

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

Distr.: General
20 May 2026
Original: English

**Open-ended Working Group of the Parties
to the Montreal Protocol on Substances
that Deplete the Ozone Layer
Forty-eighth meeting**
Bangkok, 13–17 July 2026
Items 3–5 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-eighth 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-eighth meeting (UNEP/OzL.Pro.WG.1/48/2) contains information that has become available since the preparation of that note. Section II of the addendum sets out new and updated information provided by the Technology and Economic Assessment Panel in its 2026 report and by the Secretariat in relation to items 3–5 of the provisional agenda. Section III contains updated information of relevance to the Thirty-Eighth Meeting of the Parties to the Montreal Protocol regarding submissions from parties in response to decisions XXXVII/3, on recycled, used and unwanted controlled substances, and XXXVII/5, on national and regional initiatives to support the implementation of the Kigali Amendment to the Montreal Protocol.

2. The 2026 report of the Technology and Economic Assessment Panel currently consists of two volumes:¹

- (a) Volume 1: Progress report (May 2026);
- (b) Volume 2: Assessment of the funding requirement for the replenishment of the Multilateral Fund for the period 2027–2029.

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

* UNEP/OzL.Pro.WG.1/48/1.

¹ Available on the portal for the forty-eighth meeting of the Open-ended Working Group at <https://ozone.unep.org/meetings/48th-meeting-open-ended-working-group-parties/pre-session-documents>.

Agenda item 3

Report of the Technology and Economic Assessment Panel on the 2027–2029 replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol (decision XXXVII/6)

4. Pursuant to decision XXXVII/6 and as outlined in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 4–9), the Technology and Economic Assessment Panel established a task force to prepare the report² on the appropriate level of replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the triennium 2027–2029 in support of parties operating under paragraph 1 of Article 5 (Article 5 parties) for submission to the Thirty-Eighth Meeting of the Parties through the Open-ended Working Group at its forty-eighth meeting. The executive summary of the report, as received from the Panel and without formal editing, is set out in annex I to the present addendum.

5. In the report, the task force presents, across several chapters and annexes, a detailed analysis of its estimates of funding requirements for the triennium 2027–2029 and indicative figures for the trienniums 2030–2032 and 2033–2035. The estimates are based on Article 7 data reported by parties to the Secretariat, information contained in the consolidated business plan of the Multilateral Fund for 2026–2028, relevant decisions of the Executive Committee of the Multilateral Fund taken at meetings up to and including its ninety-seventh meeting, existing cost guidelines, existing and expert-derived cost-effectiveness values, and relevant information available through the Multilateral Fund and Ozone secretariats.

6. The estimates cover activities related to the phase-out of consumption and production of hydrochlorofluorocarbons (HCFCs); the phase-down of consumption and production of hydrofluorocarbons (HFCs), including mitigation of by-product HFC-23 emissions; and institutional strengthening and standard activities (i.e. costs related to the Compliance Assistance Programme of the United Nations Environment Programme, other implementing agencies, the Multilateral Fund secretariat and the Fund Treasurer). Funding for energy efficiency, addressed in several Executive Committee decisions, is also incorporated into the estimated funding requirements for HCFC phase-out and HFC phase-down in the triennium 2027–2029. A funding window for pilot projects for regional atmospheric monitoring of controlled substances is also included in the funding estimates for the trienniums 2027–2029 and 2030–2032. Detailed analyses of the funding estimates for energy efficiency and regional atmospheric monitoring are set out in chapters 7 and 10 of the task force report, respectively.

7. As is requested in decision XXXVII/6, funding estimates for the special needs of low-volume-consuming and very-low-volume-consuming countries are included in the total estimates for all three trienniums, taking into account relevant decisions of the Executive Committee. While those estimates are based on current cost guidelines, further analysis of the special needs of those countries, set out in chapter 6 of the task force report, suggests higher funding for consideration in a potential review of cost guidelines in 2028.

8. As is also requested in the decision, the task force addressed issues related to life-cycle refrigerant management and digital technologies in the servicing sector separately in chapters 8 and 9, respectively. While detailed information on those topics is provided for parties' consideration, the topics were not taken into account in the estimated funding requirements for the three trienniums.

9. For the HCFC consumption sector, the task force derived its funding estimates assuming full phase-out by 2030, with only limited servicing tail allowances permitted during the period 2030–2040.³ It also assumed that funding requirements after 2030 would be primarily limited to disbursements for committed tranches under HCFC phase-out management plans. Furthermore, the task force assumed that 90 per cent of HCFC phase-out management plan funding would be allocated during the triennium 2027–2029, with the remaining 10 per cent allocated during the triennium 2030–2032.⁴

² <https://ozone.unep.org/system/files/documents/TEAP-DecisionXXXVII6-replenishment-TF-report-May2026-RTF-report.pdf>.

³ These allowances comprise an annual average of 2.5 per cent for servicing of existing refrigeration and air-conditioning equipment, servicing of fire suppression and fire protection equipment existing on 1 January 2030, solvent applications in rocket engine manufacturing, and topical medical aerosol for applications for the specialized treatment of burns.

⁴ Consistent with Executive Committee decision 62/17.

10. To address the parties' request in decision XXXVII/6 for a compliance-based methodology that is independent of the Multilateral Fund business plan, the task force developed two cost-effectiveness scenarios for 15 non-low-volume-consuming parties with remaining eligible manufacturing consumption: HCFC scenario 1, based on historical average cost-effectiveness values; and HCFC scenario 2, based on the cost-effectiveness thresholds established under existing cost guidelines.
11. For the HCFC production sector, funding estimates include costs for the remaining HCFC production phase-out management plans, including verification activities pertaining to one project that is expected to require funding in the 2027–2029 triennium.
12. For the HFC consumption sector, the applied methodology estimates funding to address the needs of Article 5 parties to comply with their Kigali Amendment phase-down schedules as follows:
 - (a) Article 5, group 1, parties: 10 per cent reduction from the baseline by 2029 and 30 per cent reduction from the baseline by 2035;
 - (b) Article 5, group 2, parties: freeze at the baseline level by 2028 and 10 per cent reduction from the baseline by 2032.
13. While the analysis takes into account that, as of April 2026, 125 of the 144 Article 5 parties had ratified the Kigali Amendment, it assumes that all remaining parties will ratify the Amendment by 2029, which would make all Article 5 parties eligible for funding during the triennium 2027–2029.
14. The model used draws on HFC baseline data submitted to the Secretariat and generates estimates of missing baselines using methodologies applied in earlier task force reports. It also accounts for already approved Kigali HFC implementation plans, applies existing cost-effectiveness thresholds and task force expert estimates where standard values are unavailable, and allocates funding across trienniums to reflect varying implementation schedules, reduction targets and approval cycles.
15. To present a range of estimates, the task force calculated the total costs of the HFC phase-down for stages I and II of the Kigali HFC implementation plans across the three trienniums, taking into account the reduction targets up to 2035, and subsequently applied two funding scenarios: HFC scenario 1, using cost-effectiveness thresholds in accordance with cost guidelines or task force-derived estimates and without consideration of small and medium-sized enterprises; and HFC scenario 2, using adjusted cost-effectiveness thresholds reflecting participation of small and medium-sized enterprises.
16. In addition, for each scenario the task force proposes two resource allocation schedules (A and B), set out in table 1.4 of the task force report, which differ in the distribution of funding across trienniums: schedule A reflects a faster, front-loaded funding approach, while schedule B assumes more gradual funding across later trienniums.
17. Additional assumptions include average agency support costs of 9.6 per cent and a 15 per cent deduction for foreign ownership applied in manufacturing sectors.
18. For the HFC production sector, funding estimates for 2027–2029 comprise project preparation, Kigali HFC production phase-out implementation plans for two parties, and HFC-23 mitigation projects and related preparation for four Article 5 parties.
19. On the basis of a detailed analysis, the task force estimates the total funding requirement for the replenishment of the Multilateral Fund for the triennium 2027–2029 to be between \$1.282 and \$1.361 billion in the low-end scenario and between \$1.672 and \$1.755 billion in the high-end scenario, as summarized in table 1. The ranges of total funding requirements are calculated on the basis of different scenarios and resource allocation schedules for HCFC phase-out and HFC phase-down. Detailed information on the estimation methodology is provided in the annexes to the report.

Table 1
Estimated total funding requirements for the replenishment of the Multilateral Fund for the triennium 2027–2029, low-end range and high-end range

(Millions of United States dollars)

<i>Triennium 2027–2029</i>	<i>Low-end range^a</i>	<i>High-end range^b</i>
HCFC activities (including energy efficiency)	451	573
HFC activities (including energy efficiency, HFC-23 mitigation and regional atmospheric monitoring)	702–781	970–1 053
Institutional strengthening and standard activities	129	129
Total	1 282–1 361	1 672–1 755

Abbreviations: HCFC – hydrochlorofluorocarbon; HFC – hydrofluorocarbon.

^a The low-end range is calculated on the basis of the following scenarios:

(a) HCFC scenario 1 (historical cost-effectiveness thresholds in manufacturing sectors) with 90 per cent of funding allocated during the triennium 2027–2029 and 10 per cent during the triennium 2030–2032;

(b) HFC scenario 1 (cost guidelines or expert-derived cost-effectiveness thresholds without taking into consideration small and medium-sized enterprises) with resource allocation schedule B (gradual funding approach).

^b The high-end range is calculated on the basis of the following scenarios:

(a) HCFC scenario 2 (cost-effectiveness thresholds applied in accordance with cost guidelines in manufacturing sectors) with 90 per cent of funding allocated during the triennium 2027–2029 and 10 per cent during the triennium 2030–2032;

(b) HFC scenario 2 (cost guidelines or expert-derived cost-effectiveness thresholds taking into consideration small and medium-sized enterprises) with resource allocation schedule A (front-loaded funding approach).

