfluorocarbons (PFCs), with high-GWP levels and noted the importance of continued monitoring of the situation by the panels. Several representatives, including one speaking on behalf of a group of parties, said that they wanted to continue discussions regarding such substances and the associated ozone and climate change impacts at the present meeting, noting that within the European Union the use of all fluorinated gases was regulated and the use of sulfur hexafluoride (SF-6) in new switch gear was soon to be banned. One representative requested information specifically on the use of hydrofluoroethers as inhalation anaesthetics and another representative, speaking on behalf of a group of parties, offered to share information on measures taken in those parties in that regard. One representative thanked the panels for their excellent work on solvents in

particular, noting that it was pleasing that only low levels of production of intermediates and solvents had been identified but that it remained prudent to consider the issue on a regular basis. He therefore requested that information on replacements for solvents be included in the 2026 quadrennial assessment. Another representative requested information on alternatives to the HFCs used in inhalers for managing asthma.

64. The Co-Chair requested the Medical and Chemicals Technical Options Committee to note the issues raised by representatives, after which the Working Group concluded its consideration of the matter.

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

65. Introducing the sub-item, the Co-Chair recalled that, at the Thirtieth Meeting of the Parties, in decision XXX/2 on adjustments to the Montreal Protocol, the parties had requested the Technology and Economic Assessment Panel to provide information on the availability of HCFCs in its quadrennial assessment reports to be presented in 2023 and 2027. The information was to include amounts available from recovery, recycling and reclamation, and best available information on country-level and total known stocks, as well as availability of alternative options for the “servicing tail” after the last control measure for HCFCs under the Montreal Protocol. A response to that decision was provided in chapter 3 of the 2022 quadrennial report of the Technology and Economic Assessment Panel and a summary of the information was provided in an addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.1, paras. 14–16).

66. In response to the query of one representative regarding the performance levels of recycled HCFCs in refrigeration and air conditioning, fire suppression, rocket engine manufacturing and medical aerosol applications, including any sector-specific industry experience, Ms. Tope said that if the recycling and recovery of HCFCs met the required specifications, then the HCFCs could be reused successfully.

67. One representative expressed concern regarding the baseline established for HCFCs for his country, as the data available did not accurately reflect the national situation, in particular with regard to illegally imported substances, and the future need for HCFCs in the country for agricultural use was considerable. Without significantly increased levels of technical and financial support, in particular in relation to data collection, his country would not be able to achieve the targets set.

68. One representative requested additional information on management mechanisms for stockpiles of HCFCs.

69. The Working Group took note of the information provided by the Technology and Economic Assessment Panel on the availability of HCFCs.

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

70. Introducing the sub-item, the Co-Chair recalled that, at the Twenty-Eighth Meeting of the Parties, in decision XXVIII/2 related to the amendment phasing down HFCs, the parties had requested the Technology and Economic Assessment Panel to conduct periodic reviews of alternatives, using the criteria set out in paragraph 1 (a) of decision XXVI/9, in 2022 and every five years thereafter, and to provide technological and economic assessments of the latest available and emerging alternatives to HFCs. In 2022, the Technology and Economic Assessment Panel had noted that parties had formulated a similar request to examine alternatives under paragraph 6 (e) of decision XXXI/2 on the potential areas of focus for the 2022 quadrennial assessment reports but was unclear as to how to harmonize the request with that made under decision XXVIII/2 and therefore requested guidance from the parties in that regard. In order to allow parties to consider alternatives to HFCs at the Thirty-Fourth Meeting of the Parties, a working group under the Technology and Economic Assessment Panel had prepared a report, presented in volume 5 of the 2022 report of the Panel, that had been compiled from the quadrennial assessment reports of the technical options committees being prepared at the time. The addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.1, paras. 30–33) contained a summary of the information on alternatives to HFCs contained in the 2022 quadrennial assessment reports of the Technology and Economic Assessment Panel and its technical options committees, which was consistent with the report produced by the working group under the Technology and Economic Assessment Panel.

71. The Thirty-Fourth Meeting of the Parties had considered aligning future periodic reviews on alternatives to HFCs with the preparation of the quadrennial assessment reports, as both could then be presented to the Working Group, allowing more time for consideration of the report before the next Meeting of the Parties. Parties had agreed on the need for the periodic review to remain a separate agenda item in order to preserve the intent of decision XXVIII/2 but had agreed to defer to 2023 consideration of the alignment of future periodic reviews with the quadrennial assessment reports.
72. The Co-Chair said that parties might therefore wish to consider the information on alternatives to HFCs, as well as the possible alignment of future periodic reviews on alternatives with quadrennial assessment reports.
73. Several representatives, including one speaking on behalf of a group of parties, requested additional information on the alternatives included in future reports, namely the level of market penetration and any challenges associated with a particular alternative, to support parties in decision-making, in particular in sectors where many alternatives were listed.
74. Several representatives noted that, although propane was a climate-friendly alternative, it was highly flammable and so financial and technical support was required by their countries in order to raise awareness among the public of the potential dangers, to develop the skills of technicians and engineers in the refrigeration and air conditioning industry regarding the safe handling of propane, and to ensure effective labelling and certification schemes. In addition, one representative noted that certain types of propane were currently prohibitively expensive and requested the Technology and Economic Assessment Panel to provide information regarding improving accessibility to such substances.
75. Several representatives noted that the availability of safe and economically viable low-GWP alternatives to HFCs remained a challenge, in particular in the refrigeration and air-conditioning and fire suppression sectors and for Article 5 parties, and requested information from the Technology and Economic Assessment Panel on future plans in that regard. Furthermore, one representative drew attention to the fact that in excess of 100 projects financed by the Multilateral Fund for the Implementation of the Montreal Protocol were currently behind schedule, the main reason being the scarcity of low-GWP alternatives both in local and global markets, leading some countries to turn to higher-GWP alternatives. She therefore encouraged the Technology and Economic Assessment Panel to analyse the progress of projects under the Multilateral Fund in order to obtain an accurate picture of the current availability of low-GWP alternatives. In relation to the fire suppression sector, several representatives underscored the importance of additional information on low-GWP alternatives to halons, in particular regarding the availability and managing the introduction of such alternatives.
76. Several representatives, including one speaking on behalf of a group of parties expressed a preference for aligning the future periodic reviews on alternatives with the quadrennial assessment reports but remained flexible on the issue. One representative expressed a preference for preserving the process as established under decision XXVIII/2.
77. One representative, speaking on behalf of a group of parties, sought clarification from the Technology and Economic Assessment Panel regarding the reasoning for restricting the recommended use of R-290 to monobloc units located outdoors.
78. The Working Group agreed to include consideration of the alignment of future periodic reviews on alternatives to HFCs within the mandate of the contact group expected to be established under sub-item 3 (e) on potential areas of focus for the 2026 quadrennial assessment.
79. Subsequently, the Co-Chair reported that there had been no time for any further discussions on the topic. The Working Group therefore agreed to resume discussions on the issue of alignment of reports in conjunction with the potential areas of focus for the 2026 quadrennial assessment at the Thirty-Fifth Meeting of the Parties.

E. Potential areas of focus for the 2026 quadrennial assessment

80. Introducing the sub-item, the Co-Chair drew attention to paragraph 19 of the note by the Secretariat on issues for discussion by and information for the attention of the Open-ended Working Group at its forty-fifth meeting (UNEP/OzL.Pro.WG.1/45/2), as well as terms of reference for the 2022 assessment contained in decision XXXI/2. He recalled that the three assessment panels had made presentations on their 2022 assessment reports under sub-item 3 (a) on presentations and discussion on issues arising from the 2022 quadrennial assessment and synthesis reports of the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel.

81. The representative of the European Union introduced a draft decision, set out in a conference room paper, on potential areas of focus for the 2026 quadrennial assessment. He outlined proposed areas of focus for the 2026 reports of the Environmental Effects Assessment Panel, the Scientific Assessment Panel and the Technology and Economic Assessment Panel. He suggested that the proposal be discussed in a contact group with a view to giving clear instructions to the three assessment panels.

82. Several representatives said that more in-depth discussion of the proposal or the clarification of certain of the issues therein was required. One representative noted that the proposal referred to issues being discussed under other agenda items and, as such, they required particular attention. Another representative expressed the view that the information in the proposal could be grouped together in a different manner and streamlined. He said that the potential areas of focus should be more general and less prescriptive.

83. Some representatives said that the three assessment panels should focus on the implementation of the Montreal Protocol and the Kigali Amendment rather than diversifying the scope of the quadrennial reports by introducing new elements already addressed under other conventions.

84. During the discussion, several new areas of focus were proposed and a number of the areas in the European Union proposal were endorsed. Those focus areas included raw materials used as feedstock and input materials; improvement of the safety of low GWP alternatives; assessment of whether the production of HFOs resulted in fugitive high-GWP HCFCs; the strengthening of national implementation frameworks; assessment of low-GWP alternatives and alternative technologies, especially in key industries and fields; how to improve and maintain energy efficiency while phasing down HFCs; solar radiation management; skin cancer rates globally; atmospheric concentrations of chemicals such as HFC-23; the effect of volcanic eruptions and supersonic flights on the ozone layer; refrigeration management; banks; recycling and reuse, and the use of HFCs in applications that did not have a corresponding prior HCFC use.

85. One representative recalled that, in decision XXVIII/2, the parties had asked for specific reporting of alternatives to HFCs. The reporting schedule, however, was not aligned with the timing of the quadrennial reports, and she proposed that they be aligned to reduce the burden on the Technology and Economic Assessment Panel and to ensure consistency in the information provided to parties. Another representative agreed that the issue should be discussed, with the appropriate forum to be found.

86. Several representatives stressed the challenges faced by Article 5 parties and the importance of funding to enable them to meet their compliance targets. One representative asked if there had ever been any analysis of what would happen if Article 5 parties did not receive the funding they needed; some others requested that the challenges faced by such countries and their need for support be considered both in the 2026 report and in a contact group on the present agenda item.

87. The Working Group agreed to establish a contact group, to be co-chaired by Leslie Smith (Grenada) and Cindy Newberg (United States), to consider further potential areas of focus for the 2026 quadrennial assessment, taking into account the proposal submitted by the European Union.

88. Subsequently, the co-chair of the contact group reported that, owing to time constraints, it had not been possible for the group to conclude its work, and if no additional time could be allocated for its work, parties could continue to consult during the intersessional period.

89. At a later stage in the meeting, the Co-Chair reported that there had been no time for an additional meeting of the contact group. The Working Group therefore agreed to resume discussions on potential areas of focus for the 2026 quadrennial assessment based on the draft decision with square brackets contained in section B of annex I to the present report, together with consideration of the possible alignment of future periodic reviews on alternatives to HFCs, at the Thirty-Fifth Meeting of the Parties.

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

90. Introducing the sub-item, the Co-Chair recalled that the Thirtieth Meeting of the Parties, in 2018, had adopted decision XXX/7 on the future availability of halons and their alternatives. In that decision, the parties had requested the Technology and Economic Assessment Panel, through its Halons Technical Options Committee (subsequently renamed the Fire Suppression Technical Options Committee (FSTOC)), 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.

91. The Panel had also been requested 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. The Fire Suppression Technical Options Committee had submitted a report on those issues in the Technology and Economic Assessment Panel 2020 progress report, with updates in the Panel's 2022 progress report and 2022 quadrennial assessment report. A summary of that information was provided in the addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.1).

92. Several representatives expressed concern at the possibility of shortages of halons, particularly halon-1301, for civil aviation, possibly as early as 2030. That problem could be exacerbated by other factors. One representative observed, for example, that the phase-down of HFCs had already led one manufacturer to cease production of HFC alternatives to halons for fire suppression. The possible classification of some HFCs as PFAS could also have an impact. There were also potential problems with a lack of awareness of the availability of reclaimed halons, and with some countries' restrictions on the transboundary movements of halons, including in aircraft. Other representatives agreed that it would be undesirable to have to see new production of halons, or the application of the essential-use exemption procedure to halons.

93. One representative observed that an assessment of needs for halons within his country had suggested that supply was likely to remain stable for the immediate future. Given longer-term uncertainties, however, his country had prohibited the destruction of halons in order to ensure the maximum level of recovery and reclamation.

94. Representatives also expressed concern about the discrepancies between modelled and observed atmospheric concentrations of halons and about possible emissions from feedstock and servicing uses.

95. One representative asked about the possible use of trifluoroiodomethane as an alternative for fire suppression applications, particularly given its high toxicity, ozone-depleting potential and price. In response, Mr. Verdonik, the co-chair of the Fire Suppression Technical Options Committee, said that trifluoroiodomethane had been under consideration for many years, but only for use for fire suppression in aircraft engines and auxiliary power units, which was the smaller of the two main uses of halon-1301. The Committee was monitoring the situation carefully, given the substance's high ozone-depleting potential, which was in reality even higher when it was emitted at aircraft altitudes.

96. Subsequently, the Co-Chair reported that there had been some informal discussions in the margins of the meeting. The Working Group agreed to resume discussions on the future availability of halons and their alternatives at the Thirty-Fifth Meeting of the Parties.

G. Any other issues

1. Emissions of HFC-23

97. The representative of the United States, speaking also on behalf of Australia, Canada and Norway, introduced a draft decision, set out in a conference room paper, explaining that it was intended to deal with unexplained emissions of HFC-23 in recent years. In the draft decision, the Scientific Assessment Panel and the Technology and Economic Assessment Panel were requested to provide updated information on the topic. He was aware that the issue was scheduled for discussion at the Thirty-Fifth Meeting of the Parties in any event, but expressed the view that the information requested in the draft decision was additional to that expected, and should assist discussions by the parties. In the draft decision, parties with relevant information were requested to provide it, and parties and other scientific and atmospheric organizations and institutions were encouraged to support efforts to undertake further study of emissions of HFC-23, and parties were encouraged to take appropriate measures to implement their HFC-23 obligations, in accordance with the provisions of the Kigali Amendment.

98. One representative asked for the clarification of some elements of the proposal, including on potential other sources of emissions of HFC-23; how other scientific institutions would be approached; and on the justification for reiterating parties' existing obligation with regard to the control of HFC-23 emissions. She also suggested that it might be better for further discussion to take place after the scheduled report of the Technology and Economic Assessment Panel to the Thirty-Fifth Meeting of the Parties.

99. Other representatives supported the proposal, observing that although the main source of emissions of HFC-23 was as a by-product from the production of HCFC-22, there were other sources too, and that the additional information requested in the draft decision would be helpful. Another representative stressed the efforts his party had made to ensure that enterprises controlled emissions of HFC-23, and pointed out that many of the scientific studies of emissions related to the period before 2019, which was before the entry into force of the Kigali Amendment and the beginning of parties' obligations with regard to HFC-23 emissions. Several representatives said that they would appreciate the opportunity to discuss the draft decision with its proponents and possibly to suggest additions and modifications.

100. Mr. Newman, speaking on behalf of the Scientific Assessment Panel, said that a side event on HFC-23 emissions was due to be held the following day, on 5 July. The Panel intended to update its data on emissions in time for the Thirty-Sixth Meeting of the Parties in 2024. Ms. Tope, speaking on behalf of the Technology and Economic Assessment Panel, observed that HFC-23 was emitted as a by-product from the manufacture of HCFC-22, tetrafluoroethylene and hexafluoropropene from HCFC-22 feedstock, and in some HFCs and HFOs. The Panel would be reporting to the Thirty-Fifth Meeting of the Parties later in the year, and that report would help to identify gaps in the data; the Panel would appreciate receiving more quantitative data on the issues from parties.

101. Responding to the points made, the representative of the United States explained that parties' requirements under the Kigali Amendment related only to HFC-23 emissions from the production of HFCs and HCFCs, whereas it was clear that there were other sources of emissions, and that was a matter of concern. He expressed the view that parties would benefit from more data than was provided through the standard data reports under Article 7 of the Protocol. Although the Technology and Economic Assessment Panel was due to report to the Thirty-Fifth Meeting of the Parties, he believed that the information requested in the draft decision would not duplicate the information in that report. He said that he would be happy to amend the draft decision after the Panel's report had become available, but was of the view that it was helpful to put the issues forward for discussion at the present meeting.

102. The Working Group agreed to establish a contact group, to be co-chaired by Shontelle Wellington (Barbados) and Heidi Stockhaus (Germany), to discuss the matter further.

103. Subsequently, the co-chair of the contact group reported back on the discussions held in the contact group. The group had made good progress and had completed its initial review of the six operative paragraphs of the proposed draft decision.

104. The Working Group agreed to forward the revised draft decision on HFC-23 emissions, as set out in section C of annex I to the present report, to the Thirty-Fifth Meeting of the Parties for further consideration.

2. Very short-lived substances

105. The representative of Canada, speaking also on behalf of Australia, Switzerland and the United States, introduced a draft decision, set out in a conference room paper, explaining that it had been written in response to the Scientific Assessment Panel's finding that very short-lived substances had a significant impact on ozone depletion, particularly in the lower stratosphere. The Panel had calculated that the positive effect on the ozone layer from 2020 to 2070 of eliminating emissions of very short-lived substances in 2023 would be about 1 Dobson Unit, about half the effect of eliminating all emissions of ozone-depleting substances in 2023.

106. The most significant very short-lived substance was dichloromethane. As recent studies had shown, its ozone-depleting potential was small, at 0.01–0.02, but given that 1.8 million tons had been produced in 2020, including about 1.45 million tons for emissive uses, and that the use was growing at about 10 per cent a year, its overall impact was large. He emphasized that the draft decision was not aimed at uses of those substances as feedstock.

107. Given that dichloromethane was toxic, a number of jurisdictions and companies had already restricted its use, which demonstrated both that alternatives were available and that options for reducing production existed outside the Montreal Protocol. Nevertheless, he felt that the parties to the Protocol should pay attention to the issues and promote activities leading to a reduction in emissions. Accordingly, in the draft decision the Technology and Economic Assessment Panel was requested to include in its 2024 progress report information on existing and projected production, use and emissions of dichloromethane and other very short-lived substances, and alternatives and measures for reducing emissions. Parties were also encouraged to take action to reduce the use and emissions of dichloromethane in applications for which alternatives were available and emissions control measures

were feasible. He added that the draft decision was modelled partly on the approach parties had taken in the past to controlling n-propyl bromide, another short-lived substance.

108. A number of representatives indicated that they would welcome the opportunity to discuss the topic further.

109. Subsequently, several representatives expressed concern at the proposed draft decision. They said that the very-short-lived substances referred to did not have an ozone-depleting potential and therefore did not fall under the mandate of the Montreal Protocol. In addition, they were controlled under other multilateral environmental agreements. Since their emissions derived from their use as feedstock for the production of HFC-23, the implementation of the Kigali Amendment would in any case lead to their reduction.

110. Article 5 parties in particular were facing many challenges in implementing their existing obligations under the Protocol. There was no objection to monitoring emissions of those substances, but the draft decision went beyond simply monitoring; it appeared as though its intention was to introduce new substances to the Protocol. Parties, particularly Article 5 parties, did not have the capacity to undertake any new obligations. If parties wanted to take their own domestic actions to control emissions, no one would stop them.

111. Several other representatives, however, said that there was no intention in the draft decision to introduce new substances to the Protocol. The proposal simply asked the Scientific Assessment Panel and the Technology and Economic Assessment Panel for more information, in response to a concern highlighted in the quadrennial assessment report about a significant source of emissions of substances that were not controlled under the Montreal Protocol but nevertheless did all deplete the ozone layer. Their possible ozone-depleting potentials were listed in an annex to the report of the Scientific Assessment Panel. While dichloromethane was the most significant substance in this category, other substances, such as trifluoroiodomethane, had also been mentioned under other agenda items.

112. One representative recalled that the draft decision was very similar to decisions adopted by the Meeting of the Parties in previous years on n-propyl bromide, another substance that was not controlled by the Montreal Protocol but which nevertheless depleted the ozone layer. One representative pointed out that the elimination of dichloromethane had been identified as the action with the single biggest impact on the recovery of the ozone layer. Article 2 of the Vienna Convention for the Protection of the Ozone Layer, the parent convention of the Montreal Protocol, placed an obligation on parties to address anything that affected the ozone layer. Another representative said that early action would reduce the likelihood of more onerous actions needing to be taken later, and that parties wishing to take domestic action would benefit from the request for information on possible options contained in the draft decision. She stressed the fact that the draft decision placed no additional requirements on any party.

113. The representative of Canada thanked representatives for their comments. He pointed out that it was not the case that very short-lived substances did not possess ozone-depleting potential values; they had not been assigned precise potentials only because of the difficulties in calculating them. As the report of the Scientific Assessment Panel made clear, the elimination of emissions of dichloromethane would have an impact on the recovery of the ozone layer equivalent to about half the impact of eliminating emissions of all the remaining ozone-depleting substances controlled under the Protocol. He questioned how the issue could not be a matter of concern to parties to the Protocol.

114. Noting that he was not aware of dichloromethane being controlled under any other multilateral environmental agreement, he said that it was also not the case that its emissions derived only from its use as feedstock; as the report of the Technology and Economic Assessment Panel made clear, the bulk of its emissions were from emissive uses as solvents. While it was certainly true that those substances were not controlled under the Protocol, it would not be the first time that parties had discussed issues that were not included in the Protocol. For example, at the present meeting parties had spent some time considering the management and environmentally sound disposal of substances at the end of their life, even though this did not derive from any obligation under the Montreal Protocol. Nevertheless, his delegation was happy to discuss it, and he expressed the hope that other parties would be similarly willing to discuss other matters of concern. He emphasized that the draft decision did not contain any proposal to control emissions; it simply requested more information about emissions and possible alternatives.

115. Mr. Newman, on behalf of the Scientific Assessment Panel, confirmed that the scenarios for policymakers contained in the Panel's report had included a scenario in which all emissions of dichloromethane were eliminated immediately. Since the substance had a lifetime of about six months, its atmospheric concentration would fall very quickly. While obviously this was a hypothetical

scenario, it enabled the calculation of the impact, which would be to increase ozone concentrations by about 1 Dobson Unit, equivalent to about 0.3 per cent of the total global amount of ozone.

116. Observing that there was no consensus on the issue, the Co-Chair encouraged parties to consult one another, discuss the issue with the Scientific Assessment Panel and the Technology and Economic Assessment Panel, and consider returning to the issue, either later in the present meeting or at the Thirty-Fifth Meeting of the Parties.

117. Later, the representative of Canada requested informal discussion of the draft decision on the issue set out in a conference room paper prepared by his delegation and suggested that, if such discussion was not possible, his delegation would submit the conference room paper directly to the Thirty-Fifth Meeting of the Parties for further consideration. Another representative welcomed the proposal of further discussion, but did not support discussing the draft decision contained in the conference room paper.

118. Subsequently, the Working Group agreed to establish an informal group on very short-lived substances, co-facilitated by Liana Ghahramanyan (Armenia) and Jana Mašíčková (Czechia).

119. At a later stage in the meeting, the co-facilitator of the informal group reported back on the further discussions that had been held in the informal group. She reported that the group had held a lively discussion on the general issue of very short-lived substances rather than the text of the draft decision. Several questions raised by parties had been addressed by the Scientific Assessment Panel. The group had not, however, had time to deal with all the matters raised.

120. The Working Group agreed to resume discussions on very short-lived substances at, and to forward the proposed draft decision contained in section D of annex I to the present report to, the Thirty-Fifth Meeting of the Parties.

3. Destruction technologies for controlled substances

121. The representative of the European Union introduced a draft decision, set out in a conference room paper, on destruction technologies for controlled substances, explaining that domestic legislation in the European Union was closely tied to destruction technologies approved under the Montreal Protocol, hence the European Union had an interest in keeping the list of technologies approved for destruction as up to date as possible. The draft decision provided for the addition of the cement kilns technology for the destruction of diluted sources of HFCs, as recommended by the Technology and Economic Assessment Panel. It further reflected the Panel's recommendation on consolidating the list of technologies by grouping the portable plasma arc technology under the existing nitrogen plasma arc destruction technology. It also provided for the Panel to report on the matter to the Open-ended Working Group prior to the Thirty-Seventh Meeting of the Parties, or earlier if possible. Thus, parties would be invited to submit to the secretariat any information that might be relevant to destruction technologies so that the Panel could take it into account when assessing the technologies. The delegation of the European Union was interested in speaking with other parties in the margins of the present meeting with a view to making progress on the issue.

122. Many representatives took the floor to welcome the draft decision and indicate their interest in discussing the matter. Although there was general support for the text of the draft decision as presented, some representatives introduced slight notes of caution. One, noting that the rationale for adding cement kiln technology was that it met the destruction and removal efficiency criteria of 99.99 per cent for concentrated streams and therefore should qualify for diluted streams that required a lower 95 per cent efficiency, sought confirmation from the Medical and Chemicals Technical Options Committee that, when assessing the listed destruction technologies as requested in the decision, it would consider whether other technologies could similarly be approved for diluted sources. Another asked for an opportunity to check with the Technology and Economic Assessment Panel to ensure that the matter was not already covered by past decisions directing the Panel to keep technologies under review. That concern was subsequently echoed by another representative.

123. Several representatives took the opportunity to underscore their countries' need for an easily accessible destruction facility, possible in the form of a regional centre, that would handle small quantities to be destroyed and allow for pooled collection.

124. The Working Group agreed to hold informal discussions on the matter in the margins of the present meeting.

125. Subsequently, the Co-Chair reported that there had been some informal discussions in the margins of the meeting, and that a revised draft decision had been made available. The Working Group agreed to forward the draft decision contained in section E of annex I to the present report, and resume discussions on the matter at the Thirty-Fifth Meeting of the Parties.

4. Feedstocks

126. Introducing the sub-item, the representative of Australia noted that the production of ozone-depleting substances for feedstock uses had increased by 75 per cent over the last 10 years, and that a review of the Panel reports and presentations provided to the Open-Ended Working Group had highlighted issues associated with that production. She cited a range of issues of concern that were, or were likely to be, associated with feedstock, including increased concentrations of HFC-23 in the atmosphere, sustained concentrations of carbon tetrachloride in the atmosphere and an increasing global abundances of minor CFC species in the atmosphere. There was also increased use of short-lived substances such as dichloromethane that were not controlled by the Montreal Protocol as feedstocks. In addition, halon 1301 concentrations in the atmosphere were not dropping at the rate expected. While each of those issues individually was of concern, collectively they pointed to a larger systemic issue with feedstocks. The Panel reports cited the rapidly expanding use of ozone-depleting substances and HFCs as feedstocks and their consequent emissions as a key concern, and underscored the importance of gaining a better understanding of and monitoring emissions from production for feedstock uses, by-product emissions, emissions of controlled substances as intermediates and emissions from feedstock use, owing to their contribution to overall global emissions. The use of controlled chemicals as feedstocks had been omitted from calculations of consumption and production on the understanding that emissions from feedstock uses were negligible, but based on the reports that was no longer the case. The parties had last considered the overall issue of feedstocks at the Twenty-Fourth Meeting of the Parties and it was perhaps time to take a fresh look at the issue, informed by science and technical advice. The delegation of Australia was interested in discussing the matter further, with a view to finding a way forward and possible developing a draft decision on the matter.

