Issues for discussion by and information for the attention of the Open-ended Working Group of the Parties to the Montreal Protocol at its thirty-ninth 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 thirty-ninth meeting (UNEP/OzL.Pro.WG.1/39/2) contains information that has become available since the preparation of that note. The additional information is set out in section II of the addendum; it includes brief summaries of information provided by the Technology and Economic Assessment Panel in its May 2017 report and an update on the status of the submissions of parties in response to decision XXVIII/3 on energy efficiency.

2. The May 2017 report of the Technology and Economic Assessment Panel consists of four volumes:

(a) Volume 1 contains the Panel’s May 2017 progress report, including the following:

(i) Progress reports by the Panel’s technical options committees;2
(ii) Report on essential-use nominations;
(iii) Report on issues related to the phase-out of hydrochlorofluorocarbons (HCFCs) (decision XXVIII/8);
(iv) Organizational and other matters;

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2 Flexible and Rigid Foams Technical Options Committee (chapter 2); Halons Technical Options Committee (chapter 3); Methyl Bromide Technical Options Committee (chapter 4); Medical and Chemicals Technical Options Committee (chapter 5); Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee (chapter 6).
(b) Volume 2 contains the Panel’s May 2017 interim report on the evaluation of 2017 critical-use nominations for methyl bromide and related matters;

(c) Volume 3 contains the report of the task force established by the Panel in response to decision XXVIII/4, concerning information on safety standards relevant for low-global-warming-potential (GWP) alternatives;

(d) Volume 4 contains the report of the task force established by the Panel in response to decision XXVIII/5 on the funding requirement for the 2018–2020 replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol.

3. A summary of the information and recommendations of the Panel in its 2017 report that are relevant to matters on the provisional agenda for the thirty-ninth meeting is presented in the following sections.

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

Agenda item 4
Replenishment of the Multilateral Fund for the triennium 2018–2020, including the report by the Technology and Economic Assessment Panel (decision XXVIII/5)

4. Consistent with decision XXVIII/5, the Technology and Economic Assessment Panel established a task force to prepare a report on the appropriate level of replenishment of the Multilateral Fund for the Implementation of the Montreal Protocol for the triennium 2018–2020 for submission to the Twenty-Ninth Meeting of the Parties. The task force report, which is volume 4 of the Panel’s 2017 report, is available on the meeting portal of the Ozone Secretariat website. The executive summary of the report is set out in annex I to the present addendum to the note by the Secretariat. It is presented as received from the Panel, without formal editing by the Secretariat.

5. The task force held informal consultations with representatives of 17 parties operating under paragraph 1 of Article 5 (Article 5 parties) and parties not so operating (non-Article 5 parties), and with the Secretariat of the Multilateral Fund and its four implementing agencies (United Nations Environment Programme, United Nations Development Programme, United Nations Industrial Development Organization and the World Bank). After detailed analysis, the task force estimated the total requirement for the triennium 2018–2020 at between $602.71 million and $748.85 million. In reaching that estimate, the task force calculated the funding requirements for the following components:

(a) HCFC consumption phase-out activities, comprising existing commitments from approved, in principle, stage I and stage II of HCFC phase-out management plans (HPMPs) and new planned activities for stage II and later stage HPMPs;

(b) HCFC production phase-out;

(c) Non-investment components and supporting activities;

(d) Enabling activities for HFC phase-down;

(e) HFC-23 mitigation activities.

6. The funding requirements of each component and underlying activities, along with the total, are listed in table 1 below:

Table 1
Total funding requirement for the replenishment of the Multilateral Fund 2018–2020 under each funding component as specified in the task force report
($ million)