20. In accordance with its terms of reference, the task force also provides indicative funding requirement ranges for the subsequent two trienniums, 2030–2032 and 2033–2035, as is shown in table 2.

Table 2
Indicative total funding requirements for the replenishment of the Multilateral Fund for the trienniums 2030–2032 and 2033–2035, low-end range and high-end range

(Millions of United States dollars)

<i>Triennium</i>	<i>Low-end range^a</i>	<i>High-end range^b</i>
2030–2032		
HCFC activities	83	96
HFC activities	877–908	1 050–1 085
Institutional strengthening and standard activities	137	137
Total	1 097–1 128	1 283–1 318
2033–2035		
HCFC activities	–	–
HFC activities	488–503	583–600
Institutional strengthening and standard activities	145	145
Total	633–648	728–745

Abbreviations: HCFC – hydrochlorofluorocarbon; HFC – hydrofluorocarbon.

^a The low-end range is calculated on the basis of the following scenarios:

(a) HCFC scenario 1 (historical cost-effectiveness thresholds in manufacturing sectors) with 90 per cent of funding allocated during the triennium 2027–2029 and 10 per cent during the triennium 2030–2032;

(b) HFC scenario 1 (cost guidelines or expert-derived cost-effectiveness thresholds without taking into consideration small and medium-sized enterprises) with resource allocation schedule B (gradual funding approach).

^b The high-end range is calculated on the basis of the following scenarios:

(a) HCFC scenario 2 (cost-effectiveness thresholds applied in accordance with cost guidelines in manufacturing sectors) with 90 per cent of funding allocated during the triennium 2027–2029 and 10 per cent during the triennium 2030–2032;

(b) HFC scenario 2 (cost guidelines or expert-derived cost-effectiveness thresholds taking into consideration small and medium-sized enterprises) with resource allocation schedule A (front-loaded funding approach).

21. The Open-ended Working Group may wish to consider the initial work of the task force. As is customary, parties may wish to discuss and agree on the additional information to be included in a supplementary report that may be prepared by the task force in advance of the Thirty-Eighth Meeting of the Parties.

Agenda item 4

Presentations by the Technology and Economic Assessment Panel on its 2026 progress report

22. Under item 4 of the provisional agenda, the parties will consider information provided by the Technology and Economic Assessment Panel in its 2026 progress report,⁵ which includes progress reports by its technical options committees; responses to decisions of the Meetings of the Parties related to halon 1301 and other controlled substances used for fire suppression (decision XXXVII/4); metered-dose inhalers with low-global-warming-potential propellants (decision XXXVI/6); options for the organization of the Panel and its technical options committees (decision XXXV/20); changes in the membership of the Panel; and other issues, including the evaluation of a destruction technology submitted by Canada and updated information on perfluoroalkyl and polyfluoroalkyl substances (PFAS).

23. The key messages from the progress reports of the technical options committees, as set out in the Panel's progress report, are reproduced in annex I to the present addendum, without formal editing. To avoid duplication, the parts of the key messages that relate to decisions XXXVII/4, XXXVI/6 and XXXV/20, as well as information about other key issues, have been removed from annex I and are addressed only in subsections (a), (b), (c) and (e) below.

(a) Halon 1301 and its continuing use in the aviation industry; management of other controlled substances used for fire suppression (decision XXXVII/4)

24. As is mentioned in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 10–15), in decision XXXVII/4, the Thirty-Seventh Meeting of the Parties requested the Secretariat to liaise with the secretariat of the International Civil Aviation Organization (ICAO) on the matter of fire suppression agents controlled under the Montreal Protocol and to facilitate the exchange of information between the Technology and Economic Assessment Panel, through its Fire Suppression Technical Options Committee, and the relevant ICAO technical committees and working groups in order to allow the Panel to submit a report on halon availability and the global distribution of halon banks to the parties in advance of the forty-eighth meeting of the Open-ended Working Group. The Panel's response, prepared by the Fire Suppression Technical Options Committee, is set out in section 3.8 of its progress report. A summary is provided in the following paragraphs.

25. In response to the Secretariat's letter to ICAO dated 4 February 2026, mentioned in the note by the Secretariat, the ICAO secretariat, in a letter dated 29 April 2026, designated the Chief of the Operational Safety Section of the Air Navigation Bureau as the focal point on matters concerning halon management and alternatives in civil aviation. The letter also referred to ICAO resolution A42-11 on halon replacement, adopted by the ICAO Assembly at its forty-second session, held in Montreal, Canada, from 23 September to 3 October 2025. In particular, reference was made to paragraph 6 of the resolution, in which States were encouraged, with the assistance of ICAO, to liaise with the Ozone Secretariat and the Technology and Economic Assessment Panel and its Fire Suppression Technical Options Committee to assess global halon reserves and support the sustainable management of existing halon banks, including an essential-use nomination for halon in aircraft cargo compartment applications under the Montreal Protocol to maintain aviation safety.

26. In this regard, it is also important to note that, in paragraph 7 of resolution A42-11, the Assembly directed the ICAO Council, in coordination with industry and considering the assessment of availability of the global halon reserves, to develop a proposal for a revised sustainable effective cut-off date for halon replacement for new aircraft type certificate applications. Pursuant to the resolution, the proposal should be based on comprehensive data, including on halon availability, and progress in alternative solution development, and should take account of safety considerations.

27. In the meantime, the Fire Suppression Technical Options Committee has been liaising with the Cargo Compartment Halon Replacement Advisory Group established under the International Coordinating Council of Aerospace Industries Associations. The two groups of experts have proposed that the Ozone and ICAO secretariats consider developing a joint letter requesting data from the

⁵ <https://ozone.unep.org/system/files/documents/TEAP-May2026-Progress-Report-vol1.pdf>.

parties to the Montreal Protocol with the aim of better assessing the future use of and need for halons in civil aviation.

28. The ICAO secretariat has also requested the formation of a formal expert group through the Airworthiness Panel, including but not limited to original equipment manufacturers, maintenance, repair and overhaul entities, suppliers, recyclers, non-governmental organizations, the Technology and Economic Assessment Panel and its Fire Suppression Technical Options Committee and other relevant stakeholders. This ongoing initiative is intended to facilitate the exchange of information.

29. In response to ICAO Assembly resolution A42-11 and decision XXXVII/4 of the Thirty-Seventh Meeting of the Parties, the Cargo Compartment Halon Replacement Advisory Group formed a small working group, including a member of the Fire Suppression Technical Options Committee who is also a member of the Advisory Group, to coordinate data collection and analysis aimed at assessing future demand for halon 1301. The group's work focuses both on the quantities required to sustain the current in-service aircraft fleet and on forecasting the halon 1301 needs associated with future aircraft deliveries and their continued operation. Those efforts will assist in determining the need for future essential use requests or otherwise.

30. Using a variety of relevant data sources and a number of assumptions outlined in the progress report, the group assessed the amount of halon currently installed in the actual in-service fleet (average: 2,302 metric tons). On the basis of that analysis, it was possible to estimate the quantities needed to replenish losses resulting from system discharges during fire events or false alarms, leakage and contamination during maintenance activities, and make projections of future halon 1301 requirements for new aircraft (average: 175 metric tons per year).

31. The Fire Suppression Technical Options Committee also estimated updated halon 1301 run-out dates using revised sectoral bank data from its model, adjusted through expert judgment and assessed across 20 scenarios with varying bank sizes and emission rates. Two modelling approaches were used to align projected emissions with historical Fire Suppression Technical Options Committee emissions data for the years 2015–2024. The model first projected depletion of the available bank and subsequently considered the use of reserve stocks supporting enduring uses, including civil aviation.

32. The modelling scenarios produced estimated run-out dates ranging from 2030 to 2042. However, scenarios requiring unrealistically high emission rates were considered implausible and were therefore excluded. On that basis, the most credible run-out date is estimated to be between 2031 and 2039, centred around 2035 plus or minus four years.

33. In the light of those findings, the Committee suggests that parties may wish to consider whether any changes are needed to the essential-use nomination and evaluation processes, given that individual parties may no longer be able to determine their annual halon 1301 civil aviation production and consumption needs.

34. In paragraph 4 of decision XXXVII/4, parties were invited to submit to the Ozone Secretariat, on a voluntary basis, by 31 March 2026, available information regarding the development of alternatives suitable for use as substitutes in fire suppression, and the Secretariat was requested to forward the information received to the Technology and Economic Assessment Panel for its consideration and for inclusion, at the latest, in its 2027 progress report. At the time of the preparation of the present addendum, three parties – Argentina, Ecuador and Saint Vincent and the Grenadines – had responded to the decision, in addition to the 33 parties that had done so by the time of preparation of the note by the Secretariat. All those submissions were forwarded to the Technology and Economic Assessment Panel for consideration in the preparation of its progress report for 2026, and possibly that for 2027.

35. The Open-ended Working Group may wish to consider the report and recommend a way forward.

(b) Metered-dose inhalers with low-global-warming-potential propellants (decision XXXVI/6)

36. As is mentioned in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 16–19), in decision XXXVI/6, the Thirty-Sixth Meeting of the Parties requested the Technology and Economic Assessment Panel to continue to provide in its annual progress reports updated information on low-global-warming-potential metered-dose inhaler propellants and to complement its 2026 quadrennial assessment report with timely information, including on the availability, technical feasibility, economic viability, safety and market penetration of those propellants in all parties. The Panel's response, prepared by the Medical and Chemicals Technical Options Committee, is set out in section 5.8 of its progress report. A summary is provided in the following paragraphs.

