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Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer
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Bangkok, 3–7 July 2023
Item 4, 6, 7 and 8 (b)–(f) of the provisional agenda*

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

Note by the Secretariat

Addendum

I. Introduction

1. The present addendum to the note by the Secretariat on issues for discussion by and information for the attention of the Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer at its forty-fifth meeting (UNEP/OzL.Pro.WG.1/45/2)[1] contains information that has become available since the preparation of the first addendum to the note (UNEP/OzL.Pro.WG.1/45/2/Add.1).[2] That addendum provided updates by the Secretariat in relation to items 3, 8 (a) and 10 (b) of the provisional agenda of the forty-fifth meeting of the Open-ended Working Group.

2. Section II of the present addendum contains information set out in the 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, in relation to item 4 of the provisional agenda; the reports by the Secretariat and the Panel related to the identification of gaps in the global coverage of atmospheric monitoring and options for enhancing such monitoring, in relation to item 7 of the provisional agenda; and summaries of the Panel's responses to decisions on issues to be considered by the parties, in relation to items 6 and 8 (b)–(e) of the provisional agenda. These issues pertain to energy-efficient and low- or zero-global-warming-potential (GWP) technologies, ongoing emissions of carbon tetrachloride, quarantine and pre-shipment uses (QPS) of methyl bromide, existing challenges and potential options for the future configuration and function of the Panel's technical options committees and changes in Panel membership. An issue raised by the Panel in its progress report on emerging policies related to per- and poly-fluoroalkyl substances, which parties may wish to consider under sub-item 8 (f) of the provisional agenda, is also outlined.

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

[1] Available at https://ozone.unep.org/system/files/documents/OEWG-45-2E.pdf.

[2] Available at OEWG-45-2-Add-1E.pdf (unep.org).

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

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

Agenda item 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)

4. Consistent with decision XXXIV/2, the Technology and Economic Assessment Panel established a task force to prepare a report[3] on the appropriate level of replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the triennium 2024–2026 for submission to the Thirty-Fifth Meeting of the Parties through the Open-ended Working Group at its forty-fifth meeting. The task force report is available on the meeting portal of the Ozone Secretariat website. The executive summary of the report is set out in annex I to the present addendum, as received from the Panel, without formal editing by the Secretariat.

5. The task force notes in its report that its estimates for the funding requirements for the 2024–2026 triennium, as well as those for the future trienniums requested in decision XXXIV/2, take strictly into account the compliance targets within these periods, which comprise, for the first time, both hydrochlorofluorocarbon (HCFC) and hydrofluorocarbon (HFC) reduction targets.

6. In carrying out its calculations for the funding requirements for the triennium 2024–2026, the task force used as a basis the adjusted consolidated business plan of the Multilateral Fund for 2023–2025, relevant decisions of the Executive Committee of the Multilateral Fund at its ninety-first meeting and information available through the Multilateral Fund secretariat. The task force also relied on existing cost guidelines. However, in the absence of final cost guidelines for the HFC phase-down by the time of the finalization of the report, the task force developed its own model to estimate the funding required to phase down HFCs for the 2024–2026 triennium, based on compliance targets for the triennium, the best available information, established practices, experiences in HCFC phase-out implementation, and available decisions taken and information and guidance provided by the Executive Committee.

7. The task force states that any decision that may be taken at the ninety-second meeting of the Executive Committee pertaining to the guidelines for financing the phase-down of HFC consumption and production, including the starting point for sustained aggregate reductions, the duration and level of incremental operating costs and cost-effectiveness thresholds, can be taken into account in a supplementary report.

8. Through a detailed analysis, the total funding requirement for the replenishment of the Multilateral Fund for the triennium 2024–2026 was estimated at between $975 million and $1.018 billion. The funding requirements were calculated for a low-end and a high-end scenario, which are distinguished by the number of parties operating under paragraph 1 of Article 5 of the Montreal Protocol (Article 5 parties) having ratified the Kigali Amendment (see table 1). The estimates were derived from calculations of the funding requirements for components related to the HCFC phase-out, including activities related to energy efficiency; the HFC phase-down, including project preparation for gender mainstreaming, enabling activities, and energy efficiency funding window; a funding window for end-of-life/disposal activities covering both HCFCs and HFCs; and institutional strengthening and standard activities (i.e. costs related to the compliance assistance programme of the United Nations Environment Programme, the implementing agencies, and the Multilateral Fund secretariat and Treasurer).

[3] https://ozone.unep.org/system/files/documents/TEAP-DecisionXXXIV2-replenishment-TF-report-May2023-RTF-report.pdf.

Table 1
Range of total funding requirements for the replenishment of the Multilateral Fund for the period 2024–2026 based on a low-end and a high-end scenario

(United States dollars)

Triennium 2024–2026	*Low-end scenario*[a]	*High-end scenario*[b]
Subtotal – HCFC activities (including energy efficiency)	**363 911 000**	**363 911 000**
Subtotal – HFC activities (including gender mainstreaming activities, project preparation, enabling activities and energy efficiency funding window)	**475 491 000**	**519 142 000**
Subtotal – Funding window for end-of-life/disposal activities	**13 590 000**	**13 590 000**
Subtotal – Institutional strengthening and standard activities	**121 581 000**	**121 581 000**
Grand total	**974 573 000**	**1 018 224 000**

Abbreviations: HCFC – hydrochlorofluorocarbon; HFC – hydrofluorocarbon.

[a] Based on calculated HFC baselines for the 104 Article 5 parties that had ratified the Kigali Amendment as of 3 April 2023, using a range of cost-effectiveness factors.

[b] Based on calculated HFC baselines for all 144 Article 5 parties ratifying the Kigali Amendment, using a range of cost-effectiveness factors.

9. The report provides a detailed account of the calculations of the various components and the assumptions involved in addressing the provisions of decision XXXIV/2. The task force notes, however, that owing to a lack of information, its estimates do not take into account some factors that could affect the level of funding, such as the impacts of the coronavirus disease (COVID-19) pandemic on the development of national HFC policies and regulations; the availability and accessibility of alternatives and technologies; delays in project preparation, approvals and implementation; and the capacity of implementing agencies and developing country institutions to manage the ozone-depleting substance phase-out and the HFC phase-down compliance regimes.

10. Furthermore, in chapter 1.7 of its report, the task force highlights its need to receive further guidance from the parties in relation to paragraph 4 and subparagraph 2 (f) of decision XXXIV/2. In paragraph 4 of the decision, the Panel is requested to provide indicative figures for a range of typical scenarios associated with enabling Article 5 parties to implement HCFC phase-out management plans and Kigali HFC implementation plans in a coordinated manner, using all relevant data available to the Panel. The task force notes its understanding that the request is for the Panel to consider the remaining opportunities to transition directly to lower-GWP technologies through coordination in later-stage HCFC phase-out management plans and stage I Kigali HFC implementation plans, and seeks the parties' confirmation that its interpretation is correct.

11. In subparagraph 2 (f) of the decision, the Panel is requested to consider the need to allocate resources for supporting activities related to gender mainstreaming as part of the gender policy of the Multilateral Fund, taking into account the implementing agencies' existing policies to promote gender mainstreaming and the mandate set out in Executive Committee decision 84/92.[4] While the funding requirements for gender mainstreaming are discussed in chapter 7 of the report (estimated at $13,590,000 for the 2024–2026 triennium), the task force notes that its estimates do not include funding needs to strengthen capacity on gender mainstreaming at Multilateral Fund institutions, such as its implementing agencies and its secretariat, for the 2024–2026 and future trienniums. It therefore seeks the parties' guidance on this issue.

12. In addition, the task force notes that its current estimated 2024–2026 funding requirements do not include scenarios whereby funding would be frontloaded to address challenges related to the achievement of sustainable financial flows with a view to enabling the implementation of activities under the Kigali HFC implementation plan, specifically among low-volume and very-low-volume Article 5 parties. Should the parties wish to include such scenarios, the task force could present them in a supplementary report.

