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

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**Thirty-Fifth Meeting of the Parties to  
the Montreal Protocol on Substances  
that Deplete the Ozone Layer**  
Nairobi, 23–27 October 2023  
Items 4 (a), 9 (a), 14 (a) and 20 of the provisional agenda  
for the preparatory segment\*

## **Issues for discussion by and information for the attention of the Thirty-Fifth Meeting of the Parties to the Montreal Protocol**

**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 Thirty-Fifth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer contains new and updated information that has become available since the preparation of that note.<sup>1</sup> Section II contains brief summaries of the additional information provided by the Technology and Economic Assessment Panel in its 2023 report in relation to agenda items 4 (a), 9 (a) and 14 (a) of the provisional agenda for the preparatory segment, as well as information related to nominations by parties of experts to the Scientific assessment Panel and the Technology and Economic Assessment Panel in relation to item 20.

2. The additional information provided by the Technology and Economic Assessment Panel is set out in the following three volumes of the Panel's 2023 report:<sup>2</sup>

(a) *Report of the Technology and Economic Assessment Panel, September 2023, Volume 5: Evaluation of 2023 Critical-Use Nominations for Methyl Bromide and Related Issues – Final report;*

(b) *Report of the Technology and Economic Assessment Panel, September 2023, Volume 6: Decision XXXIV/7 – Strengthening Institutional Processes with respect to Information on HFC-23 By-product Emissions;*

(c) *Report of the Technology and Economic Assessment Panel, September 2023, Volume 7: Supplement to the May 2023 Technology and Economic Assessment Panel Replenishment Task Force Report on the Assessment of the Funding Requirement for the Replenishment of the Multilateral Fund for the Period 2024–2026.*

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\* UNEP/OzL.Pro.35/1.

<sup>1</sup> UNEP/OzL.Pro.35/2.

<sup>2</sup> Available on the portal for the meeting at <https://ozone.unep.org/meetings/thirty-fifth-meeting-parties/pre-session-documents>.

## II. Overview of items on the provisional agenda for the preparatory segment (23–27 October 2023)

3. The issues covered in the present addendum are provided below in the order in which the respective items are listed on the provisional agenda for the meeting.

### A. Replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the triennium 2024–2026 (item 4 (a) of the provisional agenda for the preparatory segment)

4. As is indicated in the note by the Secretariat on issues for discussion by and information for the attention of the Thirty-Fifth Meeting of the Parties to the Montreal Protocol (UNEP/OzL.Pro.35/2, paras. 27–28), the replenishment task force of the Technology and Economic Assessment Panel took into consideration the suggestions of the Open-ended Working Group of the Parties to the Montreal Protocol (reproduced in annex I to that note) and prepared a supplementary report, available on the meeting portal for the Thirty-Fifth Meeting of the Parties.<sup>3</sup> The executive summary of the supplementary report is set out in annex I to the present addendum, as received from the Panel without formal editing by the Secretariat.

5. The updated information provided by the task force in its supplementary report revisits the estimated funding for the 2024–2026 triennium that was included in its May 2023 report and is based on:

(a) Decisions taken by the Executive Committee of the Multilateral Fund at its ninety-second session (held from 29 May to 2 June 2023), including approval of hydrochlorofluorocarbon (HCFC) and hydrofluorocarbon (HFC) activities for 43 parties and agreed cost-effectiveness values for the servicing sector;

(b) New information on Article 7 data reported by 70 additional parties that became available to the task force in the period between the finalization of its May 2023 report and 31 July 2023.

6. In calculating updated figures, the task force retained the methodology used in its May 2023 report and made no changes to the estimated funding for institutional strengthening and standard activities, preparation of gender mainstreaming action plans or end-of-life activities.

7. The updates resulted in adjustments to the high-end scenario which assumes ratification of the Kigali Amendment to the Montreal Protocol by all parties operating under paragraph 1 of Article 5 of the Montreal Protocol (Article 5 parties). A summary of the updated estimated funding requirements for the 2024–2026 triennium compared to those provided in the May 2023 task force report is reproduced in Table 1.

Table 1  
**Estimated funding requirement for the replenishment of the Multilateral Fund for the 2024–2026 triennium**  
(United States dollars)

<i>Triennium 2024–2026</i>	<i>May 2023 estimate<sup>a</sup></i>	<i>September 2023 updates<sup>b</sup></i>
HCFC activities	363 911 000	362 323 000
HFC activities	519 142 000	643 908 000
Funding window for end-of-life/disposal activities	13 590 000	13 590 000
Institutional strengthening and standard activities	121 581 000	121 581 000
<b>Grand total</b>	<b>1 018 224 000</b>	<b>1 141 402 000</b>

*Abbreviations:* HCFC – hydrochlorofluorocarbon; HFC – hydrofluorocarbon.

<sup>a</sup> Scenario where all parties ratify the Kigali Amendment, taking into consideration the decisions of the ninety-first meeting of the Executive Committee and information received by the Panel as at 7 April 2023.

<sup>b</sup> Scenario where all parties ratify the Kigali Amendment, taking into consideration the decisions of the ninety-second meeting of the Executive Committee and information received by the Panel as at 7 August 2023.

<sup>3</sup> Available at <https://ozone.unep.org/system/files/documents/TEAP-Decision-XXXIV-2%20RTF-supplementary-report-september2023.pdf>.

8. In addition to the above updates, the task force addressed all 27 suggestions of the Open-ended Working Group, including the scenarios therein, and calculated their potential impact on the updated estimated funding for the 2024–2026 triennium, which varied widely. A summary of the impact of each suggestion/scenario on the updated funding requirement is set out in table ES-3 of annex I to the present addendum, including funding estimates in cases where the same methodology could be applied.

9. With respect to the funding requirements for the next two trienniums, 2027–2029 and 2030–2032, the task force made no changes to its estimates. For ease of reference, the indicative funding requirement ranges for those trienniums are reproduced in table 2. As indicated in the May 2023 task force report, the range of funding estimates was based on the HCFC and HFC compliance targets within these periods; approved HFC-23 mitigation projects for Argentina and Mexico; and institutional strengthening and standard activities, assuming a 3 per cent increase.<sup>4</sup>

Table 2

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

(United States dollars)

<i>Triennium</i>	<i>Estimated total funding requirement range</i>	
2027–2029	933 000 000	992 000 000
2030–2032	820 000 000	893 000 000

10. The parties may wish to consider the information set out in the initial and supplementary reports of the replenishment task force in their discussions under this agenda item.