127. Several representatives, including one speaking on behalf of a group of parties, thanked the representative of Australia for proposing the matter for discussion and indicated their interest in participating in any such discussion. One recalled that there had been valuable reflections on the matter at the workshop held on 2 July, the day before the opening of the current meeting, and advised drawing on those reflections in any discussion.

128. As the issue was related to agenda item 8 (b), on ongoing emissions of carbon tetrachloride, and to agenda item 7 (b), relating to the report by the Technology and Economic Assessment Panel in response to decision XXXIV/5 on chemical pathways and sources of industrial emissions, one representative suggested that it might be worth establishing a group to address the three agenda items together. He also pointed out that it was unclear whether the emissions estimated by the Scientific Assessment Panel were from the use of substances as feedstock or from the production of substances to be used as feedstock and in the production of substances for controlled uses, such as HCFC-22 and HFCs. Adding that it was important to note that, according to the report prepared in response to decision XXXIV/5, the production of substances for both feedstock and controlled uses generated higher emission ranges than the use of feedstock in the various processes, he suggested that it would be helpful to have the Scientific Assessment Panel provide further explanations of their feedstock emissions estimates at some stage.

129. The Open-ended Working Group agreed to hold informal discussions on the matter in the margins of the meeting.

130. Subsequently, the representative of Australia introduced a draft decision on feedstock uses set out in a conference room paper. The draft decision recalled relevant parts of the Protocol and of previous decisions and took note of the information on feedstocks in the 2022 assessment reports of the Technology and Economic Assessment Panel and the Scientific Assessment Panel. It urged relevant parties to take steps to minimize emissions related to feedstocks; encouraged them to replace, where technically feasible, the use of ozone-depleting substances with non-controlled substances; and reminded them, when reporting feedstock production, to include unintentional production of isolated and non-isolated intermediates, where such production was measurable. Relevant parties were invited to provide the Ozone Secretariat with information on their domestic policies, practices and regulations relating to feedstock production and use, and the Ozone Secretariat was requested to collate and summarize that information for consideration by the Working Group at its forty-sixth meeting. The Technology and Economic Assessment Panel was requested to prepare, for consideration by the Working Group at the same meeting, a report that included information on alternative chemicals and processes and estimates of annual global emissions of ozone-depleting substances, by species, from feedstock production and by-product emissions.

131. The representative of Australia pointed out that time constraints had prevented her delegation from consulting all interested parties prior to the presentation of the proposal.

132. In the ensuing discussion, some representatives recalled decision IV/12, on clarification of the definition of controlled substances, to support their affirmation that feedstock was not controlled under the Montreal Protocol. One of them also referred to the definitions in paragraphs 4 and 5 of Article 1 of the Protocol. The other was of the view, however, that it was necessary to avoid extensive references to the Protocol or to previous decisions in any new decision taken. One of the representatives also said that fugitive leaks or losses were almost negligible, as appropriate national frameworks and processes existed. Furthermore, on the basis of the information summarized by the Medical and Chemicals Technical Options Committees in the 2023 progress report, it appeared that most parties had effective processes in place for the management of carbon tetrachloride production for use as a feedstock. Accordingly, she felt that that the Committee should propose ways of building parties' capacity in that respect, with a view to strengthening such processes overall, instead of placing an additional burden on the parties.

133. In response, the representative of Australia accepted that emissions from feedstock uses should be negligible, but said the Technology and Economic Assessment Panel had indicated that they were increasing significantly each year. Thus, it appeared that emissions from feedstock production and/or use were no longer negligible and that the parties should be looking to address the problem.

134. Some representatives said that, owing to the late posting of the proposal, insufficient time remained for them to consider it properly at the present meeting. Furthermore, as industry was intimately implicated, it was necessary to consult thoroughly with all relevant stakeholders.

135. Another representative, supported by a representative speaking on behalf of a group of countries, expressed general support for the proposal, which was highly relevant to the Montreal Protocol at the present time. They both underscored the link with the draft decision proposed by Switzerland on abating emissions of carbon tetrachloride, presented under sub-item 8 (b), on ongoing emissions of carbon tetrachloride (decision XXXIV/6). It would be important for the two proposals to be considered together by the Thirty-Fifth Meeting of the Parties.

136. The Working Group agreed to forward the draft decision proposed by Australia, as set out in section F of annex I to the present report, to the Thirty-Fifth Meeting of the Parties for further consideration and to encourage further consultations thereon in the margins of the present meeting and during the intersessional period.

5. Life cycle refrigerant management

137. Introducing the sub-item, the representative of the Federated States of Micronesia explained that her delegation had elected to spotlight the topic of life cycle refrigerant management at the present meeting because of the opportunity that a systemic approach to managing refrigerants offered to support compliance with the Kigali Amendment and secure additional climate and economic benefits. Many elements of life cycle refrigerant management, including servicing measures to address leakage; technologies for reclaiming, recycling and reusing refrigerants; and technologies for destruction, were not being employed, despite the many benefits they offered for the atmosphere and local economies. Her delegation was of the view that without explicit, concerted action within the Protocol, many of those benefits would be lost or become inaccessible, and therefore wished to encourage a deeper conversation about what could be done to enable parties to do more. As parties were aware, leakage and venting of controlled substances contributed to climate change. In addition, destruction was not a compliance obligation, yet the assessment panel reports made it clear that quantities available for recovery would increase and that timely efforts to establish and finance end-of-life management capacity to prevent HFC emissions could have a significant impact. Her delegation was therefore interested in hearing the views of other parties on what could feasibly be done under the Montreal Protocol to enhance and improve the sustainable management of controlled refrigerants.

138. Several representatives welcomed the opportunity to discuss the matter, with some underscoring the challenges their countries faced, in refrigerant recovery for some, and in destruction for others.

139. One representative, while thanking the representative of the Federated States of Micronesia for raising the issue and indicating his willingness to participate in a discussion, said that his goal in doing so would be more to gain a better understanding of the issues and challenges that countries were facing. He recalled that the Multilateral Fund, through the HCFC phase-out management plans, had been providing assistance for a large part of the cycle of refrigerant management for the past 30 years, including for servicing and for recovery, recycling and in some cases reclamation of refrigerants, and that assistance would continue under the Kigali implementation plans. He conceded that less attention had been paid to the end of the cycle and the disposal of substances that could not be reclaimed or reused; however, between 2010 and 2015, under the Multilateral Fund, around 15 pilot projects had

been implemented in countries to collect and destroy unwanted controlled substances, through a funding window that was open to all countries. Some of the projects had yielded interesting results while others had experienced challenges, in part owing to the collection of the substances that required end-of-life management, but also simply in terms of identifying quantities of waste that would provide the economies of scales that justified investment in destruction. As a result, the Executive Committee had recently discussed the need to first develop inventories, and, at its ninety-first meeting, had established a funding window for the preparation of national inventories of banks of used or unwanted controlled substances and the development of a plan for the collection, transportation and disposal of such substances, including consideration of recycling, reclamation and cost-effective destruction. That funding window was open to all countries and, in his view, represented a good first step in addressing life cycle management of refrigerants. Given that new funding window, together with the assistance being provided through the HCFC phase-out management plans and the Kigali implementation plans, it could be argued that the full life cycle of refrigerants was already being considered by the Multilateral Fund in its work.

140. The Open-ended Working Group agreed to hold informal discussions on the matter in the margins of the meeting.

141. Subsequently, the Co-Chair reported that some informal discussions had been held in the margins of the meeting. The Working Group agreed to resume discussions on life cycle refrigerant management at the Thirty-Fifth Meeting of the Parties.

IV. Report of the Technology and Economic Assessment Panel on the replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the period 2024–2026 (decision XXXIV/2)

142. Introducing the item, the Co-Chair said that, in preparation for a decision by the parties on the replenishment of the Multilateral Fund for the triennium 2024–2026, the replenishment task force of the Technology and Economic Assessment Panel had carried out a study in accordance with the terms of reference set out in decision XXXIV/2. The Panel had issued a report on the study as volume 3 of its 2023 report, entitled “Assessment of the funding requirement for the replenishment of the Multilateral Fund for the period 2024–2026”, which had been available on the meeting portal since 21 May 2023. A summary of the task force report was set out in the addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.2) and the executive summary was set out in the annex thereto.

143. The main findings of the report were presented by Shiqiu Zhang and Bella Maranion, co-chairs of the replenishment task force of the Technology and Economic Assessment Panel. A summary of the presentation, prepared by the presenters, is set out in section C of annex II to the present report.

144. In the ensuing discussion, many representatives, including one speaking on behalf of a group of parties, thanked the task force for its work and said that the report was a good basis for future discussions on the replenishment of the Multilateral Fund.

145. Several representatives, including one speaking on behalf of a group of parties, however, raised issues regarding the methodology and assumptions in the report. One of them expressed a preference for estimations based on assumptions that varied, such as different cost effectiveness values of interventions, as opposed to the number of countries that had ratified the Kigali Amendment. Another representative also queried the small range between the high and low estimates for the replenishment provided by the task force, especially given that it had been working with highly uncertain values. In that regard, one representative pointed out that the consolidated business plan of the Multilateral Fund, on which the task force had drawn, covered only the period 2023–2025, not the entire replenishment period. Another representative expressed concern regarding the approach used to calculate funding to reduce HFCs, which was based on total quantities in carbon dioxide equivalent for both the HCFC and HFC components of the baselines, instead of actual consumption of HFCs. That approach should be reviewed as it implied that the consumption funded for phase-out in each country was equal to the maximum allowed according to the baseline. Similarly, the task force had used cost effectiveness thresholds that had been agreed or were being considered by the Executive Committee, which were not the average values used to fund projects, but the maximum values that countries could receive for the different sectors. Most projects, apart from those in the servicing sector, were approved at cost-effectiveness values below the threshold levels. He proposed using an approach similar to that used in the previous replenishment reports. Ms. Maranion offered to answer specific questions on the methodology in any potential contact group.

146. Several representatives, including one speaking on behalf of a group of parties pointed out that HCFC phase-out and HFC phasedown would be taking place simultaneously and that the workload for Article 5 parties would be considerable. It was thus necessary to discuss and to understand better their future needs in terms of support from the Multilateral Fund. Some representatives, including one speaking on behalf of a group of parties stressed the importance of synergies between the two activities, particularly in the consumption and servicing sectors, and welcomed consideration of possible incentives for early action on limiting further growth of HFC. In response, Ms. Maranion said that the task force sought guidance from parties how to include the issue of greater synergy in the supplementary report for the Meeting of the Parties.

147. Several representatives, including one speaking on behalf of a group of parties, pointed out that additional decisions had been taken by the Executive Committee of the Multilateral Fund at its ninety-second meeting, which had been held since the issuance of the report. The calculations and estimations in the report by the task force would therefore need to be updated on the basis of those decisions, namely in relation to eligible incremental costs in the refrigeration servicing sector for stage I of the Kigali HFC implementation plans; the funding window established for pilot projects to maintain and/or enhance energy efficiency in the context of HFC phasedown; and the funding agreed for the preparation of the national inventories of banks of used or unwanted controlled substances and a plan for the collection, transport and disposal of such substances.

148. Specifically on the subject of HCFCs, some representatives said that funding for new HCFC phase-out management plans needed to be based on the requests for funding tranches as they were actually submitted rather than on estimates made according to a tranche distribution by percentage. Furthermore, any HCFC phase-out management plan still to be submitted by any country during the triennium was likely to be for a total phase-out, and the use of HCFCs beyond 2026 could be very limited. That likelihood needed to be reflected in the analysis by the task force. Ms. Maranion said that the calculations related to HCFC phase-out management plans had been based purely on compliance obligations, namely the percentage reduction targets, and had not taken into account the fact that newly submitted HCFC phase-out management plans might be implemented more quickly.

149. In relation to HFCs, one representative said that it would be useful for the task force to consider the likely number of industries that would be submitting projects related to energy efficiency under stage I of the Kigali HFC implementation plans. Funding needs for installation and assembly in different applications, particularly for small and medium-sized enterprises, also needed to be addressed. Some representatives were of the view that there should be a realistic assessment of the level of HFC servicing needed, especially for non-low-volume-consuming countries. Most such countries had both manufacturing and servicing sectors, and HFC consumption was likely to be lower in the servicing sector and higher in manufacturing sector.

150. One representative, supported by another, pointed out that the funding for HFC phase-down in the estimates seemed only to include what was needed for Kigali HFC implementation plans and stressed that individual HFC projects could be funded separately and thus needed to be included.

151. In response to a question by one representative about the impact of the lack of a decision by the Executive Committee on cost guidelines for the phase-down of HFCs in Article 5 parties, Ms. Maranion said that it had been challenging for the task force, which had attempted to fill gaps in data and to refer to historical approaches and previous experience under HCFC phase-out management plans.

152. Another representative expressed the view that all measures that related to conditions imposed on the approval of projects within the scope of the Multilateral Fund should be financed with money from the Fund itself. In that regard, some representatives said that activities related to gender mainstreaming should be fully integrated into the resources to be provided by the Multilateral Fund in the following replenishment period.

153. Several representatives said that the implementation of the Kigali Amendment provided an opportunity to achieve a double impact for the benefit of the climate. The financing available therefore needed to be commensurate with the efforts to be made by parties. One representative said that, at its ninety-second meeting, the Executive Committee had held discussions on the provision of support to parties that wished to accelerate their HFC phase-down, doing so earlier than the schedule set out in the Kigali Amendment. He advocated frontloading the funding available to help countries be more ambitious and said that the replenishment should enable that to happen. Another representative said that accelerated HFC phase down beyond the first 10 per cent target should be considered only when the HCFC component of the baseline was more than 10 per cent. Yet another representative said that financing was key for countries in transitioning to technologies that used climate friendly refrigerants, adding that importing and low-volume-consuming countries required such resources the most.

154. One representative highlighted the issue of the HFC baselines being based on years in which consumption was low owing to the COVID-19 pandemic. The freeze of imports for 2024 at the baseline level would be very challenging. Another representative noted that some data needed to calculate the HFC baselines were due only in September 2023 and she said that she looked forward to the relevant updates being made in the supplementary report.

155. In response to a request by one representative that the task force share the details of its calculations in the report with the parties, either in the form of annexes to the report or an Excel sheet, Ms. Maranion said that the task force had tried to include as much information as possible in the report, but some of the data were not aggregated and some were confidential.

156. One representative highlighted the discrepancy between the executive summary and the introduction to the report, which both stated that only the HCFC target in 2025 and the HFC target for Group 1 countries in 2029 were considered in the funding estimates for those substances in the replenishment for the period 2024–2026, and the body of the report and the presentations made by the task force, which made it clear that the task force had included funding to allow countries to make progress towards achieving the respective 2030 and 2032 targets.

157. One representative called on the parties to analyse the financing guidelines for countries in which imports had increased, leading to a change in their classification, as that significantly affected the financing for which they were eligible.

158. In response to a question by one representative about the rationale for turning to an expert who was not a member of the Technology and Economic Assessment Panel and currently working with an implementing agency, Ms. Maranion said that the individuals on the task force were chosen for their expertise so that the task force could respond as effectively as possible to requests from the parties.

159. In response to a suggestion by some representatives that funding to address the issue of the safety of flammable refrigerants should be included in the replenishment, Ms. Maranion said that the cost of project preparation had been included, not the specific elements that might be included in the projects.

160. Several representatives proposed further discussion in a contact group.

161. The Working Group agreed to establish a contact group, to be co-chaired by Alain Wilmart (Belgium) and Sergio Merino (Mexico), to consider further the report of the Technology and Economic Assessment Panel on the replenishment of the Multilateral Fund for the period 2024–2026 (decision XXXIV/2).

162. Subsequently, the co-chair of the contact group reported back on the discussions held in the contact group. He explained that the group had been able to agree on a list of issues for the replenishment task force to consider in a supplementary report and complete for consideration by the Thirty-Fifth Meeting of the Parties with a view to taking a decision on the matter. The tasks were grouped into sections covering: overall approach and methodology; the specific costs decided by the Executive Committee at its ninety-second meeting; HCFCs; HFCs; energy efficiency; and end of life. He thanked everyone involved in the discussions for their positive approach.

163. The Working Group agreed that the list drawn up by the contact group would be included in an annex to the present report, and would be used by the replenishment task force to produce a supplementary report for consideration by the Thirty-Fifth Meeting of the Parties.

164. The list of tasks for the replenishment task force to complete is set out in section G of annex I to the present report.

V. Strengthening Montreal Protocol institutions, including for combating illegal trade (decision XXXIV/8)

A. Outcomes of the workshop on strengthening the effective implementation and enforcement of the Montreal Protocol (UNEP/OzL.Pro.WG.1/45/6)

B. Background documents prepared by the Secretariat in accordance with decision XXXIV/8 (UNEP/OzL.Pro.WG.1/45/5, UNEP/OzL.Pro.WG.1/45/5/Add.1 and UNEP/OzL.Pro.WG.1/45/5/Add.2)

165. At the suggestion of the Co-Chair, the Working Group considered sub-items 5 (a) and (b) at the same time. On behalf of the parties, the Co-Chair thanked the facilitators, rapporteurs and

presenters for their excellent contributions to the workshop on strengthening the effective implementation and enforcement of the Montreal Protocol that had been held on Sunday, 2 July 2023 in response to decision XXXIV/8, and the Secretariat for having organized it. He drew attention to the summary of the workshop outcomes (UNEP/OzL.Pro/Workshop.11/3–UNEP/OzL.Pro.WG.1/45/6).

166. He also drew attention to a background information paper on issues to be discussed at the workshop on strengthening the effective implementation and enforcement of the Montreal Protocol (UNEP/OzL.Pro/Workshop.11/2–UNEP/OzL.Pro.WG.1/45/5); a note by the Secretariat on a summary of illegal trade practices and approaches taken by national authorities to identify and address such cases (UNEP/OzL.Pro/Workshop.11/2/Add.1–UNEP/OzL.Pro.WG.1/45/5/Add.1); and a note by the Secretariat on a summary of common features of licensing systems (UNEP/OzL.Pro/Workshop.11/2/Add.2–UNEP/OzL.Pro.WG.1/45/5/Add.2). He invited parties to suggest ways to take forward the outcomes of the workshop as well as other issues included in the background documents.

167. All the representatives who spoke congratulated the Secretariat and the rapporteurs and panellists for the excellent organization of a highly interesting and useful event and expressed their thanks for the meeting documents provided by the Secretariat. One representative highlighted the importance of interpretation of the workshop in the six official languages of the United Nations to ensure full participation.

168. One representative drew attention to the importance of the informal prior informed consent (iPIC) process to combating illegal trade, explaining that in his country in 2020 the process had contributed to the successful prevention of the illegal import of HCFC-123. Another representative observed that the intermediary agents who organized international trade were important stakeholders to involve in those kinds of discussions. Both suggested that future similar workshops would benefit from the participation of customs officers, port authorities, environment agencies and other enforcement agencies.

169. A number of representatives suggested that capacity-building for national frameworks for data collection and reporting, particularly for customs officers, would be helpful, together with recommendations for specific actions to strengthen monitoring and verification of imports and exports, and collaboration with the international community. One representative highlighted the problems caused by illegal traders, who targeted countries with weak enforcement capacities and created fraudulent import documentation designed to look legitimate. Customs officers lacked the equipment and expertise to be able to interrupt such illegal trade.

170. One representative called for strengthening mechanisms for scrutiny of feedstock uses of controlled substances. Another representative highlighted the problem of the disposal of substances seized when illegal trade was interrupted; this was not always managed and monitored carefully enough.

171. One representative suggested that further discussion on how to promote the sharing of information on illegal trade, not just when cases were fully proven but when they were suspected in advance, as called for in decision XXXIV/8; that approach could help other parties to better prevent illegal trade in the first place. She also suggested further discussion on the common features of successful licensing and quota systems.

172. Several representatives agreed to the suggestion of further discussions, particularly on illegal trade and on licensing and quota systems; it was important to retain the record of the Montreal Protocol as the most successful multilateral environmental agreement. Some of the other topics that had been discussed at the workshop were already scheduled for discussion under other items on the agenda of the Open-Ended Working Group at the present meeting. One representative called for the scope of further discussions to be limited to strengthening the institutional process through administrative or institutional actions that were pragmatic, achievable in the near term and did not aim at changing the Montreal Protocol.

173. Another representative suggested that the discussion should also include breaches of domestic regulations aimed at implementing the Montreal Protocol; national systems for monitoring imports and exports and the importance of cooperation between different agencies within countries; the need for on-the-ground as well as atmospheric measurements of emissions; information on transboundary trade; and appropriate sanctions in cases of illegal trade. He expressed the view that it would be useful to identify the essential elements of licensing and quota and reporting systems, in order to assist parties in the process of developing those measures for HFCs. He also queried whether it would be possible to give the Implementation Committee under the Non-Compliance Procedure of the Montreal Protocol a new role in providing advice and guidance to parties. Finally, he expressed an interest in exploring

possibilities for mechanisms to allow new substances to be included in the Protocol without needing an amendment process, as had been discussed in the early 2000s, and raised the possibility of developing a conference room paper for consideration at the present meeting of the Open-ended Working Group or at the Thirty-Fifth Meeting of the Parties.

174. The Working Group agreed to establish an informal group, to be co-facilitated by Martin Bjørnholst (Denmark) and Miruza Mohamed (Maldives), to facilitate further discussion of the matter.

175. Subsequently, the Working Group agreed that informal discussions on the matter would continue during the intersessional period with a view to one or several draft decisions being submitted to the Thirty-Fifth Meeting of the Parties for its consideration. The list of suggested elements for inclusion in draft decisions can be found in the meeting portal of the present meeting.¹

VI. Energy-efficient and low- or zero-global-warming-potential technologies:

A. Report by the Technology and Economic Assessment Panel (decision XXXIV/3)

176. Introducing the sub-item, the Co-Chair recalled that, at the Thirty-Fourth Meeting of the Parties, in decision XXXIV/3 on enabling enhanced access and facilitating the transition to energy efficient and low or zero global-warming-potential (GWP) technologies, the parties had requested the Technology and Economic Assessment Panel to prepare a report on the matter, and to integrate updates on energy efficiency while phasing down HFCs to enhance and maintain energy in the refrigeration, air-conditioning and heat pump sectors in its progress and quadrennial assessment reports from 2023 onward. Accordingly, the Panel had established a working group to prepare the requested report. The report was set out in a supplement to the Panel's 2023 progress report, which was available on the portal of the present meeting, and a summary of the report was set out in annex II to the addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.2).

177. The report was presented by the co-chairs of the energy efficiency working group, Omar Abdelaziz (Egypt) and Ashley Woodcock (United Kingdom). A summary of the presentation is set out in section D of annex II to the present report, without formal editing.

178. In the ensuing discussion, all the representatives who spoke thanked the Technology and Economic Assessment Panel for the comprehensive report and presentation, noting that they provided invaluable technical and scientific information that would help the parties, and in particular those with limited technical and scientific capacities, to make more informed decisions at the national level.

179. Several representatives, including one speaking on behalf of a group of parties, noted that the adoption of a systems approach was vital for implementing energy-efficiency-related policies. One representative noted, however, the significant challenge faced by Article 5 parties in particular in coordinating work on energy-efficient and low-GWP technologies at the national level between ministries, climate stakeholders and the national ozone unit, and, noting the potential for high levels of profit from such technologies, requested further guidance on how governments could strengthen their involvement in the production of such technologies. One representative, speaking on behalf of a group of parties, said that in his region there was a wide range of policies that interacted on energy efficiency, refrigerants, equipment maintenance and operation and the decarbonization of the electricity system, including legislation covering energy efficiency in buildings at a systems level, covering eco-design legislation and covering fluorinated gases, and that those, in addition to an emissions trading system, allowed the region to tackle energy efficiency holistically.

180. Several representatives drew attention to the enormous potential for climate-related and economic benefits presented by enhancing energy efficiency in the HFC phase-down, recalling that 75 per cent of emissions related to cooling were the indirect emissions from the electricity needed for cooling equipment, meaning that, by 2050, the difference in electricity use between the high efficiency gain and no efficiency gain scenarios could result in savings of between \$2 trillion and \$3 trillion. The Montreal Protocol and its Kigali Agreement could therefore play a significant role in ensuring that countries could reap the significant benefits in that regard, and increased coordination between energy and ozone officials at the national level and among governments at the international level should be encouraged. Many representatives said that the time had come to act on the issue. One representative

¹ <https://ozone.unep.org/meetings/45th-meeting-open-ended-working-group-parties/contact-groups/informal-group-strengthening-montreal-protocol>.

drew attention to the discussions of the Executive Committee regarding how best to support Article 5 parties to be able to exploit relevant opportunities through the replenishment of the Multilateral Fund and encouraged further consideration of the issue by the Working Group. Some representatives underlined the need to investigate other, novel, approaches, such as the improvement-linked incentive index proposed in the report of the Panel. A number of representatives of Article 5 parties underlined the urgent need for sufficient funding, with several representatives noting that the solutions identified by the Panel in the report were indeed extremely useful but that the funding opportunities as identified in the same report were woefully inadequate. Another representative noted that his country, in common with many other Article 5 parties, was primarily a consumer rather than a producer and that fact should be borne in mind when considering assistance needs, such as supporting the safe use of HFOs and low-GWP alternatives, including propane. One representative drew attention to the fact that the possibility of preventing an additional 0.5°C of global warming could prove vital for the very survival of a small island State such as hers and requested that a contact group be established to exchange views and discuss opportunities to enable the move from knowledge to action.

181. One representative stressed the need to ensure improved accessibility to more energy efficient equipment at the global level and noted that the application of standards and labelling programmes, as well as rigorous testing to support such programmes, would help ensure that the most efficient technologies would be used. Another representative noted that Article 5 parties still faced significant challenges with regard to the minimum energy performance standard certification process, as many importers expressed frustration with the procedures required and attempted to import products without certification or with false certification.