37. Recent reports on asthma and chronic obstructive pulmonary disease management highlight continued efforts to improve disease control and expand access to medicines. Asthma treatment relies on inhaled corticosteroids to reduce severe attacks, while concerns persist about the excessive use of short-acting inhalers. Chronic obstructive pulmonary disease management increasingly relies on long-acting inhalers and newer biologic therapies for severe cases. However, high medicine costs and limited availability remain significant barriers, particularly in low- and middle-income countries.
38. Several inhaler types are used for asthma and chronic obstructive pulmonary disease treatment, including pressurized metered-dose inhalers, dry powder inhalers, soft mist inhalers and nebulizers. Among them, pressurized metered-dose inhalers remain the most widely used, accounting for about 70 per cent of global inhaler doses, with salbutamol pressurized metered-dose inhalers representing the largest share. Although the use of dry powder inhalers and other alternatives is growing, replacing pressurized metered-dose inhalers would require substantial investment, manufacturing changes, and time.
39. As the global use of HFCs declines, the proportion used in pressurized metered-dose inhalers is becoming increasingly important. New European Union regulations aimed at reducing HFC consumption may affect the future supply of the pharmaceutical-grade HFCs needed for inhalers. Reviews and policy measures are therefore being planned to prevent shortages and maintain healthcare access.
40. The United States of America and major European countries continue to dominate the global inhaler market, with increasing demand for newer combination inhalers for severe asthma and chronic obstructive pulmonary disease. Transitioning either to dry powder inhalers or to pressurized metered-dose inhalers using lower-global-warming-potential propellants would require major technological upgrades and infrastructure investment.
41. Supplying the pharmaceutical-grade HFC propellants used in inhalers – mainly HFC-134a and HFC-227ea – is becoming increasingly challenging during the transition to lower-global-warming-potential alternatives. The production of such propellants is highly concentrated in a few manufacturers, and changing industrial demand is leading to plant closures or consolidation, which may affect long-term stability. While supply is expected to continue into the early 2030s, costs may rise and regional shortages, particularly in Europe, are possible due to quota systems and stricter regulations. Additional administrative controls on production and export further complicate availability. Emerging production capacity in countries such as India and China may help to diversify future supply of both existing HFCs and newer alternatives.
42. The transition to lower-global-warming-potential propellants in pressurized metered-dose inhalers is progressing but continues to face many challenges, including evolving environmental regulations, the stability of the supply of pharmaceutical-grade HFCs, affordability and availability of alternative devices, regulatory approval and market launch of new inhalers, and patient acceptance.
43. Two key alternative propellants are being developed: HFC-152a (with a global warming potential of 124) and HFO-1234ze(E). HFC-152a is already widely used in industry, is more flammable than current propellants and requires upgraded manufacturing safety systems, but clinical studies show no toxicity, and regulatory submissions are underway in several countries. HFO-1234ze(E) is also widely used in non-medical applications, has shown no toxicity in studies and is already in commercial pharmaceutical-grade production, with regulatory filings completed in major markets.
44. At least 10 companies worldwide appear to be developing pressurized metered-dose inhalers containing these pharmaceutical-grade lower global-warming-potential propellants, including three companies in India and one in Bangladesh. Several generics manufacturers in Latin America are also developing lower global-warming-potential pressurized metered-dose inhalers, while two companies in China have initiated the development of HFO-1234ze(E) as a bulk propellant.
45. Small and medium-sized manufacturers in low- and middle-income countries are particularly vulnerable because they often lack the licences, funding and regulatory capacity needed to shift to lower-global-warming-potential products. Without support, many may struggle to make the transition, which could widen global inequalities. Partnerships or consolidation with larger manufacturers may therefore be necessary for these manufacturers to maintain supply and keep inhalers affordable and accessible to their markets. There are also concerns that energy and fuel crises may worsen the respiratory disease burden in these regions.
46. After several years of development, the first pressurized metered-dose inhaler using a lower-global-warming-potential propellant has been launched in the United Kingdom. A second

company has submitted an application for approval, while two others have completed clinical trials and plan to seek marketing authorization.

47. The report also highlights the role of intellectual property in shaping the development of lower-global-warming-potential pressurized metered-dose inhalers and notes the existence of European Union legislation restricting the marketing of single-use plastic products when suitable alternatives are available.

48. The Open-ended Working Group may wish to consider the report and recommend a way forward.

(c) Options for the organization of the Panel and its technical options committees (decision XXXV/20)

49. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 20–22), in decision XXXV/20, the Thirty-Fifth Meeting of the Parties requested the Technology and Economic Assessment Panel to provide, in its progress report prepared ahead of the forty-seventh meeting of the Open-ended Working Group, options relating to the organization of the Panel and its technical options committees, considering the Panel's terms of reference established in decision XXIV/8, and informed by consultation with the technical options committees' co-chairs and members and by their experiences with operating, on a trial basis, with new ways of organizing their work.

50. The Panel's original response to decision XXXV/20, which was prepared by an eight-member working group, was presented to the Open-ended Working Group at its forty-seventh meeting.⁶ In its 2026 progress report, the Panel presents further analysis and highlights preferred options for its reorganization. The analysis, which was carried out by the reconvened working group, is set out in chapter 8 of the report. A summary is provided in the following paragraphs.

51. Currently, the Technology and Economic Assessment Panel comprises 21 members: 3 Panel co-chairs, 12 technical options committee co-chairs and 6 senior experts. Of those, 48 per cent are from Article 5 parties, with a gender distribution of 6 women and 15 men. Over 150 experts serve on the Panel and its technical options committees, carrying out unpaid voluntary work.

52. According to the Panel, overall, the current composition and structure of the technical options committees is functioning effectively and enabling them to carry out their work successfully. The additional analysis provided for parties' consideration concerns, in particular, each committee's preferred option to manage anticipated workload changes from 2027 onwards. Those options are grounded in current practical realities, including expected membership attrition, constraints on participation support and ongoing recruitment needs, as well as the gradual development of subcommittee-based working arrangements in the two largest technical options committees. The options are intended to remain adaptable and may be revisited as parties' needs evolve.

53. In this context, the Panel refers to its updated matrix of expertise, which highlights identified gaps and encourages parties to nominate experts to help address those needs.

54. For each technical options committee, the report presents background information on its scope and the issues it addresses, followed by an analysis of its preferred option for future configuration, including, as appropriate, associated advantages and disadvantages. In brief, the Panel's preferred options are as follows:

(a) The Flexible and Rigid Foams Technical Options Committee, currently comprising two co-chairs and 19 members, is considered well-functioning and appropriately sized. It provides critical assessments on foam sector alternatives and technical developments. It may consider minor future adjustments (such as reduced meeting frequency or reduction in size after key transitions are completed), but maintaining its current set-up for overall stability is preferred at this stage;

(b) The Fire Suppression Technical Options Committee, currently comprising two co-chairs and 17 members, is viewed as essential, providing key functions such as emissions modelling, halon banking and aviation-related supply assessments. Given the recent developments in the fire suppression sector and the likelihood of future essential-use nominations, particularly for civil aviation and other enduring uses, the current structure of the Committee, with updated or replacement members and, ideally, an additional co-chair from an Article 5 party, is considered to be appropriate. The Panel therefore recommends maintaining the current structure, noting that reducing membership

⁶ Document UNEP/OzL.Pro.WG.1/47/2 (paras. 17–21) and the addendum thereto UNEP/OzL.Pro.WG.1/47/2/Add.1 (paras. 19–28 and table 1).

could undermine its ability to meet future demands, especially for essential uses in aviation and legacy systems;

(c) The Methyl Bromide Technical Options Committee, currently comprising two co-chairs and 16 members, reports that controlled uses of methyl bromide have been largely phased out, but quarantine and pre-shipment uses remain significant. It recommends maintaining a moderately sized expert group to preserve institutional knowledge and manage remaining controlled and exempt uses, while continuing to support alternatives and emissions reduction strategies;

(d) The Medical and Chemicals Technical Options Committee, currently comprising three co-chairs and 39 members, covers a broad and expanding scope, including pharmaceuticals, solvents, semiconductor manufacturing and emerging chemical issues like PFAS and HFC emissions. Due to its growing workload and complexity, it proposes a potential future restructuring into two subcommittees, on “aerosols/medical” and “chemicals”, supported by four co-chairs, to improve efficiency while retaining technical breadth;

(e) The Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, currently comprising four co-chairs and 42 members, faces increasing workload due to global growth in cooling demand, energy efficiency policies and Kigali Amendment implementation. It proposes maintaining a large committee, with subcommittees on “comfort cooling and heating” and “cold chain and other applications”, allowing specialization while preserving coordination on cross-cutting issues.

55. Across all technical options committees, the Technology and Economic Assessment Panel highlights common challenges: expanding workload from overlapping ozone-depleting substance phase-out and HFC phase-down regimes, loss of experienced members through retirement, difficulty in funding participation (especially travel), and the strain of maintaining consensus in increasingly virtual working environments. While remote collaboration helps continuity, the Panel emphasizes that in-person meetings remain essential for trust-building and effective consensus.

56. The Open-ended Working Group may wish to consider the report and recommend a way forward.

(d) Changes in the membership of the Panel

57. In annex 2 to its 2026 progress report, the Technology and Economic Assessment Panel provides information on the status of its membership and that of its technical options committees as of May 2026.

58. A list of the Panel members whose membership expires at the end of 2026 and whose reappointment requires a decision by the Thirty-Eighth Meeting of the Parties is set out in table 3. The members of the technical options committees whose membership expires at the end of 2026 and whose reappointment does not require a decision by the Thirty-Eighth Meeting of the Parties are listed in annex III to the present addendum.