13. In accordance with its terms of reference, the task force also provides indicative funding requirement ranges for the subsequent two trienniums, 2027–2029 and 2030–2032, as is shown in table 2. The range of funding estimates was based on the HCFC and HFC compliance targets within

[4] Available at www.multilateralfund.org/84/English/1/8475ri.pdf.

these periods; approved HFC-23 mitigation projects for Argentina and Mexico; and institutional strengthening and standard activities assuming a 3 per cent increase.[5]

Table 2
Indicative total funding requirement range for the replenishment of the Multilateral Fund for the trienniums 2027–2029 and 2030–2032

(United States dollars)

Triennium	*Estimated total funding requirement range*	
2027–2029	**933 000 000**	**992 000 000**
2030–2032	**820 000 000**	**893 000 000**

14. The Open-ended Working Group may wish to consider the initial work of the task force. As is customary, parties may wish to request additional information to be included in a supplementary report prepared by the task force. The parties would need to discuss and agree such elements by consensus before the task force prepared the supplementary report.

Agenda item 6

Energy-efficient and low- or zero-global-warming-potential technologies

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

15. In subparagraph 1 (a) of decision XXXIV/3, set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, para. 33), the Technology and Economic Assessment Panel was requested to include in its 2023 progress report information on several relevant matters. In addition, in subparagraph 1 (b) of the decision, the Panel was requested to integrate updates on energy efficiency while phasing down HFCs in the refrigeration, air-conditioning and heat pumps sectors in its progress and quadrennial assessment reports from 2023 onward.

16. To respond to the decision, the Panel established a working group consisting of Panel and technical options committee members with relevant expertise and experience. The working group report is included in a separate supplement to the Panel's 2023 progress report, available on the meeting portal.[6] The executive summary of the working group report is set out in annex II to the present addendum, as received from the Panel, without formal editing by the Secretariat.

17. In its report, the working group addresses each request under subparagraph 1 (a) of the decision in separate, dedicated chapters. It also introduces the concept of the system-level approach to the efficiency of refrigeration, air-conditioning and heat pump equipment, which takes into account the whole process of delivering cooling and heating services, rather than focusing on equipment-level energy efficiency. According to the working group, by optimizing the design, operation and maintenance of the refrigeration, air-conditioning and heat pump systems that service a given facility, the overall energy consumption and environmental impact of that facility can be reduced. This requires a holistic analysis of the cooling and heating loads, equipment performance, energy sources and carriers, and the potential for waste heat recovery and thermal storage. To demonstrate this approach, examples of system-level efficiency measures for cold chain and building industry applications are presented in chapter 2 of the working group report.

18. Furthermore, in responding to the parties' request for updates relating to the availability, accessibility, electrical compatibility and cost of energy-efficient products and equipment containing low- or zero-GWP refrigerants in the refrigeration, air-conditioning and heat pumps sectors (decision XXXIV/3, subpara. 1 (a) (ii)), the working group presents in chapter 9 of its report a novel approach for assessing additional costs for improving energy efficiency while phasing down HFCs, which is contrasted with the traditional incremental cost approach. A key feature of the new approach is an efficiency-improvement-linked incentive index. The index focuses resources on those enterprises with

[5] The assumption of a 3 per cent increase is based on the expected review and revision of funding levels for institutional strengthening, to be introduced with effect from 2029 (decision 91/63 of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol for the period 2024–2026); the wide variety of tasks dealt with by implementing agencies (see UNEP/OzL.Pro/ExCom/91/67, para. 21), to be addressed at the ninety-third meeting of the Executive Committee; and increasing staff costs related to the operation of the compliance assistance programme, the United Nations Development Programme, the United Nations Industrial Development Organization, World Bank core units and the Multilateral Fund secretariat.

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

the greatest need for capacity-building and access to knowledge to design and integrate lower-cost components into their products with a view to improving from minimum to medium energy performance or better.

19. The Open-ended Working Group may wish to consider the Panel report and make any recommendations, as appropriate.

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

20. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 35–38), in decision XXXIV/4, 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 against payment or free of charge, were to submit to the Secretariat by 1 May 2023 information specified in subparagraphs 1 (a)–(d) of that decision.

21. At the time of preparation of the present addendum, five parties, namely the European Union, Ghana, Nigeria, the United States of America and Zimbabwe, had submitted to the Secretariat their response to the decision. Those submissions are available on the Secretariat website.[7]

22. The Open-ended Working Group may wish to consider this issue, taking into account the information submitted to the Secretariat, and to make any recommendations on the way forward, as appropriate.

Agenda item 7

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

23. Under this item of the provisional agenda, the Open-ended Working Group will consider the reports by the Secretariat and the Technology and Economic Assessment Panel prepared in response to decisions XXXIII/4 and XXXIV/5, respectively, related to the identification of gaps in the global coverage of atmospheric monitoring of controlled substances and options for enhancing such monitoring. The report by the Secretariat also includes updated information on the implementation of a pilot project developed in 2021 and funded by the European Union on the regional quantification of emissions of substances controlled under the Montreal Protocol. Summaries of the reports are presented in the following sections.

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

24. In decision XXXIII/4, set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 39–41), the Secretariat was requested, in consultation with relevant experts from the Scientific Assessment Panel, the Technology and Economic Assessment Panel and the Ozone Research Managers of the Parties to the Vienna Convention for the Protection of the Ozone Layer, to provide to the parties to the Montreal Protocol at the forty-fifth meeting of the Open-ended Working Group information on enhancing the global and regional atmospheric monitoring of substances controlled by the Montreal Protocol. The Secretariat's response to the provisions of that decision, prepared in consultation with relevant experts from the aforementioned bodies, is set out in the following paragraphs.

(a) Options for the regional monitoring of atmospheric concentrations of substances controlled by the Montreal Protocol, based on the existing information provided by the Scientific Assessment Panel and the Ozone Research Managers, and the challenges for operationalizing relevant recommendations

25. The global atmospheric concentrations of the gases controlled under the Montreal Protocol will remain in the parts-per-trillion range, even within a distance of a few hundred kilometres to thousands of kilometres from source regions. Space-based measurements are currently not sensitive enough to quantify emissions of controlled substances. Aircraft-based measurements can be very useful because aircraft can seek out emission regions, sample the emission plumes as a function of location and altitude, and sample the background air. However, long-term aircraft measurements are costly and best

[7] See https://ozone.unep.org/countries/additional-reported-information/information-submitted-parties-under-decision-xxxiv4.

used in focused campaigns. Consequently, the best strategy is to monitor these gases at ground stations located approximately 100 and 1,000 kilometres downstream from the emission source regions to optimize cost, emissions modelling and longer-term continuity.

26. Locations for trace gas measurement stations must be carefully chosen for effective regional monitoring purposes and to fill in the existing gaps in the global coverage of atmospheric monitoring. The farther one goes from an emission source, the harder it is to measure the resulting increases in concentrations and quantify the source strengths. In addition, emitted gases must be monitored against background levels, which means one must also measure the air unaffected by regional or local sources. Lastly, the measurement stations must not be near large local pollution sources that would overwhelm the measurements. Therefore, the options for monitoring these gases to quantify their emission strengths must be judiciously chosen.

27. Identifying potential sources of emissions (production and use regions) is important in determining which measurement locations will have the optimal capability to quantify the emissions. Emission regions may be semi-quantitatively estimated on the basis of the location of manufacturing sites, projected usage areas and trade data. In addition, station locations must be practical to house facilities and personnel and must have necessary logistics. Optimal locations for measurement stations may be evaluated by observing system simulation experiments, which essentially estimate the expected concentrations at the measurement sites as a function of distance from the station.

28. The best approach to quantifying emissions is to take high-frequency measurements using dedicated instruments. However, before such a commitment is made, it is helpful to test the feasibility of the site by taking flask samples, which are then analysed for concentrations at a proven analytical laboratory with the necessary analytical, calibration and data analysis capabilities.

(b) Identification of suitable locations for possible high-frequency measurements and flask sampling for regions not, or not sufficiently, covered by existing atmospheric monitoring with a view to strengthening monitoring capacity and networks

29. As noted above, the identification of suitable sites for the monitoring of controlled substances involves the use of appropriate techniques, such as observing system simulation experiments, and exploring the feasibility of station locations to house facilities and personnel.