182. Regarding information to be included in future reports of the Panel, one representative requested detailed information on the benefits of combining energy efficiency and HFC phase-down and on ways that industry could ensure a sustainable energy efficiency trajectory, and another representative requested coefficients of performance and other related information on the advantages and disadvantages of various oils, while a third asked for additional information on the incentive index approach to assessing the cost of enhancing energy efficiency in the refrigeration, air-conditioning and heat pump sectors.

183. On questions regarding minimum energy performance standards, Nihar Shah, on behalf of the Refrigeration Technical Options Committee, said that there was indeed a need for significant financial support and capacity-building to provide adequate testing infrastructure and regulation at the national level for all appliances. The United for Efficiency initiative, under the leadership of UNEP, had been working with the regional agency in Southern Africa, for example, towards the adoption of harmonized minimum energy performance standards for domestic refrigerators and air conditioners, and he encouraged the relevant parties to work with that initiative towards a similar adoption for commercial refrigerators and air conditioners. He urged the parties to continue discussions regarding funding.

184. On whether increased levels of wealth or of global warming were the main factor for the increased demand for cooling technology, Mr. Abdelaziz said that research in countries such as China, India and Malaysia had shown that once the income level of individuals exceeded \$10,000 annually, they were significantly more likely to purchase cooling technology, and therefore wealth was indeed the main factor.

185. In response to a question regarding the scope of the national ozone units, Mr. Abdelaziz said that the Panel was indeed suggesting that the scope could be extended and that cooperation between the units and national energy authorities could be strengthened, to allow for the units and therefore governments to benefit from additional business opportunities.

186. With regard to a question on energy efficiency ratios, Mr. Abdelaziz said that the Panel continued to advise that the application of a seasonal energy efficiency ratio was preferable, even in countries with high-ambient-temperature environments.

187. Responding to questions on insulation and the cost-effectiveness of low-GWP alternatives to foams containing HFCs, Mr. Altoé said that, depending on the amount of blowing agent used, HFOs could in fact outperform HCFCs and HFCs in foam, and, although the cost of HFOs was higher, there was an associated 80 per cent improvement in insulation performance compared with that of HCFCs or HFCs. He recalled that higher levels of insulation in buildings led to considerable improvements in energy efficiency and any initial outlay could therefore be recovered within three or four years.

188. In response to a question on the methodologies for assessing energy efficiency gains from the implementation of projects under the Multilateral Fund and on managing energy efficiency funding modalities in the context of returns to consumers and at the national level, Gabrielle Dreyfus, on

behalf of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, noted that a set of options for developing energy efficiency funding modalities had been presented by the Panel in its report, with one option focusing on maximizing energy efficiency benefits by targeting technologies with the lowest efficiency. She also drew attention to the chapters in the current report, and information in past reports of the task force on energy efficiency, regarding overcoming barriers to efficiency, including market-based, regulatory and enabling interventions.

189. In response to a question on the systems-based approach, Leyla Sayin, on behalf of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, said that, in developing countries in particular, multiple barriers to such an approach persisted and so it was vital to develop in-country skills and manufacturing and supply chain capacity, including demonstration and testing centres, as well as developing finance and business models to enable equitable uptake. Significant collaboration between high-income and low- and middle-income countries, and among governments, development agencies, academia and finance providers, was therefore required.

190. Regarding a question on approaches to minimum energy performance standards, Mr. Abdelaziz recalled that the issue was addressed in chapter 5 of the report but that the Panel could also develop the approach further by identifying the various tools available for developing countries in particular, such as the United for Efficiency initiative, and by extending the examples presented for factories and enterprises to other applications and specifically to factories working with energy efficiency and lower-GWP substances. Approaches for energy efficiency for equipment and foams could also be provided.

191. In response to questions and concerns regarding the availability of funding related to energy efficiency implementation, he noted that the issue was within the scope of the replenishment task force.

192. On concerns raised relating to safety issues, he noted that although such concerns had not been part of the scope of the current report, discussions were continuing on the matter and he recognized that the concerns needed to be addressed.

193. Responding to a question regarding coefficients of performance for various refrigerants, he drew attention to figures 9.1 and 9.2 in the 2022 report of the task force on energy efficiency, which showed the variations of the theoretical cycle and heating coefficients of performance of refrigerants. The same report had also covered refrigerant oil compatibility but he noted that oils could not be discussed in isolation but needed to be considered together with seals and other system components.

194. Regarding further development of the modelling for estimating the global benefits associated with reducing direct and indirect emissions from cooling, he recalled that there would be additional information provided at the workshop on energy efficiency due to be held in Nairobi in October 2023.

195. In response to a request for additional examples of how the incentive index approach could be applied to determine funding for specific interventions to enhance energy efficiency up to a certain standard in key applications, he said that an additional conference room paper was not required but that information would continue to be provided by the energy efficiency working group in its reports.

196. The Working Group concluded its consideration of the agenda item.

B. Illegal import of certain refrigeration, air-conditioning and heat pump products and equipment (decision XXXIV/4)

197. Introducing the sub-item, the Co-Chair recalled that, in decision XXXIV/4, the parties that had restricted the manufacture and/or import of certain refrigeration, air-conditioning and heat pump products and equipment containing or relying on controlled substances, including with respect to energy efficiency, and that did not want to receive such products and equipment from other parties had been invited to submit to the Secretariat, by 1 May 2023, a range of information specified in the decision. To date, five parties, namely the European Union, Ghana, Nigeria, the United States and Zimbabwe, had responded to that invitation. Their submissions were available on the Secretariat's website.

198. One representative objected to the use of the term "illegal imports" in the title of decision XXXIV/4, as the focus of the draft decision on the matter presented by the African States parties to the Montreal Protocol at a previous meeting had been on the dumping of non-waste, used and new equipment that did not meet the standards of the exporting countries. The issue of dumping had been broached as far back the eleventh meeting of the Open-ended Working Group, held in 1995, when, as indicated in the report of that meeting, a representative who had submitted a written proposal on the topic in conjunction with another representative had said that the practice of dumping obsolete

products and technologies that used ozone-depleting substances in Article 5 parties was on the increase, and if the situation were not addressed it could well affect the implementation of the Protocol. The same representative had added that dumping could significantly increase consumption of ozone-depleting substances in the countries in question, and that Article 5 parties were institutionally incapable of monitoring dumping effectively and therefore needed the support of their Article 2 partners.

199. In the light of the above, he requested that a contact group be established for the purpose of finding solutions to the long-standing issue of dumping of non-waste refrigeration, air-conditioning and heat pump products and equipment, containing or relying on controlled substances, including with respect to energy efficiency.

200. Many other representatives took the floor to echo the comments made and condemn the dumping of inefficient new and used high-GWP refrigeration and air-conditioning equipment in Article 5 parties. Several objected to the term “illegal imports”, with one saying that even if mostly legal, the imports were unwanted and unsustainable. Some representatives raised the concern that the differential HFC phase-down schedules would lead to an increase in unwanted imports. Several representatives noted that recipient countries had weak policy, legal and regulatory frameworks and enforcement mechanisms, and several said that the onus of addressing the problem of dumping should not be placed solely on the importer and that the responsibility for finding a solution should be shared, with the exporter being held accountable. A number of those who spoke pointed out that dumping could threaten Article 5 parties’ compliance with their obligations under the Montreal Protocol and the Kigali Amendment. Several also raised concerns regarding the high energy demand and additional servicing requirements associated with inefficient equipment, as well as its impact on climate change. All of those who spoke were in favour of discussing the matter at the present meeting, with many explicitly supporting the proposal to hold the discussion in a contact group.

201. Some other representatives, one of whom spoke on behalf of a group of countries, indicated that they were willing to discuss the matter in the margins of the meeting but reluctant to establish a contact group given the limited time remaining to finish the already heavy workload ahead. They also raised several issues and noted a number of possible misunderstandings in the views expressed thus far.

202. The representative speaking on behalf of a group of countries pointed out that the countries of his constituency had not used controlled substances as refrigerant in refrigerators since the 1990s and were therefore unlikely to be sources of unwanted exports, as claimed in one of the submissions that had been made pursuant to decision XXXIV/4. Furthermore, the early phase-out of CFCs reduced the likelihood of finding controlled refrigerants in such exports. As for energy efficiency, it was a concern for the parties to the Montreal Protocol but not the basis for binding decisions under the Protocol, which dealt with substances contained in the refrigerant circuits or in foams. Finally, it was unclear how the import of unwanted products could be prevented without putting in place a legally applicable ban and, similarly, how exporting countries could prohibit the export of such equipment if they could be legally imported, even if unwanted; a legal rule banning the imports was necessary to enable action to be taken on either side. That said, an ongoing revision of the rules on fluorinated greenhouse gases in his constituency would soon introduce an effective export ban that would apply regardless of the legal situation in the country of destination. As the revised rules would set GWP limits in such a way that only new and up-to-date equipment could be exported, energy efficiency concerns would also be indirectly addressed.

203. The other representative asked whether a draft decision on the matter was being prepared to serve as a basis for discussion. Recalling that, in decision XXXIV/4, the parties had requested, among other things, information on Harmonized Commodity Description and Coding System codes, attempted illegal imports of restricted products and equipment to their countries and minimum energy efficiency performance standards, and noting that five parties, including one representing a group of parties, had submitted information pursuant to that request, she said that her delegation would welcome further discussion based on those elements of the decision, as well as on a potential draft decision if one was being developed. She sympathized with concerns regarding products that were not allowed in countries’ domestic markets being exported to other markets, stressing that her delegation felt strongly that parties banning the sale or use of something domestically should consider restricting its export as well as its import; that stance was reflected in her country’s domestic regulations for ozone-depleting substances and would be reflected in its HFC regulations. With respect to the onus for addressing the problem being on the importing country, it had been noted at the forty-fourth meeting of the Open-ended Working Group that it would be important for importing countries to have enforceable regulations to prevent products from entering their markets and for the Secretariat to share such information, which was another potential area for discussion.

204. The Working Group agreed to establish an informal group, to be co-facilitated by Tumau Neru (Samoa) and Andrew Clark (United States), with a view to preparing a conference room paper for consideration by the Thirty-Fifth Meeting of the Parties.

205. Subsequently, the representative of Ghana, speaking on behalf of the group of African States, presented a conference room paper setting out a proposed draft decision on shared responsibility to stop the dumping of inefficient cooling equipment containing obsolete refrigerants.

206. The Working Group agreed to forward the draft decision proposed by Ghana on behalf of the African States, as set out in section H of annex I to the present report, to the Thirty-Fifth Meeting of the Parties for further consideration and to encourage further consultations thereon to take place in the margins of the present meeting and during the intersessional period.

VII. Identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring

A. Report by the Secretariat (decision XXXIII/4)

207. Introducing the sub-item, the Co-Chair recalled that the Thirty-Third Meeting of the Parties, in 2021, had adopted decision XXXIII/4 on enhancing the global and regional atmospheric monitoring of substances controlled by the Montreal Protocol. In that decision, the Secretariat had been requested to provide information on atmospheric monitoring to the parties at the forty-fourth meeting of the Open-ended Working Group, in consultation with relevant experts from the Scientific Assessment Panel, the Technology and Economic Assessment Panel and the Ozone Research Managers. The report by the Secretariat was set out in document UNEP/OzL.Pro.WG.1/45/2/Add.2.

208. Sophia Mylona introduced the presentation on behalf of the Secretariat. She recalled that in decision XXXIII/4 the parties had requested a report on options for the regional monitoring of atmospheric concentrations of controlled substances and challenges in the operationalization of relevant recommendations; the identification of suitable locations for possible high-frequency measurements and flask sampling for regions not, or not sufficiently, covered by existing atmospheric monitoring; and options for means of establishing new monitoring capacity and related costs, taking into account existing monitoring infrastructure. An update had been provided to the Open-ended Working Group at its forty-fourth meeting, and further progress had since been made.

209. She also noted that the report by the Secretariat would include updated information on the implementation of a European Union-funded pilot project, developed on the basis of a white paper by experts in atmospheric monitoring of controlled substances that had been presented at the two sessions of the eleventh meeting of the Ozone Research Managers that had taken place in 2020 and 2021. On behalf of the Secretariat, Ms. Mylona expressed sincere appreciation to all the experts who had contributed to that work, the steering committee overseeing the implementation of the pilot project, and the European Union for funding the pilot project which had been instrumental in assessing the feasibility of the concept that had been suggested in the experts' white paper.

210. The remainder of the presentation was delivered by Mr. Newman, Co-Chair of the Scientific Assessment Panel. He explained that two different approaches were used for estimating total emissions from measurements. The "global approach" used averages of measurements from monitoring stations in the networks coordinated by the National Oceanic and Atmospheric Administration (NOAA) and the Advanced Global Atmospheric Gases Experiment (AGAGE). The global average of atmospheric levels was determined by emissions of the substance in question minus losses in the atmosphere, which could be calculated by atmospheric models and laboratory measurements; for example, since the lifetime of CFC-12 was 102 years, if there were no emissions, atmospheric levels of CFC-12 would fall by about 1 per cent per year. The estimates derived from this global approach were highly dependent on the accuracy and precision of the observations, the lifetime of the substances, and the ability to measure globally average values.

211. The "regional approach" used wind trajectories and observations at various stations to monitor emissions from particular regions. The sum of the regional emissions measured did not equal the global estimate, however, because the world was not sufficiently well sampled; several regions had very little or no coverage. While the global approach enabled global estimates of emissions to be calculated, regional data was necessary for good decision-making.

212. Mr. Newman summarized the requirements for an effective regional monitoring station, which included a suitable location (ideally less than 2,000 kilometres from the emission sources), very

sophisticated analytical instruments (capable of detecting concentrations of substances of less than one part per trillion) and personnel with the expertise to operate them and, ideally, the ability to sample at high frequency. He also provided some illustrative costs.

213. He summarized the three phases of the European Union-funded pilot project currently under way: first, the identification of suitable locations and countries for flask measurements and high-frequency in-situ stations; second, the implementation of flask sampling measurement programmes in one or two developing countries; and third, the development and implementation of a collaboration plan for continuing observations, calibrations, data sharing and modelling. He also noted that the project focused on the Northern Hemisphere, where the uses and manufacture of controlled substances were the highest, and connections with relevant networks and research institutions had been established.

214. After an evaluation of potential sites, Bhola Island in Bangladesh had been chosen, and observations were now being conducted in collaboration with the University of Bristol and the University of Dhaka. Five cases (a total of 60 samples) had been collected between February and June 2023 and another three cases (36 samples) should have arrived in Bristol by the end of June. Major work was being carried out to identify calibration, sampling and other instrumental effects that could result in inaccuracies. Approximately 40 controlled substances were being measured, including both ozone-depleting substances and HFCs, and several important other greenhouse gases, including sulphur hexafluoride and carbon tetrafluoride.

215. Calibration and validation of data from the Bhola Island station was ongoing. The measurements so far mainly reflected the higher levels of emissions in the northern hemisphere, while the limited variations from the northern hemisphere baseline suggested that there were no local major HCFC-22 sources. Such variations as were observed were probably due to meteorological conditions. The preliminary data showed promise, and more would be known about the pilot in about a year's time.

216. Mr. Newman suggested ways forward to continue providing necessary information to the parties to the Montreal Protocol. The pilot project at Bhola Island needed to be completed to prove the feasibility of the concept. The network of regional monitoring sites should then be expanded, and high-frequency measurements should be carried out at suitable stations. Assistance from parties was needed to identify suitable sites with sufficient availability of expertise, willingness and a desire to share data transparently within a reasonable time frame. Additional resources would be needed to ensure this and thus provide reliable data for decision-making.

217. In conclusion, Mr. Newman stressed that while global emissions were currently well estimated, the current coverage of regional stations was insufficient. Major gaps included South America, Central America, most of Africa, the Middle East, Eastern Europe, South Asia, and the "maritime continent" (Indonesia, the Philippines, New Guinea and the Malay Peninsula). The exact locations needed to be chosen carefully, away from polluted areas (though not too far, in order to avoid complete plume mixing), with a tower, air-conditioned building, electric power, internet connectivity and adequate personnel and supplies. The stations could start with flask measurements in collaboration with an established analytical facility. Careful observations and calibration were critical; the sensitivity of observations was required to be less than 1.0 part per trillion.

218. All the representatives who spoke complimented the Scientific Assessment Panel and the Secretariat for their excellent and stimulating presentation, and also thanked the European Union for providing the funding for the pilot project.

219. Responding to a question about the one monitoring station in Africa, Mr. Safari, Co-Chair of the Scientific Assessment Panel, explained that it was the most recent station to be established in the thirty-station AGAGE network. Situated at a high altitude in Rwanda, it had been established, with funding from the Government of Rwanda, through collaboration between the University of Rwanda and the Massachusetts Institute of Technology (which had provided training for its technicians and chief scientist), and was managed by the newly-established Rwanda Space Agency. It was equipped with very modern technology, and could detect and measure 50 different species of ozone-depleting substances and greenhouse gases to a very high level of precision, including some originating as far away as Brazil or India.

220. Responding to a question about whether the Scientific Assessment Panel had considered making use of the Global Atmosphere Watch programme of the World Meteorological Organization, Mr. Newman said that the Panel had talked to the programme managers and hoped to continue the collaboration, but at present that programme was primarily aimed at measuring meteorological conditions. Responding to a question about funding, he confirmed that there was no single source or

pool of funders; funding for the existing global and regional networks was arranged primarily through scientific institutions rather than at an international level.

221. Several representatives stressed the critical nature of an adequate global and regional network of monitoring stations to maintain the effectiveness of the Montreal Protocol, including in particular detecting unexpected emissions of controlled substances. Since the full recovery of the ozone layer would take several decades, long-term monitoring of controlled substances, ozone and ultraviolet radiation continued to be essential. They suggested that further discussions should be held between parties and the scientific experts to find a practical way forward for the expansion of the monitoring network, including identifying priorities and criteria for the location of new stations. Finding additional sources of funding was of course critical; one representative suggested that possibly the Trust Fund of the Vienna Convention could be a suitable mechanism.

222. Mr. Newman confirmed that lessons were already beginning to be learnt from the pilot project, particularly over the costs of flask sampling. Ms. Mylona informed the Working Group that the pilot project was due to run from August 2021 to July 2024. The tasks listed in decision XXXIII/4 had now been met, but it was for the parties to decide to request the Secretariat to provide more updates on the project.

223. The Co-Chair suggested that an informal group could be established to discuss the issue further, but said that he was aware of the limited time left during the present meeting and the fact that several informal and contact groups had already been established. He urged parties to make rapid progress.

224. Subsequently, the Working Group agreed to establish an informal group on gaps in monitoring, co-facilitated by Ana Maria Kleymeyer (Federated States of Micronesia) and Sandrine Bernard (Norway).

225. At a later stage in the meeting, the co-facilitator reported back, noting that the group had held a constructive exchange of views on the topic. Representatives in the group had expressed interest in the pilot project under way in Bangladesh and in asking the Secretariat to report on its outcomes after the project had been finalized in 2024. They had also expressed an interest in continuing discussions on the need to identify and address the gaps in global monitoring as well as funding options during the intersessional period and at the Thirty-Fifth Meeting of the Parties. Some parties had indicated their intention to produce a draft decision for consideration at that meeting.

226. The Working Group agreed to resume discussions on the identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring at the Thirty-Fifth Meeting of the Parties.

B. Report by the Technology and Economic Assessment Panel (decision XXXIV/5)

227. Introducing the sub-item, the Co-Chair recalled that, at the Thirty-Fourth Meeting of the Parties, in decision XXXIV/5 on the identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring, the parties had requested the Technology and Economic Assessment Panel to prepare a report for the present meeting on chemical pathways, gaps in understanding the sources of those emissions and best practices available to control such emissions. The report was set out in section 5.3 of the 2023 progress report of the Panel and a summary of the report was provided in an addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.2, paras. 38–41).

228. The report of the task force was presented by Helen Tope, co-chair of the Medical and Chemicals Technical Options Committee. A summary of the presentation, as prepared by the presenter, is set out in section E of annex II to the present report, without formal editing.

229. All the representatives who spoke thanked the Panel for the excellent and concise report.

230. One representative noted that many of the 24 chemical pathways covered by the report referred to HFCs and therefore those emissions were likely to be reduced during the HFC phasedown process. She further noted that most of the best practices identified in the report were standard practices with which most chemical manufacturing companies already complied and that data obligations were already being met by all the parties. Emphasis should therefore be placed on strengthening national frameworks and systems in Article 5 parties. Another representative noted that assistance for Article 5 parties to that end could and should be considered under the Multilateral Fund.

231. Several representatives, including one speaking on behalf of a group of countries, said that, as the issues covered in the report were cross-cutting in nature, consideration should be given to using the report in a broader context, linking it, for example, with any other issues being considered at the present meeting under the agenda item on the 2022 quadrennial assessment of the Montreal Protocol, and with the sub-item on ongoing emissions of carbon tetrachloride, as well as with the report of the Secretariat on the same issue.

232. In response to questions on the criteria and the methodology used to identify the 24 chemical pathways covered in the report, Ms. Tope said that all the chemical pathways that might generate controlled substances had been considered by the Committee and then a threshold of emissions exceeding 1,000 tonnes globally annually had been used as the threshold for the pathways to be included in the report. She further noted that an explanation of the methodology used was contained in an appendix to the report, and that estimated bands had been used for global production tonnage rather than specific reported amounts in order to preserve the confidentiality of reporting under Article 7. The global estimated mean production emission rates had been calculated by subject experts and certain emission factors had been developed specifically for the report.

233. The Working Group concluded its consideration of the sub-item.

VIII. Technology and Economic Assessment Panel 2023 report, including issues relating to:

234. The Co-Chair, introducing the agenda item, drew attention to volumes 1 and 2 of the Technology and Economic Assessment Panel 2023 report, which contained information related to sub-items (a) to (e), and to the summaries of the issues set out in an addendum to the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2/Add.2, paras. 43–74).

235. Following an introduction by Ms. Pizano, co-chair of the Panel, members of the Panel and its technical options committees summarized the findings of volumes 1 and 2 of the Panel's 2023 report as follows: Mr. Porter – Methyl Bromide Technical Options Committee; Ms. Walter-Terrinoni – Flexible and Rigid Foams Technical Options Committee; Mr. Chattaway – Fire Suppression Technical Options Committee; Ms. Tope – Medical and Chemicals Technical Options Committee; Fabio Polonara – Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee; and Ms. Maranion, co-chair of the Panel – other issues. A summary of the presentation is set out in section F of annex II to the present report, without formal editing.

236. In the ensuing discussion, all those who spoke thanked the Panel for its report and its presentation.

237. A number of representatives asked questions about methyl bromide. These related to how the stocks of methyl bromide held globally had been estimated and what related uncertainties remained; whether there had been any comprehensive assessment of alternatives to methyl bromide specifically in relation to their global warming potential; the cost of alternatives to methyl bromide; the registration of such alternatives; and the correct attribution of the categories quarantine and pre-shipment and the consequent appropriate response.

238. In relation to the GWP of alternatives to methyl bromide, Mr. Porter explained that the only alternative of concern was sulfuryl fluoride, for which recapture techniques should be employed to minimize emissions. Most of the alternatives to methyl bromide, however, were not of high GWP. In relation to registration issues, he said that they were common and that registration usually took a few years. Some alternatives were already registered in various regions of the world, and this would happen elsewhere as more suitable alternatives became available. Referring to estimates of global stocks, he said that the total amount was becoming less and less certain as time went by. Previously, it had been possible to estimate stocks because parties had had to declare them in critical-use nominations. There was currently one nomination and the reporting of stocks was otherwise voluntary.

239. In relation to quarantine and pre-shipment uses, Mr. Porter said that the Panel hoped that parties would verify that the two terms were applied correctly and any methyl bromide use was permitted. If not, they could move to the use of alternatives that would be just as effective on pests. In response to a suggestion by some representatives that, in future reports, the Panel could include more technical and economic analysis of alternatives to methyl bromide for quarantine and pre-shipment uses, Mr. Porter recalled that the Methyl Bromide Technical Options Committee was one of the rare committees to have an economist among its members and that all its assessments looked at technical and economic feasibility. He explained that many of the chemical alternatives for use in quarantine and pre-shipment were similar in cost. He welcomed the suggestion by one representative that the

Panel include case studies on quarantine and pre-shipment in future reports, recalling that that had been done in the past.

240. There were comments and questions about developments in the regulation of perfluorinated and polyfluorinated alkyl substances. One representative thanked the Panel for pointing out how such regulatory developments could affect and challenge various areas of work under the Montreal Protocol. Such information was extremely useful for policymakers. She spoke of derogations in her region that had been proposed to address the specific applications for which alternatives were not yet available or would not fulfil all requirements. She said that the information in the Panel's report showed that, in many sectors, alternatives that were not defined as perfluorinated and polyfluorinated alkyl substances were available and could be used immediately. Another representative queried whether that kind of exception was sufficient to ensure that alternatives were brought to market, whether there was any uncertainty because some of the derogations were limited in time and whether there would ultimately be an impact on the availability of alternatives. Another representative expressed his concern about the impact on compliance. He requested that the Panel continue to follow closely the development of related policies and regulations, as well as access to and the application of alternatives in relevant industrial sectors, such as automobile air conditioning. Ms. Maranion said that the Panel would indeed do so because it understood the potential impact of such policies and regulations on decisions about transition.

241. In response to questions on halons and their control under the Montreal Protocol, which had led to inadequate quantities for civil aviation needs, Mr. Verdonik, co-chair of the Fire Suppression Technical Option Committee, said that the only halon 1301 that was available for the production of new or the servicing of existing aircraft had been recycled or reclaimed. He confirmed that any destruction of halon would thus cause the supply to run out even sooner, and any action that could cause a delay or uncertainty in the move to alternatives to halons within civil aviation should be thought through very carefully. He said that the civil aviation industry took the lack of halon very seriously and had been working hard on the issue. He informed the Working Group, however, that, at the forty-first meeting of the Assembly of the International Civil Aviation Organization, in September 2022, industry had presented a paper stating that existing or proposed regulations that were increasing uncertainty about halon availability were causing them to pause their efforts to seek solutions.

242. Answering questions on propellant pressurized metered-dose inhalers, Ms. Tope said that, in its assessment report, the Panel had given a very detailed analysis of the alternatives. Alternatives existed, such as dry-powder inhalers and soft-mist inhalers, although they were not suitable for every patient. Four companies had made announcements regarding the progress they had made in developing the use of low-GWP propellants, namely the hydrofluoroolefin HFO1234ze(E) and HFC-152a, and had indicated that they might launch new products from 2025 onwards. Any new products had yet to be approved by health regulatory agencies. There had been no announcements to date, however, about any redevelopment processes for salbutamol MDIs. Specifically with regard to a question about whether studies on hydrocarbon propellants had been conducted, Ms. Tope confirmed that the Panel had looked at the issue both in the past and in the present report. One development process, which had been undertaken 10 years previously, had not resulted in a product coming to market. The Medical and Chemicals Technical Options Committee considered, however, that there were cardiac-sensitivity issues associated with hydrocarbon propellants, which made them unsuitable.