<table>
<thead>
<tr>
<th>Components considered</th>
<th>Funding requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HPMP activities</strong></td>
<td></td>
</tr>
<tr>
<td>- Non-LVCs(^a) and LVCs HPMPs and HPMP verification</td>
<td>391.77–420.90</td>
</tr>
<tr>
<td>- China HPMP, stage III</td>
<td>0.0–70.81</td>
</tr>
<tr>
<td>- LVCs HPMP stage III</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>391.91–491.85</strong></td>
</tr>
<tr>
<td><strong>HCFC production phase-out</strong></td>
<td></td>
</tr>
<tr>
<td>- HPPMP(^b) for China</td>
<td>65.62</td>
</tr>
<tr>
<td>- HPPMP for Democratic People’s Republic of Korea</td>
<td>1.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67.22</strong></td>
</tr>
<tr>
<td><strong>Non-investment and supporting activities</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Non-investment activities</strong></td>
<td></td>
</tr>
<tr>
<td>- Institutional strengthening</td>
<td>31.08</td>
</tr>
<tr>
<td>- HPMP stage II preparation</td>
<td>4.35</td>
</tr>
<tr>
<td>- HPMP stage III preparation</td>
<td>4.35</td>
</tr>
<tr>
<td>- HCFC demonstration projects</td>
<td>0.0–10.0</td>
</tr>
<tr>
<td><strong>Sub-total, non-investment activities</strong></td>
<td><strong>39.78–49.78</strong></td>
</tr>
<tr>
<td><strong>Supporting activities</strong></td>
<td></td>
</tr>
<tr>
<td>- UNEP Compliance Assistance Programme</td>
<td>34.80</td>
</tr>
<tr>
<td>- Agency core unit costs</td>
<td>17.84</td>
</tr>
<tr>
<td>- Secretariat and Executive Committee</td>
<td>20.16</td>
</tr>
<tr>
<td>- Treasurer</td>
<td>1.50</td>
</tr>
<tr>
<td><strong>Sub-total, supporting activities</strong></td>
<td><strong>74.30</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>114.08–124.08</strong></td>
</tr>
<tr>
<td><strong>Enabling activities for HFC phase-down</strong>(^c)</td>
<td></td>
</tr>
<tr>
<td>- Non-investment projects</td>
<td>13.5–20.2</td>
</tr>
<tr>
<td>(including project preparation and demonstration projects)</td>
<td></td>
</tr>
<tr>
<td>- Investment projects</td>
<td>8.0–24.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21.5–44.2</strong></td>
</tr>
<tr>
<td><strong>HFC-23 mitigation</strong></td>
<td></td>
</tr>
<tr>
<td>- Enabling activities before 2020</td>
<td>0.8</td>
</tr>
<tr>
<td>- Capital and operating costs (2020 only)</td>
<td>7.2–20.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8.0–21.5</strong></td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>602.71–748.85</strong></td>
</tr>
</tbody>
</table>

Notes:
\(^a\) Low-volume countries.
\(^b\) HCFC production phase-out management plan.
\(^c\) As defined in paragraph 20 of decision XXVIII/2: capacity-building and training, institutional strengthening, Article 4B licensing, reporting, demonstration projects and development of national strategies.

7. The report provides a detailed account of the assumptions on which the calculations are based. With regard to enabling activities related to the phase-down of HFCs (decision XXVIII/5, para. 4), the task force notes that estimates of funding for HFCs for the period 2018–2020 have primarily been based on historical funding of such activities related to stage I HPMPs.
Projected funding estimates for future trienniums

8. In accordance with its terms of reference, the task force also provided indicative funding ranges for the subsequent two trienniums: $634.8 – $771 million for the triennium 2021–2023 and $548.5–$695.5 million for the triennium 2024–2026 (shown in table 2, together with the total funding requirement for the first triennium).

Table 2
Total funding requirement for the replenishment of the Multilateral Fund for the next three trienniums
($ million)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total funding requirement</td>
<td>602.71–748.85</td>
<td>634.8–771.0</td>
<td>548.5–695.5</td>
</tr>
</tbody>
</table>

9. The indicative funding estimates for the second and third trienniums are largely based on known HCFC phase-down commitments. Estimated costs for planned HCFC funding are related to HCFCs that have not been addressed in agreed and planned activities in the period up to and including 2020. For non-investment activities, a number of items, such as project preparation, could not be assessed. Funding for institutional strengthening was estimated as a range, varying from the current (2017–2020) funding level to a level that could be decided by the Executive Committee of the Multilateral Fund in 2020. It should also be noted that these estimates do not include funding requirements for HFC phase-down projects, as there are limitations imposed by issues that are still under discussion by the Executive Committee (such as cost guidelines for HFC phase-down activities). The task force noted that with appropriate guidance in the future, it would be in a position to provide updated figures.

10. The Open-ended Working Group may wish to consider the initial work of the replenishment task force and, if necessary, may request it to undertake further work to clarify various aspects prior to the submission of its final report to the Twenty-Ninth Meeting of the Parties.

Agenda item 5

Technology and Economic Assessment Panel 2017 report (volumes I and II)

11. The Panel will present its findings and recommendations as contained in volumes 1 and 2 of its 2017 report under agenda item 5 of the provisional agenda.

(a) Nominations for essential-use exemptions for 2018

12. The Medical and Chemicals Technical Options Committee evaluated a request from China for an essential-use exemption for the use of 65 metric tonnes of carbon tetrachloride for the testing of oil, grease and total petroleum hydrocarbons in water, a laboratory and analytical use, for 2018.