Table 3

Members of the Technology and Economic Assessment Panel whose membership expires at the end of 2026 and whose reappointment requires a decision by the Thirty-Eighth Meeting of the Parties

<i>Name</i>	<i>Position</i>	<i>Country</i>
Marta Pizano	TEAP co-chair	Colombia
Ashley Woodcock	TEAP co-chair	United Kingdom of Great Britain and Northern Ireland
Fabio Polonara	RTOC co-chair	Italy
Suely Machado Carvalho	TEAP senior expert	Brazil
Sukumar Devotta	TEAP senior expert	India
Bassam Elassaad	TEAP senior expert	Lebanon
Ray Gluckman	TEAP senior expert	United Kingdom of Great Britain and Northern Ireland
Marco Gonzalez	TEAP senior expert	Costa Rica
Shiqiu Zhang	TEAP senior expert	China

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

59. 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, 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”.

60. The matrix of needed expertise, identified by the Panel as of May 2026, is included in annex 3 to its progress report and has been reproduced in annex IV to the present addendum and made available on the Secretariat’s website.⁷

61. In accordance with paragraph 4 of decision XXXI/8, the Secretariat will make available, on the meeting portal for the forty-eighth meeting of the Open-ended Working Group and, later in 2026, on the meeting portal for the Thirty-Eighth Meeting of the Parties, 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.

62. 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

63. Under this agenda sub-item, the Secretariat provides in the following paragraphs summaries of the information provided by the Panel in relation to the evaluation of a destruction technology submitted by Canada and updated information on PFAS.

64. Should any party wish to discuss these issues, or any other issues relating to the Panel’s 2026 progress report at the forty-eighth meeting of the Open-ended Working Group, it may raise them at the time of the adoption of the agenda and request that such issues be included on the agenda, as appropriate.

(i) Evaluation and recommendation of a destruction technology submitted by Canada

65. Over the years, the parties have adopted a number of decisions approving destruction technologies for controlled substances for the purposes of the Montreal Protocol. The current list of approved destruction technologies is contained in annex II to the report of the Thirtieth Meeting of the Parties, as modified by the Thirty-Fifth Meeting of the Parties in decision XXXV/5.⁸

⁷ See <https://ozone.unep.org/science/assessment/teap/teap-expertise-required>.

⁸ <https://ozone.unep.org/node/1941>.

66. In decision XXXV/5, on destruction technologies for controlled substances, parties were invited to submit to the Secretariat information relevant to a review of destruction technologies. In accordance with decision IV/11 of the Fourth Meeting of the Parties, such reviews are performed by the Technology and Economic Assessment Panel and relevant recommendations are prepared for consideration by the Meeting of the Parties. As part of its assessment, the Panel, through its Medical and Chemicals Technical Options Committee, also provides technical advice about emissions of other pollutants and the technical capability of destruction technologies for consideration by parties. In this regard, the Secretariat received queries from two parties related to their destruction technologies, which were answered by the Committee through the Secretariat.

67. In November 2025, Canada submitted to the Secretariat confidential and non-confidential information regarding a patented plasma arc technology utilizing steam for evaluation by the Technology and Economic Assessment Panel. The Panel's Medical and Chemicals Technical Options Committee reviewed the submission, requested clarifications from Canada and conducted an independent technical assessment, including peer review and discussion to reach consensus.

68. The Committee's evaluation followed the established criteria for destruction technologies, focusing on demonstrated destruction and removal efficiency, emissions limits (including for dioxins/furans and acid gases, particulate matter and carbon monoxide) and minimum processing capacity. Data were assessed for several controlled substances, including CFC-11, CFC-12, HCFC-22 and HFC-134a.

69. Based on the Committee's review of performance data submitted by Canada, the technology demonstrated that the destruction and removal efficiencies achieved for the destruction of CFC-12, CFC-11, HCFC-22 and HFC-134a are greater than 99.99 per cent, meeting the destruction and removal efficiency performance criteria⁹ for those controlled substances for the purposes of destruction under the Montreal Protocol. Pollutant emissions were also found to be below recommended thresholds, and processing capacities exceeded minimum criteria. On that basis, the Committee concluded that the technology is technically capable of meeting destruction requirements for concentrated sources of Annex A, group I, Annex C, group I, and Annex F, group I, substances.

70. The Committee also reviewed how the technology aligns with existing plasma arc categories and concluded that, although it has similarities with previously approved plasma arc systems, it is sufficiently distinct from them. Accordingly, the Technology and Economic Panel recommends that the technology, under a new generic category "steam plasma arc", be approved for destruction of concentrated sources of Annex A, group I, Annex C, group I, and Annex F, group I, controlled substances for the purposes of the Montreal Protocol.

71. The Open-ended Working Group may wish to consider the issue and recommend a way forward.

(ii) Emerging policies and sector information related to PFAS

72. Consistent with previous reports of the Technology and Economic Assessment Panel, chapter 7 of its 2026 progress report provides updated policy-relevant information related to PFAS and outlines the potential implications of transitioning to alternatives from substances controlled under the Montreal Protocol in the fire suppression, foams, medical, and refrigeration, air-conditioning and heat pump sectors.

73. The Panel emphasizes that, while PFAS are often incorrectly grouped together as "forever chemicals", in fact not all PFAS are persistent, bioaccumulative and toxic. Much of the concern focuses on chemicals such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), which are very persistent, harmful and already heavily restricted in many jurisdictions.

74. As in previous reports, the Panel notes that definitions of "PFAS" vary widely among international, national and state regulations, resulting in inconsistent treatment of substances relevant to the Montreal Protocol. Different organizations and governments use different criteria, and some definitions are broad enough to include refrigerants, fire suppressants, foam-blowing agents, fluoropolymers and medical aerosol propellants controlled under the Montreal Protocol as well as substances used as substitutes for them. Regulations based solely on chemical structure rather than

⁹ Although the submission states that the destruction technology was tested on more than 60 compounds, including perchlorinated and brominated compounds, no supporting data were provided for those compound classes. Therefore, beyond the controlled substance categories where data were presented, no data-based assessment could be made in relation to those other substances.

actual environmental or health risk may unintentionally ban substances that are not highly toxic or persistent.

75. Regulatory approaches also differ significantly. The Stockholm Convention on Persistent Organic Pollutants restricts only specific PFAS, such as PFOS and PFOA, without targeting Montreal Protocol-related substances. In contrast, proposed European Union PFAS restrictions under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation could affect alternatives to ozone-depleting and high-global-warming-potential substances. Canada is considering broader PFAS controls, potentially including some Montreal Protocol-related chemicals, while excluding fluoropolymers. In the United States, the Environmental Protection Agency applies a risk-based approach focused on toxicity and exposure, and some states have adopted broader PFAS definitions and restrictions.

76. The uncertainty around future PFAS regulations is already slowing investment in replacement technologies. Companies are hesitant to invest in alternatives that may later be banned. This uncertainty could delay progress towards Montreal Protocol and Kigali Amendment targets by reducing the availability of low-global-warming-potential substitutes and discouraging innovation.

77. In the fire suppression sector, aircraft fire protection systems still rely heavily on halons because alternatives for some applications, especially cargo compartments and engine nacelles, remain technically inadequate despite decades of research. Potential replacements such as 2-BTP and fluoroketones may themselves be classified as PFAS under broad definitions, creating uncertainty about their long-term viability. Civil aviation stakeholders are therefore reconsidering the continued long-term use of halon 1301, which could prolong dependence on ozone-depleting substances for many decades because aircraft systems are designed and certified over extremely long timelines.

78. In the foam insulation sector, which plays an important role in reducing energy use in buildings and refrigeration systems, manufacturers have already delayed decisions about foam-blowing agents because of uncertainty surrounding fluorinated alternatives and possible future bans. Since no single blowing agent works optimally for all applications, reducing the number of available options could create technical and economic difficulties.

79. In the medical sector, pressurized metered-dose inhalers used to treat asthma and chronic obstructive pulmonary disease may also be affected. The industry is transitioning away from high-global-warming-potential propellants towards lower-global-warming-potential alternatives such as HFC-152a and HFO-1234ze(E). However, some proposed PFAS regulations could restrict HFO-1234ze(E) despite its extremely low global warming potential. Because developing new inhalers takes many years and because hundreds of millions of patients rely on those medicines, uncertainty about future regulations is creating concern in the healthcare and pharmaceutical sectors.

80. The refrigeration, air-conditioning and heat pump sector is identified as especially important because it accounts for most global HFC consumption under the Kigali Amendment. According to the Panel, nearly all commonly used fluorinated refrigerants except HFC-32 could potentially fall under broad PFAS definitions. While non-fluorinated alternatives such as hydrocarbons, ammonia and carbon dioxide are suitable in some applications, they also have limitations related to flammability, toxicity, pressure, efficiency, and suitability for certain climates and building types. Broad PFAS bans could therefore reduce refrigerant choices, slow the adoption of heat pumps, lower energy efficiency and ultimately increase greenhouse gas emissions.

81. Another major concern noted in the report involves fluoropolymers used in refrigeration, air-conditioning and heat pump equipment. These materials are essential for seals, compressors, valves, wiring insulation, heat exchangers, coatings and electronics because of their durability and chemical resistance. Restrictions on fluoropolymers could therefore disrupt manufacturing across this sector regardless of refrigerant type, since many systems using carbon dioxide, ammonia or hydrocarbons also depend on fluoropolymers.

82. Under decision XXXV/3, on potential areas of focus for the 2026 quadrennial reports of the Environmental Effects Assessment Panel, the Scientific Assessment Panel and the Technology and Economic Assessment Panel, all panels were requested to include in their 2026 quadrennial assessment reports information on controlled substances and their alternatives and breakdown products, in particular PFAS. The Technology and Economic Assessment Panel is coordinating with the two other panels on the scope of information on this topic to be covered in the respective quadrennial assessment reports.