243. One representative sought more information about the ease of converting from the use of HFC134a as the propellant agent in pharmaceutical aerosols to HFC-152a. Ms. Tope said that there would be incremental costs involved in moving from high- to low-GWP propellants. The formulations would need to be optimized for the new propellants; the drug formulations and the contents of MDIs would need to be reformulated; stability studies, then clinical trials would need to be conducted; packaging components might need to be changed; and there would be regulatory considerations. The storage of bulk propellant might also need to be considered. The Panel considered that an estimated additional 10 to 15 per cent or more of original capital expenditure might need to be invested to modify production lines.

244. Regarding carbon tetrachloride, one representative asked whether the Panel, when summarizing the similarities between parties in terms of control policies for carbon tetrachloride, had undertaken some preliminary evaluation of the effectiveness of those policy frameworks. Ms. Tope recalled that decision XXXIV/6 had not asked the Panel to do so, and it was furthermore beyond the mandate of the Panel, which was tasked with technical and economic assessment.

245. On the issue of foams, questions were posed in relation to the supply of foams and the use of alternatives in their manufacture. Ms. Walter-Terrinoni and Mr. Altoé, co-chair of the Foam Technical Options Committee, confirmed that some supply concerns had eased slightly with the advent of

additional capacity in the production of several hydrofluoroolefin alternatives and some additional cyclopentane plants. The Panel remained in close contact with companies that had raised concerns about the available supply, and it seemed that they were now moving towards transition. Mr. Altoé agreed that use of hydrocarbons as a blowing agent in foams could pose difficulties for small and medium-sized enterprises. Nevertheless, in the Panel's view, new formulations blown with hydrofluoroolefins were stable, and any of the products that had been launched could be used without major problems. Ms. Walter-Terrinoni said that there had been a lot of focus on new formulations that would reduce the loading of some of the fluorocarbons in them and optimize cost, energy efficiency and thermal load. There was a constant stream of papers being produced about work to optimize such various features.

246. In response to questions about safety issues related to the flammability of hydrocarbons and their use in large systems, Mr. Polonara, co-chair of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, referred parties to the chapter in the Panel's report dealing with large systems, which spoke of how large systems could use hydrocarbons, although there were limitations.

247. With regard to alternatives in general, Mr. Abdelaziz, co-chair of the Technology and Economic Assessment Panel, agreed with the comment by one representative that, in the choice of alternative, for each application, it was necessary to balance several parameters: safety-related, economic and environmental. He drew the attention of the Working Group to the chapters on applications in the section of the report by the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee. Some representatives bemoaned the lack, for some applications, of alternatives that met safety-related, economic and environmental requirements, especially as compliance targets and dates were looming. Another representative wondered whether life cycle refrigerant management would be sufficient to provide for the transition and whether reclaimed and recycled HFCs could reach the same level of purity as newly produced HFCs. Mr. Abdelaziz said that he thought that reclaimed and recycled HFC would be insufficient in both quantity and quality, including because of projected growth in refrigerant consumption.

248. One representative said that his party had concerns about the impact of imports of blends on the transition to alternatives to HCFCs; it was believed that imported preblended polyols might contain substances that were no longer consumed in his country. Exporting countries, he said, should pay particular attention to how exports of such products were recorded.

249. Questions were posed by some representatives about the options for the proposed future configuration and functioning of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, whether members would participate in both or only one of the subcommittees and whether it might be more effective to split the Committee into two new ones. Experience, said one representative, had shown that it was often difficult to achieve consensus between the two subcommittees. Furthermore, the creation of two separate committees made sense if the intention was for them to work independently; in any case the standards on refrigeration equipment and — air-conditioning equipment under the International Electrotechnical Commission and UL standards were usually distinct. In response, Mr. Abdelaziz recalled that the proposal to have two committees had been made the previous year and had not found support among the parties. She also drew attention to the existence of application standards, such as ISO 5151 or ASHRAE 15, which were cross-cutting. There were many such cross-cutting standards, which needed to be considered, and it would be the job of the co-chairs to manage cross-cutting issues. Furthermore, Ms. Maranion recalled that the experts were members of the Technology and Economic Assessment Panel and its technical options committees on a voluntary basis, and the Panel was mindful of their workload; it would thus not be desirable for a member of the committee to serve on both subcommittees. Mr. Abdelaziz added that with the new membership of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee had seen a significant improvement in terms of geographic and gender balance.

250. Responding to a question, Mr. Abdelaziz explained that working groups were short-lived subsidiary bodies that could be formed by technical options committees in the same way that the Panel could set up task forces.

A. Nomination for critical-use exemption for methyl bromide for 2024

251. Introducing the sub-item, the Co-Chair referred representatives to the interim recommendation of the Methyl Bromide Technical Options Committee on the critical-use nominations put forward by one party, which had been included in the Technology and Economic Assessment Panel's presentation and was set out in volume 2 of the Panel's 2023 report and summarized in document UNEP/OzL.Pro.WG.1/45/2/Add.2 (paras. 46–50).

252. The representative of Canada expressed his gratitude to the Committee for its work in assessing his country's critical-use nomination for strawberry runners on Prince Edward Island and congratulated Argentina, Australia and South Africa for having been able to end their critical-use nominations in recent years. His country, as the only party to submit a critical-use nomination for 2024, remained committed to the complete phase-out of methyl bromide and he noted that, as alternative fumigants were not available on Prince Edward Island, the grower continued to dedicate substantial efforts and resources to researching suitable alternatives. A suitable soilless technology had been identified as the only technologically viable alternative, although it remained economically difficult, and a transition period would be required by the grower for scaling up the use of that technology. Having committed to reducing the amounts in its critical-use nomination in 2024 and subsequent years at the Thirty-Fourth Meeting of the Parties, Canada was therefore pleased to note both that its critical-use nomination had reduced significantly from 4.65 to 3.857 tons for 2024, and that the nomination aligned with the Committee's interim recommendation. The country intended to reduce the nomination still further in 2025 to no more than 2.85 tons and to cease submitting nominations from 2026 onward. He expressed his willingness to discuss and provide further details regarding his country's nominations with any interested parties in the margins of the present meeting and looked forward to the final recommendation of the Committee in advance of the Thirty-Fifth Meeting of the Parties.

253. One representative speaking on behalf of a group of countries commended Canada for its significantly lower critical-use nomination for 2024 and its commitment to the phase-out of methyl bromide under a policy-based approach. He also welcomed the fact that South Africa had not submitted, and would no longer be submitting, critical-use nominations for methyl bromide.

254. The Working Group concluded its consideration of the sub-item.

B. Ongoing emissions of carbon tetrachloride (decision XXXIV/6)

255. Introducing the sub-item, the Co-Chair recalled that decision XXXIV/6 on ongoing emissions of carbon tetrachloride had been adopted by the Thirty-Fourth Meeting of the Parties, after extensive discussions in 2019 and 2022 and intersessional efforts led by Switzerland, the proponent of the original proposal for a draft decision. In decision XXXIV/6, parties that had production of carbon tetrachloride, as well as by-production, or use of carbon tetrachloride as a feedstock for other substances or as a process agent, were invited to provide to the Ozone Secretariat on a voluntary basis, by 1 February 2023, information on the national procedures and frameworks in place for the management of such activities in their respective countries. A review of the submissions received by the Secretariat, namely from China, the European Union, Japan, the United Kingdom and the United States, had been conducted by the Medical and Chemicals Technical Options Committee and was set out in section 5.4 of the Panel's 2023 progress report.

256. Several representatives expressed their thanks to the parties that had submitted information to the Secretariat on their national procedures and frameworks for managing emissions of carbon tetrachloride, and to the Committee for its review of the important issue. One representative encouraged parties that had not submitted information to do so, on a voluntary basis, even if they did not have carbon tetrachloride production but had by-production of the substance from feedstock or used it as a processing agent, as such information could help to explain the discrepancy between the global production and estimated emission rates of the substance. In addition, one representative noted that it would be beneficial for parties to share best practices for monitoring and minimizing the emissions and to consider using the practices and techniques identified for application to controlled substances in general by the Medical and Chemicals Technical Options Committee in the 2022 quadrennial report of the Scientific Assessment Panel.

257. One representative, recalling that his party had submitted its national carbon tetrachloride management framework, said that his country had observed that carbon tetrachloride production, storage, transportation and residue disposal all inevitably led to unintentional emissions and additional scientific research and studies regarding ways of minimizing such emissions would therefore be beneficial for parties.

258. Some representatives noted with concern that the Scientific Assessment Panel had identified in its 2022 quadrennial report that the abundance of carbon tetrachloride continued to decrease at a lower rate than expected and so estimated emissions, and therefore also the associated discrepancy in emissions, were higher than when the issue had previously been considered by the Working Group. There therefore remained a need for additional information in order to close the gap between expected concentrations and observed concentrations, which should form part of the consideration of the agenda item on feedstocks in general. In addition, another representative noted that the issue of carbon

tetrachloride was cross-cutting and that information provided by parties under the agenda item on the identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring could also assist parties in better understanding and managing the gap between reported production and consumption, and emissions.

259. Some representatives called upon parties to explore the technologies available and the options to strengthen practices to minimize unintended emissions of carbon tetrachloride.

260. A number of representatives, including one speaking on behalf of a group of countries, expressed support for further discussion on the matter and the representative of Switzerland said that his country was preparing a conference room paper in that regard.

261. Subsequently, the representative of Switzerland presented a conference room paper containing a proposed draft decision on abating emissions of carbon tetrachloride.

262. One representative sought clarification regarding how the proposed draft decision would address the processes followed in various regions and support the abatement of emissions in the context of the information regarding best practices already presented in the current report. In response, the representative of Switzerland said that the best practices presented in the current report represented a good starting point but were generic and covered a variety of feedstock processes, so it would be beneficial for further work to be carried out to identify any particular difficulties encountered in specific processes, including at the regional level.

263. The Working Group agreed to forward the draft decision proposed by Switzerland, as set out in section I of annex I to the present report, to the Thirty Fifth Meeting of the Parties for further consideration and to encourage further consultations thereon to take place in the margins of the present meeting and during the intersessional period.

C. Quarantine and pre-shipment uses of methyl bromide for which alternatives are available (decision XXXIV/10, para. 4)

264. Introducing the sub-item, the Co-Chair recalled that, in paragraph 1 of decision XXXIV/10, the parties had been invited to submit to the Ozone Secretariat, on a voluntary basis, by 1 June 2023, a list of the pest and commodity combinations in which methyl bromide was needed or used in their respective countries. In paragraph 4 of the same decision, the parties had requested the Technology and Economic Assessment Panel and its Methyl Bromide Technical Options Committee, in consultation with the secretariat of the International Plant Protection Convention, to provide updated information on current quarantine and pre-shipment uses for which alternatives were available. The response of the Methyl Bromide Technical Options Committee to that request was set out in section 4.2 of the Panel's progress report, where the Committee noted that, at the time of finalization of the progress report, only one party had submitted its data, the deadline for submission being later than that, and it was therefore unable to provide updated information about the specific use of methyl bromide in quarantine and pre-shipment sectors and had instead utilized the major categories and pests shown in recent surveys and past reports to discuss alternatives. Since the finalization of the report, two additional parties had submitted their data.

265. During the ensuing discussion, several representatives, including one speaking on behalf of a group of countries, thanked the Methyl Bromide Technical Options Committee for its work and parties that had submitted information to the Secretariat for doing so.

266. Some representatives, including the one speaking on behalf of a group of countries, noted that the Committee's report indicated that the elimination of the emissions from quarantine and pre-shipment use was the single largest short-term gain that could be made to benefit the ozone layer, and that alternatives to methyl bromide were available for pre-shipment uses. One, speaking on behalf of a group of countries, said that her delegation wished to see work on methyl bromide continue as a follow-up to the findings in the Panel's progress report and decision XXXIV/10. She proposed work focusing on improving reporting and categorization of quarantine and pre-shipment uses in accordance with the agreed definitions of the Montreal Protocol through the continued gathering of information on the pest and commodity combinations for which methyl bromide was needed or used by parties, with the information collected enhanced to include the quantities involved, for the purpose of gaining a better overview of where alternatives could be used; taking stock of the implementation of decision XX/6, in which parties had been encouraged to submit to the Secretariat their national strategies to reduce methyl bromide use and/or emissions in the quarantine and pre-shipment sector; and reducing emissions through accelerated adoption of available alternatives as well as the use of recapture technologies and other emission prevention strategies. In addition, the Technology and Economic Assessment Panel would be requested to prepare a report summarizing that information, for the

consideration of the Working Group at its forty-sixth meeting. Her delegation had already started to engage with others in the margins of the present meeting and wished to continue to do so with a view to preparing a draft decision for consideration by the Thirty-Fifth Meeting of the Parties. The second representative was supportive of the proposal and indicated his willingness to participate in any discussion on the matter.

267. Another representative pointed out that parties' adherence to the obligations related to controlled uses of the substance had led to a significant decline in atmospheric emissions of methyl bromide and stressed that natural emissions were not the main source of emissions. Furthermore, parties had concerns about the effectiveness of alternatives and the high GWP and high cost of key alternatives. Consequently, her delegation did not support the addition of any new restrictions or obligations, although they were comfortable with requesting parties to submitting information on methyl bromide use to the Secretariat on a voluntary basis.

268. Two other representatives subsequently aligned themselves with her statement. One indicated that he was willing to discuss the proposal for further work but presented a number of concerns, pointing out that many of the goals of the proposal could be achieved through voluntary action: many countries were already reducing emissions from quarantine and pre-shipment uses of methyl bromide on a voluntary basis, for instance, and parties uncertain about the definitions of quarantine and pre-shipment had many opportunities to seek advice from other parties or members of the Methyl Bromide Technical Options Committee. In terms of requesting the Technology and Economic Assessment Panel to produce a further report, he noted that a report was a major undertaking for the Panel as well as the parties providing information, and the Panel had just produced both the current progress report and a quadrennial report. The second representative concurred with those arguments, although he said that he was in favour of requesting the Methyl Bromide Technical Options Committee to analyse the information submitted by parties to date, which it had not yet been able to do.

269. One representative said that in a situation where alternatives to methyl bromide were being used, cooperation between importers and exporters was required to ensure that the importing party did not have an issue with the alternatives being used, and another representative echoed concerns regarding the efficacy of alternatives to methyl bromide for quarantine and pre-shipment use.

270. The Working Group agreed to continue discussion of the matter in the margins of the meeting. It subsequently agreed to consider the matter further at the Thirty-Fifth Meeting of the Parties.

D. Existing challenges and potential options for the future configuration and function of Panel technical options committees (decision XXXIV/11, para. 1)

271. Introducing the item, the Co-Chair recalled that in decision XXXIV/11, the Thirty-Fourth Meeting of the Parties had requested the Technology and Economic Assessment Panel to provide more information on existing challenges and potential options for the future configuration and function of its technical options committees, for consideration at the present meeting. In response, the Panel had established a working group, whose recommendations were set out in chapter 8 of its 2023 progress report and summarized in document UNEP/OzL.Pro.WG.1/45/2/Add.2.

272. As had been presented by the Technology and Economic Assessment Panel earlier in the meeting, the Panel proposed to maintain its current structure of five technical options committees, but to establish two sub-groups of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, one dealing with cold chains for the conservation of food and vaccines, and the other on space heating and cooling by heat pumps and air-conditioning equipment and systems. Cross-cutting issues such as refrigerants and energy efficiency would be managed across the two sub-groups, and four co-chairs would be appointed for the committee as a whole.

273. Several representatives said that they welcomed the suggestions made by the Panel, which had followed from the very positive discussions conducted in 2022. The structure of two sub-groups was logical, and to a certain extent mirrored the way in which companies tended to specialize in one sector or the other, and standards were written for one or the other. They stated that they would welcome hearing more detail about how the discussions on cross-cutting issues such as refrigerants, energy efficiency, servicing, industrial refrigeration, heat engines and modelling would be organized, however, since those issues were of critical importance.

274. Some representatives suggested that an alternative way forward could be to create two technical options committees rather than two sub-groups of one committee, while ensuring communication and cross-fertilization between them. It was of course important to deal effectively

with cross-cutting issues but in practice some issues cut across several of the technical options committees.

275. One representative said, however that she did not fully understand the rationale for splitting the committee into two sub-groups. It did not seem to align with the systems approach that, for example, the task force on energy efficiency had followed. To take another example, supermarkets needed to deal with both cold chains and space cooling, and considering both those aspects together would allow greater energy efficiency gains. She had no objection to appointing a larger number of experts to the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee, given the importance of the topic, but she would prefer the committee to remain as a single body.

276. The Co-Chair encouraged parties to discuss the issue in the margins of the meeting.

277. Subsequently, the Co-Chair reported that there had been some informal discussions in the margin of the meeting. The Working Group agreed to resume discussions on existing challenges and potential options for the future configuration and function of technical options committees at the Thirty-Fifth Meeting of the Parties.

E. Panel membership changes

278. Introducing the sub-item, the Co-Chair of the Working Group recalled that annex 4 to the Panel's 2023 progress report contained updated information on the status of the membership of the Panel and its technical options committees. He drew attention to document UNEP/OzL.Pro.WG.1/45/2/Add.2, which contained a table listing the Panel members whose terms of office would expire at the end of 2023. The matrix of needed expertise and standardized nomination form had been posted on the meeting portal for easy access and parties were instructed to use them when making nominations. The procedures for nominating and appointing members and co-chairs were set out in the terms of reference for the Panel. According to those procedures, senior experts and co-chairs of the Panel, including the co-chairs of the technical options committees, were appointed by a decision of the Meeting of the Parties.

279. The Co-Chair noted that one nomination had been received to date, for the position of the co-chair of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, and the nomination form and the curriculum vitae of the nominated expert had been posted on the meeting portal. Parties could continue to submit nominations during the intersessional period, and they would be posted on the portal as they were received.

280. The Co-Chair encouraged interested parties to consult informally with each other and with Panel members in the margins of the present meeting, with a view to deciding on nominations at the Thirty-Fifth Meeting of the Parties.

F. Any other issues

281. A representative speaking on behalf of a group of countries provided what he described as a point of information. Voicing appreciation for the information on metered-dose inhalers in the Technology and Economic Panel's report and the update on the new low-GWP propellants that were available, he said that companies in the European Union had started announcing plans to introduce new low-GWP propellants towards 2025 and a full portfolio switch by 2030, for which the update of the European Union F-gas regulation was expected to provide incentives. As noted in the Panel's report, the European Medical Agency had issued guidelines for MDI manufacturers wishing to apply for authorization for projects with new propellants, and had made initial contacts with partner agencies in other regions of the world. As the Panel had raised concerns about the transition and stressed the need for managing the transition with an eye on patients' health, his delegation was interested in exploring, with other parties, ways to coordinate and facilitate approval processes for the new propellants, and planned to approach other delegations in the margins of the present meeting on the topic. Another representative provided information about the "co-chairs training" organized by the Secretariat of the Basel, Rotterdam and Stockholm conventions, noting that some delegates from among the Montreal Protocol community had been able to benefit from that training course. He encouraged the two secretariats to continue such cooperation.

282. No further issues were raised.

IX. Stocks of methyl bromide (decision XXXIV/10, para. 3)

283. Introducing the item, the Co-Chair recalled that at the Thirty-Fourth Meeting of the Parties the parties had adopted decision XXXIV/10, on stocks and quarantine and pre-shipment uses of

methyl bromide, after extensive discussions in plenary, informal group and contact group sessions during 2022. Among other things, in the decision parties had been invited to submit to the Secretariat by 1 June 2023, on a voluntary basis, accessible data on the volumes of pre-phase-out methyl bromide stocks held at the country level. Submissions had subsequently been received from three parties: Australia, Canada and the United States.

284. One representative said that her delegation wished to thank those parties that had submitted data. However, in view of the conclusions of the Methyl Bromide Technical Options Committee, as presented earlier, that estimates of the quantities of stocks of methyl bromide held were becoming less certain, it seemed that in reality the parties to the Montreal Protocol had not made much progress on the issue. She expressed the hope that other parties would also be able to submit data to the Secretariat.

285. The representative of Ethiopia said that data from his country would soon be reported to the Secretariat. The representative of Cameroon said that 10.2 tons of methyl bromide had been imported into his country in 2010 in error, given that imports were prohibited, and in any case the substances had turned out to be obsolete. He wished to bring this to the attention of the Secretariat.

286. Following the discussion, the Co-Chair encouraged other parties to report their data on stocks of methyl bromide to the Secretariat and closed the consideration of the agenda item.

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

A. Hydrofluorocarbons consumption data reported by relevant Group 1 parties operating under paragraph 1 of Article 5 (decision XXXIV/13, paras. 1 and 2)

287. Introducing the sub-item, the Co-Chair recalled that, in decision XXXIV/13, Article 5 parties that believed that their reduced consumption of HFCs during the baseline years of 2020–2022, stemming from the effects of the COVID-19 pandemic, could hinder their ability to comply with the freeze in the consumption of HFCs in 2024, had been encouraged to submit to the Ozone Secretariat, no later than 1 May 2023, their HFC consumption data for 2022. In the same decision, the Ozone Secretariat had been requested to prepare for the consideration of the Working Group at the present meeting, information on the HFC consumption data reported by the Group 1 Article 5 parties. That information was set out in the document entitled “Potential impacts of the COVID-19 pandemic on HFC consumption for Group 1 parties operating under paragraph 1 of Article 5: hydrofluorocarbons consumption data reported by relevant Group 1 parties operating under paragraph 1 of Article 5 (decision XXXIV/13, paras. 1 and 2)” (UNEP/OzL.Pro.WG.1/45/4/Rev.1). The Co-Chair also drew attention to paragraphs 75 to 81 of the note by the Secretariat on issues for discussion by and information for the attention of the Open-Ended Working Group at its forty-fifth meeting (UNEP/OzL.Pro.WG.1/45/2).

288. The representative of the Secretariat presented document UNEP/OzL.Pro.WG.1/45/4/Rev.1, noting that the original document had been revised on 4 July to correct two errors. It also included new submissions and revisions to previously reported data provided by parties after the original document had been prepared. Summarizing the information in tables 1 and 2 of the document, he said that 118 parties had reported HFC consumption for at least one of the years from 2018 to 2022; 44 parties had reported HFC consumption for all the years from 2018 to 2022; 21 parties had expressed concern about the impact of the COVID-19 pandemic; and 12 parties had communicated that they did not have any concerns about meeting the freeze in HFC consumption in 2024.

289. In the ensuing discussion, one representative said that the data showed that there were several parties that considered themselves in a precarious position themselves. He and another representative said that they looked forward to considering the proposal to be discussed under sub-item 10 (b) on proposed adjustments to the Montreal Protocol. The latter representative underscored the need to find an approach that was flexible.

290. The Working Group agreed to consider the matter further together with agenda item 10 (b).

B. Proposed adjustments to the Montreal Protocol

291. Introducing the sub-item, the Co-Chair recalled that, on 22 April 2023, the Secretariat had circulated a proposed adjustment to the Montreal Protocol submitted by Cuba. That proposal was set out in document UNEP/OzL.Pro.WG.1/45/7. He also drew attention to paragraphs 56 and 57 of the

note by the Secretariat on issues for discussion by and information for the attention of the Open-ended Working Group at its forty-fifth meeting (UNEP/OzL.Pro.WG.1/45/2).

292. The representative of Cuba presented the document. He said that the reason for his country's submission of the proposal was the concern regarding the fact that, during the COVID-19 pandemic, there had been economic contraction and reduced imports of refrigerant gases compared with pre-pandemic years. If those years were used in the calculation of the baseline for HFC phase-down, not only would they not be representative but they could also lead to parties being unable to comply with their phase-down obligations. The proposal would make the selection of baseline years more flexible to support parties' efforts.

293. In the ensuing discussion, a number of representatives stated that they were in the same situation as Cuba, also owing to the post-pandemic economic growth that had occurred, including expansion of the construction sector and increased demand for refrigeration and cooling, which would only continue to grow. They had the same fears about future compliance based on a baseline calculated using the pandemic years. They requested the other parties to show their characteristic flexibility to enable them to remain in compliance.

294. Several representatives expressed their support for the proposal by Cuba, while several others, although they were convinced that it was important to address the problem, did not agree fully with the approach set out in proposal. They requested that there be a discussion on the proposal and other options. A number of representatives agreed that it was necessary to show flexibility.

295. Several representatives, including one speaking on behalf of a group of countries, recalled that document UNEP/OzL.Pro.WG.1/45/4/Rev.1, which had been produced pursuant to decision XXXIV/13 and considered under sub-item 10 (a), gave parties the data needed to make an informed decision on the issue. They noted that not all Article 5 parties were affected in the same way, that their cases were heterogenous and that some did not require changes to their baselines. One representative recalled that, when the Kigali Amendment had been negotiated, parties had chosen to formulate the HFC baseline on the basis of both HFC and HCFC consumption, which had meant that there was significant variation from country to country. Another representative said that he was in favour of considering the countries severely affected by the pandemic on a case-by-case basis.

296. The Working Group agreed to establish a contact group, to be co-chaired by Juan José Galeano (Argentina) and Patrick McInerney (Australia), to consider the proposal by Cuba and other possible ways of addressing the impact of the COVID-19 pandemic on the HFC baselines of certain Article 5 parties.

297. At a later stage in the meeting, the co-chair of the contact group reported back on the discussions held in the contact group. The group had made good progress, particularly in exchanging information.

298. The Working Group agreed to resume discussions on the proposed adjustment to the Montreal Protocol at the Thirty-Fifth Meeting of the Parties.

XI. Other matters

299. No other matters were raised.

XII. Adoption of the report of the meeting

300. The parties adopted the present report on the basis of the draft report that had been circulated, as orally amended. The Ozone Secretariat was entrusted with the finalization of the report.

XIII. Closure of the meeting

301. Following the customary exchange of courtesies, the forty-fifth meeting of the Open-ended Working Group of the Parties to the Montreal Protocol was declared closed at 8.50 p.m. on Friday, 7 July 2023.

Annex I

Draft decisions and other input to be forwarded to the Thirty-Fifth Meeting of the Parties

The Working Group agreed to forward to the Thirty-Fifth Meeting of the Parties, the following draft decisions and other input for further consideration, on the understanding that they did not constitute agreed text and were subject in their entirety to further negotiation.