30. In addition to the location, other essential needs are: (a) the availability of suitable infrastructure at the monitoring location; (b) the availability of willing participants/partners who can be trained in the sophisticated methodology used to carry out the measurements; (c) the ability to import and export air samples and equipment; (d) a connection to an established measurements programme, such as the programme of the National Oceanic and Atmospheric Administration or that of the Advanced Global Atmospheric Gases Experiment to use the traceable gas standard scales; (e) the ability and willingness to share the data in a transparent and timely way; and (f) a long-term commitment to support and manage the effort.

31. The stations currently available for carrying out measurements are marked on the map set out in the white paper[8] prepared by the Scientific Assessment Panel and experts in atmospheric monitoring of controlled substances for consideration by the Ozone Research Managers at parts I and II of their eleventh meeting, held in 2020 and 2021. The map, which is still valid, shows that vast regions in Eastern Europe; western, southern and central Asia; all of South America; portions of North America; large parts of South-East Asia; Australia and New Zealand; and most of Africa are not monitored.

(c) Options for possible means of establishing new monitoring capacity and related costs, taking into account existing monitoring infrastructure

32. Listed in the white paper are options for establishing new monitoring sites, associated costs and other feasibility issues. The scientific community has also established such costs through discussions at the meetings of the Ozone Research Managers held from 2020 to 2022 and an online workshop[9] organized by the steering committee overseeing the pilot project funded by the European Union.

33. The scientific community has determined that the best way to proceed in establishing new monitoring sites is to set up a flask sampling programme for one to two years, whereby an established analytical facility analyses the flasks.

[8] https://ozone.unep.org/system/files/documents/ORM11-II-4E.pdf.

[9] www.sparc-climate.org/2022/03/01/virtual-discussion-forum-for-the-expansion-of-the-global-network-of-odss-hfcs-and-other-compounds-of-interest-to-the-montreal-protocol/.

34. Establishing a high-frequency measurement station requires a suitable air intake tower, an air-conditioned building space, reliable electric power, data connectivity, and access to personnel and supplies. Flask sampling locations, on the other hand, require a subset of these conditions, including an air intake tower, protected space and electric power. The associated costs depend significantly on the extent to which existing resources and personnel can be used. In addition, the costs of modelling proposed sites with observing system simulation experiments and maintaining a modelling capability are on the order of $150,000 per year. Approximate costs associated with establishing measurements at a pre-existing station, based on recent experience, are:

(a) ***High-frequency observations.*** Initial costs of the measurement instrumentation and ancillary equipment at an existing station are on the order of $400,000, and the annual operating cost is on the order of $150,000 to $350,000 (in the Advanced Global Atmospheric Gases Experiment example), depending greatly on the costs of personnel;

(b) ***Flask sampling.*** For weekly sampling, the costs are on the order of $15,000 for reusable flasks and pumps, and the annual cost of shipping and analysis (without any sampling tower or flask-filling personnel costs) is on the order of $25,000 (in the National Oceanic and Atmospheric Administration example). Daily flask sampling increases the initial costs to approximately $100,000 and the annual costs to approximately $90,000. Increasing the frequency of flask sampling at 10 sites to weekly also generally requires personnel travel for training at a cost of $200,000 to $250,000. Annual costs of shipping are approximately $200,000. These cost totals can be accrued over time, starting at a few locations and expanding year after year.

Updated information on the implementation of the pilot project funded by the European Union

35. The pilot project on the regional quantification of emissions of substances controlled under the Montreal Protocol,[10] funded by the European Union, is based on the white paper mentioned above. The project is managed by the Ozone Secretariat, and its implementation is overseen by a steering committee.

36. Updates on the implementation of the pilot project had been provided by the Secretariat at the forty-fourth meeting of the Open-ended Working Group and the Thirty-Fourth Meeting of the Parties.[11] Since the time of the latter meeting, the following progress has been made under the pilot project:

(a) Analysis of observing system simulation experiments, conducted by experts at the Massachusetts Institute of Technology in the Northern Hemisphere, led to the identification of several possible locations for flask-sampling measurements and high-frequency in situ measurements in Article 5 parties (e.g., Armenia, Bangladesh, China, India, Maldives and Morocco). Preliminary consideration has also been given to other locations. Based on these findings, and taking into consideration other factors (e.g., population distribution, locations of potential emissive industries and activities, regions of high economic activity or growth, site location, evaluation of sampling locations in terms of existence of infrastructure and a long-term financial and work commitment or access to appropriate logistical support), the steering committee decided to establish a flask-sampling site on Bhola Island, Bangladesh;

(b) The institution identified to assist in the implementation of flask sampling and analysis of data is the University of Bristol, which has long-standing expertise and a record of high-quality data generation and curation. University of Bristol experts are implementing the project in close cooperation with experts from the University of Dhaka;

(c) The measurement programme on Bhola Island is now under way, and many valuable data will become available in the coming months. With the knowledge gained from these measurements, the steering committee expects to have the necessary information to consider expanding to other parts of the globe. Of course, such an expansion would require fiscal resources, countries willing to collaborate to carry out the measurements, availability of expertise in those locations, and the ability to freely exchange data in a timely fashion. In addition, observing system simulation experiments can be carried out whenever new stations are proposed.

[10] An outline of the pilot project is available on the Ozone Secretariat website at: https://ozone.unep.org/eu-funded-project-regional-quantification-emissions-substances-controlled-under-montreal-protocol.

[11] Available at https://ozone.unep.org/system/files/documents/OEWG-44-2-Add-1E.pdf and https://ozone.unep.org/system/files/documents/MOP-34-2-Add-1E.pdf.

37. The parties may wish to take this information into consideration in the discussions under this topic.

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

38. In response to decision XXXIV/5, set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, para. 44), the Technology and Economic Assessment Panel prepared a report addressing chemical pathways in which substantial emissions of controlled substances are likely to occur, gaps in understanding those emission sources and best available practices to control such emissions.

39. The approach followed by the Medical and Chemicals Technical Options Committee to respond to the decision and the outcomes of the Committee's assessment are set out in section 5.3 of the Panel's progress report. In brief, the Committee determined that the term "substantial emissions" may reasonably refer to global emissions of controlled substances that are greater than 1,000 tonnes per year. The assessment concluded that most production processes will only emit such quantities when they produce controlled substances or use them as feedstocks. It also showed that 24 chemical pathways were considered likely to have substantial emissions of 18 controlled substances, including certain CFCs and HCFCs, carbon tetrachloride and 1,1,1-trichloroethane.

40. Best practices available to control emissions include optimizing plant design, equipment, operation and 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 that any or all emissions mitigation measures are implemented by operators, and to require emissions and other reporting.

41. The report outlines several gaps in understanding the sources of emissions from chemical pathways with substantial emissions, in particular existing gaps in publicly available data, some of which may be unavailable owing to commercial confidentiality.

Agenda item 8

Technology and Economic Assessment Panel 2023 report and related issues

42. The 2023 progress report of the Technology and Economic Assessment Panel includes progress reports by its technical options committees and their key messages, responses to decisions that are due for consideration by the Open-ended Working Group at its forty-fifth meeting, and information on other matters, including membership and organizational matters. The issues addressed in the report relating to sub-items 8 (b)–(f) of the provisional agenda are summarized in the following sections.

(a) Ongoing emissions of carbon tetrachloride (decision XXXIV/6)

43. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 52–55), in decision XXXIV/6, 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 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.

44. By the time of the preparation of the present addendum, five parties, namely China, the European Union, Japan, the United Kingdom of Great Britain and Northern Ireland and the United States had submitted their response to the decision. The submissions were shared with the Technology and Economic Assessment Panel for its review, as requested in the decision.

45. The review of those submissions, conducted by the Medical and Chemicals Technical Options Committee, is set out in section 5.4 of the Panel's progress report. It includes a generic summary of the reported information, identifying similar elements of national procedures and frameworks that have been established by the reporting parties. A non-exhaustive list of national procedures and frameworks included in the submissions is also provided in the Committee's report.