13. China is commended for its ongoing efforts to find an ozone-depleting-substance-free method for the analysis of oil in water and the Committee recommends an exemption of 65 metric tonnes of carbon tetrachloride for 2018. The Technical Options Committee also requests that China provide information on a number of issues, such as progress in the development of its method using tetrachloroethylene as an alternative to carbon tetrachloride; including the purification of tetrachloroethylene; evaluation of available alternative sources of higher purity tetrachloroethylene; any further evaluations regarding the use of international or other national analytical methods; and timelines for the phase-out of carbon tetrachloride in laboratory and analytical uses, indicating the anticipated steps and end date in that process (volume 1, subsection 5.2).

(b) Nominations for critical-use exemptions for 2018 and 2019

14. As set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/39/2, para. 32), the Methyl Bromide Technical Options Committee evaluated eight nominations for critical-use exemptions submitted by two parties not operating under paragraph 1 of Article 5 (Australia and Canada) and three parties operating under paragraph 1 of Article 5 (Argentina, China and South Africa). The results of the evaluation, together with the initial recommendations of the Committee, are set out in volume 2 of the Technology and Economic Assessment Panel’s 2017 report. Table 3 summarizes the nominations of the parties and the interim recommendations of the Committee, with brief explanations in the footnotes to the table when the recommendations differ from the amounts nominated.

15. The nominating parties and the Methyl Bromide Technical Options Committee are expected to discuss further bilaterally, including during the thirty-ninth meeting of the Open-ended Working Group, the interim recommendations and additional information that may be provided to the
Committee for its final evaluation and recommendations. The final report of the Committee will be available prior to the Twenty-Ninth Meeting of the Parties to the Montreal Protocol.

Table 3  
Summary of the nominations for 2018 and 2019 critical-use exemptions for methyl bromide submitted in 2017 and the interim recommendations of the Methyl Bromide Technical Options Committee  
(Metric tonnes)*

<table>
<thead>
<tr>
<th>Party</th>
<th>Nomination for 2018</th>
<th>Interim recommendation</th>
<th>Nomination for 2019</th>
<th>Interim recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parties not operating under paragraph 1 of Article 5 and sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Australia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strawberry runners</td>
<td>75.400</td>
<td>[47.700]*</td>
<td>28.980</td>
<td>[23.180]*</td>
</tr>
<tr>
<td>2. Canada</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strawberry runners</td>
<td>5.261</td>
<td>(Unable to assess)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5.261</td>
<td>28.980</td>
<td>[23.180]</td>
<td></td>
</tr>
<tr>
<td><strong>Parties operating under paragraph 1 of Article 5 and sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Argentina</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato</td>
<td>45.300</td>
<td>[29.000]*</td>
<td>25.140</td>
<td>[16.800]*</td>
</tr>
<tr>
<td>Strawberry fruit</td>
<td>74.617</td>
<td>[68.880]*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. China</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginger open field</td>
<td>18.360</td>
<td>[18.360]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginger protected</td>
<td>45.000</td>
<td>[42.750]*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. South Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mills</td>
<td>5.000</td>
<td>[2.900]*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>268.938</td>
<td>[209.590]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Tonne = metric ton.

a The 20 per cent reduction in the nomination is made to conform to the standard presumptions of the Methyl Bromide Technical Options Committee (MBTOC) of 20.0 g/m² regarding dosage rates of methyl bromide.

b MBTOC is unable to assess this nomination, noting that a key chemical alternative, chloropicrin (Pic), is currently permitted for use in mixtures with methyl bromide, but its use alone or in combination with other alternatives is banned due to concerns over groundwater contamination in Prince Edward Island. The party confirmed that testing of groundwater for chloropicrin was not being conducted. In view of this situation, MBTOC seeks guidance from the parties as to how best to assess this nomination.

c The reduction in the nomination is based on a lower dosage rate (26.0 to 15.0 g/m²) for the adoption of barrier films (for example, totally impermeable film (TIF)) over a transition period of three years, as per MBTOC’s standard presumptions, for a total of 54.1 tonnes (including 10.8 tonnes for Mar Del Plata and 43.3 tonnes for La Plata). The nomination was further reduced by 10 per cent (6.4 tonnes, based on the 2017 critical use exemption) to accommodate the uptake of other chemical and non-chemical alternatives, such as integrated pest management (nematicides, biofumigation with chicken manure, steam and 1,3-D/Pic (Agrocelhone)).