**B. Strengthening institutional processes with respect to information on HFC-23 by-product emissions: report by the Technology and Economic Assessment Panel (decision XXXIV/7) (item 9 (a) of the provisional agenda for the preparatory segment)**

11. As is mentioned in the note by the Secretariat (UNEP/OzL.Pro.WG.1/35/2, paras. 52–53), in response to decision XXXIV/7, the Technology and Economic Assessment Panel prepared a report providing information on the possible chemical pathways that could be used in the production of Annex C, Group I substances (HCFCs), or Annex F substances (HFCs) that might generate HFC-23 as a by-product; a compilation of information on the amount of HFC-23 generation and emissions from facilities that manufacture HCFCs or HFCs, the reporting of which is required under Article 7 of the Montreal Protocol; and best practices available to control those emissions.

12. The full report of the Technology and Economic Assessment Panel, prepared by its Medical and Chemicals Technical Options Committee, is posted on the portal of the Thirty-Fifth Meeting of the Parties<sup>5</sup> and its executive summary is set out in annex II to the present addendum, as received from the Panel, without formal editing by the Secretariat.

13. Further to addressing the provisions of decision XXXIV/7, the report provides explanations of several key terms, background information on HFC-23 by-production and additional contextual information that the Committee considered useful in understanding the relative importance of chemical pathways used in the production of HCFCs and HFCs that may generate HFC-23 as a by-product. A summary of some salient points is provided in the following paragraphs.

14. In the report, “generation” is defined as the total HFC-23 produced as a by-product, without taking into account abatement of emissions. On the other hand, “emissions” are defined as the total

<sup>4</sup> The assumption of a 3 per cent increase is based on the expected review and revision of funding levels for institutional strengthening, to be introduced with effect from 2029 (see decision 91/63 of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol); the wide variety of tasks dealt with by implementing agencies (see UNEP/OzL.Pro/ExCom/91/67, para. 21), to be addressed at the 93rd meeting of the Executive Committee; and increasing staff costs related to the operation of the Compliance Assistance Programme of the United Nations Environment Programme, the United Nations Development Programme, the United Nations Industrial Development Organization, World Bank core units and the Multilateral Fund secretariat.

<sup>5</sup> Available at <https://ozone.unep.org/system/files/documents/TEAP-MCTOC-response-to-decision%20XXXIV7-report-september2023.pdf>.

HFC-23 emitted from a facility that generates HFC-23 as a by-product, after any abatement, with the dominant emission pathway being direct emissions to atmosphere.

15. The chemical pathways considered in the report are those used to produce HCFC-22, HCFCs other than HCFC-22 and HFCs, as well as substances other than HCFCs or HFCs, such as tetrafluoroethylene (TFE) and hexafluoropropylene (HFP) and CFCs, which are outside the scope of the decision. For the range of these chemical pathways considered in the report, the global generation of HFC-23 as a by-product was estimated to amount to around 25,000 metric tons per year, based on current expert knowledge of production quantities and HFC-23 by-product generation rates by process.

16. Around 95 per cent of the estimated total global HFC-23 by-product generation was attributed to the chemical pathway used to produce HCFC-22, while around 1 per cent was due to chemical pathways producing other HCFCs and HFCs. The remaining 3–4 per cent was attributed to processes producing substances other than HCFCs or HFCs.

17. Information on the amount of HFC-23 generation and emissions from facilities that manufacture HCFCs or HFCs was compiled from several sources, including submissions to the United Nations Framework Convention on Climate Change by parties included in Annex I to the Convention; the Intergovernmental Panel on Climate Change (IPCC); Article 7 data reported under the Montreal Protocol for 2019, 2020 and 2021 (with 2021 data being the most complete); data reported to the Executive Committee of the Multilateral Fund; and the Science Assessment Panel.

18. Most reported data for HFC-23 by-product generation are available for HCFC-22 production. Based on IPCC default factors, HFC-23 by-product generation from HCFC-22 production is expected to be in the range of about 15,000 to 30,000 metric tons per year.

19. According to the 2022 quadrennial assessment of the Scientific Assessment Panel,<sup>6</sup> estimated HFC-23 emissions derived from atmospheric monitoring amounted to 17,200 metric tons in 2019 and 16,500 metric tons in 2020. Those figures are comparable with the combined reported HFC-23 emissions from HCFC-22 production (submitted to the United Nations Framework Convention on Climate Change and under Article 7 of the Montreal Protocol), which amounted to 2,572 metric tons in 2021.

20. The best practices available to control emissions of HFC-23 as a by-product are consistent with those used to control other emissions associated with chemical manufacturing. These include optimizing plant design, equipment, operation and maintenance; instrumentation and monitoring of process and emissions; training and instruction for plant operators; periodic mass balancing; technologies for destruction (i.e., thermal oxidation) or for separation and chemical transformation to treat unwanted co-products or by-products and abate their emissions; and regulatory controls to provide the economic framework to ensure any or all of the above emission mitigation measures are implemented by operators, and to require reporting on emissions and other reporting.

21. The report also outlines a sample of various measures implemented or being implemented by some parties (Argentina, China, the European Union, India, Mexico, the United Kingdom of Great Britain and Northern Ireland and the United States of America) to control emissions of HFC-23 as a by-product. Finally, the Medical and Chemicals Technical Options Committee underscores the importance of improved data in estimating and drawing conclusions on global HFC-23 generation and emissions and recommends that parties consider measures to improve the reported data for HFC-23 generation and emissions, including their accuracy and their scope.

### **C. Nominations for critical-use exemptions for methyl bromide for 2024 (item 14 (a) of the provisional agenda for the preparatory segment)**

22. As is mentioned in the note by the Secretariat (UNEP/OzL.Pro.35/2, paras. 75–77), the Methyl Bromide Technical Options Committee of the Technology and Economic Assessment Panel evaluated one critical-use exemption for methyl bromide for 2024 submitted in 2023 by Canada, a party not operating under paragraph 1 of Article 5 (non-Article 5 party).

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

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<sup>6</sup> Available at <https://ozone.unep.org/system/files/documents/Scientific-Assessment-of-Ozone-Depletion-2022.pdf>.

24. In accordance with customary practice, the Committee evaluated the nomination and made an interim recommendation for approval of the full amount nominated by Canada for 2024, as set out in volume 2 of the 2023 report of the Technology and Economic Assessment Panel,<sup>7</sup> which was considered by the Open-ended Working Group at its forty-fifth meeting in July 2023. In making its recommendation, the Committee took into consideration that the nomination represented a significant (17 per cent) decrease in the amount that had been approved for 2023, and that the party had made a policy decision, producing a step-down plan to reduce the nominated amounts over the next few seasons with the intention of phasing out methyl bromide use by 2026.