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

46. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, paras. 56–60), in paragraph 4 of decision XXXIV/10, parties 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, as part of its progress report to the Open-ended Working Group at its forty-fifth meeting, on current QPS for which alternatives are available.

47. In paragraph 1 of the same decision, parties were 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 is needed or used in their respective countries. In paragraph 5, they were invited to take into account the standards and guidelines under the International Plant Protection Convention in their national processes and to consider the potential for uptake of practices to minimize the use of methyl bromide.

48. The response of the Methyl Bromide Technical Options Committee is included in section 4.2 of the Panel's progress report. At the time of the finalization of the Committee's report, two parties (Australia and Canada) had submitted information in response to the decision for the Committee's review. As the submission deadline is 1 June 2023, the Committee notes that it has been unable to provide further information about the specific use of methyl bromide in QPS sectors at this time but has utilized the major categories and pests shown in recent surveys and past reports to discuss an update of alternatives.

49. The Committee underscores that, according to parties' responses to surveys developed by the Committee in connection with the preparation of its 2022 quadrennial assessment report, it appears that there remains uncertainty as to the correct interpretation of the QPS definitions, as some uses that are classified by parties as QPS do not fit within the definitions adopted by the parties to the Montreal Protocol in decision VII/5.[12]

50. To assist parties in clarifying which methyl bromide treatments satisfy the QPS criteria, the Committee provides an updated flow chart in figure 4.1 of the Panel's progress report. In addition, the report includes clarification on QPS definitions and examples of typical methyl bromide uses that fall into these categories, together with cases that are often erroneously classified as QPS and may fall under the controlled use definition. Analyses of the main categories of use, the main controlled pests, and alternatives currently adopted or under research and trial are also provided.

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

51. In response to paragraph 1 of decision XXXIV/11, set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/45/2, para. 63), a Technology and Economic Assessment Panel working group was established to address issues related to existing challenges and potential options for the future configuration and function of its technical options committees, contained in chapter 8 of the progress report. In doing so, the Panel has taken into account, among other things, discussions and questions raised by parties at the forty-fourth meeting of the Open-ended Working Group and the Thirty-Fourth Meeting of the Parties, reflected in the report on the latter meeting[13] and in the list of party questions available on the portal for the contact group on restructuring the Panel.[14]

52. The Panel anticipates that the high level of its workload and that of its technical options committees over the past several years will remain the same, owing to the annual requests of the parties for technical and economic information on specific issues of interest in addition to several standing requests for information to be provided on an annual, triennial, quadrennial and quintennial basis. The Panel notes its intention to continually assess its organization and functioning to ensure an effective and efficient structure, and reaffirms its commitment to meet all current and emerging technical and economic needs of the parties.

53. In its 2022 progress report, the Panel presented its proposal to reconfigure two of its technical options committees with a view to continuing to support the parties needs efficiently and effectively and facilitating greater collaboration and synergy across sectoral topics with commonalities, in

[12] https://ozone.unep.org/treaties/montreal-protocol/meetings/seventh-meeting-parties/decisions/decision-vii5-definition-quarantine-and-pre-shipment-applications.

[13] UNEP/Ozl.Pro.34/9, sect. IX.

[14] https://ozone.unep.org/meetings/thirty-fourth-meeting-parties/contact-groups/restructuring-teaptocs.

particular across the refrigeration, air-conditioning and heat pumps sector and the foams sector. Upon further consideration of the issues and questions raised by the parties in response to that proposal at the forty-fourth meeting of the Open-ended Working Group and the subsequent Thirty-Fourth Meeting of the Parties, the Panel is now proposing a modified approach that is still aimed at ensuring an effective and efficient organization to respond to ongoing party needs and requests. In doing so, the Panel acknowledges not only the importance of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee in dealing with the vast majority of HFC uses and their alternatives, but also the crucial contribution of the other technical options committees to the sectors that they serve which, although smaller, are crucial in the functioning, health and safety of society.

54. In particular, the Panel proposes to maintain the current structure with the existing five technical options committees aligned with the Montreal Protocol sectors: flexible and rigid foams, fire suppression, methyl bromide, medical and chemicals, and refrigeration, air conditioning and heat pumps.

55. The Panel also proposes that the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee continue to be a single body but be organized into two working groups around the two main areas under its purview:

(a) ***Cold chain working group,*** covering refrigeration applications including cold chain for the conservation of food and vaccines, domestic refrigeration, commercial refrigeration, transport refrigeration (road, rail, sea and air), industrial food and medical refrigeration;

(b) ***Air-conditioning working group***, covering all technologies devoted to maintaining comfort conditions in inhabited spaces, both in winter and in summer (building and mobile, also considering the thermal management of electrical vehicles), and technologies for the climatization of industrial process and special applications (e.g., for microelectronics industry and clean rooms).

56. It is also proposed that the entire Committee meet as a single body at the same location, but that issues related to its two main areas be discussed by the respective subgroups in breakout sessions. A single consensus report of the entire Committee would be produced.

57. From a workload and management standpoint, it is suggested that the Committee acquire one additional co-chair, for a total of four co-chairs: two from Article 5 parties and two from parties not operating under paragraph 1 of Article 5 of the Montreal Protocol (non-Article 5 parties). Two co-chairs would coordinate the activities of the cold chain subgroup and the other two would coordinate the activities of the air conditioning subgroup. The four co-chairs would work together for the coordination of all the activities of the Committee.

58. For cross-cutting issues, such as refrigerants, energy efficiency, servicing, industrial refrigeration, heat engines and modelling, the co-chairs would manage the work across the two main areas. Considering that many cross-cutting issues are shared with the Flexible and Rigid Foams Technical Options Committee (e.g., energy efficiency, minimization of cooling and heating loads in buildings and cold chambers), the co-chairs of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee would also work closely with the co-chairs and members of that Flexible and Rigid Foams Technical Options Committee. When appropriate, experts from these two technical options committees would coordinate to give consistent answers to common technical issues or work together on those topics, for example in temporary subsidiary bodies.

59. The Panel mentions that this approach would involve, among other things, critically reviewing and renewing the organization and membership of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee with a view to providing broader and more varied expertise to addressing cross-cutting and emerging issues.

60. In addition to the above, the Panel elaborates on the workload and configuration of all technical options committees and presents in annex 5 of its progress report the matrix of needed expertise identified as at May 2023, which is set out in annex III to the present addendum and posted on the Secretariat website.[15]

61. The Open-ended Working Group may wish to consider the Panel's report and proposal under this sub-item of the provisional agenda and make any recommendations, as appropriate.

[15] https://ozone.unep.org/science/assessment/teap/teap-expertise-required,

(d) Panel membership changes

62. In annex 4 to its 2023 progress report, the Technology and Economic Assessment Panel provides information on the status of its membership and that of its technical options committees as at May 2023.

63. Table 3 lists the members of the Panel whose membership expires at the end of 2023 and whose reappointment requires a decision by the Meeting of the Parties. The members of the technical options committees whose membership expires at the end of 2023 and whose reappointment does not require a decision by the Meeting of the Parties are listed in annex IV to the present addendum.

Table 3
Members of the Technology and Economic Assessment Panel whose membership expires at the end of 2023 and whose reappointment requires a decision by the Meeting of the Parties

Name	*Position*	*Country*
Omar Abdelaziz	RTOC co-chair	Egypt
Kei-ichi Ohnishi	MCTOC co-chair	Japan
Roberto Peixoto	RTOC co-chair	Brazil
Jianjun Zhang	MCTOC co-chair	China
Suely Machado Carvalho	TEAP senior expert	Brazil
Marco Gonzalez	TEAP senior expert	Costa Rica
Ray Gluckman	TEAP senior expert	United Kingdom of Great Britain and Northern Ireland
Shiqiu Zhang	TEAP senior expert	China

Abbreviations: TEAP – Technology and Economic Assessment Panel; MCTOC – Medical and Chemicals Technical Options Committee; RTOC – Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee.