d The reduction in the nomination is based on a lower dosage rate (26.0 to 15.0 g/m²) for the adoption of barrier films (for example, TIF) over a transition period of three years for use with remaining methyl bromide treatments and a subsequent decrease as per MBTOC’s standard presumptions. A further 10 per cent reduction was applied for the adoption of available alternatives using best practice (namely, 1,3-D/Pic, rotations and improved application techniques for fumigants).

e The reduction in the nomination is derived from the MBTOC calculation, based on the adoption of barrier films in the total nominated area at the rate of 30 g/m² (229.59 ha x 30 g/m² = 68.88 tonnes).

f The 29 per cent reduction in the nomination is based on the amount of methyl bromide sufficient for one fumigation per year and per mill as a transitional measure to allow time for adoption and optimization of alternatives in an integrated pest management system. The recommendation is based on a dosage of 20 g/m² (MBTOC standard presumptions), applied to well-sealed structures.

g The nomination has been reduced by 5 per cent to account for the planned implementation of control measures involving application of heat.

(c) The phase-out of hydrochlorofluorocarbons (decision XXVIII/8)

16. As described in the note by the Secretariat (UNEP/OzL.Pro.WG.1/39/2, paras. 33–35), in decision XXVIII/8, the Twenty-Eighth Meeting of the Parties requested the Technology and Economic Assessment Panel to continue its assessment of the possible need for HCFCs in non-Article 5 parties after the phase-out of those substances by 1 January 2020. In line with decision XXVII/5, which had raised the same issues, the assessment addresses the possible need of non-Article 5 parties for essential uses; servicing requirements for refrigeration and air-conditioning equipment and other sectors; and
production of HCFCs to satisfy basic domestic needs of Article 5 parties beyond the phase-out date for non-Article 5 parties.

17. Parties were also invited to provide information to the Secretariat by 15 March 2017 for inclusion in the Panel’s assessment to be reported to the thirty-ninth meeting of the Open-ended Working Group. Information was received from the following parties: Armenia, Bangladesh, the European Union, Jamaica, Japan, Mauritius, Mexico and the United States of America.

18. The report of the Panel is included in section 7 of its progress report (volume 1) and its corrigendum, while the substantive parts of submissions from parties are reproduced in annex 2 to the report (posted separately on the website of the Ozone Secretariat).

19. The findings of the Panel’s assessment, which are similar to those of its 2016 assessment in response to decision XXVII/5, are as follows:

1. On basic domestic needs

(a) The 2020 HCFC consumption is estimated to be lower than the HCFC production allowed under the Protocol. On the basis of that comparison and extrapolations performed thereafter, the Panel concluded that production by non-Article 5 parties to satisfy basic domestic needs of Article 5 parties would not be needed after 2020;

2. On servicing needs and essential uses

(b) Quantities of newly produced HCFC-123 and certain HCFCs for blends in the refrigeration and air-conditioning sector may be required in non-Article 5 parties for the period 2020–2030 in certain applications;

(c) After 2030, when the 0.5 per cent servicing tail is no longer available for non-Article 5 parties, it is possible (but not yet clear) that newly produced HCFCs may be needed to service existing equipment that uses HCFC-123 or HCFC blends in very specific critical applications;

(d) In fire protection, volumes of HCFC-123 not exceeding 750 tonnes annually in non-Article 5 parties could be needed; combined with potential amounts required for servicing, this would imply a total consumption of some 900 tonnes annually (approximately 20 ODP-tonnes);

(e) In the foam sector, there is currently no information indicating that HCFC uses could potentially be considered essential after 2020;

(f) Very specific small (as yet unidentified) uses in niche applications in the refrigeration and air-conditioning sector could potentially be essential (satisfying the criteria set out in decision IV/25);

(g) It is possible that certain niche solvent applications, such as aerospace or military applications, might require small quantities of HCFCs (such as HCFC-121, HCFC-122a, HCFC-141b and HCFC-225ca/cb) to service existing equipment;

(h) Essential uses in non-Article 5 parties are likely to be required for laboratory and analytical uses, for research into and development of new substances, and potentially for certain solvent uses. It is estimated that such applications may require HCFCs in the order of tens of tonnes (that is, in the order of 1 ODP tonne) annually;

(i) Sterilant and aerosol uses will almost certainly not require any HCFC production for essential uses in non-Article 5 parties. There are a variety of technically and economically feasible alternatives to the use of HCFCs in sterilization and aerosols, making them unlikely to be justifiable as an essential use in non-Article 5 parties.