25. Given that no reassessment of the nomination was required, and no further information or issues were raised by the Working Group, the Committee put its interim recommendation forward as a final recommendation. The nomination submitted by Canada for 2024 and the final recommendation by the Committee are listed in table 3 below. The report of the Committee, containing detailed information on the final recommendation, is available on the meeting portal for the Thirty-Fifth Meeting of the Parties.<sup>8</sup>

Table 3

**Summary of the nomination for the 2024 critical-use exemption for methyl bromide submitted in 2023 and the final recommendation of the Methyl Bromide Technical Options Committee**

(Metric tons)

<i>Party</i>	<i>Nomination for 2024</i>	<i>Final recommendation for 2024</i>
<b>Non-Article 5 party and sector</b>		
Canada		
Strawberry runners	3.857	[3.857]
<b>Total</b>	<b>3.857</b>	<b>[3.857]</b>

26. In addition to the final recommendation on the submitted critical-use nomination, the report of the Methyl Bromide Technical Options Committee includes information on the reporting requirements under relevant decisions; trends in methyl bromide critical-use nominations and exemptions for all parties that have submitted nominations to date; and the reported accounting frameworks for critical uses and stocks of methyl bromide.

27. According to the accounting framework information submitted by the nominating party in 2023, at the end of 2022 Canada had no available stocks.

28. As in its previous reports, the Committee reiterated that the current accounting information presented did not accurately show the total stocks of methyl bromide held globally for controlled uses by Article 5 parties. This is because reports on stocks are required only from parties applying for critical-use exemptions, some parties have no formal mechanism to account accurately either for such stocks or for stocks used in quarantine and pre-shipment applications, and there is no requirement for parties under the Montreal Protocol to report pre-2015 stocks. According to the Committee, such stocks might be substantial (approximately 1,000 metric tons).

29. The Committee was also concerned that not all parties might be aware of the need to report all uses, whether controlled or not, under Article 7 of the Protocol and suggested that these parties would benefit from additional guidance or assistance to fulfil their reporting obligations.

30. The parties may wish to consider the final report and recommendations of the Methyl Bromide Technical Options Committee and adopt decisions on critical-use exemptions as appropriate.

**Emergency use reported by Israel**

31. The report of the Methyl Bromide Technical Options Committee addresses an emergency use which was reported to the Ozone Secretariat by Israel on 30 May 2023. In that correspondence, the Government of Israel notified the Secretariat that it would give permission for the use of 2 kg (0.002 metric tons) of methyl bromide, under the emergency methyl bromide use provision in decision IX/7, to control an infestation by the common furniture beetle (*Anobium punctatum*) in the furniture and antiques exhibited in Weizmann House, the residence of the first President of Israel. The collection contained various ancient artifacts made of wood and/or metal.

<sup>7</sup> Available at <https://ozone.unep.org/system/files/documents/TEAP-CUN-interim-report-may-2023.pdf>.

<sup>8</sup> <https://ozone.unep.org/system/files/documents/TEAP-CUN-final-report-September-2023.pdf>.

32. Israel also noted that although the licensed pesticide commonly used in the country against the pest *Anobium punctatum* was phosphine, it was corrosive to metals and therefore could not be used for fumigation, as it would damage the metal-containing artifacts. Preparations using sulfuryl fluoride could not be used either as that substance was not registered in Israel.

33. In accordance with decision IX/7, the Secretariat and the Technology and Economic Assessment Panel have evaluated that use. In its report, the Methyl Bromide Technical Options Committee recognized the difficulties presented by the specific circumstances, noting that other alternatives such as inert gases (e.g., nitrogen, carbon dioxide) were being evaluated globally and might be available for similar uses in the future.

34. The parties may wish to take note of the emergency use reported by Israel in 2023.

## **C. Consideration of nominations by parties of experts to the Scientific Assessment Panel and the Technology and Economic Assessment Panel (item 20 of the provisional agenda for the preparatory segment)**

### **1. Nominations to the Scientific Assessment Panel**

35. Two co-chairs of the Scientific Assessment Panel, John Pyle and Paul A. Newman, notified the Secretariat, on 8 March 2023 and 14 July 2023, respectively, that they had decided to step down from their positions as Panel co-chairs. Given these resignations, it is expected that the parties will take a decision on appointing two new Scientific Assessment Panel co-chairs.

36. In considering nominations for possible new Panel co-chairs, the parties may wish to take into account the following relevant historical information, practice and current situation. At the Fourth Meeting of the Parties to the Montreal Protocol in 1992, the parties noted that each assessment panel was to have three co-chairs, of which one should be from a developing country.<sup>9</sup> The Scientific Assessment Panel currently has three co-chairs from non-Article 5 parties (two from the United States and one from the United Kingdom) and one co-chair from an Article 5 party from the African States (Rwanda). The Environmental Effects Assessment Panel has two co-chairs from non-Article 5 parties (Australia and the United States) and one co-chair from an Article 5 party from the Asia-Pacific States (India). The Technology and Economic Assessment Panel has two co-chairs from non-Article 5 parties (the United States and the United Kingdom) and one co-chair from an Article 5 party from the Latin American and Caribbean States (Colombia). The regional balance has been maintained since 1992.

37. In the light of the resignations of Mr. Newman and Mr. Pyle after many years of dedicated service to the ozone treaties, the parties may wish to consider appointing two new co-chairs of the Scientific Assessment Panel.

### **2. Nominations to the Technology and Economic Assessment Panel**

38. Information about the status of membership of the Technology and Economic Assessment Panel and its technical options committees, including an outline of the nomination process, is set out in the note by the Secretariat (UNEP/OzL.Pro.35/2, paras. 106–113 and annex III). Pursuant to decision XXXI/8, parties wishing to nominate experts to the Panel are requested to use the Panel's nomination form, available on the Secretariat's website, and are urged to follow the terms of reference of the Panel, consult the co-chairs of the Panel and refer to the matrix of needed expertise prior to making nominations.

39. At the time of preparation of the present addendum, the Secretariat had received a submission from Japan nominating Takeshi Eriguchi, currently a member of the Medical and Chemicals Technical Options Committee, to serve as a co-chair of the Committee for a term of four years. The submitted nomination form and curriculum vitae of the nominee are posted on the portal of the Thirty-Fifth Meeting of the Parties.

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<sup>9</sup> At the Eighth Meeting of the Parties in 1996, the co-chairs of the Scientific Assessment Panel suggested that, in order to recognize the significant research efforts undertaken in Europe, an additional co-chair from that region should participate in the following scientific assessment. Following that suggestion, the representative of a regional economic integration organization proposed an expert from France to become the fourth co-chair of the Scientific Assessment Panel.