Agenda item 5

Enhancing regional atmospheric monitoring of substances controlled by the Montreal Protocol (decision XXXVII/1)

83. As is mentioned in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 26–30), in decision XXXVII/1, the Secretariat was requested to report to the Open-ended Working Group at its forty-eighth meeting and to the Thirty-Eighth Meeting of the Parties on progress in and any outcomes of the following activities: evaluation of the suitability of potential sites for monitoring emissions of controlled substances situated within the regions and locations identified in the information provided by the Advisory Committee of the General Trust Fund for Financing Activities on Research and Systematic Observations Relevant to the Vienna Convention for the Protection of the Ozone Layer, with the voluntary participation of and in consultation with the concerned parties; and preparation, in consultation with the concerned parties that had expressed interest, for possible next steps towards establishing monitoring activities at the potential sites, taking into account the prioritization presented by the Advisory Committee at the Thirty-Seventh Meeting of the Parties and the phased sampling approach presented in the addendum to the note by the Secretariat on issues for discussion by and information for the attention of the Thirty-Seventh Meeting of the Parties (UNEP/OzL.Pro.37/2/Add.1). To support those activities, the Secretariat was authorized to use, on an exceptional basis, a 2026 budget line item of \$100,000, funded through the cash balance of the Trust Fund for the Montreal Protocol. The Secretariat's progress report is summarized in the following paragraphs.

84. Pursuant to decision XXXVII/1, and following the Thirty-Seventh Meeting of the Parties, the Secretariat continued to review existing monitoring sites and available infrastructure, with a focus on the five regions prioritized by the Advisory Committee. In coordination with the secretariat of the World Meteorological Organization (WMO), a member of the Ozone Secretariat visited the WMO headquarters in Geneva at the end of 2025 and worked closely with WMO experts to identify suitable existing stations and related infrastructure within the Global Atmosphere Watch network and other WMO-coordinated networks. The assessment also considered the availability of the local technical and scientific expertise necessary to support measurement activities. The results of that work were presented to the Advisory Committee during its twentieth online meeting, organized by the Secretariat on 9 March 2026.

85. Taking note of the Secretariat's findings and the contribution of WMO, the Advisory Committee emphasized, among other things, the importance of ensuring sustained scientific expertise to maintain monitoring instruments, particularly for long-term measurements conducted at monitoring stations. The Committee also agreed that the next phase of work should focus on exploring the interest of parties in the prioritized regions in hosting such monitoring activities.

86. In consultation with the Secretariat, a Co-Chair of the Advisory Committee conducted informal consultations with country representatives and scientists in five countries in the five priority regions. Those discussions aimed to clarify technical and scientific issues related to the possible establishment of monitoring stations, on the basis of the documents previously prepared, and to gain a better understanding of relevant national circumstances. As a result of the consultations, and by the time the present addendum was prepared, the Secretariat had received expressions of interest from two parties in continuing discussions on the possibility of establishing a monitoring station in their countries.

87. In addition, following the Secretariat's announcement at the Thirty-Seventh Meeting of the Parties regarding its intention to develop an interactive and user-friendly online tool for estimating the costs of establishing and operating a monitoring station, a first version of the tool will be made available at the forty-eighth meeting of the Open-ended Working Group with a view to inviting parties to test it and provide comments and suggestions to the Secretariat to support the preparation of a final version to be launched at the Thirty-Eighth Meeting of the Parties.

88. The Open-ended Working Group may wish to consider the report and recommend a way forward.

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

A. Recycled, used and unwanted controlled substances (decisions XXXVII/3, para. 3, XXXVII/4, para. 3, and XXXVI/7, para. 5)

89. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 47–48), in paragraph 3 of decision XXXVII/3, the Thirty-Seventh Meeting of the Parties invited parties to submit to the Ozone Secretariat, on a voluntary basis, by 31 May 2026, information on existing reclamation and destruction facilities in their respective countries and, where available, their respective capacities, including information on the identification of existing destruction and reclamation facilities that could accept used refrigerants from other countries and the conditions associated with exporting used refrigerants for disposal at such facilities, taking into account any legislative barriers to transboundary movements. In the same paragraph, the Secretariat was requested to make that information available to the parties.

90. At the time of preparation of the present report, six parties – Argentina, Australia, Canada, the European Union, Peru and the United States of America – had responded to paragraph 3 of the decision. The feedback provided was forwarded to the Technology and Economic Assessment Panel for its consideration. As is also requested in the decision, the information provided will be posted on the Secretariat's website in due course.

B. National and regional initiatives to support the implementation of the Kigali Amendment to the Montreal Protocol (decision XXXVII/5)

91. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.WG.1/48/2, paras. 45 and 46), in paragraph 1 of decision XXXVII/5, the Thirty-Seventh Meeting of the Parties invited parties to submit to the Ozone Secretariat, by 1 June 2026, information, including on policies, activities and key lessons learned, in relation to centres of excellence for sustainable cooling and testing centres for energy efficiency related to the implementation of the Kigali Amendment.

92. At the time of the preparation of the present addendum, 21 parties, namely Armenia, Burkina Faso, China, Colombia, Ecuador, Georgia, Haiti, Jordan, Kenya, Liberia, Mali, Nigeria, Oman, Peru, Qatar, Slovakia, Somalia, Tuvalu, the United Kingdom of Great Britain and Northern Ireland, Vanuatu and Zimbabwe, had provided such information. The Secretariat will collate and summarize the submitted information and make it available to the Thirty-Eighth Meeting of the Parties for its consideration.

Annex I*

2026 Report of the Technology and Economic Assessment Panel (Volume 2)

Assessment of the funding requirement for the replenishment of the Multilateral Fund for the period 2027-2029

Executive summary

The Montreal Protocol Multilateral Fund (MLF) has been replenished eleven times since its initial capitalisation of US\$ 240 million for the period 1991-1993. The replenishments of the MLF are indicated in Table ES.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.

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

<i>Triennium</i>	<i>Approved</i>	<i>Carry-over</i>	<i>Interest accrued</i>	<i>Total MLF Budget</i>
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
2024-2026	\$ 525 600 000	\$ 428 699 680	\$ 10 700 320	\$ 965 000 000

* Does not include the initial capitalisation of US\$ 240 million for 1991-1993.

** In addition, the Fifth Extraordinary Meeting of the Parties also noted that US \$246 million in remaining funds that were due to the Multilateral Fund during the triennium 2018 – 2020 will be used after 2023 to support the implementation of the Montreal Protocol (decision Ex.V/1).

Since its inception and as of the 97th of the Executive Committee (ExCom-97), the MLF has supported 144 Article 5 (A5) parties by approving US\$ 4.38 billion (including support costs) for a total of 10,363 projects, 87% of which have been completed.¹

The replenishment of the MLF for the 2027-2029 triennium will provide financing to A5 parties for the incremental costs to complete the phase-out of ODS and to continue implementing the phase-down of hydrofluorocarbons (HFCs). Annex C Group I (hydrochlorofluorocarbons (HCFCs)) and Annex F (HFCs) substances are the only substances under the Montreal Protocol where consumption and production are still allowed.

- For Annex C, Group 1, controlled substances (HCFCs), the compliance target for the 2027-2029 triennium is a 97.5% reduction from baseline by 1 January 2030.

An annual average of 2.5% is restricted to the servicing of refrigeration and air-conditioning equipment existing during 2030-2040. Decision XXX/2 referring to Annex I of the MOP-30 report², adjusted this part of A5 (as well as 2F) to include other uses, i.e., the servicing of fire suppression and fire protection equipment existing

* The annex has not been formally edited.

¹ <https://www.multilateralfund.org/our-impact>.

² <https://ozone.unep.org/treaties/montreal-protocol/meetings/thirtieth-meeting-parties/decisions/annex-i-adjustments>.

on 1 January 2030; solvent applications in rocket engine manufacturing; and topical medical aerosol for applications for the specialised treatment of burns.

- For Annex F controlled substances (HFCs), the compliance targets for the 2027-2029 and the subsequent two triennia are as follows:

Group 1 parties: A 10% reduction from baseline by 1 January 2029, and for future triennia 2030-2032 and 2033-2035, a 30% reduction from baseline by 1 January 2035.

Group 2 parties³: A freeze of production and consumption by 1 January 2028, and for future triennia 2030-2032 and 2033-2035, a 10% reduction from baseline by 1 January 2032, and a 20% reduction by January 1, 2037.

Decision XXXVII/6 and TEAP approach

At the Thirty-Seventh Meeting of the Parties (MOP-37), parties adopted decision XXXVII/6 which 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 2027-2029. The parties requested the TEAP to prepare a report for submission to MOP-38, and presentation to the Open-ended Working Group at its forty-eighth Meeting (OEWG-48), to enable parties at MOP-38 to take a decision.

The TEAP established a Decision XXXVII/6 Replenishment Task Force (RTF), with members from TEAP, its Technical Options Committees, and other outside experts. In December 2025, one TEAP Senior Expert attended the ExCom-97 to conduct informal discussions with ExCom members and bilateral and IAs present at that meeting.

In this report, the RTF estimated the funding requirements for the 2027-2029 triennium and future triennia based on official Article 7 (A7) data and informed by the “Consolidated Business Plan of the Multilateral Fund for 2026-2028,”⁴ relevant decisions of the ExCom up to its 97th meeting, and information available through the Multilateral Fund Secretariat (MLFS) and Ozone Secretariat (OS). The RTF worked primarily online and held a meeting in Montreal in February 2026, during which the RTF also held discussions with the MLFS. The RTF prepared its draft report which was reviewed at the TEAP’s meeting held in April 2026 in Brussels. After addressing all comments, the TEAP submitted the RTF’s report to the Ozone Secretariat in May 2026 for posting and review by parties.