64. Parties may wish to submit nominations, as necessary, in accordance with paragraph 3 of decision XXXI/8, whereby they are requested, "when nominating experts to the Panel, its technical options committees or its temporary subsidiary bodies, to use the Panel's nomination form and associated guidelines so as to facilitate the submission of appropriate nominations, taking into account the matrix of needed expertise, and geographical and gender balance, in addition to the expertise needed to address new issues related to the Kigali Amendment, such as energy efficiency, safety standards and climate benefits". In paragraph 5 of the same decision, the parties are urged "to follow the terms of reference of the Panel, consult the Panel's co-chairs and refer to the matrix of needed expertise prior to making nominations for appointments to the Panel".

65. In accordance with paragraph 4 of decision XXXI/8, the Secretariat will make available on the meeting portal for the forty-fifth meeting of the Open-ended Working Group, as well as on the meeting portal for the Thirty-Fifth Meeting of the Parties later in 2023, any forms submitted by parties nominating members to the Panel, with a view to facilitating the review of and consultations on the proposed nominations by parties.

66. Nominations to the technical options committees other than for co-chair positions, as well as nominations to temporary subsidiary bodies, can be made at any time. Appointments are made by the co-chairs of the relevant committees in consultation with the Panel.

(e) Any other issues

67. The present section contains a summary of information provided by the Technology and Economic Assessment Panel in chapter 7 of its progress report on emerging policies related to the production and use of controlled substances and their alternatives. These issues would fall under sub-item 8 (f) of the provisional agenda should parties wish to discuss them.

68. The Panel addresses the increasing focus on the use, emissions, and environmental and health effects of per- and poly-fluoroalkyl substances (PFAS) and provides updated information on regulatory developments and possible implications for the foams, fire suppression, and refrigeration, air-conditioning and heat pumps sectors.

69. Specifically, the Panel notes that PFAS have been defined differently by national and subnational jurisdictions. The Organisation for Economic Co-operation and Development definition of PFAS, for instance, encompasses several fluorinated chemicals which are controlled substances under

the Montreal Protocol and/or are used as alternatives to those substances. Proposed restrictions under Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, which applies in the European Economic Area, and regulatory developments in Canada and the United States, as well as under the Stockholm Convention on Persistent Organic Pollutants, are also outlined in the report.

70. In general, the incorporation of PFAS definitions into potential future regulations may or may not include Montreal Protocol controlled substances and their substitutes, or their breakdown products, such as trifluoroacetic acid and its salts. As a result, there is uncertainty in the industry sector regarding the long-term availability of certain alternatives to ozone-depleting substances and HFCs. Some companies and other stakeholders have reported that they are delaying decisions on the choice of alternatives and the associated investments, owing to concerns about the impact of future regulations on the availability of some or all fluorinated alternatives. Such a development could affect the phase-out of ozone-depleting substances and the phase-down of high-GWP HFCs.

71. In the fire suppression sector, although many halon applications have transitioned to alternatives, most in-kind halon and high-GWP alternatives are considered PFAS in some definitions and are being proposed for a complete phase-out in some regulations. Some regulations may curtail or prohibit most of the in-kind alternatives available, leaving the original halons (which have high ozone-depletion potential (ODP) and high GWP), HFC-23 (which has very high GWP) and, potentially, trifluoroiodomethane (CF3I) (which has toxicity issues and, potentially, ODP issues) as the only viable alternatives.

72. In the foams sector, some companies and other stakeholders have reported that they are delaying decisions regarding the selection of alternatives owing to concerns about how those fluorinated alternatives might be limited as a result of proposed regulations. The limitation of mainstream uses of fluorinated gases could have wider implications for investment in hydrofluoroolefins and hydrochlorofluoroolefins going forward.

73. In the refrigeration, air-conditioning and heat pumps sector, the proposed broad-range bans of PFAS would include the majority of fluorinated refrigerants used, with the only commonly used HFC refrigerant falling outside the PFAS definition being HFC-32. Such bans on the market would likely slow the uptake of low-GWP alternative refrigerants, limit the energy efficiency of medium-sized systems and slow the roll-out of heat pumps, which are much needed to decarbonize heating. These developments would likely lead to an increase in greenhouse gas emissions from this sector.

74. The Panel also states that one long-time manufacturer of several alternatives has announced its intention to cease production of chemicals falling under the PFAS definition by the end of 2025, owing to the rapidly evolving regulatory and business landscape. Some of these manufactured chemicals are currently used as alternatives to controlled substances in end-uses, including solvent applications, semiconductor and electronics manufacturing, and magnesium production. This development, therefore, has the potential to delay the transition to lower-GWP options in such applications.

Annex I*

2023 Report of the Technology and Economic Assessment Panel (Volume 3)

Assessment of the funding requirement for the replenishment of the Multilateral Fund for the period 2024-2026

Executive summary

The Montreal Protocol Multilateral Fund (MLF) has been replenished ten times since its initial capitalisation of US$ 240 million for the period 1991-1993. The replenishments of the MLF are indicated in Table E-1, which include anticipated contributions from the MLF and other sources from the previous triennium, known as "carry-over", and from interest accruing to the Fund during that triennium. The MLF has also received additional voluntary contributions amounting to over US$ 25.5 million from a group of donor countries to finance fast-start activities for the implementation of the hydrofluorocarbon (HFC) phase-down[1].

Table ES-1
Replenishments of the MLF (US$)*

Triennium	Approved	Carry-over	Interest accrued	Total MLF Budget
1994-1996	$ 455 000 000	$ 55 000 000	N/A	$ 510 000 000
1997-1999	$ 466 000 000	$ 74 000 000	N/A	$ 540 000 000
2000-2002	$ 440 000 000	$ 35 700 000	N/A	$ 475 700 000
2003-2005	$ 474 000 000	$ 76 000 000	$ 23 000 000	$ 573 000 000
2006-2008	$ 400 400 000	$ 59 600 000	$ 10 000 000	$ 470 000 000
2009-2011	$ 400 000 000	$ 73 900 000	$ 16 100 000	$ 490 000 000
2012-2014	$ 400 000 000	$ 34 900 000	$ 15 100 000	$ 450 000 000
2015-2017	$ 437 500 000	$ 64 000 000	$ 6 000 000	$ 507 500 000
2018-2020	$ 500 000 000	$ 34 000 000	$ 6 000 000	$ 540 000 000
2021-2023	$ 475 000 000	$ 65 000 000	N/A	$ 540 000 000

* Doesn't include the initial capitalisation of US$ 240 million for 1991-1993

Since its inception, and as of the 91st meeting of the Executive Committee (ExCom), the MLF has supported 144 A5 parties by approving US$ 3.98 billion (including support costs) in project funding. As of December 2021, completed projects had phased out 289,332 ODP tonnes (ODPt) of consumption and 204,189 ODPt of production[2].

The replenishment of the MLF for the 2024-2026 triennium represents a significant milestone in assistance to developing countries to comply with the terms of the Montreal Protocol – for the first time, the MLF will provide financing for the incremental costs of not just the phase-out of ozone-depleting substances (ODS) but also the phase-down of HFCs.

- For Annex C, Group 1, controlled substances (ozone-depleting hydrochlorofluorocarbons or 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 97.5% reduction from baseline by 1 January 2030. The annual average of 2.5% is restricted to the servicing of refrigeration and air-conditioning equipment existing during 2030-2040 and subject to review in 2025.
- For Annex F controlled substances (HFCs), the compliance targets for the 2024-2026 and next two triennia are as follows:

* The annex has not been formally edited.

[1] http://www.multilateralfund.org/default.aspx

[2] UNEP/OzL.Pro/ExCom/91/8

- Group 1 parties: In the 2024-2026 triennium, a 10% reduction from baseline by 1 January 2029;
- Group 2 parties: For the next two triennia 2027-2029 and 2030-2032, a 30% reduction from baseline by 1 January 2035 and a 50% reduction by 1 January 2040.