40. The parties may wish to consider this nomination, along with the nomination set out in the note by the Secretariat (UNEP/OzL.Pro.35/2, para. 112) and any other nominations that the Secretariat may receive prior to and during the Thirty-Fifth Meeting of the Parties.

**Annex I\*****2023 Report by the Technology and Economic Assessment Panel,  
Volume 7****Supplement to the May 2023 Technology and Economic  
Assessment Panel replenishment task force report: Assessment of  
the funding requirement for the replenishment of the Multilateral  
Fund for the period 2024–2026****Executive Summary**

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

- For Annex C, Group 1, controlled substances (ozone-depleting hydrochlorofluorocarbons or HCFCs), the compliance target for the 2024–2026 triennium is a 67.5% reduction from baseline by 1 January 2025.
  - For the next two triennia 2027–2029 and 2030–2032, the next HCFC phase-out compliance target is a 97.5% reduction from baseline by 1 January 2030. The annual average of 2.5% is restricted to the servicing of refrigeration and air-conditioning equipment existing during 2030–2040 and subject to review in 2025. Decision XXX/2 referring to Annex I of the MOP30 report<sup>1</sup>, adjusted this part of Article 5 (as well as 2F) to include other uses, i.e., the 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 specialised treatment of burns.
- For Annex F controlled substances (HFCs), the compliance targets for the 2024–2026 and next two triennia are as follows:
  - Group 1 parties: A 10% reduction from baseline by 1 January 2029 and a 30% reduction from baseline by 1 January 2035.
  - Group 2 parties: For the next two triennia 2027–2029 and 2030–2032, a freeze of production and consumption by 1 January 2028 and a 10% reduction from baseline by 1 January 2032.

Decision XXXIV/2 of the Thirty-fourth Meeting of the Parties (MOP-34) (see Annex 1) provided the terms of reference (TOR) for the work of the Technology and Economic Assessment Panel (TEAP) to prepare a report on the appropriate level of the replenishment of the MLF for the triennium 2024–2026. The parties requested the TEAP to prepare a report for submission to the Thirty-fifth Meeting of the Parties (MOP-35), and to present it to the Open-ended Working Group (OEWG) at its Forty-fifth Meeting (OEWG-45), to enable MOP-35 to take a decision.

The TEAP established a Replenishment Task Force (RTF), with members from TEAP, its Technical Options Committees (TOCs), and other outside experts. In December 2022, RTF members attended the 91st Meeting of the Executive Committee of the MLF (ExCom-91) to conduct informal discussions with ExCom members, and Bilateral and Implementing Agencies (IAs) present at that meeting. RTF members also attended ExCom-92 prior to OEWG-45. RTF members also attended ExCom-92 prior to OEWG-45.

The RTF Report was published by UNEP in May 2023 as volume 3 of the TEAP 2023 Progress Report, entitled “Assessment of the funding requirement for the replenishment of the Multilateral Fund for the period 2024–2026.” In that report, the RTF estimated the funding requirements for the 2024–2026 triennium and future triennia informed by the “Consolidated Business Plan of the Multilateral Fund for 2023–2025,” relevant decisions of the ExCom up to its 91st meeting,

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\* The annex has not been formally edited.

<sup>1</sup> <https://ozone.unep.org/treaties/montreal-protocol/meetings/thirtieth-meeting-parties/decisions/annex-i-adjustments>



information available through the Multilateral Fund Secretariat (MLFS), and information available to the RTF as of 3 April 2023, the cut-off date used by the RTF in order to fix its modelling assumptions and complete its report drafting and consensus review process in time for submission of its report to OEWG-45. The RTF relied on existing cost guidelines under the MLF and, where these remained under discussion in the ExCom, the RTF noted these limitations in its estimates.

The RTF presented its May 2023 report at OEWG-45 and responded to clarifying questions from parties. Subsequently, the Working Group established a Contact Group to further consider the report. During the discussions, the RTF provided clarification and additional information for the members of the Contact Group. The Contact Group then discussed several topics and agreed on a list of 27 suggestions for additional analysis to be addressed by the RTF in a supplementary report on MLF replenishment for the period 2024–2026.

### Approach to Supplementary Report

In the May 2023 Report, the RTF considered a range for the estimated HFC consumption costs based on the following two scenarios for the triennium 2024–2026:

- **Low-end scenario:** Calculated HFC baselines for 104 A5 countries that have ratified the Kigali Amendment as of the 3 April 2023 using a range of cost effectiveness factors; and
- **High-end scenario:** Calculated HFC baselines for all 144 A5 countries, assuming they will be ratifying the Kigali Amendment by 2026, using a range of cost effectiveness factors.

In this report, the RTF updated the high-end scenario (i.e., assuming all parties ratify the Kigali Amendment by 2026) based on decisions from ExCom-92 and revised HFC baseline calculations based on new information through Article 7 (A7) reporting (see Table ES-1 and ES-2). These updates are discussed below.

For the range to its estimated funding for the 2024–2026 triennium, the RTF refers to the scenarios requested by parties at OEWG-45 (see Table ES-3), some of which significantly increase or decrease the updated estimated funding. For example, the requested scenario estimating funding for KIPs where 90% of Group 1 countries and 30% of Group II countries request funding in this triennium is estimated to reduce the total funding for the triennium by US\$ 124 million. Other requested scenarios, however, are estimated to increase the total funding. Given the many varied scenarios requested by parties, the RTF presents these scenarios without presuming which ones parties may wish to use, combine, or discard. The range of funding for this triennium would then be dependent on these choices.

When developing scenarios, if a methodology, different than the one that RTF used in its May 2023 report, was required/ and or instructed by the suggestions' list from OEWG-45, the respective results were presented in the chapter where the item was addressed, as they could not be compared.

### Updates to May 2023 RTF Report Estimated Funding for 2024–2026

Based on the above approach, in this report, the RTF provides updates to its May 2023 estimated funding for the 2024–2026 triennium based on ExCom-92 decisions and information available to the RTF. In addition, the RTF addressed the requests from the Contact Group at OEWG-45 for additional information and scenarios related to the estimated funding based on information available to the RTF by 7 August 2023, within the timeframe required to complete its report for the 35th Meeting of the Parties (MOP-35).

The RTF made the following updates to its May 2023 RTF Report estimated funding for the 2024–2026 triennium based on the following:

- Decision XXXIV/2 (with the same request from Item 4 of the OEWG-45 Contact Group list of suggestions) request to the RTF to adjust funding requirements based on any relevant decisions taken at the ExCom-92 and
- New information available as of 7 August 2023 from A7 reporting by 70 additional parties since the May 2023 RTF Report and revised HFC baseline calculations.