A. Stratospheric aerosol injection and protection of the ozone layer

Submission by Australia and Canada

The Thirty-Fifth Meeting of the Parties decides,

Taking note with appreciation of the 2022 quadrennial assessment report of the Scientific Assessment Panel¹ and its chapter 6 on stratospheric aerosol injection and its potential effect on the stratospheric ozone layer,

Taking note of the 2023 United Nations Environment Programme report *One Atmosphere: An Independent Expert Review on Solar Radiation Modification Research and Deployment*,² which provides an expert review of solar radiation modification research and deployment in relation to stratospheric aerosol injection,

Noting that limited scientific information is available about the risks to the ozone layer of stratospheric aerosol injection,

Noting the potential for negative effects that stratospheric aerosol injection may have on the ozone layer, including depleting stratospheric ozone, delaying recovery of the ozone layer, and influencing stratospheric chemistry,

1. *Invites* the global scientific community to address risks and uncertainties for the ozone layer in any scientific studies or assessments undertaken in relation to stratospheric aerosol injection;
2. *Requests* the Scientific Assessment Panel to engage with the global scientific community regarding, and to continue to bring to the attention of the parties, any important developments with respect to stratospheric aerosol injection, including the inclusion of updated or new scenarios or modelling to assist with understanding of the potential impacts of stratospheric aerosol injection on the ozone layer.

B. Potential areas of focus for the 2026 quadrennial reports of the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel

Submission by the European Union

The Thirty-Fifth Meeting of the Parties decides,

Noting with great appreciation the excellent and highly useful work of the members of the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel of the Montreal Protocol and their colleagues worldwide in preparing the Panels' 2022 assessment reports, in particular the efforts made to condense vast amounts of pertinent information into a concise and understandable form for better use by policymakers,

1. To request the Scientific Assessment Panel, the Environmental Effects Assessment Panel and the Technology and Economic Assessment Panel to prepare quadrennial assessment reports and submit them to the Secretariat by 31 December 2026 for consideration by the Open-ended Working Group and the Meeting of the Parties in 2027, as well as [presenting] [finalizing] a synthesis report [in time for the Meeting of the Parties] [by 30 April 2027], noting that the panels should continue to exchange information during the process of developing their respective reports in order to

¹ Available at <https://ozone.unep.org/system/files/documents/Scientific-Assessment-of-Ozone-Depletion-2022.pdf>.

² Available at <https://www.unep.org/resources/report/Solar-Radiation-Modification-research-deployment>.

[avoid duplication] [ensure consistency] [and to provide comprehensive information to the parties to the Montreal Protocol];

2. To request the assessment panels to bring to the notice of the parties any significant developments that [in their opinion] deserve such notice, in accordance with decision IV/13;

3. To encourage the assessment panels to closely involve relevant scientists from parties operating under paragraph 1 of Article 5 of the Montreal Protocol with a view to promoting gender and regional balance, to the best of their ability, in producing the reports;

4. To request the Environmental Effects Assessment Panel, in preparing its 2026 assessment report, to pay particular attention to the most recent scientific information, including forward-looking projections and scenarios, and to assess the [effects of] changes in the ozone layer and ultraviolet radiation[, including] and their interaction with the climate system on:

(a) Human health;

(b) The biosphere, biodiversity, and the health of flora, fauna and the ecosystem environment, including biogeochemical processes and global cycles;

(c) Ecosystem services, agriculture and materials, including for construction, transport, photovoltaic use and microplastics;

(d) [Potential effects of solar radiation management [and associated changes in ultraviolet radiation on the elements mentioned in subparagraphs 4 (a) to 4 (c) above][, particularly in relation to its potential effect on stratospheric ozone]];

5. [To also request the Environmental Effects Assessment Panel, in preparing its 2026 assessment report, to assess the effects and accumulation of breakdown products from controlled substances and their alternatives, in particular any substances that are very persistent in the environment, such as perfluoro- and polyfluoroalkyl substances, including trifluoroacetic acid, in ground and surface waters and other relevant sinks;]

6. That the 2026 report of the Scientific Assessment Panel should include:

(a) An assessment of the state of the ozone layer and its future evolution;

(b) An evaluation of global and polar stratospheric ozone, including the Antarctic ozone hole and Arctic winter and spring ozone depletion and the predicted changes in these phenomena as well as [any other occurring events of ozone depletion][other latitude regions];

(c) An updated assessment of past and projected contributions of the Montreal Protocol to mitigating climate change in terms of total avoided CO₂ equivalent emissions and avoided temperature increase;

(d) An evaluation of trends in the top-down derived emissions, abundances and fate in the atmosphere of trace gases of relevance to the Montreal Protocol, in particular controlled substances and other substances of importance to the ozone layer, [which should include a comparison of top-down estimations and available bottom-up estimations of such emissions with a view to identifying currently unknown emission sources and explaining discrepancies between [reported] emissions [derived from reported information] and observed atmospheric concentrations (Scientific Assessment Panel/Technology and Economic Assessment Panel)];

(e) An evaluation of consistency with reported production and consumption of those substances and the likely implications for the state of the ozone layer, including its interaction with the climate system;

(f) An assessment of the interaction between changes in stratospheric ozone and the climate system, including consideration of [related policy scenarios] [possible future policy scenarios relating to ozone depletion [and related policy scenarios] [and climate change][and climate impacts][and climate systems]];

(g) [Suggestions regarding policy scenarios designed to contribute further to ozone layer protection and climate change mitigation, taking into account potential timelines to allow for the implementation of such scenarios, and presenting their benefits in terms of impacts on the total column ozone and equivalent effective stratospheric chlorine, advancing the recovery of the ozone layer, and avoiding CO₂ equivalent emissions, as relevant;]

(h) Early identification and quantification of any substances that could be of concern, including other halogenated gases, in particular those with high global warming potential, breakdown products of controlled substances and their alternatives that remain for a long time in the environment

such as perfluoro- and polyfluoroalkyl substances, including trifluoroacetic acid, N₂O and very short-lived substances such as dichloromethane, and their main sources of emissions;

- (i) An assessment of information and research related to solar radiation management;
- (j) An assessment of the potential effects of supersonic aircraft, rockets, wildfires and volcanic eruptions on the stratospheric ozone layer and their interactions with the climate;
- (k) Relevant information on any newly detected substances that are relevant for the Montreal Protocol;
- (l) Identification and quantification, where possible, of any other issues of importance to the ozone layer and the climate system, consistent with the objectives of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol;

7. That the 2026 report of the Technology and Economic Assessment Panel should include an assessment and evaluation of the following topics:

- (a) Technical progress in the production and consumption sectors in the transition to technically and economically feasible, climate- and environment-friendly and sustainable alternatives that pose no harm or other lasting effects to the environment, and to practices that minimize or eliminate the use of controlled substances in all sectors;
- (b) Process agents and feedstock uses for which the use of controlled substances is no longer required and identification of alternative pathways or technologies that can replace these uses, taking into account costs, energy use, and other environmental and economic considerations;
- (c) An assessment of information and research relating to relevant emissions of controlled substances from common feedstock and production processes and other manufacturing processes, and identification of best practices and technologies for minimizing such emissions;
- (d) The status of banks and stocks of controlled substances, their alternatives and other substances of importance to the ozone layer, including those used as feedstocks and those resulting from by-production, and the options available for managing them so as to avoid emissions to the atmosphere;
- (e) Challenges facing all parties to the Montreal Protocol in implementing obligations under the Protocol and maintaining the phase-outs already achieved, including challenges related to preventing emissions from feedstock uses and by-production, and technically and economically feasible options for addressing those challenges;
- (f) The impact of the phase-out of controlled ozone-depleting substances and the phase-down of hydrofluorocarbons on sustainable development;
- (g) Technical advances in developing alternatives to hydrofluorocarbons, taking into account in particular energy efficiency, safety, and suitability for use in high-ambient-temperature countries.

[Additional areas to be considered for inclusion in the terms of reference:

- (1) An assessment of information and research relating to relevant emissions of controlled substances from common feedstock and production processes and other manufacturing processes, and identification of best practices and technologies for minimizing such emissions;
- (2) Refrigerant management;
- (3) Banks and rates of recovery, recycling and reuse;
- (4) Sectors where hydrochlorofluorocarbons (HCFCs) were not previously used but hydrofluorocarbons (HFCs) are, such as electronics manufacturing;
- (5) Energy efficiency, including minimum energy performance standards, cold chain management and buildings;
- (6) Use of raw material as feedstocks and input materials;
- (7) Safety measures for low-global-warming-potential alternatives;
- (8) Assessment of whether production of hydrofluoroolefins is resulting in fugitive high-global-warming-potential HFCs;
- (9) Alignment of the HFC alternative reports under decision XXVIII/2, paragraph 4;

- (10) The potential impact of the evolution of the management of per- and polyfluoroalkyl substances (PFAS) on the implementation of the Montreal Protocol and the selection of alternatives in relevant sectors.]

C. Emissions of HFC-23

Submission by Australia, Canada, Norway and the United States of America

The Thirty-Fifth Meeting of the Parties decides,

Recalling the provisions under paragraphs 6 and 7 of Article 2J of the Montreal Protocol on by-product emissions from each production facility that manufactures Annex C, Group I substances or Annex F substances,

Expressing serious concern about the recent scientific findings showing unexplained increases in emissions of HFC-23 in recent years,

Taking note of the information on HFC-23 emissions in the 2022 quadrennial assessment report of the Scientific Assessment Panel,³

Taking note also of the information on chemical pathways that may generate HFC-23 by-product emissions and on best practices for controlling such emissions in the 2022 assessment report of the Medical and Chemical Technical Options Committee of the Technology and Economic Assessment Panel and in the Technology and Economic Assessment Panel's decision XXXIV/7 report,

1. To request the Scientific Assessment Panel to provide an update on HFC-23 emissions to supplement the information in the 2022 quadrennial assessment report, including by reflecting any new information regarding atmospheric monitoring and atmospheric modelling, with its underlying [assumptions][methodology] with respect to such emissions, and to prepare a report on the matter to the Thirty-Sixth Meeting of the Parties;
2. To request the Technology and Economic Assessment Panel to prepare a report to the Thirty-Sixth Meeting of the Parties containing information regarding:
 - (a) Potential sources of emissions of HFC-23 from facilities that manufacture Annex C, Group I substances, Annex F substances [or other relevant chemicals, and consumptive uses] that may lead to HFC-23 emissions;
 - (b) Any additional relevant information on chemical manufacturing, other than the manufacture of Annex C, Group I substances or Annex F substances, that may generate HFC-23 by-product emissions[, including estimates of the scale of such emissions, when such estimates are possible];
 - (c) The quantity of HFC-23 being consumed, [by country and] by sector;
 - (d) Best practices for reducing emissions of HFC-23 from consumption sectors;
3. To [request][invite] parties with available relevant scientific or technical information that may help inform the reports of the Scientific Assessment Panel and the Technology and Economic Assessment Panel mentioned in paragraphs 1 and 2 above to provide that information to the Secretariat by 1 March 2024;
4. To encourage Parties, as appropriate, to support scientific efforts, including in relation to atmospheric measurements, to further study and [characterize – *to be further specified*] emissions of HFC-23, and to share data from such scientific efforts in a timely manner;
5. To encourage [scientific and atmospheric organizations and institutions – *to be further considered*] to further study and elaborate on the current findings related to HFC-23 emissions, as relevant and appropriate to their respective mandates, with a view to contributing to the assessment described in paragraph 1 above;
6. [To request Parties to take appropriate measures to ensure that they are effectively implementing their HFC-23 obligations in accordance with paragraphs 6 and 7 of Article 2J of the Protocol.]

³ Available at <https://ozone.unep.org/system/files/documents/Scientific-Assessment-of-Ozone-Depletion-2022.pdf>.

[7. That “the extent practicable” referred to in Article 2J, paragraph 6 is defined as a maximum of 0.1 kg of HFC-23 by-product emitted per 100 kg of the relevant Annex C/I or Annex F substance produced. – *to be further considered*]

D. Very short-lived substances, including dichloromethane

Submission by Australia, Canada, Switzerland and the United States of America

The Thirty-Fifth Meeting of the Parties decides,

Taking note with appreciation of the information on very short-lived substances in the 2022 quadrennial assessment report of the Scientific Assessment Panel and the 2022 assessment report of the Medical and Chemical Technical Options Committee of the Technology and Economic Assessment Panel,

Noting that the 2022 quadrennial assessment report of the Scientific Assessment Panel indicates that chlorine emissions from very short-lived substances not controlled by the Montreal Protocol, in particular from dichloromethane, continue to increase and are estimated to contribute about 4 per cent of total chlorine input to the stratosphere, and that future emissions of dichloromethane have the potential to lead to more ozone depletion than emissions from many of the other alternative scenarios explored in the report,

Concerned about the continued substantial increase of emissions of dichloromethane, which is the main component of very short-lived substances chlorine, estimated to have averaged 13 per cent annually between 2011 and 2019, according to information contained in the 2022 assessment report of the Medical and Chemical Technical Options Committee,

Noting that, according to the policy-relevant scenarios considered in the 2022 quadrennial assessment report of the Scientific Assessment Panel, the positive effect on the ozone layer from 2020 to 2070 of eliminating emissions of dichloromethane in 2023 would be about 40–80 per cent of the effect of eliminating all emissions of ozone-depleting substances in 2023,

Recalling decisions XIII/7 and XVIII/11 pertaining to the very short-lived substance n-propyl bromide,

1. To request the Technology and Economic Assessment Panel to include in its 2024 progress report, for consideration by the Open-ended Working Group at its forty-sixth meeting:

(a) Information on alternatives to dichloromethane and measures for reducing emissions in the main applications for which it is currently used;

(b) Any relevant updates regarding existing and projected production, use and emissions of dichloromethane and other very short-lived substances discussed in the 2022 assessment report of the Medical and Chemical Technical Options Committee;

2. To encourage parties to take action to reduce the use and emissions of dichloromethane in applications for which alternatives are available and emissions control measures are feasible.

E. Destruction technologies for controlled substances

Submission by the European Union

The Thirty-Fifth Meeting of the Parties decides,

Noting with appreciation the 2022 report by the Technology and Economic Assessment Panel’s Medical and Chemical Technical Options Committee that contains the response to decision XXX/6 on destruction technologies for controlled substances,

Noting with appreciation also the Technology and Economic Assessment Panel’s assessment of destruction technologies with regard to their destruction and removal efficiency and its recommendations to parties for potential approval for inclusion on the list of approved technologies, and suggesting that parties consider this information in the development and implementation of their domestic regulations,

Also noting that Decision XXX/15 requests the Technology and Economic Assessment Panel to provide a review of destruction technologies, if new compelling information becomes available,

1. To approve the following destruction technology, for the purposes of paragraph 5 of Article 1 of the Montreal Protocol, as an addition to the technologies listed in annex VI to the report of the Fourth Meeting of the Parties and modified by decisions V/26, VII/35, XIV/6, XXIX/4 and

XXX/6, for diluted sources of ODS and Annex F, group I substances for which there is already approval for concentrated sources: cement kiln;

2. To remove portable plasma arc technology as a separate approved technology for the purposes of paragraph 5 of Article 1 of the Montreal Protocol, given that portable plasma arc technology is a subset of the already approved category of nitrogen plasma arc destruction technology.
3. To invite parties to submit to the Secretariat information relevant for a review of destruction technologies.

F. Feedstock uses

Submission by Australia

The Thirty-Fifth Meeting of the Parties,

Recalling paragraph 5 of Article 1 of the Montreal Protocol, which excludes the calculated level of controlled substances entirely used as feedstock in the manufacture of other chemicals from the definition of production of controlled substances,

Recalling also decision IV/12, in which Parties were urged to take steps to minimize emissions of such substances, including such steps as avoidance of the creation of such emissions, reduction of emissions using practicable control technologies or process changes, containment or destruction,

Taking note with concern of the 2022 assessment reports of the Technology and Economic Assessment Panel and the Scientific Assessment Panel, which highlight the significant increases in the production of controlled substances used as feedstock and the unexplained abundance of ozone-depleting substances in the atmosphere, which may result from increased emissions of these substances from feedstock production or use, or by-product emissions from other chemical processes,

Decides:

1. To urge relevant Parties, in accordance with decision IV/12, to take steps to minimize emissions of controlled ozone-depleting substances produced or used as feedstock, including such steps as avoidance of the creation of such emissions and reduction of emissions using practicable control technologies or process changes, containment or destruction;
2. To encourage relevant Parties to replace, where technically feasible, the use of ozone-depleting substances with non-controlled substances in feedstock manufacturing processes or in the production of products currently relying on ozone-depleting substances;
3. To remind Parties, when they are reporting feedstock production, to include unintentional production of isolated and non-isolated intermediates, where such production is measurable;
4. To invite Parties with production or use of ozone-depleting substances for feedstock to provide to the Ozone Secretariat by [1 June 2024] information on their domestic policies, practices and regulations relating to the management of such production and use, including any controls on resulting emissions;
5. To request the Ozone Secretariat to collate and summarize the information provided pursuant to paragraph 4 above for consideration by the Open-ended Working Group at its forty-sixth meeting.
6. To request the Technology and Economic Assessment Panel to prepare a report for consideration by the Open-ended Working Group at its forty-sixth meeting that includes:
 - (a) Information on alternative chemicals and processes, including best-practice control technologies, that can be used or implemented to reduce the need for feedstock production or use of controlled ozone-depleting substances;
 - (b) Estimates of annual global emissions of ozone-depleting substances by species from feedstock production, by-product emissions and use based on bottom-up calculations and estimates made by the Scientific Assessment Panel arising from atmospheric observations, including different emission factors previously identified;
 - (c) Any other relevant updated information.

G. Suggestions for additional analysis in a supplementary report on MLF replenishment for the period of 2024-2026

Overall suggestions/ Methodological approach

1. where the RTF uses cost estimates for specific activities drawn from the MLF business plan include a scenario with a discounting approach as applied by previous replenishment reports. It should reflect that the funding approvals in ExCom were on average found to be lower by 15 to 20% (at present 26% lower) compared to the original cost and expenditures estimated in the business plans;
2. Include 2 new scenarios for estimating the funding for the HCFC phase-out and HFC phase-down that are based on the actual consumption (or estimates of such consumption when not reported) to be reduced for countries to meet compliance targets including both the freeze target and the 10% reduction target for the HFC phase-down and ranges for the respective funding requirements to account for uncertainties;
3. Adjust the funding estimated for the HCFC phase-out and HFC phase-down by taking into account potential approvals of projects and project preparation requests at the 93rd meeting of the ExCom;

ExCom92 Decisions

4. Adjust all elements of the funding requirements based on any relevant decisions taken at the 92nd meeting of the ExCom;
5. Include a scenario, wherein some Article 5 parties submit proposals to phase down HFCs in advance of applicable compliance targets in accordance with ExCom decisions 92/44 and 92/37;

HCFC

6. When estimating the funding requirement for new HPMPs, identify the sectors that would likely be addressed by these HPMPs, based on remaining HCFC consumption per sector, and apply cost effectiveness factors to calculate funding for these sectors that are based on historical experience under the Multilateral Fund;
7. Consider scenario removing the HCFC production phase-out plan for India that is not included in the consolidated BP of ExCom;
8. Review the funding requirement for HPMP preparation funding to account for all the countries identified to require new HPMPs in the 2024-2026 triennium;

HFC

9. Develop a scenario estimating funding for KIPs for Group I and Group II countries which have ratified the Kigali Amendment assuming that 90% of Group I and 30% of Group II countries request funding;
10. Add scenario for frontloading funding for KIPs during 2024-2026, taking into account the lessons learned from the implementation of HPMPs;
11. Reviewing funding requirement for KIPs preparation funding to account for all the countries identified to require KIPs in the 2024-2026 triennium;
12. A scenario prioritizing the manufacturing sectors for non-LVCs;
13. When estimating the funding requirement for KIPs, apply cost effectiveness factors for manufacturing sectors that are based on historical experience under the MLF and/or a technical assessment of the costs to transition to alternatives, taking into account any available information from MLF documents, previous TEAP reports and other sources and ExCom agreed cost guidelines.
14. Review the funding requirement for the phase-down HFC production and HFC-23 by-product mitigation, based on a technical assessment of the costs, to the extent possible, taking into account the experience with such projects under the MLF and the past funding practice in the production phase-out/down projects;
15. A scenario for funding 10 to 15 individual investment projects;

16. A scenario to address the challenges for SMEs including safety issues, including in the installation and assembly sectors in implementation of KIPs;
17. Evaluate the potential cost implications of leapfrogging and/or taking early action to phase down HFCs in advance of compliance targets;

Energy efficiency

18. A scenario for funding 10 to 15 energy efficiency pilot projects ;
19. Include a scenario wherein an incentive is provided as part of the funding for KIPs to enhance EE while phasing down HFCs in accordance with ExCom decision 92/38;
20. Consider activities to support SMEs in design and development of energy efficient technology and their implementation;
21. Consider EE related policies and regulations capacity building;
22. Consider additional costs for energy efficient foam products;
23. Consider regional testing centers for monitoring and verification of energy efficiency;
24. Analyze additional costs for including energy efficiency as an incentive for enhancing ambitious HFC-phase down and leapfrogging HFCs in the frame of the HPMPs and KIPs;
25. Provide cost estimates of potential support for systemic approaches to EE in KIPS, beyond the pilot window;

End of Life

26. Provide estimates of costs of managing reclamation, recycling, and cost-effective destruction of banks, including collection, transport, and disposal activities;

Consider a scenario for end-of-life activities considered under ExCom decision 91/66 where only 30 % of countries request funding during this replenishment

H. Shared responsibility to stop dumping of inefficient cooling equipment containing obsolete refrigerants

Submission by Ghana on behalf of the African States

The Thirty-Fifth Meeting of the Parties,

Recognizing that compliance with the Montreal Protocol on Substances that Deplete the Ozone Layer and its amendments involves sharing of responsibility between importing and exporting Parties,

Welcoming the commitments of certain Parties to prohibit, in domestic regulations, the export of cooling equipment not satisfying their national regulations and/or standards,

1. *Requests* that Parties manufacturing and exporting cooling equipment consider instituting measures involving shared responsibility to stop exporting cooling appliances with obsolete refrigerants and encourage the supply of next-generation cooling equipment;
2. *Requests* the Technology and Economic Assessment Panel to provide a preliminary report to the Parties at the forty-sixth meeting of the Open-ended Working Group, and to provide an updated version of that report for discussion at the Thirty-Sixth Meeting of the Parties, providing examples of technically and economically feasible measures for shared responsibility where cooling equipment that is prohibited from use in a domestic market is also prohibited from export.

I. Abating emissions of carbon tetrachloride

Submission by Switzerland

The Thirty-Fifth Meeting of the Parties decides,

Recalling decision XXXIV/6, in which Parties having production of carbon tetrachloride, as well as by-production, or use of carbon tetrachloride as a feedstock for other substances or as a process agent, were invited to provide to the Secretariat on a voluntary basis, by 1 February 2023, information on the national procedures and frameworks in place for management of such activities in their respective countries,

Recalling also decision XXXIV/5, in which the Technology and Economic Assessment Panel was requested to prepare a report on chemical pathways in which substantial emissions of controlled substances were likely to occur, best practices available to control those emissions, and gaps in understanding the sources of those emissions,

Acknowledging the valuable information that the Technology and Economic Assessment Panel has provided on sources and emissions of carbon tetrachloride in its responses to the above-mentioned decisions through its 2023 progress report,

Recognizing with concern the range of estimated emission rates provided in the 2023 progress report of the Technology and Economic Assessment Panel, which indicates significant emissions from processes involving carbon tetrachloride,

To request the Technology and Economic Assessment Panel:

- (a) To compile a list of best practices and technologies, by process and by geographical region, for minimizing carbon tetrachloride emissions and emission rates, based on the information provided by the Parties addressed in decision XXXIV/6 and further information;
- (b) To indicate, by process and by geographical region, the minimum carbon tetrachloride emission rates that have been achieved, based on the information provided by Parties and further information.

Annex II

Summaries of presentations by the members of the Technology and Economic Assessment Panel¹

A. Presentation on the quadrennial assessment 2022

1. Presentation by the Scientific Assessment Panel on the highlights of the 2022 scientific assessment of ozone depletion

The Co-Chairs of the Montreal Protocol Scientific Assessment Panel (SAP) presented a brief summary of the highlights of their 2022 Scientific Assessment of Ozone Depletion. The presentation began with a tribute to Daniel L. Albritton of the US National Oceanic and Atmospheric Administration who passed away in April 2023. Dr. Albritton was one of the first co-chairs of the SAP of the Montreal Protocol and made substantial contributions to establishing the scientific foundation for the decisions of the Protocol. He was widely regarded as an outstanding communicator of scientific information. The highlights of the assessment include:

- actions taken under the Montreal Protocol which continue to decrease atmospheric abundances of controlled ozone-depleting substances (ODSs) and advance the recovery of the stratospheric ozone layer;
- observations which show that recovery of ozone in the upper stratosphere and Antarctica is progressing and that the near-global average ozone will recover in 2040;
- the decline in the unexpected emissions of CFC-11 and the identification of the source region for at least half of these emissions;
- continued decrease in CCl₄ atmospheric abundances at slower rates than expected; CH₃Br abundances which have varied annually between 6.5 ppt and 6.9 ppt during 2016–2020 with no clear overall trend;
- the recent increase in HFC-23 global emissions that is inconsistent with reported abatement;
- continued increase in dichloromethane along with many non-ODS, non-HFC, highly fluorinated substances; and
- the first assessment of the impact on the ozone layer of stratospheric aerosol injection (SAI), which has been proposed as a possible option to offset global warming.

Several policy options were analyzed including the elimination of ODS feedstock emissions which would accelerate the reduction in stratospheric halogen loading. The panel noted that several space-borne instruments that provide valuable stratospheric observations are due to be retired within a few years.

There are heightened concerns about influences on 21st century ozone that include impacts of: further increases of greenhouse gases; rapidly expanding ODS and HFC feedstock use and emissions; climate change on total column ozone in the tropics; extraordinary wildfires and volcanic eruptions; increased frequency of civilian rocket launches and the emissions of a proposed new fleet of supersonic commercial aircraft. Looking forward, the panel noted that the exceptional eruption of the 2022 Hunga Tonga-Hunga Ha'apai volcano may lead to a unusually large Antarctic ozone hole in 2023 and provide an unprecedented opportunity to test computer models of stratospheric processes. Finally, the panel introduced the 2022 edition of the Twenty Questions and Answers document which is an illustrated narrative addressing ozone depletion, ozone-depleting substances and the success of the Montreal Protocol.