Decision XXXIV/2 of the Thirty-fourth Meeting of the Parties (MOP-34) provided the terms of reference (TOR) for the work of the Technology and Economic Assessment Panel (TEAP) to prepare a report on the appropriate level of the replenishment of the MLF for the triennium 2024-2026. The parties requested the TEAP to prepare a report for submission to the Thirty-fifth Meeting of the Parties (MOP-35), and to present it to the Open-ended Working Group (OEWG) at its Forty-fifth Meeting (OEWG-45), to enable MOP-35 to take a decision.

The TEAP established a Replenishment Task Force (RTF), with members from TEAP, its Technical Options Committees (TOCs), and other outside experts. In December 2022, RTF attended the 91stmeeting of the Executive Committee of the MLF (ExCom-91) to conduct informal discussions with ExCom members, and Bilateral and Implementing Agencies (IAs) present at that meeting.

In this report, the RTF estimated the funding requirements for the 2024-2026 triennium and future triennia informed by the "Consolidated Business Plan of the Multilateral Fund for 2023-2025,"[3] relevant decisions of the ExCom up to its 91st meeting, and information available through the Multilateral Fund Secretariat (MLFS). The RTF relied on existing cost guidelines under the MLF and, where these remained under discussion in the ExCom, the RTF noted these limitations in its estimates.

HCFC Phase-out

The estimate for the HCFC phase-out funding requirement for the 2024-2026 triennium and beyond is based on Article 5 (A5) parties meeting the upcoming reduction targets. The RTF considered, amongst other information, the adjusted "Consolidated Business Plan of the Multilateral Fund 2023-2025," to present the costs for activities in the HCFC consumption and production sectors which include the following:

- HCFC consumption sector costs include:
  - Funding for approved HCFC Phaseout Management Plans (HPMPs) (including projects for HCFC-141b Polyols);
  - Funding for project preparation costs;
  - Funding for estimated HPMPs;
  - Funding for energy efficiency (EE); and
  - Funding for verification.
- HCFC production sector funding estimates include:
  - Funding for project preparation, including audit, and
  - Funding for HCFC Production Phaseout Management Plans (HPPMPs), including verification

HFC Phase-down

The RTF undertook several steps including conversions between units [ozone depletion potential (ODP), Global Warming Potential (GWP), metric tonnes, kilograms, and million metric tonnes of carbon dioxide equivalent ($MMTCO_2eq$)] to calculate the total estimated funding for an HFC phase-down. The RTF will refer to phase-down plans as the "Kigali HFC Implementation Plans" or "KIPs"[4], and to "Kigali HFC Production Phase-down Management Plans (KPPMPs).

Estimated funding requirement for the HFC consumption and production sectors include the following:

- HFC consumption sector funding estimates include:
  - Funding for KIPs – approved, project preparation (including additional resources needed for gender mainstreaming activities), estimated (including for the special needs of low-volume consuming countries (LVCs) and very low-volume consuming countries (VLVCs); and a funding window for EE;
  - Funding for enabling activities;
  - Funding for verification, if any.

[3] UNEP/OzL.Pro/ExCom/91/22

[4] UNEP/OzL.Pro/ExCom/87/IAP/3.para. 188(b)

- HFC production sector and HFC-23 mitigation funding estimates include:
  - Funding for HFC production sector preparation;
  - Funding for KPPMPs, if any;
  - Funding for HFC-23 mitigation project preparation; and
  - Funding for HFC-23 mitigation project approved and investment project proposed.

Separate estimates are included for funding windows for estimated resources for EOL/disposal and funding to maintain or enhance energy efficiency. during the phase-down of HFCs,

As of 3 April 2023, 104 out of 144 A5 parties had ratified the Kigali Amendment. So, the RTF considered a range based on the following two scenarios for the triennium 2024-2026:

- **Low-end scenario:** Calculated HFC baselines for 104 A5 countries that have ratified the Kigali Amendment as of the 3 April 2023 using a range of cost effectiveness factors; and
- **High-end scenario**: All 144 A5 countries ratifying the Kigali Amendment using a range of cost effectiveness factors.

The RTF used agreed cost effectiveness (CE) values, and where these were absent pending further discussion by the ExCom on HFC cost guidelines, the RTF considered available CE values for HCFCs, for the servicing and other sectors for all non-LVC countries in both Group 1 and Group 2 categories under the Kigali Amendment.

The RTF has also included the approved funding window for EE and considered options to address EE in the HFC cost guidelines under preparation. Those options may help parties in finding solutions to quantify and fund energy efficiency improvements at the time of the HFC conversion in the refrigeration and air conditioning (RAC) manufacturing sector and could be detailed in a Supplementary Report if parties may wish so.

The funding window for end-of-life management or disposal of controlled substances was included as a separate line, as it covers not only HFCs but also HCFCs.

For the HFC production sector and HFC-23 by-product emission mitigation, the funding requirement includes HFC production section project preparation, HFC production sector KPPMPs, HFC-23 by-product emissions mitigation project preparation, and HFC-23 by-product emissions mitigation.

Institutional Strengthening & Standard Activities

The estimated funding requirement includes institutional strengthening (IS) and Standard Activities. The estimated funding requirement for standard activities, such as the UNEP Compliance Assistance Programme (CAP), Core Unit of UNDP, UNIDO and the World Bank, MLFS/ExCom and Treasurer, were based on the Adjusted Consolidated Business Plan of the MLF 2023-2025 and the 2022 and 2023 MLF budget as approved by the ExCom.

Estimated Total Funding Requirements for the 2024-2026 Triennium

The total estimated funding requirement for the replenishment of the MLF in the 2024-2026 triennium, including support costs, is **US$ 975-1,018 million**[5] as presented in Tables ES-2 and ES-3 below.

Table ES-2
Range of Total Funding Requirement for Replenishment of the MLF 2024-2026 Based on Different Scenarios (US$)

2024-2026 TRIENNIUM	*LOW-END*	*HIGH-END*
SUBTOTAL - HCFC Activities (including energy efficiency)	$ 363 911 000	$ 363 911 000
SUBTOTAL - HFC Activities (including gender mainstreaming activities, project preparation, enabling activities and energy efficiency funding window)	$ 475 491 000	$ 519 142 000
SUBTOTAL - Funding Window on EOL/Disposal	$ 13 590 000	$ 13 590 000
SUBTOTAL - IS & Standard Activities	$ 121 581 000	$ 121 581 000
GRAND TOTAL	**$ 974 573 000**	**$ 1 018 224 000**

[5] Note: figures may not sum due to rounding.

Table ES-3
Total funding requirement for the replenishment of the MLF 2024-2026 (US$)

2024-2026 Triennium Estimated Funding	
HCFC Consumption Sector	
HCFC Approved HPMPs	$ 116 746 000
HCFC Prep Costs	$ 170 000
HCFC Estimated HPMPs (including LVCs/VLVCs)	$ 205 405 000
HCFC Verification	$ 1 766 000
HCFC Energy Efficiency Special Funding	$ 11 092 000
Subtotal – HCFC Consumption Sector	**$ 335 179 000**
HCFC Production Sector	
HCFC Production Sector Stage I PRP	$ 148 000
HCFC Production Sector Stage I HPPMP	$ 5 352 000
HCFC Production Sector Stage II HPPMP	$ 23 232 000
Subtotal – HCFC Production Sector	**$ 28 732 000**
SUBTOTAL - HCFC Activities	**$ 363 911 000**

2024-2026 Triennium Estimated Funding	*LOW-END*	*HIGH-END*
HFC Consumption Sector		
HFC Approved KIPs	$ –	$–
HFC Prep Costs (including gender mainstreaming)	$ 16 802 000	$ 16 802 000
HFC RTF Estimated KIPs	$ 405 764 000	$ 449 415 000
HFC Enabling Activities	$ 1 011 000	$ 1 011 000
HFC Energy Efficiency Funding Window	$ 20 000 000	$ 20 000 000
Subtotal – HFC Consumption Sector	**$ 443 577 000**	**$ 487 228 000**
HFC Production Sector		
HFC Production Sector Prep		$ 2 000 000
HFC Production Sector KPPMP RTF Estimated		$ 20 000 000
HFC-23 Mitigation Prep		$ 193 000
HFC-23 Mitigation Approved		$ 1 721 000
HFC-23 Mitigation RTF Estimated		$ 8 000 000
Subtotal – HFC Production and HFC-23 Sector		**$ 31 914 000**
SUBTOTAL - HFC Activities	**$ 475 491 000**	**$ 519 142 000**