### ExCom-92 approvals and new A7 data

Relevant decisions taken at ExCom-92<sup>2</sup>, including approval of HCFC and HFC activities for 46 countries, were used by the RTF to update its estimated total funding for the 2024–2026 triennium.

<sup>2</sup> UNEP/OzL.Pro/ExCom/92/56.

The RTF updated the high-end scenario (i.e., assuming all parties ratify the Kigali Amendment by 2026) based on decisions from ExCom-92 and revised HFC baseline calculations based on new information through A7 reporting.

For HCFC activities, the updates:

- Increased the funding for approved HCFC Phase-out Management Plans (HPMPs) from US\$ 116.7 to 123.2 million, an increase of US\$ 6.5 million;
- Increased the funding for HCFC project preparation costs from US\$ 170,000 to 2.8 million, an increase of US\$ 2.7 million;
- Reduced the funding for the estimated HPMPs from US\$ 205.4 to 195.6 million, a reduction of US\$ 9.8 million; and
- Reduced the funding for the HCFC energy efficiency special funding from US\$ 11.1 to 10.2 million, a reduction of US\$ 872,335

For HFC activities, compared with the high-end scenario where all parties are assumed to ratify the Kigali Amendment by 2026, the updates:

- Added funding of US\$ 434,420 for one approved Kigali Implementation Plan (KIP);
- Increased the funding for the HFC project preparation from US\$ 16.8 to 20.4 million, an increase of US\$ 3.6 million;
- Increased the funding for estimated KIPs from US\$ 449.4 to 569.6 million, an increase of US\$ 120.2 million;
- Reduced the HFC energy efficiency funding window from US\$ 20 million to 19.97 million, a reduction of US\$ 34,000; and
- Added funding of US\$ 678,000 for HFC technical assistance.

The largest impact for the HFC updated funding estimates come from the HFC data reported under A7 by an additional 70 parties since the May 2023 RTF Report. The new data increased the total HFC baseline from 1,643 to 1,840 MMTCO<sub>2e</sub>, therefore increasing the needed reductions for meeting compliance targets covered in the 2024–2026 triennium.

For this report, and in the absence of final HFC cost guidelines, RTF updated estimated funding based on ExCom-92 approvals and decisions taken, including the agreed cost-effectiveness value for servicing sector. That said, and with those changes mentioned, the RTF retained the methodology for estimating funding as detailed in the May 2023 RTF Report. The RTF made no changes to its estimated funding for institutional strengthening and standard activities, preparation of gender mainstreaming action plans, and end-of-life activities. The RTF updates adjusted only the high-end scenario, assuming all parties ratify the Kigali Amendment by 2026. The RTF made no change to its estimated funding for future triennia (2027–2029 and 2030–2032).

### **Summary of Updated Estimated Funding Requirements for the 2024–2026 Triennium**

Following its approach above for the supplementary report, the RTF updated the high-end scenario (i.e., assuming all parties ratify the Kigali Amendment by 2026) based on decisions from ExCom-92 and revised HFC baseline calculations based on new information through A7 reporting. Tables ES-1 and ES-2 provide this updated high-end of the range for the estimated funding requirement for the replenishment of the MLF in the 2024–2026 triennium of **US\$ 1,142 million**<sup>3</sup>.

Table ES-3 provides a summary of the scenarios requested in the OEWG-45 Contact Group list of suggestions and the impact to the updated total estimated funding requirement for the 2024–2026 triennium.

<sup>3</sup> Note: figures may not sum due to rounding.

**Table ES-1. Estimated funding requirement for the replenishment of the MLF 2024–2026 (US\$)**

<i>2024–2026 TRIENNium</i>	<i>May 2023 estimate (all parties ratify scenario)<sup>4</sup></i>	<i>Sept 2023 Updates (all parties ratify scenario)<sup>5</sup></i>
SUBTOTAL - HCFC Activities	\$ 363 911 000	\$ 362 323 000
SUBTOTAL - HFC Activities	\$ 519 142 000	\$ 643 908 000
SUBTOTAL - EOL/Disposal	\$ 13 590 000	\$ 13 590 000
SUBTOTAL - IS & Standard Activities	\$ 121 581 000	\$ 121 581 000
<b>TOTAL</b>	<b>\$ 1 018 224 000</b>	<b>\$ 1 141 402 000</b>

**Table ES-2. Updated funding requirement for the replenishment of the MLF 2024–2026 (US\$)**

<i>2024–2026 Triennium Estimated Funding (May 2023)</i>	<i>Sept 2023 Updates</i>	
<b>HCFC Consumption Sector</b>		
HCFC Approved HPMPs	\$ 116 746 000	\$ 123 181 000
HCFC Prep Costs	\$ 170 000	\$ 2 839 000
HCFC Estimated HPMPs (including LVCs/VLVCs)	\$ 205 405 000	\$ 195 582 000
HCFC Verification	\$ 1 766 000	\$ 1 766 000
HCFC Energy Efficiency Special Funding	\$ 11 092 000	\$ 10 220 000
<b>Subtotal – HCFC Consumption Sector</b>	<b>\$ 335 179 000</b>	<b>\$ 333 588 000</b>
<b>HCFC Production Sector</b>		
HCFC Production Sector Stage I PRP	\$ 148 000	\$ 148 000
HCFC Production Sector Stage I HPPMP	\$ 5 352 000	\$ 5 352 000
HCFC Production Sector Stage II HPPMP	\$ 23 232 000	\$ 23 232 000
<b>Subtotal – HCFC Production Sector</b>	<b>\$ 28 732 000</b>	<b>\$ 28 732 000</b>
<b>SUBTOTAL - HCFC Activities</b>	<b>\$ 363 911 000</b>	<b>\$ 362 320 000</b>

<b>HFC Consumption Sector</b>		
HFC Approved KIPs	\$ -	\$ 434 420
HFC Prep Costs (including gender mainstreaming)	\$ 16 802 000	\$ 20 369 000
HFC RTF Estimated KIPs	\$ 449 415 000	\$ 569 643 000
HFC Enabling Activities	\$ 1 011 000	\$ 1 011 000
HFC Energy Efficiency Funding Window	\$ 20 000 000	\$ 19 966 000
HFC Technical Assistance	\$ -	\$ 678 000
<b>Subtotal – HFC Consumption Sector</b>	<b>\$ 487 228 000</b>	<b>\$ 612 101 420</b>
<b>HFC Production Sector (Unchanged from May 2023 estimates)</b>		
HFC Production Sector Prep	\$ 2 000 000	\$ 2 000 000
HFC Production Sector KPPMP RTF Estimated	\$ 20 000 000	\$ 20 000 000
HFC-23 Mitigation Prep	\$ 193 000	\$ 193 000
HFC-23 Mitigation Approved	\$ 1 721 000	\$ 1 614 000 <sup>6</sup>
HFC-23 Emissions Control (per BP formerly Mitigation RTF Estimated)	\$ 8 000 000	\$ 8 000 000
<b>Subtotal – HFC Production/HFC-23 Sector</b>	<b>\$ 31 914 000</b>	<b>\$ 31 807 000</b>
<b>SUBTOTAL - HFC Activities</b>	<b>\$ 519 142 000</b>	<b>\$ 643 908 000</b>

<sup>4</sup> As of ExCom-91 and information received by TEAP as of 7 April 2023.