2. Presentation of the Environmental Effects Assessment Panel (EEAP) on the environmental effects of stratospheric ozone depletion

On behalf of the Environmental Effects Assessment Panel, Co-chairs, Janet Bornman, Paul Barnes and Krishna Pandey, presented the 2022 Quadrennial Assessment on the environmental effects of stratospheric ozone depletion, UV radiation, and interactions with climate change. The EEAP Quadrennial Assessment is comprised of the Highlights, Executive Summary, main text, and

¹ The summaries are presented without formal editing.

Questions & Answers. The EEAP Assessment was written by 49 individuals, and reviewed by 64 reviewers.

The topics covered effects from UV radiation, ozone depletion and climate change on human health including COVID-19, terrestrial and aquatic ecosystems, biogeochemical cycles, troposphere and air quality, natural and synthetic materials, and microplastics in the environment.

The Montreal Protocol has been instrumental in preventing further growth of the Antarctic ozone hole and consequent large increases in UV radiation. It has also contributed to reducing global warming by phasing out ozone-depleting substances with high global warming potentials. Furthermore, without the Montreal Protocol, the large increases in UV-B (280-315 nm) radiation would have resulted in substantial reduction of carbon dioxide uptake by vegetation, resulting in an increase in atmospheric carbon dioxide and enhanced global warming.

With respect to human health, millions of skin cancers and eye diseases have been avoided, although incidence of skin cancers is still high in many countries. Drug-induced skin sensitivity to solar UV radiation also results in severe loss of quality of life, and some of the drugs may induce certain types of skin cancer. With regard to the corona virus, SARS-CoV-2, it was noted that the many positive outcomes of the Montreal Protocol far outweigh any potential advantage for disinfection of the virus by higher amounts of solar UV radiation. In addition, the Montreal Protocol has allowed the beneficial effects to be gained from moderate exposure to solar UV radiation through spending time outdoors. Some of these beneficial effects include vitamin D production, and improved protection by certain immune systems.

The Assessment has continued to emphasise the likely interactive effects on ecosystems of UV radiation and extreme climate events (ECE) associated with increased global warming from greenhouse gas emissions and changes in stratospheric ozone. ECEs are occurring together with the more gradual changes in the environment, such as the rising surface temperatures and carbon dioxide. The risks to biodiversity and survival of tropical coral reefs from high amounts of UV radiation and pollution, as well as the sensitivity of the corals to water pollution and small changes in temperature were also noted.

UV radiation is a significant factor in controlling air quality in the troposphere, which has consequences for human health and the environment. Many chemicals are released into the atmosphere from human activities, and these can be transformed by UV radiation into tropospheric smog. UV radiation also generates the main cleaning agent, the hydroxyl radical (OH), which removes many of the substances emitted by human activities and natural processes, including the ODS replacements, HFCs, HCFCs, HFOs. However, in the process, these ODS replacements are degraded to trifluoroacetic acid (TFA). While the presence of TFA in the environment and potential toxicity continues to be of concern, current assessments indicate that adverse effects in the foreseeable future are unlikely. Nevertheless, the possible risks should continue to be investigated and assessed for unexpected effects. High concentrations of TFA are also generated from substances not currently under the Montreal Protocol.

On the topic of the role of UV radiation and climate on plastic pollution and its consequences for human health and the environment, the susceptibility of many natural and synthetic materials to degradation by UV radiation and climate was addressed. At present, the potential negative biological impacts of micro- and nanoplastics have not been conclusively established, and research is ongoing. To help counteract the decreases in useful lifetime of plastics and other materials, UV-stabilisers and additives are being developed, including eco-friendly plant-based substances. These technologies will be important, since plastic pollution also feeds back to the climate system when plastics degrade, releasing carbon.

In conclusion, reference was made to the contributions of EEAP to environmental sustainability, human health and well-being in alignment with many of the UN Sustainable Development Goals (SDGs).

B. Presentation by the Technology and Economic Assessment Panel and the technical options committees on the Panel's assessment report

Mr. Ashley Woodcock introduced the highlights of its 2019-2022 Quadrennial Assessment Report on behalf of his co-chairs Bella Maranion and Marta Pizano, and all of the members of the Technology and Economic Assessment Panel (TEAP).

He reported that the TEAP currently has 3 co-chairs, four senior experts and 13 co-chairs of its five Technical Options Committees. He gratefully acknowledged the almost 150 experts from around the

world who served on TEAP, its TOCs and Task Forces on a voluntary basis and who contributed to the 2022 assessments.

He indicated that Decision XXXI/2, has the following specific areas of focus for TEAP for the 2022 quadrennial reports

- (a) *Technical progress in the production and consumption sectors in the transition to technically and economically feasible and sustainable alternatives and practices that minimize or eliminate the use of controlled substances in all sectors;*
- (b) *The status of banks and stocks of controlled substances and the options available for managing them so as to avoid emissions to the atmosphere;*
- (c) *Challenges facing all parties to the Montreal Protocol in implementing Montreal Protocol obligations and maintaining the phase-outs already achieved, especially those on substitutes and substitution technologies, including challenges for parties related to feedstock uses and by production to prevent emissions, and potential technically and economically feasible options to face those challenges*
- (d) *The impact of the phase-out of controlled ozone-depleting substances and the phase down of HFCs on sustainable development;*
- (e) *Technical advancements in developing alternatives to HFCs suitable for usage in countries with high ambient temperatures, particularly with regard to energy efficiency and safety.*

Mr. Woodcock then presented some overarching messages in progress in phasing down/out ozone depleting substances. He reported continued progress in consumer, commercial, industrial, agricultural, medical and military sectors, with ODS no longer used in many applications worldwide. He highlighted that the phase-out of HCFC-22 is essentially complete in non-A5 parties, and is progressing in A5 parties: for almost every foam application, commercially available alternatives are used; in methyl bromide, phase out of controlled, non-QPS uses, is virtually complete; In sterilization, controlled substances are likely no longer used; in aerosols, alternatives are available for almost all uses, and for for refrigeration, air conditioning and heat pumps, alternative zero ODP refrigerants are available for all sectors.

Mr. Woodcock then presented key messages updating progress with HFCs. He indicated that 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 RACHP and foam applications. However, this does present challenges in finding the best solution for each application, considering factors such as flammability, toxicity, availability, and operating conditions.

He noted that restricting the growth of products containing high-GWP and energy-inefficient RACHP equipment would reduce both the servicing tail of unwanted high GWP refrigerants, and energy demand. He also noted that shortages of supply of low-GWP alternatives in some sectors has coincided with increasing global demand. While these supply issues are less severe now, they will need careful monitoring as extended shortages in supply could delay transition away from HFCs. Mr. Woodcock stated that In most A5 parties, but especially in low- and very low-volume consuming countries, the majority of ODS and HFC refrigerants are used for RACHP servicing. As a result ensuring support for proper training and servicing would reduce direct emissions of ODS and HFC refrigerants and also reduce indirect emissions by reducing the loss of energy efficiency through RACHP equipment through its lifetime by proper maintenance.

He noted that in foams, challenges remain for SMEs in some A5 parties related to the availability, safety, and cost of some lower-GWP alternatives as well as product performance requirements. In electronics manufacturing and magnesium production, while global consumption of HFCs is relatively small, it is increasing for electronics manufacturing, and the alternatives to HFCs currently include other fluorinated gases, many of which have higher GWPs. And finally, that transition away from high-GWP HFC-pressurized metered dose inhalers (pMDIs) is a major undertaking with serious potential public health risks for asthma and COPD patients unless it is carefully managed.

Mr. Woodcock ended by noting that on PFAS, TEAP investigated this topic during the first quarter of 2023, and would report to parties on the potential implications for the different sectors the 2023 TEAP Progress Report which will be presented tomorrow.

Mr. Paulo Altoé, co-chair of the FTOC continued the presentation Next, Paulo Altoe, co-chair of the Flexible and Rigid Foams Technical Options Committee (FTOC) presented details of the FTOC 2023 Progress Report, recognizing his co-chair, Helen Walter-Terrinoni. He noted that generally, transitions to non-ozone depleting substances (ODSs) and low global warming potential (GWP) alternatives have

been successful and transitions continue to move forward. However, he commented that there is no single 'drop-in' FBA replacement for currently used HCFCs or hydrofluorocarbons (HFCs).

He then commented that there are different technical, economic, safety, and environmental performance properties for each low GWP, zero ozone depletion potential (ODP) alternative and different needs for each market subsector causing a proliferation of FBA blends across the whole of the foam sector.

Mr. Altoe reminded parties that technical and economic challenges remain for some sectors and small and medium enterprises (SMEs) and that the price of HFC blowing agents has risen substantively and is nearly as high as hydrofluoroolefin (HFO) and hydrochlorofluoroolefin (HCFO) prices were in some A5 parties. This is especially challenging for SMEs. He further shared that newly announced low global warming potential (GWP) foam blowing agent capacity has eased the shortage of supply and cost of alternatives, especially cyclopentane and hydrofluoroolefins (HFOs). He went on to say that additional capacity required to alleviate the shortage suggests that there was insufficient capacity to meet regulated needs for low GWP FBAs. However, HFC-365 manufacture will cease in 2023, after significant resource investment by foam manufacturers to convert. He noted that insufficient capacity to meet regulatory mandates is likely to recur without intervention and that patents have restricted options to address local supply chains.

Mr. Adam Chattaway summarized the FSTOC assessment Report. Many halon applications have transitioned to alternatives, some of which are high-GWP HFCs. However, halons are still needed for several enduring uses (e.g., oil & gas, nuclear power plants, military, civil aviation), the last of which is still growing.

The FSTOC is concerned that classification and regulation of fire suppressants as PFAS will impact transition away from halons and high-GWP HFCs.

Looking at emissions of halon, they may be higher than the FSTOC models predict. For halon 1301, the FSTOC needs further information on emissions from feedstock production and use, and the location of these emissions. For halon 1211, the FSTOC needs further information on regional emissions, since emissions derived from global atmospheric concentrations are near or above reported amounts produced. Finally, for halon 2402, the FSTOC is aware of some decommissioning activities on the Asian continent, but it needs further information on this topic.

Looking at the run-out date for halon 1301; this is now estimated to be 2-5 years sooner than in the 2018 Assessment Report, i.e. 2030 to 2049 as compared to 2032 to 2054. The cause for this is that less halon 1301 is projected to be available to support enduring uses.

The world's first halon destruction for carbon offset project occurred in February 2022 in the US. The FSTOC is very concerned that destroying halon 1301 for carbon credits could deplete the bank even faster and therefore contribute to global shortages / regional imbalances of halon 1301 needed for enduring uses.

Turning to HFCs; 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 source of supply and is likely to increase in the future.

More generally, the FSTOC continues to see issues regarding the loss of historical knowledge due to the length of time over which the Montreal Protocol activities have been implemented. The FSTOC notes that this lack of experience and historical knowledge is becoming more challenging as it works with various parties and organizations on issues related to acquiring halons to meet their continuing needs. Parties may wish to consider addressing awareness programmes to re-establish this loss in institutional memory.

The FSTOC continues to express concern with expanded use of flammable refrigerants. This could be a significant issue, especially in A5 parties' HFC phase-down. Parties may wish to consider ensuring continuing support for training / capacity building in A5 parties.

Mr. Ian Porter, co-chair of the MBTOC presented a summary of the committee's 2022 Assessment Report. He highlighted that by 2022, 99.8% of methyl bromide consumption for controlled uses had reportedly been phased out. Only 43.6 t were approved for use under the Critical Use Exemption in 2022, compared to 16,050 t in 2005. Alternatives now exist for all pre-plant soil and non-QPS structural and commodity uses of MB and MB production is entirely for exempted QPS and feedstock uses.

Reporting on analysis of MB used for quarantine and pre-shipment uses, Mr. Porter said that global MB consumption for QPS use fluctuates at around 10,000 t/yr with 95% occurring in 17 countries.

Only 55 of 198 parties report use of MB for QPS. He continued to say that recapture technologies are available to reduce emissions and that alternatives exist for the majority of PS treatments (30-40% of total QPS). These include irradiation, ethane-dinitrile (EDN), hydrogen cyanide (HCN), sulfuryl fluoride (SF). He then commented that concern continues about sulfuryl fluoride (SF), a key alternative to MB, owing to its GWP (i.e. 4780) and the impact of its possible inclusion under the EU F-gas regulation.

In finishing his presentation, Mr. Porter referred to MB emissions. He mentioned that anthropogenic emissions of MB have declined by ~71% from the peak emission of ~ 50,000 tonnes in 1998, but they have remained relatively stable for the last six years with no obvious decline. He cited some major concerns including that of the 10,000 t of MB used per year for QPS treatments, over 80% is emitted and that there is an unexplained gap in bottom up vs. top down measurements in atmospheric concentrations. Owing to the short lifetime of MB in the atmosphere (0.7 years), adoption of alternatives has an immediate benefit in reducing atmospheric MB levels.

Ms. Helen Tope, co-chair of the Medical and Chemical Technical Options Committee (MCTOC), stated that most aerosol propellants had migrated to hydrocarbons and dimethyl ether, while some had migrated to HFCs or still use HCFCs, where flammability, toxicity, safety, VOC content, are considerations. Alternatives for aerosol uses of controlled substances are available but they might not be suitable in all circumstances. She said that parties may wish to consider advantages of reducing HFC use in aerosols, where technically and economically feasible. For sterilization, she reported that technologies and applications continue to deploy environmentally safer processes as best practice and, with the alternatives available, MCTOC believes that sterilization applications using controlled substances are no longer a relevant risk for the Montreal Protocol and will not include sterilization in their future technical updates.

Regarding pressurised metered dose inhalers (pMDIs) for asthma and chronic obstructive pulmonary disease containing HFC-134a and HFC-227ea propellants, she stated that dry powder and soft mist inhaler alternatives, where available, affordable, and suitable, have much lower carbon footprints than pMDIs with high GWP propellants. She reported that lower GWP HFC-152a and HFO-1234ze(E) propellants are under development as alternatives. She said that complex considerations are necessary when patients and healthcare professionals make an informed choice about a patient's inhaled therapy. She cautioned that transition away from high GWP HFC pMDIs is a major undertaking with serious potential public health risks unless carefully managed, and that 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.

For chemicals, she reported that the increase in ODS feedstock uses over last decade is mostly due to HCFC feedstock uses, particularly HCFC-22, and the recent increase in CTC feedstock use is due to HFO production. She recalled that the manufacture of HCFC-22 generates HFC-23 by-production and emissions, for which Article 2J establishes destruction requirements. She reported that the manufacture of tetrafluoroethylene (TFE) and hexafluoropropene (HFP) from HCFC-22 feedstock generates by-production and emissions of HFC-23 and PFC-c-318 (c-C4F8) with very high GWP, which are not covered by Article 2J destruction requirements, and that as CO₂ equivalents, the combined estimated emissions of HFC-23 and the PFC from the manufacture of TFE and HFP, without consideration of their possible abatement, are larger than estimated emissions of HFC-23 from HCFC-22 production assuming 0.1% emissions are achieved. She noted that parties may wish to consider the significance of these potential emissions. For HFCs not listed in Annex F, she stated that parties may wish to consider any actions that they might want to take concerning those HFCs not listed in Annex F with GWPs above 53 with known commercial use, with a list proposed in the report and that parties may also wish to consider any actions concerning anaesthetics that are halogenated ethers (HFEs and HCFEs) and other halogenated ethers (e.g., HFEs used as solvents) with GWPs above 53 with known commercial use.

For process agent applications, she said that most removals of process agent applications from Table A have resulted from plant closures, rather than substitution of the ODS process agent and that for some remaining ODS process agent applications, no alternatives are currently available. For solvent uses, she reported that alternatives to controlled substances include not-in-kind technologies and in-kind solvents such as chlorinated solvents and fluorinated solvents, including high-GWP HFCs not listed in Annex F and low-GWP HFOs, HCFOs and HFEs, and their blends. For laboratory and analytical uses, she noted that parties may wish to consider actions to facilitate the adoption of ODS alternatives in A5 parties, such as international cooperation between different standards organisations and between parties.

For semiconductor and other electronics manufacturing, she described that HFCs are used for etching circuits, chamber cleaning, and as heat transfer fluids to control temperature, and that HFC-134 is used as a cover gas in magnesium production. She explained that alternatives include a range of fluorinated chemicals, many with higher GWPs, such as SF₆ for etching, chamber cleaning, and magnesium production, and that for semiconductor and electronics manufacturing, emissions controls significantly reduce HFC emissions. She noted that some parties appear to report HFC production/consumption in semiconductor manufacturing in the same way as other emissive uses, whereas other parties treat it as feedstock use excluding the portion resulting in HFC emissions, and that parties may wish to consider how to treat HFC production and consumption for semiconductor uses for the purposes of Article 7 data reporting.

In response to Decision XXX/6, requesting TEAP to assess destruction technologies listed (in annex II to the report of the Thirtieth Meeting of the Parties) as not approved or not determined, as well as any other technologies, based on MCTOC's assessment, she noted that parties may wish to consider inclusion of cement kilns as an approved destruction technology for dilute sources of ODS and Annex F, Group 1, HFCs, for which there is already approval for concentrated sources, and that they may also wish to consider removing the category, Portable Plasma Arc, as a separate approved technology to rationalise the list of approved destruction technologies.

Regarding banks and stocks of controlled substances, she noted that effective management of banks of ODS and HFCs, by maximising recovery, reuse, recycling, reclamation, and destruction after all other options have been exhausted, can minimise global impacts of potential emissions at end-of-life (EOL). She stated that the largest banks overall of controlled substances in RACHP and foams are currently in non-A5 parties and will rapidly reach EOL in the next decade. She said that while ODS banks have been more concentrated in non-A5 parties, HFC banks are currently more evenly distributed between non-A5 and A5 parties, and that the quantity of banks in A5 parties will exceed those in non-A5 parties by the early 2030s, resulting from declining banks in non-A5 parties and the rapid uptake of HFC-containing equipment in A5 parties. She noted that with quantities potentially available for recovery and management expected to increase in A5 parties, timely efforts to establish effective EOL management capacity would have a significant impact, given predicted size and growth of banks in larger industrialised A5 parties. She stated that addressing the barriers to the transboundary movement of EOL ODS/HFCs will be important in supporting preferential recovery/recycling and environmentally sound destruction, thereby minimising emissions, and that parties may wish to consider how relevant international treaty bodies can work together to facilitate transboundary movement of EOL ODS/HFCs.

Mr. Peixoto then presented the highlights from the RTOC 2022 Assessment Report key messages. Initially he mentioned that while high-GWP HFC phasedown focuses on the direct GHG emissions from the RACHP sector, the indirect GHG emissions are equally or more impactful to climate. He said that the indirect GHG emissions are due to energy consumption from the RACHP applications and can be reduced significantly through improved equipment energy efficiency, reduced demand using high-performance buildings and cold-chain, and reduced carbon intensity of the electricity network.

Mr Peixoto mentioned that there is no "ideal" refrigerant. Benefits and risks must be balanced; weighing multiple factors. He also mentioned that recent safety standards enabled increased use of flammable refrigerants in many sectors, and that ultralow-, low-, and/or medium-GWP alternative refrigerants are available for all RACHP applications, but accessibility is still a major hindrance for the widescale adoption and progress toward the HFC phasedown.

He said that proposed PFAS regulations are very broad and not product-specific at this time, and the use of some HFO and HFCs could be affected by new policies.

Mr Peixoto said that in the RTOC 2022 assessment report there are extensive details for each and every refrigerant, and many of the alternative refrigerants that are now being used are expected to only play a temporary role in the phasedown process.

He also said that HFC sector-specific end-uses are not included in Article 7 reporting data increasing the uncertainty for equipment-based modelling emissions and banks.

He mentioned that in 2022, there were an estimated 2 billion domestic refrigerators worldwide; and the current production has mostly converted to isobutane. Regarding commercial refrigeration; he said that retrofit of existing system can use low-and medium-GWP refrigerants, and for new systems, the shift is to ultralow- and low-GWP refrigerants. He stressed that maintaining or improving the energy efficiency, is also important in the expansion of a sustainable cold chain. Mr. Peixoto also said that in commercial refrigeration the most common – ultralow and low-GWP refrigerants being applied are natural refrigerants and HFO blends.

Mr Peixoto said that HFC-32 is broadly used in air conditioning equipment, and several medium-GWP HFC/HFO blends are being adopted. The transition to propane for single split and portable AC units is underway in several regions, and larger, more complex, and distributed systems pose the greatest challenges to adoption of medium- and low-GWP alternatives. He pointed out that complete range of chillers using lower-GWP refrigerants is available in all major markets, there are medium and low GWP refrigerant options for water heating heat pumps, and for mobile AC, HFC-134a is used globally. He also said that where regulations require low GWP refrigerants, HFO-1234yf and CO₂ provide market options.

Finally, he mentioned that heating only heat pumps have a role in buildings decarbonisation by replacing fossil fuel powered heating systems, there are medium and low GWP refrigerant options for water heating heat pumps, and not-in-kind technologies are generally not competitive with vapor compression technology except in niche applications such as absorption chillers.

In closing the presentation, Ms. Marta Pizano, co-chair of the TEAP referred that Decision XXXI/2 requested the TEAP, in its 2022 Assessment Report, to consider the “impact of the phase-out of controlled ozone-depleting substances and the phase-down of HFCs on sustainable development.” She said the approach taken by the panel was to consider key UN decisions, agreements and reports relevant to sustainable development, and to relate these to the impact of the global transition away from ODS in the various sectors of use, as addressed in TOCs quadrennial assessments.

She then highlighted that elimination of the production and consumption of 99% of ODS, and the projected recovery of the stratospheric ozone layer, are among the biggest environmental success stories of the 21st century. She further indicated that the Kigali Amendment has challenged parties – especially A5 parties - with preparing for and achieving the HFC phase-down, sometimes whilst implementing the final stages of their HPMPs.

As a conclusion, the co-chair said that for 35 years, the MP has contributed in many ways to the achievement of most SDGs. Its contributions are particularly significant in protecting human health, improving livelihoods, protecting the environment, fostering sustainable production practices, and improving food security. Contributions to industry and innovation, clean and efficient energy and economic growth are also important.

C. Presentation by the Technology and Economic Assessment Panel on the replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol (decision XXXIV/2) for the period 2024–2026

Ms. Shiqiu Zhang, co-chair of the TEAP Replenishment Task Force (RTF), started the presentation on behalf of her co-chairs Suely Carvalho (who unfortunately could not attend this meeting) and Bella Marañon. She elaborated on the mandate in decision XXXIV/2, which requested the Technology and Economic Assessment Panel to prepare a report on the appropriate level of the replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol (MLF) for the triennium 2024–2026. She reviewed key parts of the decision which provided the terms of reference (TOR) for TEAP including but not limited to the following: that TEAP would take into account all control measures and relevant decisions agreed upon by the parties to the Montreal Protocol and the Executive Committee (ExCom) of the MLF up to and including its ninety-second meeting; that the TEAP take into account the special needs of low-volume-consuming and very-low-volume-consuming countries; the need to allocate resources to enable all A5 parties to comply under the ODS phasedown and HFC phaseout; the need to allocate resources for activities to maintain and/or enhance energy efficiency while phasing down HFCs; the need to allocate resources for supporting activities related to gender mainstreaming; the need to allocate resources for a funding window for activities to support end-of-life management and disposal of controlled substances; a scenario to increase funding for institutional strengthening and the compliance assistance programme. The TOR also noted that TEAP should use a clearly explained compliance-based methodology that is informed by, but independent of, the business plan of the MLF, provide indicative figures associated with enabling A5 parties to implement HCFC phase-out management plans (HPMPs) and Kigali HFC implementation plans (KIPs) in a coordinated manner. The TEAP should also consult widely, complete its report for the forty-fifth meeting of the Open-ended Working Group (OEWG) and provide indicative figures for the periods 2027–2029 and 2030–2032 to support a stable and sufficient level of funding.

She expressed appreciation for the commitment and efforts of the members of the TEAP Replenishment Task Force (RTF) and also for the support of Ozone Secretariat (OS) and Multilateral Fund Secretariat (MLFS). She noted that the 2024–2026 triennium represents a significant milestone under the Montreal Protocol as the MLF funding will address both HCFC phaseout and HFC phasedown. The RTF estimated funding requirements for the 2024–2026 triennium and future triennia

take strictly into account the relevant compliance targets within these periods as requested by the decision. She noted that the May 2023 RTF Report for OEWG is based on data and information available to the RTF as of 3 April 2023 and ExCom Decisions up to the 91st meeting. The RTF supplementary report will consider the following: new data available (e.g., A7 data); decisions, guidance, and discussions from ExCom-92 (e.g., cost guidelines for refrigeration servicing sector); and revised assumptions and scenarios based on guidance from parties at OEWG-45 replenishment contact group discussions. The RTF requested further guidance on a number of issues including Paragraph 4 of the TOR requesting TEAP “to provide indicative figures associated with enabling [A5] parties to implement HPMPs and KIPs in a coordinated manner.” TEAP also requested guidance on addressing challenges to sustainable financial flow in the implementation of KIPs and could present further in its supplementary report.

In terms of the approach taken by TEAP on its report, she mentioned that TEAP established a Replenishment Task Force (RTF) that consulted widely, relied on existing cost guidelines under the MLF, noted limitations on any funding estimates provided (i.e., where cost guidelines for HFC phase-down activities remained under discussion in the Executive Committee), and used the “Adjusted business plan of the MLF for 2017-2019 after the 77th meeting of the Executive Committee” (also referred to as the “Business Plan”).