2024-2026 Triennium Estimated Funding	
IS and Standard Activities	
IS	$ 44 500 000
UNEP CAP	$ 36 437 000
UNDP, UNIDO, World Bank Core Unit	$ 18 161 000
MLF Secretariat and ExCom Costs	$ 20 983 000
Treasurer	$ 1 500 000
SUBTOTAL - IS & Standard Activities	**$ 121 581 000**
2024-2026 Triennium Estimated Funding	
Funding Window on EOL/Disposal	$ 13 590 000
SUBTOTAL – EOL/Disposal	**$ 13 590 000**

Annex II*

Technology and Economic Assessment Panel 2023 Progress Report (Supplement to Volume 1)

Enabling enhanced access and facilitating the transition of energy-efficient and low or zero-GWP technologies

Key messages

Chapter 2: Energy Efficiency: A Systems Approach

- To decarbonise heating and cooling in a cost-efficient manner, energy efficiency needs to go beyond a pure product-based approach. Taking an integrated approach to the energy system offers massive opportunities to reduce the need for energy generation, cost and emissions and to increase the resilience of the energy system. Analysing and optimising heating and cooling loads, energy sources and carriers, as well as the potential of waste heat recovery and thermal storage will pave the way for system-based energy and cost savings as well as increased emission reductions.
- Cold chains are a global challenge. Food production will need to increase significantly to feed the expected human population of 9.7 billion by 2050. In addition, food loss due to the lack of cold chains accounts for more than 1 gigaton of CO2-equivalent emissions. Building up the cold chain with energy efficient equipment and low GWP refrigerants, combined with renewables-based electricity generation and increased use of electric vehicles will prevent food loss and significantly reduce emissions. To make it happen, all actors need to cooperate: governments, industry, academia and finance will be needed for research, skills development, new business models, and adoption at scale.
- According to the International Energy Agency (IEA), space cooling is responsible for around 10% of global electricity consumption and 5% of global greenhouse gas emissions. Energy-efficient HVAC equipment in buildings optimises energy usage in cooling and heating systems, resulting in significant energy and cost savings. Additionally, it enhances indoor air quality and extends equipment lifespan. Implementing building codes and regulations, working with industry associations and standards bodies, and considering lifecycle costs are all critical for encouraging the adoption of energy-efficient equipment.

Chapter 3: Energy Efficiency Associated with Improvements in Foams

- Continued efforts to reduce energy consumption in buildings and refrigerating appliances have encouraged increased use of insulating foams. Building codes and standard mandates, insulation performance standards, labelling mandates, and other policies establish requirements to reduce heating and cooling loads in both commercial and residential buildings and for refrigeration. Investment in decarbonization and infrastructure will drive increased use of insulation including several end-uses for foam products specially the high insulating ones like polyurethane, polystyrene and phenolic foams.
- Walls with appropriate foam thickness produced with low thermal conductivity and low GWP blowing agents can provide substantial benefits of insulation with superior energy efficiency with less CO2 emissions for applications in buildings and cold chain.
- High performance insulating foams improve energy efficiency by creating an air barrier and reducing heat transfer. Insulation foams applied in building reduce heat loss or heat gain which improves individuals' comfort and can lower energy costs. For cold chain, high performance foams also create an air barrier and reduce heat gain to keep temperature in storage, transport, consumption and conservation of food, medicines and a variety of products that need temperature control with reduced energy consumption and cost.
- The continuous improvement in foams technology to provide high insulatingBM:: materials in combination with more efficient refrigerating systems provide a notable improvement in energy efficiency. For example, the typical new refrigerator uses 75% less energy than a

* The annex has not been formally edited.

typical refrigerator 70 years ago while offering roughly 20% more storage capacity and other features. New refrigerator technology also eliminated ODS and high GWP blowing agents and refrigerants with a significant reduction of CO2 emission in the manufacturing process.

- Foam insulation can create an air barrier making assurance of sufficient ventilation and possibly monitoring of air quality more important, as highlighted during the pandemic.

Chapter 4: Energy Efficiency Technologies: Availability and Accessibility

- RACHP and MAC equipment that are at, or below, the global average efficiency levels are still being manufactured and sold posing a problem to the adoption, implementation, and compliance of Minimum Energy Efficiency Performance Standards (MEPS) in many countries
- A 2023 IPCC report confirms that concerted efforts on Energy Efficiency (EE) measures and emissions mitigation measures can reduce costs and produce better results
- The availability of high energy efficiency technology in manufacturing countries does not automatically result in accessibility at the importing countries
- The assembly sector typically waits for a new technology to evolve, and the economies of scale to take place before they adopt. For a faster adoption of new technologies, the assembly sector could benefit from the demonstration of higher energy-efficiency low-GWP technologies through activities such as the creation of regional centres of excellence.
- Electrical voltage and frequency variation are often overlooked as a barrier to product availability and therefore, accessibility of products worldwide
- Product certification to stated performance and performance standards is one of the most important differentiators in a crowded market where consumers can make trusted choices on what they purchase
- Manufacturers are typically faced with the choice of either buying the EE technology/component or building the internal capacity to develop and manufacture it (make vs. buy). Scale, based on the production volume, and speed, based on the capital recovery period, play a role in deciding the business strategy
- The majority of refrigerants used in new car MAC is mainly HFC-134a (GWP 1430). HFO-1234yf (GWP 3) is used as a substitute by car manufacturers in some regions.
- The thermal management system with heat pump technology has been accepted as an energy-efficient solution for electric vehicles, which require refrigerants compatible with electrically driven compressors and can provide heating and cooling capacity. R-744, HC-290, and other new refrigerant blends are under assessment and gaining renewed attention.
- Cost of new technologies, supply chain issues, and lack of industry collaboration are existing barriers related to the availability and accessibility of low GWP refrigerants in MAC and mobile heat pumps in electric vehicles.
- Upgrading technicians' capacity and improving their awareness on advantages of labelling that could be communicated to their customers helps in achieving the energy efficiency benefits from the policy.

Chapter 5: Measurement Verification and Enforcement Tools

- Energy test methods are central to appliance standards and labelling programs to validate efficiency claims by manufacturers before products enter markets and to ensure that products continue to meet program requirements and identify non-compliant products once on the market.
- Energy test methods for cooling appliances have been developed by international standards organizations like the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and other regional and national standard bodies. Several international and national energy test methods are in use in different regions for the most common residential cooling equipment – domestic refrigerators and room air conditioners.
- Test method attributes can and should be evaluated on an ongoing basis as the products and technologies they are intended to evaluate continue to evolve.

- Appliance energy and performance testing requires qualified test facilities where the laboratory, test equipment, personnel training, and operating procedures are all appropriate for the product being tested. Testing is one of the most resource-intensive and time-consuming aspects of an energy efficiency program but there are approaches to conduct effective testing with limited resources.
- Certifying and enforcing compliance is critical to safeguard climate and cost savings from energy efficiency programs. Robust, cost-effective, and well-rounded compliance processes protect markets from inefficient and low-quality products. Common approaches for conformity assessment adopted by governments around the world include supplier's declaration of conformity and third-party testing and certification by independent parties or government agencies.
- Product Registration Systems are effective tools for tracking compliance. They document tested and certified products on the market and can support market surveillance and enforcement efforts.

Chapter 6: Barriers to Energy Efficiency

- The dumping of low energy efficient products in low-income countries coupled with the lack of knowledge and higher cost of purchase of energy efficient products contribute greatly to their low uptake.
- Barriers to the introduction of EE RACHP equipment can be overcome by:
    - education and consumer awareness campaigns,
    - reducing the investment risk through incentive schemes such as rebates and innovative financial mechanisms for the consumer,
    - stringent regulations and enforcement such as bans on the import of used equipment and products; the development of regulatory frameworks including MEPS for new and used equipment; investment in testing to provide consistency and clarity for consumers and businesses,
    - upgrading/ developing of training materials/ programs for RACHP technicians in vocational institutions and national associations, to incorporate the specialised knowledge and skills needed to install and maintain EE refrigeration systems.