HCFC phase-out in the consumption and production sectors

Consumption sector

Most A5 parties have submitted last stage/tranches for the complete phaseout of HCFCs by 2030. Therefore, at the end of 2027-2029 triennium the MLF will be celebrating the fact that the Fund will be addressing the last remaining consumption of HCFCs for the few parties that will be submitting their last HPMPs stages and tranche requests.

That said, the HCFC phase-out funding requirement for this triennium was calculated considering that the large majority of HPMPs are addressing complete phaseout by 2030. Parties that wish to phase out HCFCs completely by 1 January 2030 may do so but must ensure through regulatory and policy measures that HCFCs would not be imported after that date, except for those allowed for a servicing tail between 2030 and 2040, where required, consistent with the provisions of the Montreal Protocol.

The ExCom decided (Decision 86/51) that, to allow for consideration of the final tranches of the HCFC phase-out management plans (HPMPs) for any consuming country requesting funding for the complete phase-out of HCFCs, the relevant Government should submit a detailed description of the regulatory and policy framework in place to implement measures to ensure that HCFC consumption was in compliance with paragraph 8 ter(e)(i) of Article 5 of the Montreal Protocol for the period 2030-2040. If the country is intending to have consumption during the period 2030-2040, modifications need to be made to its Agreement with the ExCom covering the period beyond 2030. It is important to emphasize that parties with HPMPs for total phase-out have no more remaining HCFC consumption eligible for funding. Accordingly, changes to the Agreement might affect targets but not funding levels.

³ Decision XXVIII/2, para. 2, under the Montreal Protocol refers to Article 5, group 2, parties as Bahrain, India, the Islamic Republic of Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, and the United Arab Emirates.

⁴ UNEP/OzL.Pro/ExCom/97/20.

The TOR, approved by parties in decision XXXVII/6, instructed the RTF to use "a clearly explained compliance-based methodology that is informed by, but independent of, the business plan of the Multilateral Fund, and that applies a range of cost-effectiveness figures for the manufacturing sectors based on historical experience rather than only on cost-effectiveness thresholds approved by the Executive Committee". Responding to that, the RTF considered a range for the estimated funding requirements, for the HCFC consumption sector, based on two cost-effectiveness (CE) scenarios, and applied to 15 non-LVC parties (including the largest consuming party-China) with remaining eligible consumption in manufacturing sectors, as follows:

- **HCFC scenario 1:** Applying average historical CE thresholds in manufacturing sectors for those non-LVCs with remaining eligible consumption;
- **HCFC scenario 2:** Applying CEs in cost guidelines, in manufacturing sectors, for those non-LVCs with remaining eligible consumption.

In calculating funding, RTF applied a deduction of 15% to manufacturing sectors to account for potential ineligible foreign ownership of enterprises.

The RTF considered options for scenarios for a funding range within the scope of its TOR, including whether to apply the latest CEs approved for the party with the highest HCFC consumption, but would need guidance from parties on applying this or other approaches that could considerably change the funding range.

RTF considered the total phaseout to happen by 2030 with the special allowances under the Montreal Protocol, as described previously, regarding the servicing tail. ExCom Decision 62/17 "requested the bilateral and IAs, when preparing multi-year HPMPs, to ensure that the last tranche comprised 10% of the total funding for the refrigeration servicing sector in the agreement and was scheduled for the last year of the plan." RTF considered that the last tranche of the HPMPs would occur in 2030; consequently, 90% of the total phase-out resource allocation would be within the 2027-2029 triennium and the 10% for the last tranche would be allocated to the next triennium 2030-2032, following the intention of decision ExCom 62/17.

Production sector

The total production of HCFC is well below the aggregated production baseline. Only one production sector project (China Stage III HCFC Production Phaseout Management Plan (HPPMP)) had been included in the "Consolidated Business Plan of the Multilateral Fund for 2026-2028" and would require funding in the 2027-2029 triennium.

Summary of Funding Estimates for HCFC Phaseout in the Consumption and Production Sectors

The estimated total funding requirement range for 2027-2029 triennium and 2030-2032 triennium for the HCFC consumption and production sectors are summarised below and in Table ES.2:

- **2027-2029: US\$ 451 million to US\$ 573 million**
- **2030-2032: US\$ 83 million to US\$ 96 million**

Table ES.2
Estimated funding requirement for HCFC total phase-out for 2027-2029 and 2030-2032 (US\$ million)

<i>Triennium</i>	<i>Sector</i>	<i>HCFC ESTIMATED FUNDING RANGE</i>	
		<i>HCFC Scenario 1 with 90%/10% Allocation</i>	<i>HCFC Scenario 2 with 90%/10% Allocation</i>
2027-2029	HCFC Consumption sector	427.56	549.44
	HCFC Production sector	23.54	23.54
	TOTAL RANGE	451.10	572.98
2030-2032	HCFC Consumption sector	58.96	72.50
	HCFC Production sector	23.54	23.54
	TOTAL RANGE	82.5	96.04

HFC phase-down in the consumption and production sectors

HFC consumption sector

The estimates for the HFC phase-down funding requirement for the 2027-2029 triennium and future triennia, 2030-2032 and 2033-2035, are based on A5 parties meeting the relevant Group 1 (G1) or Group 2 (G2) reduction targets.

Estimated funding requirements for the HFC consumption sector include the following:

- Committed Funding for approved Kigali HFC Implementation Plans (KIPs);
- Estimated Funding for new KIPs;
- Estimated Funding for project preparation costs;
- Estimated Funding for HFC consumption verification;
- Estimated Funding associated with energy efficiency activities (ExCom Decision 91/65 for the servicing sector, ExCom Decision 94/60 for the manufacturing sectors, and ExCom Decision 95/87 for a revolving fund); and
- Funding for enhancing regional atmospheric monitoring capacity.

As of 8 April 2026, 125 A5 parties, out of 144, had ratified the Kigali Amendment. For the analysis of estimated funding in the 2027-2029 triennium for HFC phase-down, the RTF assumed ratification by the remaining 19 parties will happen by 2029.

Given that KIPs are only in the early stages of implementation, RTF did not identify sufficient historical analysis of CEs for the manufacturing sectors from approved KIPs, and available data did not provide sufficient information to consider historical values beyond the CE cost guidelines. RTF estimated the funding based on HFC KIP Stage I Cost Guidelines for the agreed manufacturing sectors. When these were absent for some individual sectors treated on a case-by-case basis, the RTF used CEs based on TEAP, the TOCs, and the RTF sector experts' advice. Funding was also estimated for Stage II KIPs, using Stage I CEs, without considering any potential impact of the guidelines review expected in 2028. Important to note that the CE for servicing under Stage I was considered for the period when a country's KIP and HPMP would be implemented simultaneously. Stage II would be predominantly implemented when such simultaneous implementation did not take place.

RTF is using the Kigali Amendment schedules for its compliance model and using reductions from the established baseline definition. For funding estimates, the 65% HCFC component of the baseline is considered as consumption under the servicing sector, and funding calculated following cost guidelines CE thresholds approved for the sector.

As detailed in Chapter 3 and Annexes 3 and 4 of this report, the RTF compliance model methodology for the consumption sector calculates funding to address the needs of parties to comply with the Kigali Amendment phase-down schedules, as follows:

- G1 parties: 10% reduction from the baseline by 2029 (Stage I KIP), 30% reduction by 2035 (Stage II KIP),
- G2 parties: freeze by 2028; a 10% reduction from the baseline by 2032 (Stage I KIP).

The RTF compliance model to estimate required funding reflects the MLF project cycle to account for different progress by different parties, as well as reductions that exceed control targets for some parties. The model takes into consideration each individual country reduction addressed under a KIP. The model estimates the funding needs for the HFC consumption sector by starting with the calculation of the total funding required to address both Stage I and Stage II (10% and 30%) reduction targets for G1 parties, and for G2 parties the freeze and Stage I (10%) reduction target. These totals cover funding needs for a 9-year period (2027 to 2035).

Then, RTF distributed the estimated total funding required (Stages I and II) to each of the three triennia in the 2027 to 2035 period, using two Resource Allocation Proposals (A and B), suggested for parties' consideration, and/or any further instructions for the RTF supplementary report. This methodology allows consideration of different compliance targets for G1 and G2 parties while addressing national circumstances and different control targets in the two groups of parties.

The TOR, approved by parties in decision XXXVII/6, instructed the RTF to use "a clearly explained compliance-based methodology that is informed by, but independent of, the business plan of the Multilateral Fund, and that applies a range of cost-effectiveness figures for the manufacturing sectors

based on historical experience rather than only on cost-effectiveness thresholds approved by the Executive Committee". In response to this request and in the absence of historical CE values due to limited experience with KIP implementation, and in order to present an estimated funding range, RTF based its calculations on two scenarios, as follows:

- HFC Scenario 1: applying the approved CEs for the different sectors as per cost guidelines, and without small- and medium-sized enterprises (SMEs) consideration;
- HFC Scenario 2: applying CEs according to the percentage (SMEs) participation in some manufacturing sectors and applies their (larger) CE thresholds;

For both scenarios:

- RTF proposes two resource allocation schedules (A and B) per triennium as shown in Table 1.4 of the RTF report. For both proposals, RTF assumed full ratification for G1 and G2 parties by 2029. The two resource allocation schedules differ in the percentage of the KIP funding to be allocated to each different triennium;
 - For G1 and G2 parties without KIPs, schedule A for funding Stage I is faster while schedules A and B are the same for funding Stage II for G1 parties without KIPs.
 - For G1 parties with KIPs Stage I, schedule A proposes faster funding for Stage II.
- a 15% deduction was applied to account for ineligible foreign ownership in the manufacturing sectors (please refer to note below);
- Stage I cost guidelines CEs were applied to Stage II funding calculations. The potential impact of any guidelines review in 2028 was not considered.