Ms. Zhang turned to chapter 2 of the RTF report, covering the funding for HCFC phaseout for 2024–2026 and future triennia. For HCFCs, the compliance target for the 2024–2026 triennium is a 67.5% reduction from baseline by 1 January 2025. For the next two triennia 2027–2029 and 2030–2032, the next HCFC phase-out compliance target is a 100% reduction from baseline by 1 January 2030. HCFC phaseout funding needs are addressed separately for the consumption and production sectors. For consumption, estimates considered approved and estimated HCFC Phaseout Management Plans or HPMPs, project preparation costs, funding for energy efficiency, and funding for verification and technical assistance, where applicable. For the HCFC consumption sector, RTF in consultation with the MLFS, looked at funding tranches for approved HPMPs agreed until 2031, which totals US\$ 137.4 million. For 2024-2026, RTF used approved HPMPs tranche of US\$ 116.7 million as of 91st ExCom. The RTF has calculated projected funding based on the incremental reduction targets for each country, based on its baseline, starting points, cumulative reductions, and remaining eligible tonnage. The RTF considered the cost needed to reach the reduction targets of 67.5% by 2025, 80.5% by 2027 (to get to 100% by 2029), plus corresponding support costs, totaling \$ 205.4 million. The projected funding only took into account the % needed for compliance based on Agreements between ExCom and country; no other factor such as business planning figures for future stages were taken into account. Informed by the MLF consolidated business plan for 2023–2025, RTF estimated for the 2024-2026 period the following: for project preparation, RTF used US\$ 170,000 in 2024-2026; for HPMP verification, US\$ 1.77 million, and nil for technical assistance. RTF considered relevant ExCom decisions to estimate funding related to energy efficiency (EE) for LVCs in servicing sector, which are highlighted in this slide. These include: MOP Decision XXVIII/2, which requested the ExCom to increase funding available for EE; ExCom Decision 89/6, which established a funding table and defined additional activities for inclusion in existing and future HPMPs; and ExCom Decision 91/37, clarifying that ExCom Decision 89/6 applies to LVC countries that have already completed their HPMPs. RTF estimated funding related to EE based on Decision 89/6 for LVCs, which detailed the funding brackets and number of countries in each funding bracket as well as the funding levels agreed by ExCom. RTF estimated EE funding for 2024–2026 to be US\$ 11.1 million to include support costs for 94 LVCs. These figures are as of the 91st ExCom meeting and will be adjusted for the supplementary report based on approvals at 92nd ExCom.

For the production sector, estimates include project preparation and audit and funding for the HCFC Phaseout Production Management plans or HPPMPs and include verification costs. Seven A5 parties produced HCFCs. RTF estimated funding includes: Project Preparation for Stage I: US\$148,000 (including US\$ 128,000 for India and US\$ 20,000 for DPRK); HCFC Production Phaseout Management Plans or HPPMPs: US\$ 5.35 million for India (Stage I) and US\$ 23.23 million for China (Stage II). The total estimated funding for the production section 2024–2026 is US\$ 28.7 million. The total funding requirement for 2024–2026 triennium for HCFC consumption and production activities is estimated at about US\$ 364 million.

RTF co-chair, Ms. Bella Maranion, started the presentation on Chapter 3 of the RTF report which addresses funding estimates for HFC phasedown. The RTF used HFC control measures to estimate funding needs. The compliance targets for the 2024-2026 and next two triennia are as follows: For Group 1 parties, the freeze in 2024 and a 10% reduction from baseline by 1 January 2029; for the next two triennia 2027-2029 and 2030-2032, a 30% reduction from baseline by 1 January 2035; for Group 2 parties, in the next two triennia 2027-2029 and 2030-2032, we have a freeze of production and

consumption by 1 January 2028 and a 10% reduction from baseline by 1 January 2032. RTF estimated funding is based on the following: these compliance targets; established practices and experiences in HCFC phase-out implementation; available decisions and guidance by ExCom as of 91st meeting; and A7 and Country Programme data reported to the OS and MLFS, and available to RTF before April 2023 since the RTF deadline to submit the report to Ozone Secretariat for the OEWG was mid-May.

Funding estimates include HFC consumption and production sectors, including HFC-23 mitigation. For approved Kigali HFC Implementation Plans (KIPs), the RTF could only consider up to 91st ExCom. This is because RTF report submission deadline was prior to 92nd ExCom meeting in June, so the implications of the Decisions at 92nd ExCom to funding estimates will be considered in the Supplementary Report. For the consumption sector, the RTF also estimated funding for KIPs, project preparation, eligible enabling activities, and energy efficiency.

The RTF followed five steps to calculate the funding requirements for estimated KIPs: 1) A5 countries were allocated into five brackets based on HCFC baseline consumption in metric tons, going from bracket A for the largest consumption country to bracket E with 94 LVCs, some classified as such for funding purposes; 2) Calculate HFC baseline, filling in data gaps when A7 data or Country Programme data not available (Annex 1 of the RTF report shows in detail how the data gaps were filled); 3) Apply assumptions for sector distribution of consumption as detailed in our report; 4) Apply Cost Effectiveness (CE) factors - due to ongoing discussions at ExCom, RTF based these on information available up to the 91st meeting of the ExCom; 5) Calculate cost for 80% and 85% phasedown targets agreed for Groups 1 and 2, respectively, under the Kigali Amendment, then apply the low- and high-end scenarios based on Kigali ratification status available to TEAP as of April 2023, and then present the estimated cost for KIPs for the triennium. RTF presented final estimated costs based on a low- and a high-end scenario, taking into consideration for a low-end scenario that 104 parties had ratified at the time of submission of this report, and a high-end considering that all 144 A5 parties will have ratified by 2026.

For countries in Brackets A to D, and in the absence of final HFC cost guidelines, RTF used different CE factor per sector, based on what is available and documented. That is, some CE were the ones used for HPMPs, some agreed as per current negotiations as of 91st ExCom (such as for Domestic Refrigeration and PU Foam) and others based on average CE previously presented by TEAP (ExMOP3). For solvents an average of what was applied to ODS phaseout plans was used. RTF will update in supplementary report based on decisions from ExCom-92.

For Bracket E or LVCs, costs are calculated differently as per current practice, and this slide presents a summary of the discussions and proposals submitted at the 91st ExCom. The RTF considered the average costs of negotiation proposals from the 91st ExCom for the 94 LVCs. Costs were estimated only for 10% reduction from the baseline spanning over 5 years of implementation. RTF did not consider any funding upfront for addressing needs of sustainable financial flow, nor any acceleration. While the total cost estimated on this basis is US\$ 17.2 million, for the current triennia, it is estimated to be \$8 to 10 million. RTF supplementary report will consider new decisions from 92nd ExCom meeting.

The RTF applied the distribution of compliance target reductions. The percentage is multiplied by the total HFC cost per country per year to calculate the estimate for a particular year. Then the low- and high-end scenario was applied bringing the final estimates for KIPs in the triennium. The estimated funding for KIPs for 2024-2026 ranged from US\$ 406 to 449 million.

Since many countries have already received funding for KIP project prep, the RTF's estimate was informed by the most recent MLF business plan and totals US\$ 3.2 million. ExCom Decision 79/46 provided the levels of funding for enabling activities, based on meeting eligibility requirements (e.g., ratification and/or letter of intent to ratify sent to the MLFS). For Enabling Activities, and as of the 91st ExCom – some countries had still not accessed the funds. Total estimated by RTF is about \$ 1 million USD. Related decisions and approvals at the 92nd Excom will be considered in the Supplementary Report.

The TOR requested the TEAP to consider the “need to allocate resources for activities to maintain and/or enhance energy efficiency while phasing down HFCs.” ExCom Decision 91/65 established a funding window for pilot projects in the amount of US \$20 million with the possibility of augmenting that funding window at a future meeting. RTF has considered a total of \$ 20 million USD for 2024–2026 triennium. RTF did not estimate funding for future triennia for energy efficiency pending further guidance from parties.

The TOR requested the TEAP to consider the “need to allocate resources for supporting activities related to gender mainstreaming as part of the gender policy of the MLF.” ExCom Decision 91/65

established a funding window for pilot projects in the amount of US \$20 million with the possibility of augmenting that funding window at a future meeting. RTF reviewed policies and practices of other global funds (Adaptation Fund, the Global Environment Facility or GEF and the Green Climate Fund). In those cases, a Gender Action Plan is prepared and presented linked to the specific project submitted for approval and implementation. In order to estimate funding needs, RTF used the approved costing framework for "End of Life Management" project preparation (Dec 91/66), which also includes data collection and preparation of an action plan.

RTF considered similar workload and need for gender mainstreaming experts to collect gender specific and disaggregated data. RTF considered for 2024-2026, funding for data collection and development of a gender action plan, following example of other global funds. RTF estimated funding needs in 2024-2026 totals US\$ 13.6 million. RTF did not estimate funding for future triennia for gender mainstreaming action plan implementation pending further guidance from parties.

RTF estimated funding requirements for HFC production sector phase-down and HFC-23 mitigation for the 2024-2026 period, covering all five producers. It includes: US\$ 2 million for production project preparation costs (China, India, and DPRK); US\$ 20 million for Kigali Production Phase-down Management Plans (KPPMPs) (China, India, and DPRK); US\$ 193,000 for HFC-23 mitigation preparation costs (India, China, and DPRK); US\$ 1.72 million for HFC-23 mitigation plan already approved (Argentina and Mexico); US\$ 8 million estimated for HFC-23 mitigation project proposal (India). The total production sector and HFC-23 mitigation cost for 2024-2026 is estimated at US\$ 31.9 million. The estimated costs for HFC phasedown for both consumption and production for the 2024- 2026 triennium is US\$ 475 to 519 million.

The TOR requests the TEAP to consider the "need to allocate resources for a funding window for activities to support end-of-life management and disposal of controlled substances in an environmentally sound manner." The 91st ExCom established a funding window for the preparation of national inventories of banks of used or unwanted controlled substances and a plan for the collection, transport and disposal of such substances. ExCom Decision 91/66 agreed on maximum funding levels for project preparation. RTF did not estimate funding for future triennia for implementation of developed action plans pending further guidance from parties.

Ms. Maranion presented the funding requirements for Institutional Strengthening (IS) and Standard Activities for the 2024-2026 triennium. The funding approved for IS support has played a paramount role in establishing and maintaining the capacity of national ozone units throughout the 35 years of implementation of the Montreal Protocol. The Standard Activities (SA) are part of the administrative cost regime established by the parties to support the implementation of obligations under the Montreal Protocol. These activities comprise the operations of the ExCom and the MLFS, including monitoring, evaluation, and Treasurer functions; UNEP's Compliance Assistance Programme (CAP), and the Core Unit funding for Implementing Agencies (UNDP, UNIDO and the World Bank). In estimating the funding needs RTF has recognized that IS has been increased at the 91st Excom and that IS is to be reviewed with effect from 2029 (Decision 91/63). RTF also considered that Core Unit cost are to be addressed at the 93rd ExCom, and assumed that UNEP CAP, the budgets of the Core Units for UNDP, UNIDO and the World Bank, as well as the MLF Secretariat, would increase by 3% in both future triennia to reflect increases in staff costs. For 2024-2026, the estimated cost for IS and Standard Activities is US\$ 121.6 million. The Total Estimated Fund Requirements for the 2024-2026 triennium is shown in the summary table, with a range of US\$ 975 to 1,000 million.

Ms. Maranion concluded the TEAP presentation by providing the estimated funding for future triennia. The RTF considered the relevant compliance targets: for HCFCs, the 100% phaseout target by 2030; for HFCs Group 1, a 10% reduction from baseline by 1 January 2029 and a 30% reduction from baseline by 1 January 2035; for HFCs Group 2 parties, a freeze of production and consumption by 1 January 2028 and a 10% reduction from baseline by 1 January 2032.

D. Presentation of the Technology and Economic Assessment Panel on energy efficiency (decision XXXI /3)

Mr. Ashley Woodcock (EEWG co-chair) stated that Decision XXXIV/3 is a complex decision on enabling enhanced access and facilitating the transition to energy-efficient and low- or zero-global-warming-potential technologies. The Decision has requests to the Executive Committee and the Ozone Secretariat, with six specific requests to TEAP, which are presented as requested within this supplementary report to the TEAP 2023 Progress Report.

Mr. Woodcock presented the Energy Efficiency Working Group (EEWG) membership, co-chaired by TEAP and RTOC co-chairs (Mr. Ashley Woodcock and Mr. Omar Abdelaziz), and including the

FTOC co-chair (Paulo Altoé) and 14 RTOC members. The EEWG has a majority from A5 parties and equal gender balance.

Mr. Woodcock presented Chapter 1 saying that Energy Efficiency provides substantial added value in terms of climate benefit to the Kigali Amendment to phasedown HFCs. He said that and although low GWP/high EE RACHP equipment is now available worldwide, it is not accessible everywhere. Previous Energy Efficiency Task Forces have suggested that National Ozone Units coordinate with national energy and climate authorities on issues related to integrating energy efficiency with HFC phasedown, for example on policy, avoiding dumping, improving servicing, and focus on both energy and refrigerant conservation.

Mr. Woodcock then presented Chapters 2 and 3 on a systems level approach to RACHP equipment efficiency that looks at the whole process. He pointed out that this requires an understanding both of the RACHP equipment performance, but also the cooling loads and energy sources, for which there are details in the report.

He indicated some of the impacts of the lack of effective and efficient refrigerated cold chains in low income countries. There is a huge economic and health impact. He pointed out the crazy paradox that in hot low-income countries only 20% of food gets refrigerated, whereas in much cooler high-income countries, 60% of food gets refrigerated. In addition, 1.5 million people die from vaccine preventable diseases, at the same time as billions of dollars of vaccines are wasted. Food and Vaccine loss can be minimized by expanding cold chain infrastructure in a sustainable way, using low GWP and energy efficient technologies.

He described cold chains as complex, temperature-controlled supply chains. And showed examples of the system architecture – from “farm to fork” for food, and “manufacturer to arm” for vaccine.

Every link in these chains are critical for the whole chain ...Break it at one point and the whole thing falls over and food and vaccines get wasted. The greatest energy efficiency is needed at every step to reduce overall energy demand

Mr. Woodcock then stated that the same principles apply to Space cooling which uses about 10% of global electricity and is increasing steadily. The Cooling load and energy use are lower in Efficient Buildings, with a focus on design, insulation, leaks, lighting, and windows. There is synergy with the efficiency of HVAC equipment which requires a system level approach to cost effectiveness

One example is the Build-ME project in residential buildings in the Middle East which achieved 75% energy savings through integrated cost-effective interventions detailed here of which the efficiency of the HVAC equipment was only one

He then described the ACES project, which, is an example of such a systems approach to develop energy efficient and climate friendly cold-chains at scale. It is a major collaborative effort between governments, agencies, companies, and academics, mainly funded by the UK at 20 million dollar.

This is a regional Model with the Hub appropriately based in Kigali, with Specialised Outreach and Knowledge Enterprises (SPOKES) in Kenya, Lesotho and Senegal; Replication is in early stages in Haryana and Hyderabad in India. The aims include providing technical business assistance and training to small-holder farmers and rural communities; Building a skilled engineering workforce for installation and maintenance of the whole cold chain end to end, optimising the use of low GWP and high efficiency equipment, and conducting research on the nutritional and benefits in terms of food and vaccine loss

Mr. Woodcock asserted that insulation is a critical component of any systems approach to energy efficiency. The foam blowing agent (FBA) encapsulated inside foams, lowers thermal conductivity, which reduces the cooling and heating loads in buildings, and can allow more storage space in refrigeration equipment.

Foams manufactured with low GWP alternative FBAs can achieve similar or better thermal performance than HFC's or HCFCs unless FBA blends are modified to reduce cost.

Performance-based standards and codes for foam insulation and for products containing foams (e.g., refrigerators), setting minimum thermal conductivity requirements, can eliminate this risk

Mr. Woodcock handed over to Mr. Omar Abdelaziz for the remainder of the report. He described The working group provided updates on Availability, accessibility and cost of equipment containing low- or zero global warming-potential refrigerants in chapter 4 of the report; the presentation provided high level key messages.

Mr. Abdelaziz suggested that lower cost equipment with lowest possible efficiency (e.g., MEPS level) generally dominate the market. They also found that manufacturers are typically faced with the choice of either buying higher efficiency technologies or components or building internal capacity and they have a strategic decision on “make vs. buy”. Finally, they noted that the IPCC AR6 synthesis report supports the conclusion that concerted effort on energy efficiency and low GWP actions can reduce cost and produce better results.

With respect to the market dynamics, Mr. Abdelaziz mentioned that certified labels enable trusted choice through mandatory or voluntary certification schemes and that upgrading technicians’ knowledge spreads awareness. He highlighted that technician certification improves operational practices and implementation of efficiency retrofits reduce energy consumption. He also suggested that the SMEs in the assembly sector can benefit from regional centers of excellence and performing demonstration or end-user projects enhance their capabilities. Finally, he suggested that electrical incompatibility is one of the main restricting accessibility factors in some regions.

He also presented recent development in electric vehicles suggesting fast growth and a switch towards heat pump technology with a focus on using lower GWP refrigerants. The group also presented another potential cost saving opportunity, the use of waste heat/cold recovery technology. This is an integrated approach to energy systems which reduces the need for energy generation; which adds flexibility, and reduces emissions.

Mr. Abdelaziz also looked at testing equipment and procedures for validation of energy efficiency claims to enforce minimum energy efficiency standards and labels, and voluntary labelling programmes. He mentioned that this is detailed in chapter 5 of the report. He presented a figure showing the general ecosystem for the energy efficiency including MEPS, testing and certification, measurement, verification, and enforcement.

Mr. Abdelaziz said that the energy efficiency working group (EEWG) found that measurement, verification, and enforcement are important for energy efficiency ecosystem. The cornerstone of which are the energy test methods, which should evolve to adapt with new products and technology development. MEPS requires qualified facilities, laboratories, test equipment, trained personnel, and operating procedures. Finally, he noted that certifying and enforcing compliance safeguard energy efficiency related climate and cost savings.

Mr. Abdelaziz presented an example of the variation of MEPS and need for harmonization through the difference in how MEPS for room air conditioning are set in 8 countries. It was noted that the MEPS presented in 8 countries use 3 different reference standard and have 8 different energy efficiency metrics. He mentioned that this makes global competition only possible for large manufacturers with significant resources and reduces global competition.

Next, he showed example costs for setting up test laboratories. The presented figures suggested that it can be quite resource expansive especially for developing nations. The working group showed some options for low cost high quality testing including pooling the resources of neighboring countries by forming regional testing laboratories, relying on existing test facilities from the country of origin, and cooperating with existing test laboratories in the private sector or at technical universities.

Mr. Abdelaziz showed the different paths for certification and compliance: supplier’s declaration of conformity or third party testing and certification. He showed a table; which provides all the information on how to achieve the certification and compliance and the benefits for each path.

Mr. Abdelaziz presented chapter 6 and discussed barriers to consumer and business acceptance of the adoption of more energy-efficient products and equipment containing low- or zero global warming-potential refrigerants and potential means to address them. These include: dumping of low energy efficient products in low-income countries where the lack of knowledge and higher cost of purchase for energy efficiency equipment. Some means to overcome these barriers include:

Consumer education

Reducing investment risk through mechanisms such as rebates, on bill financing, etc.

Better regulations and enforcement: Ban the import of used equipment, Developing MEPS, Investing in MV&E

Upgrading and developing training materials for technicians

Mr. Abdelaziz went on and presented Chapter 7 which describes the potential co-benefits for concurrent energy efficiency and refrigerant conversion. Mr. Abdelaziz described that chapter 7 has two parts: part A – on a global scale using the HFC outlook model and part B on a project level using the joint investment framework as shown next.

While modelling future pathways for RACHP it was shown that there is a massive growth in equipment stock. It was noted that this is driven by growing wealth and population in warm / hot regions.

Under the BAU scenario, the cooling capacity grows by a factor of 3 between 2020 and 2050; even higher growth may occur due to rising global temperatures and improved access to cooling.

Without improved EE, energy use will also rise by a factor of 3. This would result in significant CO₂ emissions, very large investment in new power plants, and leaving end-users facing high energy costs

Mr. Abdelaziz mentioned that modelling shows that energy efficiency policies can significantly reduce energy consumption in the future. He showed that even with a factor of 3 increase in global cooling capacity; the global energy consumption is increased by only 8% under the high energy efficiency gains scenario.

Mr. Abdelaziz discussed how investment in RACHP EE can create significant power generation savings. He suggested that global peak power requirements will be reduced by 1 to 1.5 TW and avoids building 1000 to 1500 large power stations (1000 MW each), saving USD 2 to 3 trillion. He showed a chart depicting that the comfort cooling has larger impact compared with cold chain application.

Mr. Abdelaziz then discussed how indirect Green house gas emissions is affected by the electric grid carbon emissions. It is also important to understand the future electricity decarbonization pathways and their impact on the future prediction. It was mentioned that some countries have different electricity grid carbon factors and plans for decarbonisation ranging from zero carbon grids by 2035 to 2100 or even later.

Kigali amendments to the Montreal protocol effectively phases down the direct emissions as seen by the reduction in the blue area shown on this diagram. To maximize the environmental co-benefits, we need to improve the RACHP energy efficiency in order to curb the orange area shown on the graph.

As show, in the year 2050; the remaining direct emission are the most important to work on which is the heart of the Montreal Protocol.

Cost modelling is crucial for valuing energy efficiency investments that depend on multiple factors such as climate, income, electricity prices, hours of use, electricity grid carbon emissions, and the costs of labour and capital.

Standards setting bodies conduct analyses of the costs to manufacturers and consumers of the revision of minimum energy performance standards (MEPS) or energy efficiency labels.

We then moved to track the range of, and trends, in refrigerants' global warming potential and energy efficiency of refrigeration, air-conditioning and heat pump equipment, for which there are available data as requested in the decision

On this slide we see the status of MEPS for room air conditioners, domestic refrigeration, and commercial refrigeration globally indicated by green color where it is mandatory, light green where it is voluntary, or blue where it is being worked on. Parties with no data are shown in grey.

There is a general trend toward increasing adoption of MEPS for room air conditioners and domestic refrigerators as shown on the top left and right respectively.

Commercial refrigeration MEPS are still in progress as shown in the map on the bottom right.

It is important to note that many A5 parties lack regulatory development capacity

There is an ongoing need for technical assistance and financing in these areas.

There is a global trend towards the use of lower GWP refrigerants driven by the Kigali amendments to the MP

We can see on this table that there is a general trend of increasing adoption of inverter driven room air conditioners. This trend is of increasing energy efficiency is general across other RACHP equipment

Mr. Abdelaziz went on to present Chapter 9 which suggest approaches for the parties to consider to estimate the cost for implementing energy efficiency while phasing down high global warming potential refrigerants.

He said that the energy efficiency working group used the terminology of "additional capital and operational cost" to fund energy efficiency to differentiate from the "incremental capital and operational cost" used for the chemical conversion funding. He then we presented two approaches; the first is a conventional approach "A" based on traditional incremental cost and a novel approach B

based on potential improvement in energy efficiency. This approach was called “improvement-linked incentive”.

Mr. Abdelaziz said that Approach B pays a certain percentage of the additional cost for the beneficiary based on the “start” and “end” energy efficiency levels compared with international levels.

This approach, provides the highest incentive to those who need it the most – beneficiaries starting with the lowest energy efficiency capabilities and planning to achieve the maximum energy efficiency benefit.

This would result in enabling MEPS tightening and enable the greatest benefits

Mr. Abdelaziz showed a chart, for a BAU scenario for a manufacturing party in a developing region. In this chart, Mr. Abdelaziz explained that the government is regulating to at lower MEPS in order to accommodate SMEs and low-EE capability manufacturers. As such, the importing countries and LVCs in the same region would only have access to low efficiency equipment.

He then showed another depiction for the potential funding scheme “approach B” that can achieve higher MEPS levels on a regional basis. He said that this approach would target funding to enterprises with lower EE capabilities. As such, the manufacturing party and LVCs will be able to regulate to higher MEPS, and LVCs will have access to higher EE technology.

Mr. Abdelaziz said that funding energy efficiency matters. He showed typical technology learning curves which depicts that additional EE costs are expected to decrease as enterprises “learn by doing” and increase capacity. He noted that it can take several years for companies to recoup the initial investment

As such, he suggested that funding energy efficiency is an important to improve cost-effectiveness.

Mr Woodcock concluded the presentation with the main conclusions of the EEWG Report as follows:

To understand and realise the full synergy for energy efficiency, a systems approach is required for both building cooling and cold chains.

The energy efficiency co-benefit during HFC phasedown is not yet being achieved where the major growth in RACHP is taking place, in many A5 parties.

Synergy between energy efficiency improvement and high global warming potential refrigerant transition would result in the greatest climate benefit at the lowest cost.

By 2050, energy savings could result in up to 3 US\$ trillion savings by avoiding the building of 1500 new power plants.

An incentive-linked funding approach to improve energy efficiency has been described which has the potential to maximize the climate co-benefit.

E. Presentation on the response to decision XXXIV/5: Identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring

Ms. Helen Tope, co-chair of the Medical and Chemical Technical Options Committee, on behalf of the Technology and Economic Assessment Panel presented the report from the Panel in response to decision XXXIV/5 on identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring, which requested the TEAP to prepare a report on chemical pathways in which substantial emissions of controlled substances are likely, best practices available to control these emissions and gaps in understanding the sources of those emissions.

She explained that in its assessment of chemical pathways in which substantial emissions of controlled substances are likely, MCTOC assigned chemical pathways into associated global annual production bands and likely emission rates for related controlled substances, identified chemical production pathways that are likely able to produce “substantial emissions” of controlled substances, i.e., those having a sufficiently high combination of likely emission rate and annual global production, and considered a reasonable threshold for “substantial emissions” to be global emissions greater than 1,000 tonnes of controlled substance per year from a chemical pathway.

She reported that, based on its assessment, 24 chemical pathways are considered likely to have substantial emissions of controlled substances. She referred to Table 5-5 of the 2023 TEAP Progress Report and the related matrix, Figure 5-3, showing those pathways with substantial emissions. She noted that the assessment shows that most production processes will only have substantial emissions

of controlled substances when producing controlled substances or using them as feedstocks, and that any other controlled substances involved in the process will only be produced and then released in much smaller quantities, which may be negligible. She noted exceptions where chemical pathways are likely able to produce substantial emissions of unwanted by-products, namely, HFC-23 by-production from chloroform to HCFC-22 chemical pathway, CTC by-production from methyl chloride to dichloromethane to chloroform chemical pathway, and CFC-115 by-production from perchloroethylene to HFC-125 chemical pathway. She also noted that there are chemical pathways with annual emissions of by-products likely to be on the boundary of substantial emissions used in this assessment, for example, HFC-23 by-production from dichloromethane to HFC-32 and HFC-23 by-production from HCFC-22 pyrolysis to tetrafluoroethylene and hexafluoropropene.

She outlined a range of best practices available to control emissions of controlled substances arising from production, by-production, and feedstock use, including optimising plant design, equipment, operation, maintenance; instrumentation and monitoring of process and emissions; training and instruction for plant operators; periodic mass balancing; technologies for destruction, or for separation and chemical transformation, to treat unwanted co-products or by-products and abate their emissions; and regulatory controls to provide the economic framework to ensure any or all of the above emissions mitigation measures are implemented by operators, and to require emissions and other reporting.