Chapter 7: Potential Benefits of Energy-Efficient RACHP, Including Climate Benefits and Costs, while Phasing down HFCs

- Modelling shows significant potential for energy savings and reductions in peak power. By 2050, the difference in electricity use between "No efficiency gain" and "High efficiency gain" scenarios could be nearly 10,000 TWh per year. The High efficiency gain scenario leads to capital investment savings of USD 2 to 3 trillion by reducing the need to build new power station between now and 2050.
- The residential and commercial sectors dominate the use of electricity for cooling, representing around 44% and 42% of total consumption, respectively.
- Comfort cooling represents around 60% of electricity use, with refrigeration representing the remaining 40%.
- Reduction in the indirect energy related CO2 emissions from RACHP systems will be driven by efforts to reduce cooling demand (e.g., through better building design), improved equipment efficiency and improved operation and maintenance. The decarbonisation of the electricity supply is also a crucial factor.
- In 2023, indirect emissions represent around 75% of RACHP GHG emissions, with direct HFC emissions representing the remaining 25%. Both direct and indirect emissions can be substantially reduced by 2050.
- The cost impact of energy saving measures need to be evaluated on a project-by-project basis as the cost effectiveness is influenced by a range of project-specific technical factors and also by the local conditions (e.g., cost of electricity and grid carbon factor).

- Modelling the costs of energy efficiency improvement can be difficult given that relevant data is proprietary and may involve design changes that manufacturers typically prefer not to disclose publicly.
- On a per-project basis, modelling such costs is crucial for understanding the value of energy efficiency investments that depend on factors such as climate, income, electricity prices, hours of use, CO2 intensity of the grid and the costs of labour and capital.
- Standards setting bodies such as the US Department of Energy or EU Ecodesign conduct analyses of the costs to manufacturers and consumers of the revision of minimum energy performance standards (MEPS) or energy efficiency labels. These vary in their depth, analytical rigor, and cost from multi-year studies with detailed engineering analysis to short market studies.
- Lawrence Berkeley National Laboratory has designed the Joint Investment Framework (JIF) tool for providing initial estimates of the costs and benefits of efficiency improvement in parallel with the phasedown of refrigerants under the Montreal Protocol on a per-project basis using publicly available data. Initially developed as a spreadsheet-based tool and currently implemented in Python for room AC projects, it is being further refined.

Chapter 8: Range and Trends in GWP and EE of RACHP Equipment

- There is a general trend toward increasing adoption of Minimum Energy Performance Standards (MEPS) and Labelling programs globally for RACHP equipment.
- Many Parties lack regulatory capacity and testing infrastructure to design, implement and enforce stringent MEPS programs, so there is an ongoing need for improvement and potentially technical assistance and/or financing in these areas.
- In all applications, there is a general trend of increasing efficiency e.g., through increased adoption of inverter drives that save energy when operating at part load conditions
- Similarly, there is a global trend towards lower GWP refrigerants, driven by the Kigali Amendment, with the weighted average GWP trending downward significantly with increasing deployment of lower GWP refrigerants globally.
- More efficient equipment on a market at any particular time will show more efficient models typically cost more than entry-level models due to multiple reasons including the bundling of non-energy related features in premium models. Hence retail prices may not actually reflect the real cost of energy efficiency improvement.
- Costs of more efficient equipment and components tend to come down over time as a new technology becomes mainstream and due to economies of scale.

Chapter 9: Potential Approaches for Assessing Additional Costs for Improving EE while Phasing Down HFCs

- Additional costs associated with improving the energy efficiency of equipment alongside conversion to HFC alternatives are summarised drawing on information presented in previous EETF reports and presented as Additional Capital Cost (ACC) and Additional Operating Cost (AOC) to differentiate from the Incremental Capital Cost and Incremental Operating Cost.
- The EEWG presents a novel approach for assessing additional costs using an efficiency improvement-linked incentive index. This approach is contrasted with a traditional incremental cost approach. A key feature of the incentive index is that it focuses resources on those enterprises with the greatest need for capacity building and access to knowledge for designing and integrating lower-cost components into their products to improve from minimum to medium and better energy performance. Such an approach focused on where manufacturing EE capacity is most needed, would address a key barrier to access to higher energy efficient equipment in manufacturing and importing countries.

Annex III*

Matrix of expertise needed by the Technology and Economic Assessment Panel as of May 2023

Body	Required Expertise	Article 5/ Non-Article 5
Foams TOC	Experts in extruded polystyrene production in India and China	Article 5
	Polyurethane system house technical experts (especially from small and medium enterprises)	Article 5 from southern Africa, the Middle East, Southeast Asia, or Mexico
	Foam chemistry experts and expertise in building science related to the cross-cutting issue of energy efficiency from	Article 5 or non-Article 5
Fire Suppression TOC	Use of HFCs and Alternatives	South America, Middle East and Africa (2)
	Halon use in merchant shipping and recovery from shipbreaking	Article 5
Methyl Bromide TOC	QPS uses of MB and their alternatives particularly SE Asia	Article 5
	Alternatives to QPS uses of MB adopted in Europe	Non-Article 5
	Members with expertise in disinfestation of agricultural produce and bilateral trade agreements and links to the Technical Panel on Phytosanitary treatments Committee (TPPT) and the International Plant Protection Convention.	Non-Article 5 or Article 5
	Nursery industries, especially issues affecting the strawberry runner industries globally	Article 5 or non-Article 5
Medical and Chemical TOC	Aerosols	China, Indonesia, Latin America
	Semiconductor/electronics manufacturing and use	East Asia and non-Article 5
	End-of-life management Non-refillable and refillable containers, storage	Article 5 Article 5 and non-Article 5
Refrigeration, Air Conditioning and Heat Pumps TOC	After 17 new members were appointed to cover the expected scope for the next Assessment term, no required expertise is needed at present Following the outcomes of the discussion of the TOCs TOR for the next Assessment Report, new expertise may be needed and will be appropriately addressed	
Senior Experts	Experts with extensive experience on TEAP technical and economic assessments, especially sector transitions and challenges in A5 parties; extensive knowledge and experience of Multilateral Fund (MLF) decisions, guidelines, operations, and related funding to meet financial needs of A5 parties under the ODS phaseout and HFC phasedown Expert in the analysis and assessment (including modelling) of factors, including energy efficiency and regional economics, for forecasting the market penetration and potential future disposition of HCFCs, HFCs, and alternatives	Article 5 or non-Article 5

* The annex has not been formally edited.

Annex IV*

Members of the Technology and Economic Assessment Panel technical options committees[a] whose membership expires at the end of 2023 and whose reappointment does not require a decision by the Meeting of the Parties

Name	*Position*	*Country*
Members of technical options committees		
Paul Ashford	FTOC member	United Kingdom
Rick Duncan	FTOC member	United States
Shpresa Kotaji	FTOC member	Belgium
Simon Lee	FTOC member	United States
Dave Williams	FTOC member	United States
Johan Åqvist	FSTOC member	Sweden
Youri Auroque	FSTOC member	France
Tim Widmer	MBTOC member	United States
Christian Sekomo Birame	MCTOC member	Rwanda
Rabinder Kaul	MCTOC member	India
B. Narsaiah	MCTOC member	India
Jose Pons Pons	MCTOC member	Venezuela
David Sherry	MCTOC member	United Kingdom
Peter Sleigh	MCTOC member	United Kingdom
Ashley Woodcock	MCTOC member	United Kingdom

Abbreviations: FTOC – Flexible and Rigid Foams Technical Options Committee; FSTOC – Fire Suppression Technical Options Committee; MBTOC – Methyl Bromide Technical Options Committee; MCTOC – Medical and Chemicals Technical Options Committee.

* The annex has not been formally edited.