<sup>5</sup> As of ExCom-92 and information received by TEAP as of 7 August 2023.

<sup>6</sup> Excluding Penalty of US \$107,000 applied as per decision 92/31(b)(iii) for Argentina.

IS/Standard Activities/EOL (Unchanged from May 2023 estimates)		
IS	\$ 44 500 000	\$ 44 500 000
UNEP CAP	\$ 36 437 000	\$ 36 437 000
UNDP, UNIDO, World Bank Core Unit	\$ 18 161 000	\$ 18 161 000
MLF Secretariat and ExCom Costs	\$ 20 983 000	\$ 20 983 000
Treasurer	\$ 1 500 000	\$ 1 500 000
<b>SUBTOTAL - IS &amp; Standard Activities</b>	<b>\$ 121 581 000</b>	<b>\$ 121 581 000</b>
Funding Window on EOL/Disposal	\$ 13 590 000	\$ 13 590 000
<b>SUBTOTAL – EOL/Disposal</b>	<b>\$ 13 590 000</b>	<b>\$ 13 590 000</b>
<b>TOTAL</b>	<b>\$ 1 018 224 000</b>	<b>\$ 1 141 402 000</b>

### OEWG-45 Contact Group suggestions and scenarios

In the remainder of this report, the RTF addresses the suggestions, including scenarios, made by the OEWG-45 Contact Group, to the extent information was available to the RTF as of 7 August 2023 and in time to meet its timeline to prepare this report for MOP-35. There were 27 varied items suggested for RTF to consider in its supplementary report, which was a significant challenge given the timeline and the scope of various analyses involved. The impacts of the resulting different scenarios to the updated estimated funding for the 2024–2026 triennium varied widely. The funding estimates resulting from OEWG-45 requests are only comparable when the same methodology was used. When different, RTF presented the new figure in a separate line or in separate sections of the Report. For instance, the analysis on costs for including energy efficiency as an incentive payment and estimates of potential support for systemic approaches to EE beyond the pilot window are presented separately as in the Table ES-3 below.

Reductions or increases in estimated funding from the application of different scenarios requested at OEWG-45, and which, required a different methodology from the one used for RTF May 2023 Report, are also indicated in a separate column in Table ES-3. Reductions are shown in numbers in parentheses. Increases are indicated with a plus (+) sign. As mentioned above, when the methodology changed and RTF could not compare funding, information was provided in different report sections as indicated in the table below.

**Table ES-3. OEWG-45 Contact Group suggestions/scenarios: Potential changes to funding requirement for 2024–2026**

<i>Item</i>	<i>Suggestions/Scenarios</i>	<i>Potential change to updated funding requirement 2024–2026 using May 2023 RTF Report methodology* (US\$)</i>	<i>Remarks and additional information provided when methodology in parties request at OEWG-45 differed from RTF's</i>	<i>September 2023 RTF Report sections</i>
<b>Overall Suggestions/Methodological Approach</b>				
1	Where the RTF uses cost estimates for specific activities drawn from the MLF business plan include a scenario with a discounting approach as applied by previous replenishment reports. It should reflect that the funding approvals in ExCom were on average found to be lower by 15 to 20% (at present 26% lower) compared to the original cost and expenditures estimated in the business plans;	(\$ 3.71 million)		3.2
2	Include 2 new scenarios for estimating the funding for the HCFC phase-out and HFC phase-down that are based on the actual consumption (or estimates of such consumption when not reported) to be reduced for countries to meet compliance targets including both the freeze target and the 10% reduction target for the HFC phase-down and ranges for the respective funding requirements to account for uncertainties;	(\$ 168.5 million)	For both scenarios. Information provided in section uses actual consumption	3.3

<b>ExCom92 Decisions</b>				
3	Adjust the funding estimated for the HCFC phase-out and HFC phase-down by taking into account potential approvals of projects and project preparation requests at the 93rd meeting of the ExCom;		Information provided using 2023 BP figures; information available not sufficient to adjust estimated updated funding for 2024–2026 triennium	3.4
4	Adjust all elements of the funding requirements based on any relevant decisions taken at the 92nd meeting of the ExCom;	Adjusted		2.2
5	Include a scenario, wherein some Article 5 parties submit proposals to phase down HFCs in advance of applicable compliance targets in accordance with ExCom decisions 92/44 and 92/37;	+ \$4.86 million		5.2
<b>HCFC</b>				
6	When estimating the funding requirement for new HPMPs, identify the sectors that would likely be addressed by these HPMPs, based on remaining HCFC consumption per sector, and apply cost effectiveness factors to calculate funding for these sectors that are based on historical experience under the Multilateral Fund;		Information provided; new methodology used as per item 6 request (different than in May 2023 RTF report)	4.2
7	Consider scenario removing the HCFC production phase-out plan for India that is not included in the consolidated BP of ExCom;	(\$ 5.48 million)		4.3
8	Review the funding requirement for HPMP preparation funding to account for all the countries identified to require new HPMPs in the 2024–2026 triennium;	+\$ 2.84 million		4.4
<b>HFC</b>				
9	Develop a scenario estimating funding for KIPs for Group I and Group II countries which have ratified the Kigali Amendment assuming that 90% of Group I and 30% of Group II countries request funding;	(\$124 million)		5.3
10	Add scenario for frontloading funding for KIPs during 2024–2026, taking into account the lessons learned from the implementation of HPMPs;	+\$ 30.7 million		5.4
11	Reviewing funding requirement for KIPs preparation funding to account for all the countries identified to require KIPs in the 2024–2026 triennium;	+\$ 3.57 million		5.5
12	A scenario prioritizing the manufacturing sectors for non-LVCs;		Qualitative assessment	5.6
13	When estimating the funding requirement for KIPs, apply cost effectiveness factors for manufacturing sectors that are based on historical experience under the MLF and/or a technical assessment of the costs to transition to alternatives, taking into account any available information from MLF documents, previous TEAP reports and other sources and ExCom agreed cost guidelines.	(\$ 106 million)	RTF used historical experience of economies of scale for manufacturing sectors.	5.7
14	Review the funding requirement for the phase-down HFC production and HFC-23 by-product mitigation, based on a technical assessment of the costs, to the extent possible, taking into account the experience with such projects under the MLF and the past funding practice in the production phase-out/down projects;	(\$10.3 million - \$11.7 million)		5.8
15	A scenario for funding 10 to 15 individual investment projects;		Examples and costs provided	5.9
16	A scenario to address the challenges for SMEs including safety issues, including in the installation and assembly sectors in implementation of KIPs;		Information provided	5.10