She explained that there are many gaps in understanding the sources of emissions from chemical pathways with substantial emissions, the main reasons being the existing gaps in publicly available data, some of which may be unavailable due to commercial confidentiality, and that, as a result, estimations of mean emission rates of controlled substances and annual global production have a high degree of uncertainty. She elaborated some gaps in understanding the sources of emissions, that: the global capacity and production by chemical pathway are not accurately known; production and feedstock quantities are available for controlled substances under Article 7 reporting but might not be available for chemical pathways producing or using non-controlled substances that might emit controlled substances; for most production facilities, actual emissions and global locations are not reported by parties; average global generation and mean emission rates of controlled substances by different chemical pathways are not accurately known and likely vary over time; while the sources of emissions from chemical pathways and emission rates used in our assessment are likely to be reasonable estimates, they might change over time.

F. Presentation on the progress report 2023 of the Technology and Economic Assessment Panel

Marta Pizano, on behalf of her co-chairs of the TEAP Bella Marañon and Ashley Woodcock, introduced the panels' presentation on their 2023 Progress Report. Ms. Pizano stated that aside from the progress reports of the five technical options committees composing the TEAP, the report contained the Critical Use Nomination (CUN) 2023 interim report, responses to Decisions XXXIV/10 on MB stocks and QPS uses, XXXIV/6 on carbon tetrachloride (CTC) and XXXIV/11 on TOC configurations. Short references to polyfluorinated and alkyl substances (PFAS) and TEAP organizational matters were also included in the report. Since January 2023, the TEAP had submitted, for consideration of the parties, five TOC Assessment Reports, the TEAP Assessment Report, the replenishment report (Decision XXXIV/2) and the Synthesis Report.

Ms. Pizano and Mr. Ian Porter then proceeded to present the Methyl Bromide Technical Options Committee Progress Report, the Critical Use Nominations 2023 interim report and the TOC's response to Decision XXXIV/10 on MB stocks and QPS uses. In summarizing the progress report findings with the controlled and exempted uses of methyl bromide, Ms. Pizano indicated that MB had been recommended for inclusion in Annex III of the Rotterdam Convention allowing 165 Parties to influence potential tracking and importation of MB under the Prior Informed Consent procedure (PIC). She further highlighted that sulfur fluoride (SF), a widely adopted alternative to MB for structures and commodities and some QPS uses has been listed under Annex II of the proposed F-gas regulation of the EU owing to its high GWP of 4780. If approved, this regulation could restrict use and increase the costs SF. She then stated that research on alternatives to MB for many QPS uses continues and registration of chemical alternatives such as hydrogen cyanide (HCN), ethane dinitrile (EDN), ethyl formate (EF) is expanding around the world.

Ms. Pizano then proceeded to present the interim CUN evaluation. MBTOC received one application for critical use in 2024 for 3.857 t from Canada, representing a 17% reduction from the approved amount at 34th MOP. This request had received full recommendation from MBTOC. The party reported zero stocks at the end of 2022 and indicated a reduction plan to phase out MB entirely by 2026. No A5 party submitted a CUN for MB use in this round.

In finalizing her presentation, Ms. Pizano described the tasks set out by Decision XXXIV/10, which invited parties to submit, on a voluntary basis, a list of pest and commodity combinations in which methyl bromide is needed and data on pre-phaseout stocks of MB. At this time three parties had submitted such information to the Ozone Secretariat. With respect to MBTOC, the decision requested that the committee, in consultation with the secretariat of the International Plant Protection Convention (IPPC), provided information on current QPS uses for which alternatives are available.

Continuing with the presentation, Mr. Ian Porter stated that in order for MBTOC to respond to its task under the Decision XXXIV/10/4 it required accurate information about the commodities and classification (i.e. whether quarantine or pre-shipment) as the availability of alternatives differed. He then followed by showing a figure of the breakdown the available reported MB uses by commodity provided in voluntary responses to surveys from the 2018 and 2022 assessment reports. He showed that 50% of the use was for logs, wooden product and softwood packaging material and thus if an effective alternative (such as heat, sulfuryl fluoride or potentially ethanedintrile) was available and used it could replace a large portion of QPS use.

He then followed with slides which demonstrated whether uses fit with the classification of Quarantine (i.e. when a quarantine pest was officially targeted for the need for control) or pre-shipment (where the treatment was not for a quarantine pest, but had an official regulation requiring treatment) and those which did not have an official regulation for treated nor a quarantine pest and thus fitted neither the definition for quarantine nor pre-shipment.

Mr. Porter proceeded to show a flow chart which showed how to classify uses into quarantine and pre-shipment fumigation) and suggested to parties to consider the chart when determining whether to use methyl bromide. A list of the main suitable alternatives, their targets and commodities was then presented with examples of uses that were suitable for up to 30-40% of the total QPS uses and where alternatives were accepted and available for quarantine treatments listed in the International Standards for Phytosanitary Measures accepted for various quarantine treatments internationally by the International Plant Protection Convention.

Mr. Porter concluded the presentation by giving a set of ways of improving the adoption of alternatives including ensuring consistent differentiation between quarantine and endemic pests, acceptance of efficacy levels below the default Probit 9 (99.997% efficacy) when considering bilateral negotiations, increasing registration of alternatives in different regions where efficacy of the alternative has been shown and to continually review trade partner approvals and implementing IPPC accepted alternatives.

Next, Helen Walter-Terrinoni, co-chair of the Flexible and Rigid Foams Technical Options Committee (FTOC) presented details of the FTOC 2023 Progress Report, recognizing her co-chair, Paulo Altoe. She noted that generally, transitions to non-ozone depleting substances (ODSs) and low global warming potential (GWP) alternatives have been successful and transitions continue to move forward. However, she commented that there is no single 'drop-in' FBA replacement for currently used HCFCs or hydrofluorocarbons (HFCs).

She then commented that there are different technical, economic, safety, and environmental performance properties for each low GWP, zero ozone depletion potential (ODP) alternative and different needs for each market subsector causing a proliferation of FBA blends across the whole of the foam sector.

Ms. Walter-Terrinoni reminded parties that technical and economic challenges remain for some sectors and small and medium enterprises (SMEs) and that the price of HFC blowing agents has risen substantively and is nearly as high as hydrofluoroolefin (HFO) and hydrochlorofluoroolefin (HCFO) prices were in some A5 parties. This is especially challenging for SMEs.

Ms. Walter-Terrinoni shared that newly announced low global warming potential (GWP) foam blowing agent capacity has eased the shortage of supply and cost of alternatives, especially cyclopentane and hydrofluoroolefins (HFOs). She went on to say that additional capacity required to alleviate the shortage suggests that there was insufficient capacity to meet regulated needs for low GWP FBAs. However, HFC-365 manufacture will cease in 2023, after significant resource investment by foam manufacturers to convert. She noted that Insufficient capacity to meet regulatory mandates is likely to recur without intervention and that patents have restricted options to address local supply chains.

Ms. Walter-Terrinoni went on to describe challenges and opportunities during the transition. First she explained that there continues to be a trend away from the use of fluorocarbon (FC) FBAs with every transition estimating a reduction of 80% . She then noted that as the phaseout of HCFCs and the

phasedown of HFCs progress, there will be limited availability and increasing prices of FBAs which will drive the selection of alternative foam blowing agents.

She stated that as the phaseout of HCFCs and the phasedown of HFCs progress, there will be limited availability and increasing prices of FBAs which will drive the selection of alternative foam blowing agents in part due to direct conversions to other FBAs and in part as a result of the use of blends with lower concentrations of FCs.

She also noted that in parties without standards related to minimum thermal performance requirements, optimizing foam costs could result in higher energy consumption for buildings and refrigerating equipment.

Mr. Chattaway then summarized the FSTOC Progress Report. He commented that there was little new information since the Assessment Report was published and the FSTOC were focusing on two key issues: the halon run-out date and increasing emissions of halon 1301.

He presented a chart showing how the Halon 1301 run-out date range continues to move earlier, because the available halon 1301 bank is being depleted faster than the total bank. He noted that some of the enduring uses are not transitioning to alternatives. He gave two examples: (1) the civil aviation industry is still producing aircraft fitted with halon 1301 in the engines and cargo compartments. These aircraft have a 30-year expected life and will need halon 1301 for that entire life. (2) Some military vehicles are being upgraded and receiving life extensions for 20, 30 or more years into the future. These vehicles will also require halon 1301 for their entire lifetime.

Mr. Chattaway also stated that emerging PFAS policies are already influencing industry's transition to halon alternatives owing to uncertainty over the long-term future viability of the alternatives if they are classified as PFAS.

Turning to emissions, Mr Chattaway presented a chart comparing halon 1301 emissions derived from atmospheric measurements with those based on the FSTOC model (i.e., those from a steadily-declining bank). The emissions derived from atmospheric measurements continue to show unexplained deviations in recent years over and above those expected from a steadily declining bank in the absence of any production. The amount of these discrepancies (i.e., the area between the curves) represents approximately 4,600 tonnes, which is a substantial fraction of the estimated remaining bank of halon 1301. Therefore, it seems reasonable that these emissions are not from the fire protection bank. Instead, the FSTOC thinks these could be from production for feedstock of Fipronil and other substances. To help understand this situation better, and in turn provide a better prediction of the run-out date for halon 1301, the FSTOC is requesting additional information production for feedstock and resulting emissions, if possible, on a regional basis.

Ms Helen Tope, co-chair of the Medical and Chemical, reported that in 2021 total ODS production and import reported for feedstock uses was 1.8 million tonnes, a significant increase from 2020, and an increase of about 50% over the last decade, and that the largest reported HFC feedstock was HFC-152a, in the thousands of tonnes.

She noted that the TEAP Progress Report elaborates further on challenges described in the 2022 MCTOC Assessment Report that could emerge in transition from high-GWP propellant pressurised metered dose inhalers (pMDIs) to inhalers with lower GWPs and with continued supply of technical- and pharmaceutical-grade HFC-134a and HFC-227ea, and that these and other market-based challenges and uncertainties, within the context of the HFC phase-down, reinforce the need for a well-planned transition to ensure patients do not face critical shortages or price increases that make pMDIs unaffordable. She explained that as global HFC production diminishes, pMDI manufacturers, including in A5 parties, may find bulk pharmaceutical-grade high-GWP propellant sourced from the United Kingdom increasingly difficult to obtain and that their cost will increase. She noted that these pMDI manufacturers may have to switch to pharmaceutical-grade propellant currently available in India or China, and that gaining qualification for an alternative propellant source takes months to years. She said that for pMDI manufacturers in A5 parties that export to non-A5 parties, a switch of propellant manufacturer requires additional studies to gain pMDI regulatory approval, which would take time and could impact the continued supply of these pMDIs to non-A5 markets. She noted that there will be incremental costs for pMDI manufacturers in A5 parties in the transition from high GWP pMDIs to pMDIs with lower GWP propellants that parties may need to consider. She highlighted two possible options for provision of pharmaceutical-grade propellant in future years if technical-grade feedstock plants can no longer supply HFC-134a "just-in-time", which means supply to meet immediate needs. She elaborated that the first option is for pharmaceutical-grade HFC (134a or 227ea) to be produced in earlier years and stored in a way that retains its purity and medical status and the second options is for technical-grade HFC to be stockpiled and later converted to

pharmaceutical-grade by passing through a medical purifier plant. She noted that planning for both would be very challenging, considering cost, regulatory, practical issues, and that there is a risk that insufficient time may be left between when decisions are made to build stock and when technical-grade HFC manufacturing assets must shut down, so that stock building may become impractical.

She reported on TEAP's response to decision XXXIV/6 on ongoing emissions of carbon tetrachloride (CTC), which invited parties to provide information on national procedures and frameworks for the management of CTC production, by-production, feedstock and process agent uses, and requested the TEAP to review and present this information in its 2023 progress report. She reported that China, the EU, Japan, UK, and the US, submitted information in response to the decision and referred the meeting to the progress report, where there is a generic summary of the information in the submissions that identifies similar elements of national procedures and frameworks established by this sample of parties and a non-exhaustive list of national procedures and frameworks taken from the submissions.

RTOC co-chair Fabio Polonara presented the RTOC Progress Report summary. He started recalling that the work on the 2022 RTOC Assessment Report had continued until the end of February 2023 and since then no compelling new information is available on the technology.

He then moved to present the work done by the RTOC co-chairs after the completion of the Assessment Report, mostly regarding the evolution of the RTOC membership for the next two years, with the goal of tackling current commitments and future challenges.

The current RTOC membership consists of 43 members, 26 of which are old members and 17 are new nominations. In order to comply with gender and geographical balances the new RTOC consist of 33 men and 10 women, while 22 members are from nonA5 parties and 21 are from A5 parties. Mr Polonara then concluded by mentioning the RTOC contribution to the Energy Efficiency Working Group (EEWG) established by TEAP in response to Decision XXXIV/3. As a matter of fact, the EEWG includes 15 members from RTOC, who worked to prepare the report that had been presented to OEWG45 the day before and that can be found as a supplement to the TEAP 2023 Progress Report.

TEAP co-chair Bella Maranion presented information contained in the progress report on per- and poly-fluoroalkyl substances (PFAS) and some of the emerging policies and sector information followed by TEAP. There is increasing focus on the use, emissions, and environmental and health effects of PFAS. Ongoing regional, national and subnational actions related to PFAS may or may not restrict products using chemicals controlled under the Montreal Protocol and their substitutes, as well as their breakdown products, such as trifluoroacetic acid and its salts (TFA). This is creating uncertainty for industry regarding the long-term availability of certain alternatives to ODS and HFCs. This could have unintended impacts, i.e., delaying the phase-out of ODS and phase-down of high GWP HFCs.

She noted that PFAS have been defined differently by national and sub-national jurisdictions. For example, the Organisation for Economic Co-operation and Development (OECD) definition would include controlled substances under the Montreal Protocol; it includes most HFCs, HFOs, and TFA. Another example is the U.S. Environmental Protection Agency (EPA) working definition of PFAS which excludes most, if not all, HFCs, HFOs, and specifically TFA. In addition, in the U.S., some states are considering or enacting policies on PFAS with definition and scope to include substances controlled under the Montreal Protocol.

Regulations related to PFAS include the European Chemicals Agency (ECHA) proposes bans under the Regulation, Evaluation, Authorisation, and Restriction of Chemicals (REACH) regulations 18 months after entry into force" but may allow for some exceptions for a limited period of time. Some examples of proposed derogations for fluorinated gases include the maintenance of existing heating, ventilating, air conditioning, and refrigeration (HVACR) equipment; refrigerants in HVACR equipment in buildings; and refrigerants in mobile air conditioning systems. In the United States, EPA is evaluating priority groups of PFAS chemicals under their "PFAS Strategic Roadmap: EPA Commitments to Action 2021-2024." Some states in the United States have enacted bans for controlled substances effective 2030 and beyond, with an opportunity for exceptions. Canada initiated a rulemaking considering the OECD definition. Some jurisdictions (e.g., China and Japan) restrict certain PFAS under the Stockholm Convention on Persistent Organic Pollutants or POPs, including PFOS, PFOA, PFHxS only.

TEAP considered potential sector impacts from a possible broad ranging definition of PFAS and associated restrictions. For the fire-suppression sector, low GWP alternatives 2-BTP, FK-5-1-12 would be considered PFAS, but all Halons, CF3I, and high-GWP HFC-23 would not be considered PFAS. This will affect civil aviation's replacement of Halon 1211 with 2-BTP. For the foams sector,

HFO/HCFO alternatives would be considered PFAS, with uncertainty delaying selection. For pressurized metered-dose inhalers, HFC-134a, HFC-227ea, and potential alternative HFO-1234ze(E) would be considered PFAS with impact on global supply, affordability, and accessibility of current propellants. Specialist uses could have limited, if any, lower GWP options: e.g., electronics manufacturing, magnesium production, and precision cleaning for aerospace and military use. In the RACHP sector, most current and low-GWP alternative fluorinated refrigerants (except five e.g., HFC-32) would be considered PFAS, including HFC-134a, R-404A and R-410A and all HFOs. A potential broad-ranging PFAS restriction could affect uptake of low GWP alternative refrigerants, energy efficiency of medium-sized RACHP systems, and adoption of decarbonising heat pumps. Most of the fluoropolymers used as flexible seals in compressors, valves and other RACHP components would also fall within OECD definition of PFAS. This use would also apply to other sectors.

Ms. Maranion then presented the TEAP's response to Decision XXXIV/11 which requested TEAP, in consultation with its TOCs, "to provide further information on existing challenges and options for future configuration and function of its TOCs." TEAP anticipates its workload and that of its TOCs will remain at least at the same high level as in the past several years. In addition to yearly requests for technical and economic information, the TEAP and its TOCs have several standing requirements for annual, triennial, quadrennial and quintennial analyses and reports on ODS phase-out, HFC phase-down and alternatives, destruction technologies, process agents, n-propyl bromide, laboratory and analytical uses, replenishment, energy efficiency, cross panel issues, etc. TEAP has in the past, and will continue in the future, to organise its activities to meet all of these current and emerging technical and economic assessment needs of the parties. TOC co-chairs continually review their membership to ensure having the expertise necessary to provide parties with the latest technical and economic information in their sector, and to be able to respond to specific party requests.

TEAP proposes to maintain the structure of its current five TOCs aligned along the Montreal Protocol sectors: FTOC, FSTOC, MBTOC, MCTOC, RTOC. Considering its workload, TEAP proposed that the RTOC continues as a single body primarily organised around two specific areas, the cold chain and space heating and cooling. TEAP proposes a fourth RTOC co-chair, two from A5 and two from non-A5 parties to better manage its two specific areas. RTOC will continue to meet in one location, holding separate breakout working groups focused on these two areas, and producing a single consensus report. The co-chairs will manage the work across cross-cutting issues in addition to ensuring collaboration with other TOCs.

Ms. Maranion concluded the presentation by reporting on a number of organizational matters. At the end of 2023, terms of appointment will end for some TEAP members including two co-chairs each for MCTOC and RTOC and all Senior Experts (see Annex 4 of the TEAP 2023 Progress Report). As indicated in the TEAP TOR, the Senior Experts to the TEAP fulfil an important role by providing specific expertise not covered by the other members (TEAP or TOC co-chairs). TEAP has identified its current needed expertise for Senior Experts and TOC members in the matrix of needed expertise contained in Annex 5 of the TEAP 2023 Progress Report.

Annex III

Statements delivered at the time of the adoption of the agenda in chronological order

A. Statement by the representative of Ukraine¹

For more than 9 years, Ukraine has been waging an unprecedented, full-scale war, unleashed by the terrorist state Russia against Ukraine.

This immoral war in the heart of Europe is a war against the Ukrainian nation, the Ukrainian environment, the Ukrainian economy and the Ukrainian identity itself.

Genocide and ecocide of Ukraine are taking place.

It causes concern that Russia's aggression against Ukraine already has irreversible consequences not only for Ukrainian biodiversity, but also for the sustainable development of the European continent and the world.

The temporary occupation of the Ukrainian territories destroys the possibility of obtaining reliable reporting data and destroys the credibility of the reports provided by the Ozone Secretariat.

In recent years, Ukraine has made significant progress in developing a system for monitoring and regulating controlled substances. The Law of Ukraine "On Regulation of Economic Activity with Ozone Depleting Substances and Fluorinated Greenhouse Gases" has been adopted, HFC licensing was introduced, a register of operators is being created, and more. But there can be no effective policy without peace. The Russian war has caused a lot of destruction - residential buildings, schools, hospitals, grocery retail chains, and cooling systems are being destroyed. Large amounts of refrigerants are being released directly into the air, which reduces the results of the efforts of all countries that are Parties to the Montreal Protocol.

What is the climate price of the war waged by Russia?

A report released on the sidelines of the UN climate summit in Bonn estimates that the first 12 months of the war will result in a net increase in greenhouse gas emissions of 120 million tonnes. And the continuation of military armed aggression deepens this crisis.

There can be no effective climate policy without peace on Earth. Russia must shut up its guns and hide its missiles so that the world can finally hear what we can all do together to save ourselves from climate catastrophe. The world needs peace.

I would like to thank the parties to the protocol for their solidarity and support of the Ukrainian people who are fighting for their survival against genocide and ecocide.

We thank everyone who works for peace.

To all who take seriously the need to protect life on Earth for all people: all nations, all classes, all cultures.

We ask to include this statement in the report of 45th meeting of the Open-ended Working Group of the Parties

Thank you for your attention

B. Summary of the statement by the representative of the United States of America, speaking on behalf of Australia, Canada, Israel, Japan, Norway, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America

The representative of the United States of America, speaking on behalf of Australia, Canada, Israel, Japan, Norway, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America, condemned what he termed the ongoing brutal attack by the Russian Federation on civilians and critical infrastructure in Ukraine, which also caused environmental damage and transboundary harm. He noted the resolution adopted by the United Nations General Assembly on 23 February 2023 and reaffirmed the principles of the United Nations Charter as well as unwavering

¹ This statement is reproduced as delivered, without formal editing.

commitment to a comprehensive, just, and lasting peace in Ukraine. According to him, the actions of the Russian Federation were a violation of international law and the United Nations Charter and those responsible should be held to account. He called on the Russian Federation to abide by its international obligations, cease all hostilities in Ukraine, withdraw its troops and facilitate humanitarian aid in the country.

C. Summary of the statement by the representative of the European Union and its member States

The representative of the European Union and its member States said that multilateral cooperation, based on mutual respect, was crucial for addressing the huge environmental challenges faced by humanity. She therefore expressed full solidarity with the people of Ukraine, condemning what she termed the unprovoked and unjustified aggression by the Russian Federation. She said that the invasion of a sovereign country by the Russian Federation was a gross violation of international law and the United Nations Charter and was severely undermining international security, causing immense human suffering and exacerbating the challenges that the global environmental community was seeking to address.

D. Summary of the statement by the representative of Georgia

The representative of Georgia, expressing full support for Ukraine and the Ukrainian people, said that the actions of the Russian Federation were unjustified, unprovoked and premeditated and had gravely altered the security environment and had had humanitarian and environmental costs that could reverse sustainable development and hinder humanity's efforts in tackling several environmental challenges. He expressed concern about attacks on civilian infrastructure and civilian casualties and what he termed a clear violation of international law and the United Nations Charter. He expressed unwavering support to Ukrainian independence, sovereignty and territorial integrity, and the hope that the war would soon be over.

E. Statement by the representative of the Russian Federation²

We have listened attentively to the statements of the delegations that have once again accused Russia of unprovoked aggression against Ukraine. We really did not want to have a political discussion at this meeting, but we were not the ones who started it. As a result, you are now going to hear the truth about the alleged and so-called unprovoked aggression. This is in fact a lie which has been deliberately widely propagated, because the military actions were certainly provoked, and that provocation took the form of years-long pressure on Russia from all sides. The countries of the aggressive military bloc NATO have done everything to arm Ukraine to the teeth and make it an enemy not only of Russia, but of all that is Russian, including the population – its own population – living in the vast territory of eastern Ukraine. In essence, the goal of the NATO countries was to provoke a civil war so that Russians would kill Russians. But what is Ukraine? Ukraine is a part of greater Russia, once the greater Russian Empire, and Kiev is the historical cradle of the Russians, and of the Russian lands. Ukraine never existed; it appeared artificially on the ruins of the Soviet Union only 30 years ago. Before that, this region of the Russian Empire was called Malorossiya, that is, Little Rus'. Since 2014, when a military coup d'état took place in Kiev through the efforts of Western countries, Ukrainian forces, mainly nationalist and neo-fascist battalions, have regularly directed artillery and mortar fire at civilians, homes, hospitals and schools in the eastern provinces of Ukraine, on the sole grounds that Russians who did not recognize the nationalist military coup d'état in Kiev in 2014 live there. For eight years, women and children have been dying continuously under the shells of Ukrainian troops, and President Zelensky has even addressed them on television in Russian – which happens to be his native language – and said: “If you want to live, run to Russia”. That is a quote, I heard it with my own ears. His predecessor, President Poroshenko, said from a podium, and this is also a quote, “Our children will go to school, and their children will sit in basements.” What was there left for the Russians living in eastern Ukraine to do? They took up arms and turned to Russia for help. That is why Russia launched a military operation to stop civilian deaths and protect people living in eastern and southern Ukraine. We do not need new territories, but there was no way that we could leave Russian people in trouble and condemn them to destruction. In addition, the goal of Russia's military operation was to eliminate the military potential of Ukraine's nationalist and neo-Nazi regime, which held up as national heroes Stepan Bandera and his associates – Nazi criminals of World War II – on the sole grounds that they fought for independence and at the same time massacred Russians, Jews and Poles in full compliance with Hitler's instructions for waging war in Eastern Europe. As a victorious country

² This statement is reproduced as delivered, without formal editing.

that defeated Nazism in 1945, Russia cannot reconcile itself with the existence in Ukraine of fascists, and all the more so because they have openly issued a challenge to the Russian population and all things Russian. Now the so-called Western world is trying to destroy Russia by the hands of the Ukrainians. The NATO countries are arming neo-Nazis and are willing to forgive them anything just so they can defeat Russia on the battlefield. This is a very short-sighted and dangerous policy. I would particularly like to point out that from the very beginning of the conflict in Ukraine the population of most countries has been receiving information about what is happening in Ukraine that is not just distorted, but is deliberately painting a false picture based on fakery. That empire of lies, with its well-proven technologies of deception, has made it possible to reach the desired goal efficiently and quickly, moulding Russia into the image of a villain and an enemy. In what looks to many people like a victory in the information war, there has been success in removing all alternative sources of information by banning the operation of Russian, and not only Russian, media, discarding the foundations of democracy and of human rights, including freedom of speech. But that is really a Pyrrhic victory, and everyone will soon be convinced that that is the case. The course of history will put everything in its place, and the truth about the war in Ukraine will surely prevail. I would also like to say that the delegations that left the room when the representative of the Russian Federation began speaking are showing basic disrespect. They have been listened to, but they do not want to hear, and they have no need for another opinion. They only want to know their own truth, or rather the false information that is usually disseminated everywhere. I will not dwell on the environmental consequences mentioned by the distinguished delegate of Ukraine, but I will mention just one fact: for more than a year, Ukrainian troops have been shelling the Zaporozhye nuclear power plant, which happens to be the largest in Ukraine. They are using artillery fire, although the power plant is in a fairly calm area and is being guarded by Russian troops. Of course, it is absolutely clear to everyone that the purpose of such shelling is to repeat the Chernobyl disaster. This speaks to how Ukraine, or rather its current regime, cares about the environment.

Thank you, Mr. Co-Chair.