Under caveats in section 1.6.10, there are two considerations mentioned under caveats in section 1.6.10 regarding the additional costs of project management units that were not included in the modelling, and the 15% foreign ownership deduction for the manufacturing sectors which was included. The combined effect of these two considerations is to potentially increase the total estimated funding requirement by around 15%. RTF made these deviations for reasons explained in section 1.6.10 and appreciates the parties' guidance on the need to adjust its estimates accordingly for the RTF supplementary report.

HFC production sector

HFC production sector and HFC-23 mitigation funding estimates include:

- Estimated Funding for HFC Production project preparation;
- Estimated Funding for Kigali HFC Production Phase-down Management Plan (KPPMPs), if any;
- Estimated Funding for HFC-23 mitigation investment project;
- Estimated Funding for HFC-23 mitigation project preparation; and
- Committed Funding for approved HFC-23 mitigation project.

RTF considered two A5 HFC producing countries for estimated funding requirement for the production sector 2027-2029. Both China (G1) and India (G2) reported production of HFC are significantly below the 10% reduction target from baseline for G1 parties and the 2028 freeze and 10% reduction target for G2 parties. RTF estimated that for the 2027-2029 triennium, only project preparation funding may be needed for HFC production sector plans preparation for the two parties, with no investment funding required in this triennium.

To support A5 parties in meeting their obligations under the Kigali Amendment, the MLF funds the costs for A5 parties to reduce emissions of HFC-23, a by-product of the production process of HCFC-22, by reducing emission rate in the process, destroying it from the off-gas, or by collecting and converting it to other environmentally safe chemicals. For the 2027-2029 triennium, the RTF estimated funding requirements for two parties with approved HFC-23 phase-out plans and project preparation and implementation funding for two additional parties.

Summary of funding estimates for HFC phase-down in the consumption and production sectors

The range of estimated total funding requirement for the HFC consumption and production sectors for the 2027-2029 and future triennia are summarised below and in Table ES.3.

Table ES.3

Estimated total funding requirement for HFC phase-down for 2027-2029 and future triennia (US\$ million)

Triennium	Sector	HFC ESTIMATED FUNDING RANGE (US\$ million)	
		HFC Scenario 1 with Resource Allocation A	HFC Scenario 2 with Resource Allocation B
2027-2029	HFC Consumption sector	958 – 1 042	690 – 769
	HFC Production sector and HFC-23 mitigation	11.76	11.76
	TOTAL RANGE	970 – 1 053	702 – 781
2030-2032	HFC Consumption sector	876 – 907	1 049 – 1 084
	HFC Production sector and HFC-23 mitigation	0.51	0.51
	TOTAL RANGE	877 – 908	1 050 – 1 085
2033-2035	HFC Consumption sector	487 – 503	583 – 600
	HFC Production sector and HFC-23 mitigation	0	0
	TOTAL RANGE	487 – 503	583 – 600

HFC Phase-down funding range for the 2027-2029 triennium:

- US\$ 970-1,053 million under a resource allocation schedule A
- US\$ 702-781 million under a resource allocation schedule B

Other funding considerations and information for parties

In accordance with the decision XXXVII/6 TOR for the RTF's assessment, funding requirements were estimated for institutional strengthening and standard activities, funding for energy efficiency, and a funding modality for pilot projects aimed at enhancing regional atmospheric monitoring. RTF also provided updated information on “the special needs of low-volume-consuming and very-low-volume consuming countries”, and on “digital technologies and tools within the servicing sector”, and on lifecycle refrigerant management (LRM) given ongoing discussions under ExCom Decision 97/89. While detailed information is provided on these topics for parties' consideration, these did not factor into the estimated funding requirements for the three triennia.

Range of total estimated total funding requirements for the 2027-2029 triennium

The range of total estimated funding requirement (including support costs) for the replenishment of the MLF in the 2027-2029 triennium includes HCFC and HFC consumption and production sectors, and IS and Standard Activities, and is presented in Tables ES.4.

Table ES.4

Range of total funding requirement for the replenishment of the MLF 2027-2029 based on different scenarios and resource allocation schedules, and IS and SA (US\$ million)

2027-2029 Triennium	Low-end Range	High-end Range
SUBTOTAL – HCFC ACTIVITIES	451	573
SUBTOTAL – HFC ACTIVITIES	702 – 781	970 – 1 053
SUBTOTAL – IS & SA	129	129
GRAND TOTAL	1 282 – 1 361	1 672 – 1 755

Annex II*

Technology and Economic Assessment Panel 2026 progress report (volume 1)

Key messages from Technical Options Committees

Key messages arising from TOC progress reports are presented in this section.

Fire Suppression Technical Options Committee (FSTOC)

The FSTOC progress report is contained in Chapter 3 of this report and includes the following updates:

- In response to “Decision XXXVII/4: Halon availability and global distribution of halon banks”, the FSTOC has worked with the International Civil Aviation Organization (ICAO) and has refined the halon 1301 run-out date. This is now estimated to be in the 2035 +/- 4 years timeframe, based on the latest available data from civil aviation, oil and gas, and nuclear power plants, together with the amounts being recovered from shipbreaking activities.
- Parties may wish to consider determining what, if any, changes may be needed to the Essential Use Nomination (EUN) and Evaluation Processes, given that every individual party will be unable to determine their civil aviation needs, i.e., production and consumption, on an annual basis.
- The FSTOC model continues to compare well with emissions derived from atmospheric measurements of halon 1301, now through 2024.
- The FSTOC is not aware of any new fire protection/extinguishant agents under development.
- The European Chemicals Agency (ECHA) Socio-Economic Analysis Committee (SEAC) draft opinion, released on March 26, 2026, on the European Union (EU) per- and polyfluoroalkyl substances (PFAS) restriction proposal would lead to bans on the use of critical halon alternatives following the entry into force of any regulation, unless a derogation allows a grace period. The SEAC draft opinion on the EU PFAS restriction proposal recommends a 12-year derogation for 2-bromo-3,3,3-trifluoropropene (2-BTP) in hand-held extinguishers on aircraft. No derogation is being proposed for the potential future use of the 2-BTP/carbon dioxide (CO₂) blend to replace halon 1301 in cargo compartments.

Flexible and Rigid Foams Technical Options Committee (FTOC)

The FTOC progress report is contained in Chapter 2 of this report and includes the following updates:

- Parties are successfully transitioning the foam industry from hydrochlorofluorocarbons (HCFCs) in Article 5 (A5) parties and high global warming potential (high-GWP) hydrofluorocarbons (HFCs) in non-Article 5 (non-A5) parties and some A5 parties, with emphasis on avoiding adoption of high-GWP HFCs where possible. Regulation and supply phase-down are driving transitions.
- As available global HCFC-141b inventories are diminished, parties may wish to consider completing transitions from HCFC-141b. In 2026, the China Ministry of Ecology and Environment (MEE)¹ did not allocate quota for HCFC-141b production, and supply of HCFC-141b will cease. Manufacturers of hydrofluoro-olefins/hydrochlorofluoro-olefins (HFO/HCFOs) have increased capacity to meet the demand for lower GWP blowing agents that is expected to result from the implementation of lower GWP regulations. There have been significant improvements in the development and availability of additives, co-blowing agents, equipment and formulations enabling the successful commercialisation of foams containing lower GWP blowing agents.
- Foam manufacturers continue to work to reduce costs and optimise the characteristics of foams with new foam blowing agents (FBAs), co-blowing agents and additives in both A5 and non-A5 parties. New FBA co-blowing agents and additives have different toxicity and thermal

* The annex has not been formally edited.

¹ Announcement of the Issuance of ODS and HFCs Production Quotas in 2026

properties that can result in safety challenges in handling, and lower thermal performance of insulation.

- Generally, costs have increased in 2025-26 due to additional taxes, anti-dumping duties, and geopolitical impacts to energy cost and availability. Some parties may be more impacted by these issues. These economic impacts may affect construction and demand for equipment and foams.

Methyl Bromide Technical Options Committee (MBTOC)

The MBTOC progress report is contained in Chapter 4 of this report and includes the following updates:

- Phase out of methyl bromide (MB) for controlled non-quarantine and pre-shipment (non-QPS) uses was completed with the last critical use nomination (CUN) received in 2025. Together with the MB phase out achieved prior to the CUN process, this has led to about 62,000 tonnes of MB being phased out globally over 30 years. No new CUNs were received in 2026.
- Reported global production of MB for QPS in 2024 was 8,935 tonnes. Reported QPS consumption in 2024 was approximately 8,000 tonnes of MB (about 900 tonnes less than the reported production). There is evidence of widespread uptake of alternatives to MB for QPS uses in some parties over the past several years. Still, some clear areas of concern remain, i.e., atmospheric concentrations of MB have stopped declining as QPS uses continue. Over recent years, MB reporting by some parties has been difficult to understand and has required follow up by MBTOC and the Ozone Secretariat to review potential errors. The accuracy of reported data is essential for TEAP to be able to compare bottom-up and top-down estimates of MB emissions.
- Recent surveys have shown unreported uses of MB in sectors where MB has neither been approved as a controlled use nor exempted as a QPS use. Publications from China have raised concerns about unexplained MB emissions and there is no further clarification on the source (~4,000-9,000 tonnes per year) (Hu et al., 2024).
- MB is highly toxic to humans, and increasingly subject to control during occupational exposure. Several parties which use MB for QPS applications already have or are planning to introduce stringent reductions in permitted workspace concentrations for MB. This will have a major impact on MB use with the requirement for large buffer zones.
- MB use for QPS uses is exempted from controls under the MP. The use of MB for specific quarantine pests (“Q”) may likely be required in the long-term in many jurisdictions. However, for pre-shipment uses (“PS”), several alternatives (e.g., hot and cold temperatures, irradiation, phosphine, ethyl formate, hydrogen cyanide, ethane dinitrile) are at least as effective as MB, and safer both for humans, the environment and the products being treated. Confusion over classification between Q and PS is still problematic for many parties.
- Parties may wish to consider how to more strongly focus on how to prevent emissions from QPS uses, limit MB exemptions for PS uses, and prevent the misuse of non-QPS MB by clarifying and focusing solely on quarantine (Q) uses. This could prevent the emissions which are of a similar magnitude to those that were reduced due to the phase-out of MB under the CUN process.