17	Evaluate the potential cost implications of leapfrogging and/or taking early action to phase down HFCs in advance of compliance targets;		Information provided for early action/ see chapter for leapfrogging remark	5.11
<b>Energy efficiency</b>				
18	A scenario for funding 10 to 15 energy efficiency pilot projects;		No change – examples provided	6.2
19	Include a scenario wherein an incentive is provided as part of the funding for KIPs to enhance EE while phasing down HFCs in accordance with ExCom decision 92/38;		Information provided	6.3
20	Consider activities to support SMEs in design and development of energy efficient technology and their implementation;		Included in Item 16	6.4
21	Consider EE related policies and regulations capacity building;		Information provided	6.5
22	Consider additional costs for energy efficient foam products;		Information provided	6.6
23	Consider regional testing centers for monitoring and verification of energy efficiency;		Information provided	6.7
24	Analyse additional costs for including energy efficiency as an incentive for enhancing ambitious HFC-phase down and leapfrogging HFCs in the frame of the HPMPs and KIPs;		Analysis provided	6.8
25	Provide cost estimates of potential support for systemic approaches to EE in KIPS, beyond the pilot window;		Information provided	6.9 (see also 6.2, 6.3, 6.4 6.5, 6.7)
<b>End of Life</b>				
26	Provide estimates of costs of managing reclamation, recycling, and cost-effective destruction of banks, including collection, transport, and disposal activities;		Information provided	7.1
27	Consider a scenario for end-of-life activities considered under ExCom decision 91/66 where only 30 % of countries request funding during this replenishment.	(\$9.15 million)		7.2

\* The symbol “+” indicates increase while parentheses indicate reduction to updated estimated funding for the triennium.

## Annex II\*

## 2023 Report by the Technology and Economic Assessment Panel, Volume 6

### Response to decision XXXIV/7: Strengthening institutional processes with respect to information on HFC-23 by-product emissions

#### Executive Summary

This report includes sections responding to each of the following sub-paragraphs of decision XXXIV/7, relating to HFC-23 by-product generation and emissions from the manufacture of Annex C, Group I, or Annex F substances:

- (a) Information on the possible chemical pathways that could be used in the production of Annex C, Group I, or Annex F substances that may generate HFC-23 as a by-product;
- (b) Compilation of information on the amount of HFC-23 generation and emissions from facilities that manufacture Annex C, Group I, or Annex F substances, the reporting of which is required under Article 7 of the Montreal Protocol; and
- (c) Best practices available to control these emissions.

The report includes additional contextual information on other HFC-23 generation and/or emissions, i.e., from chemical pathways used in the production of substances that are not Annex C, Group I, or Annex F substances, and from feedstock and consumptive uses. This additional contextual information was considered useful in understanding the relative importance of chemical pathways used in the production of Annex C, Group I, and Annex F substances that may generate HFC-23 as a by-product, which is the focus of this decision.

Two key terms from the decision are defined as follows:

- *Generation* is defined as the total HFC-23 produced as a by-product, without taking into account abatement of emissions.
- *Emissions* are defined as the total HFC-23 emitted from a facility that generates HFC-23 as a by-product, after any abatement. Although HFC-23 may be emitted via different routes, the dominant emission pathway is direct emissions to atmosphere.

#### ES.1 Chemical pathways that could be used in the production of Annex C, Group I, or Annex F substances that may generate HFC-23 as a by-product

There are several chemical mechanisms that can, by their nature, generate HFC-23 as a by-product in chemical production processes, including:

- *Over- or under-reaction of chemicals* present in the reaction vessel enroute to the intended product, e.g., HFC-23 is an over-fluorination of HCFC-22.
- *Presence of impurities in the feedstocks that are being reacted*, e.g., the chloroform impurity in dichloromethane feedstock, used to produce HFC-32, is hydro-fluorinated to HFC-23.
- *Unintended side reactions*, where the feedstock follows a different reaction path than the one that is desired to make the product, e.g., cleavage of carbon-carbon bond in the production of HFC-125 from perchloroethylene, with subsequent hydro-fluorination of the resulting mono-carbon molecule to form HFC-23.

The estimated global generation of HFC-23 as a by-product is around 25,000 tonnes per year for the range of chemical pathways considered in this report. This estimate is based on current expert knowledge of production quantities and HFC-23 by-product generation rates by process. HFC-23 generated will only be emitted if it is not captured, used as feedstock, or destroyed before it leaves the process, e.g., by incineration. HFC-23 is primarily generated by the fluorination of chloroform, via the chloroform, HCFC-21, HCFC-22 to HFC-23 pathway in fluorination or hydro-fluorination chemical

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\* The annex has not been formally edited.

processes. This process is widely understood to be the main source of global HFC-23 by-product generation, at around 95% of the estimated total global HFC-23 generation. Chemical pathways used in the production of other Annex C, Group I, (other than HCFC-22) or Annex F substances can also generate HFC-23 as a by-product, which in combination, are currently estimated to generate up to around 1% of the total global HFC-23 generation. Some chemical pathways used to produce substances other than Annex C HCFCs or Annex F HFCs are also understood to generate HFC-23 by-product, which in combination, are currently estimated to account for around 3–4% of the total global HFC-23 by-product generation.

For many processes producing fluorinated controlled substances, HFC-23 by-product generation is possible. In the production of HCFC-22, HFC-23 by-product generation cannot be eliminated, with 1–3 wt% HFC-23 generation being typical. For other processes, very low generation rates are possible; with careful design and operation of the process, HFC-23 by-product generation rate can be minimised to less than 0.1 wt%, often less than 0.01 wt%, of production, with emission mitigation reducing the final HFC-23 emission rate further. For many HCFC and HFC production processes, little or no effort has been taken to date to eliminate HFC-23 by-product generation because the "natural" HFC-23 generation rate of the process is so low as to not make it cost-effective. With an effectively operated HFC-23 mitigation step, e.g., thermal oxidation, HFC-23 emission rates can be significantly lower than the HFC-23 by-product generation rates because destruction efficiencies can exceed 99%.

***The chemical pathway used to produce HCFC-22***, involving the two-step reaction of chloroform and anhydrous hydrogen fluoride to produce HCFC-22, is employed in many plants around the world. HFC-23 generation rates are typically around 1–3 wt%, or 10–30 kg of HFC-23 by-product generated per tonne of HCFC-22, and can be as high as 4 wt%. This process is widely understood to be the main source of global HFC-23 generation, at ***around 95% of the estimated total global HFC-23 by-product generation***.

***Chemical pathways used to produce Annex C, Group I, substances other than HCFC-22, and Annex F substances*** can also generate HFC-23 as a by-product. In combination, these other chemical pathways are currently estimated to generate up to ***around 1% of total global HFC-23 by-product generation***.

Some chemical pathways used to produce Annex C HCFCs and Annex F HFCs have good evidence of HFC-23 generation and its associated rates (e.g., HCFC-22 from chloroform). Other chemical pathways used to produce Annex C HCFCs and Annex F HFCs have more limited evidence of HFC-23 generation, although generation is theoretically feasible (e.g., HFC-32 from dichloromethane, HFC-125 from perchloroethylene, HFC-134a from trichloroethylene). Evidence is limited due to insufficient data, with a lack of emissions reporting and a lack of reference to HFC-23 generation in patents. Nevertheless, HFC-23 generation is theoretically feasible and potentially present in trace amounts. For some chemical pathways, the rate of HFC-23 generation may be so low (practically zero) that HFC-23 would remain undetected in routine analysis.

While noting these uncertainties, for additional context and understanding of the potential relative contributions to HFC-23 by-product generation, the report provides indicative estimations of relative global HFC-23 generation by relevant chemical pathways based on available information and/or expert opinion.

With these data qualifications in mind, the chemical pathways that could be used to produce Annex C HCFCs and Annex F HFCs that *may* generate HFC-23 as a by-product are:

- HCFC-22 from chloroform, including co-production of HCFC-21
- HFC-32 from dichloromethane
- HFC-125 from perchloroethylene, including co-production of HCFC-124 and HCFC-123
- HFC-134a from trichloroethylene, including co-production of HCFC-133a
- HCFC-142b from vinylidene chloride or trichloroethane
- HFC-152a from vinyl chloride
- HFC-143a from trichloroethane
- HFC-227ea from hexafluoropropylene (HFP)
- HFC-245fa from pentachloropropane



*Some chemical pathways used to produce substances other than Annex C HCFCs or Annex F HFCs (around 3–4% of global HFC-23 by-product generation), which are outside the scope of decision XXXIV/7, are also understood to generate HFC-23 by-product. The largest contributor of these chemical pathways to global HFC-23 by-product generation is likely to be the pyrolysis of HCFC-22 to make tetrafluoroethylene (TFE) and hexafluoropropylene (HFP), which can be used to produce fluoropolymers. This process is understood to generate up to around 1 kg of HFC-23 per tonne of HCFC-22 consumed (0.1 wt%). Other chemical pathways where HFC-23 by-product generation is theoretically feasible include those used to produce CFCs, namely CFC-113 from perchloroethylene and CFC-114 from perchloroethylene. In combination, these chemical pathways are currently estimated to account for around 3–4% of the total global HFC-23 by-product generation.*

## **ES.2 Compilation of information on the amount of HFC-23 generation and emissions**

In response to decision XXXIV/7, paragraph b, this report provides a compilation of information on the amount of HFC-23 generation and emissions from facilities that manufacture Annex C, Group I, or Annex F substances. It draws on several sources for this information, including UNFCCC submissions by Annex 1 countries; the Intergovernmental Panel on Climate Change (IPCC); Article 7 data reported under the Montreal Protocol; data reported to the Executive Committee (ExCom); and the Science Assessment Panel (SAP).

Most reported data for HFC-23 by-product generation are available for HCFC-22 production. Based on IPCC default factors, HFC-23 by-product generation from HCFC-22 production is expected to be in the range of about 15,000 to 30,000 tonnes per year.

HFC-23 emissions data reported under Article 7 are incomplete for 2019, 2020 and 2021 due to the timing of reporting obligations and depending on when parties ratified the Kigali Amendment. The dataset for 2021 is the most complete. The combined HFC-23 emissions reported as by-product from HCFC-22 production (UNFCCC and under Article 7) is 2,572 tonnes in 2021.

Other information on HFC-23 emissions is provided as additional contextual information, including from sources other than facilities that manufacture Annex C HCFC and Annex F HFCs.

The SAP 2022 Assessment reports estimated HFC-23 emissions, derived from atmospheric monitoring, of  $17.2 \pm 0.8$  Gg yr<sup>-1</sup> (17,200 tonnes) in 2019, and a similar value of  $16.5 \pm 0.8$  Gg yr<sup>-1</sup> (16,500 tonnes) in 2020. This compares with the combined reported HFC-23 emissions from HCFC-22 production (UNFCCC and under Article 7), which is 2,572 tonnes in 2021.

A range of sources other than facilities that manufacture Annex C HCFC and Annex F HFCs are considered, with associated estimates of *annual* HFC-23 emissions, as follows:

- Pyrolysis of HCFC-22 to produce TFE/HFP (~100–1,000 tonnes, based on estimated associated HFC-23 by-product generation without possible emissions abatement)
- Feedstock use of HFC-23 (~10 tonnes)
- HFC-23 present as an impurity in other chemicals that are used in emissive uses (e.g., ~40 tonnes HFC-23 emissions arising from the HCFC-22 bank)
- Fire protection (~50 tonnes)
- Low temperature refrigerant (similar order of magnitude to fire protection)
- Semiconductor and electronics manufacturing (~90 tonnes)

## **ES.3 Best practices available to control HFC-23 by-product emissions**

In response to decision XXXIV/7, paragraph c, the report provides a summary of information on best practices available to control emissions of HFC-23 by-product from facilities that manufacture Annex C HCFCs or Annex F HFCs. These best practices to control emissions of HFC-23 are consistent with those used to control other emissions associated with chemical manufacturing. This report also summarises a sample of measures implemented or being implemented by parties to control emissions of HFC-23 by-product.

#### **ES.4 Recommendation**

Uncertainties and data discrepancies have been identified in this report that impact the accurate estimation of global HFC-23 generation and emissions based on currently available data. With improved data, more refined estimates and conclusions could be drawn.

Parties may wish to consider measures to improve the reported data for HFC-23 generation and emissions, including their accuracy and their scope.

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