Medical and Chemical Technical Options Committee (MCTOC)

The MCTOC progress report is contained in Chapter 5 of this report and includes:

- Updated information on the production and use of controlled substances for chemical feedstock;
- An evaluation of and recommendation for a destruction technology submitted by Canada for TEAP review and consideration by parties to be recognised as an approved destruction technology under the Montreal Protocol; and
- Developments regarding metered-dose inhalers (MDIs) with low-GWP propellants in response to Decision XXXVI/6.

MCTOC has not identified compelling new information to report to parties in this progress report on developments in process agent uses, n-propyl bromide, and laboratory and analytical uses.

Feedstocks

- Data reported by parties to the Ozone Secretariat on production and import of controlled substances used as feedstock for the years up to and including 2024 was provided to the MCTOC.
- In 2024, total production and import reported for feedstock uses of ozone-depleting substances (ODS) (including process agents) was 1,947,949 tonnes, a slight decrease to the quantity in 2023 (1,965,768 tonnes). HCFC-22 is, by a considerable margin, the largest feedstock used, with 990,395 tonnes reported in 2024, an increase from the revised quantity reported for 2023 (978,084 tonnes).
- The reported amounts of HFCs produced for feedstock use was 183,539 tonnes in 2023 and 211,326 tonnes in 2024. The increase in production of HFC for feedstock use in 2024 is mainly due to HFC-152a, with reported HFC-236ea also increasing into the 1,000–10,000 tonnes band in 2024.

Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee (RTOC)

The RTOC progress report is contained in Chapter 6 of this report and includes the following updates:

- The growing global demand for refrigeration, air conditioning, and heat pump (RACHP) systems creates a dual climate challenge from both direct refrigerant leakage and indirect electricity consumption, requiring comprehensive lifecycle assessments.
- Reducing cooling and heating loads through passive measures such as insulation and shading is the most critical first step, capable of cutting cooling demand and energy consumption by approximately 30%.
- There is no single "ideal" refrigerant; selection requires balancing legal, safety, environmental, suitability, cost, efficiency, and usability factors, with increasing attention on lifetime risk assessment.
- Implementing Lifecycle Refrigerant Management could halve the projected 2050 emissions but face a growing skills gap and urgent need for capacity building and trained technicians capable of handling lower GWP and flammable refrigerants.
- Strengthening national systems for collecting RACHP-related data is essential to improve modelling accuracy on RACHP banks, consumption and emissions and enable evidence-based mitigation strategies.
- In commercial refrigeration, there is a significant shift away from R-404A toward R-744 (CO₂) as the leading sustainable solution, particularly in lower ambient temperature countries like those in Europe. In other regions, lower GWP A2L refrigerants are being adopted along with R-744 and R-290 in small charge systems.
- In industrial refrigeration, R-717 (ammonia) and R-744 (CO₂) are the preferred lower GWP refrigerants and are expected to increase in use, while transport refrigeration faces slower transition due to safety, infrastructure, and long equipment lifecycles.
- Reducing energy consumption remains key in comfort cooling, with a global trend toward inverter-type compressors (to achieve variable capacity), though this technology remains under-represented in many A5 parties and some non-A5 parties.
- Integrated systems for combined heating and cooling can improve overall energy efficiency by 30-50% and significantly reduce CO₂e emissions by replacing fossil fuel heating.
- Except for absorption and adsorption, non-vapour compression (not-in-kind) technologies are currently not capable of replacing mechanical vapour compression for comfort cooling, with most remaining at emerging or research and development stages. Key messages arising from TOC progress reports are presented in this section.

Annex III***Members of the Technology and Economic Assessment Panel technical options committees whose membership expires at the end of 2026 and whose reappointment does not require a decision by the Meeting of the Parties**

<i>Name</i>	<i>Position</i>	<i>Country</i>
Members of technical options committees		
Cecilia Girotti	FTOC member	Italy
Sascha Rulhoff	FTOC member	Germany
Enshan Sheng	FTOC member	Singapore
Jamal Alfuzai	FSTOC member	Kuwait
Michelle M. Collins	FSTOC member	United States of America
Emma Palumbo	FSTOC member	Italy
Xiaomeng Zhou	FSTOC member	China
Jonathan Banks	MBTOC member	Australia
Aocheng Cao	MBTOC member	China
Guillermo Castellá	MBTOC member	Uruguay
Kang Fenfen	MBTOC member	China
Ayze Ozdem	MBTOC member	Turkey
Ken Glassey	MBTOC member	New Zealand
Eduardo Gonzalez	MBTOC member	Philippines
Takashi Misumi	MBTOC member	Japan
Christoph Reichmuth	MBTOC member	Germany
Alejandro Valeiro	MBTOC member	Argentina
Emmanuel Addo-Yobo	MCTOC member	Ghana
Fatima Al-Shatti	MCTOC member	Kuwait
Paul Atkins	MCTOC member	United States of America
Nick Campbell	MCTOC member	United Kingdom of Great Britain and Northern Ireland
Nee Sun (Robert) Choong Kwet Yive	MCTOC member	Mauritius
Jianxin Hu	MCTOC member	China
Javaid Khan	MCTOC member	Pakistan
Tim Noakes	MCTOC member	United Kingdom of Great Britain and Northern Ireland
John Pritchard	MCTOC member	United Kingdom of Great Britain and Northern Ireland
Rabbur Reza	MCTOC member	Bangladesh
Kristine Whorlow	MCTOC member	Australia
Lifei Zhang	MCTOC member	China
Yosr Allouche	RTOC member	Tunisia
Jitendra Bhambure	RTOC member	India
Maria C. Britto Bacellar	RTOC member	Brazil

* The annex has not been formally edited.

<i>Name</i>	<i>Position</i>	<i>Country</i>
Feng Cao	RTOC member	China
Ana Maria Carreño	RTOC member	Colombia
Radim Čermák	RTOC member	Czechia
Yu Chen	RTOC member	United States of America
Daniel Colbourne	RTOC member	United Kingdom of Great Britain and Northern Ireland
Sukumar Devotta	RTOC member	India
Hilde Dhont	RTOC member	Belgium
Gabrielle Dreyfus	RTOC member	United States of America
Bassam Elassaad	RTOC member	Lebanon
Kylie Farrelley	RTOC member	Australia
Qiang Gao	RTOC member	China
Ray Gluckman	RTOC member	United Kingdom of Great Britain and Northern Ireland
Samir Hamed	RTOC member	Jordan
Herlin Herlianika	RTOC member	Indonesia
Yuky Kamioka	RTOC member	Japan
Michael Kauffeld	RTOC member	Germany
Mary Koban	RTOC member	United States of America
Juergen Kohler	RTOC member	Germany
Lambert Kuijpers	RTOC member	Netherlands (Kingdom of the)
Steve Kujak	RTOC member	United States of America
Richard Lawton	RTOC member	United Kingdom of Great Britain and Northern Ireland
Tingxun Li	RTOC member	China
Carloandrea Malvicino	RTOC member	Italy
Akio Miyara	RTOC member	Japan
Petter Nekså	RTOC member	Norway
Mr.Tetsuji Okada	RTOC member	Japan
Pallav Purohit	RTOC member	India
Tao Ren	RTOC member	China
Giorgio Rusignuolo	RTOC member	United States of America
Madi Sakande	RTOC member	Burkina Faso
Leyla Sayin	RTOC member	Türkiye
Andrea Voigt	RTOC member	Germany
Asbjørn L. Vonsild	RTOC member	Denmark
Christian M. Wisniewski	RTOC member	United States of America
Samuel Yana Motta	RTOC member	Peru

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.

Annex IV***Matrix of expertise needed by the Technology and Economic Assessment Panel as of May 2026**

Body	Required Expertise	Article 5/Non-Article 5
	Use of HFCs and alternatives	Central and/or South America, Middle East and southern Africa (2)
Fire Suppression Technical Options Committee	Use of halons and alternatives in merchant shipping and recovery from shipbreaking	Pakistan
	Nuclear power plants	A5 and non-A5
	Civil aviation, (especially maintenance, repair and overhaul (MRO) activities)	A5 and non-A5
	Halon and HFC recycling	A5
Foam Technical Options Committee	Halon 1301 feedstock use and emissions	A5 and non-A5
	Extruded Polystyrene (XPS) Production in India and China – to replace departing experts.	A5 or non- A5
	Polyurethane system house technical experts – particularly from Southern Africa, the Republic of Korea, the Middle East, Latin American parties, especially experts within small and medium enterprises (SMEs)	
Methyl Bromide Technical Options Committee	FBA chemistry and foam interactions	
	Members with expertise in MB alternatives used to effectively treat quarantine pests affecting import and export of agricultural commodities globally	A5 or non-A5
Medical and Chemical Technical Options Committee	Aerosols and MDI propellant manufacturing	A5 (Africa, China, South America), non-A5
	CTC and VSLs global manufacturing and use	A5 or non-A5
	Semiconductor and other electronics manufacturing	East Asia, non- A5
Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee	End-of-life management and destruction technologies	A5 and non-A5
	No additional expertise needed at this time	
Senior Experts	Current senior expert members provide expertise needed	

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