20. The report also notes that the Technology and Economic Assessment Panel and its Medical and Chemical Technical Options Committee have become aware of a number of manufacturing processes that currently use HCFCs as solvents in processes that might be considered similar to process agent uses and would potentially be impacted by the 2020 phase-out. Known applications include processes using HCFC-141b and HCFC-225ca/cb as solvents, amounting to a total HCFC use of approximately 100 tonnes. Although alternative processes are under development and expected to

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5 http://conf.montreal-protocol.org/meeting/oewg/oewg-39/presession/Background-Documents/TEAP-Progress-Report-May2017.pdf; and

be completed by 2020, some uncertainties remain. The corrigendum to the report further includes a schedule for the submission of possible essential use nominations for the production or consumption of HCFCs from 1 January 2020 onwards. For an HCFC essential use exemption to be authorized by parties and to take effect in 2020, a corresponding nomination should be submitted by 31 January 2018 or 31 January 2019, so that a decision authorizing such an exemption can be taken in 2018 or 2019, respectively.

21. The Working Group may wish to consider the progress reports of the technical options committees and make appropriate recommendations.

(d) Organizational and other matters

22. The present section contains information on organizational matters related to the Technology and Economic Assessment Panel and other matters arising from the Panel’s progress report. The latter include information and recommendations on the use of controlled substances as process agents, as well as key messages arising from the progress report. Those key messages are reproduced in annex II to the present addendum, as set out in the Panel’s report, without formal editing by the Secretariat.

1. Organizational matters

23. Information on the status of membership of the Technology and Economic Assessment Panel (TEAP) and its technical options committees as at 31 May 2017 is included in annex 3 of the 2017 progress report (volume 1). The terms of reference of the Panel, approved by the parties in decision XXIV/8, specify in paragraph 2.3 that “the Meeting of the Parties shall appoint the members of TEAP for a period of no more than four years. The Meeting of the Parties may re-appoint Members of the Panel upon nomination by the relevant party for additional periods of up to four years each.”

24. With regard to the technical options committees (TOC), paragraph 2.5 of the terms of reference specifies that “[t]he TOC members are appointed by the TOC co-chairs, in consultation with TEAP, for a period of no more than four years. TOC members may be re-appointed following the procedure for nominations for additional periods of up to four years each.” The Panel has clarified that new appointments to a technical options committee start from the date of appointment by the committee’s co-chairs and end on 31 December of the fourth year of appointment.

25. The co-chairs and members whose membership expires at the end of 2017 are listed in table 4.

Table 4
Technology and Economic Assessment Panel and its technical options committees*

Co-chairs and members whose membership expires at the end of 2017

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members of the Technology and Economic Assessment Panel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marta Pizano</td>
<td>TEAP and MBTOC Co-Chair⁴</td>
<td>Colombia</td>
</tr>
<tr>
<td>Marco Gonzalez</td>
<td>TEAP Senior Expert</td>
<td>Costa Rica</td>
</tr>
<tr>
<td>Shiqiu Zhang</td>
<td>TEAP Senior Expert</td>
<td>China</td>
</tr>
<tr>
<td>Sergey Kopylov</td>
<td>HTOC Co-Chair and TEAP member</td>
<td>Russian Federation</td>
</tr>
<tr>
<td>Helen Tope</td>
<td>MCTOC Co-Chair and TEAP member</td>
<td>Australia</td>
</tr>
<tr>
<td>Mohamed Besri</td>
<td>MBTOC Co-Chair and TEAP member</td>
<td>Morocco</td>
</tr>
<tr>
<td>Ian Porter</td>
<td>MBTOC Co-Chair and TEAP member</td>
<td>Australia</td>
</tr>
<tr>
<td>Roberto Peixoto</td>
<td>RTOC Co-Chair and TEAP member</td>
<td>Brazil</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Members of technical options committees</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlos Grandi</td>
<td>HTOC member</td>
<td>Brazil</td>
</tr>
<tr>
<td>Donald Thomson</td>
<td>HTOC member</td>
<td>Canada</td>
</tr>
<tr>
<td>Mitsuru Yagi</td>
<td>HTOC member</td>
<td>Japan</td>
</tr>
<tr>
<td>Jordi Riudavets</td>
<td>MBTOC member</td>
<td>Spain</td>
</tr>
</tbody>
</table>

⁴The five technical options committees are: Flexible and Rigid Foams Technical Options Committee (FTOC), Halons Technical Options Committee (HTOC), Medical and Chemicals Technical Options Committee (MCTOC), Methyl Bromide Technical Options Committee (MBTOC), and Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee (RTOC).

b The expiration of appointment at the end of 2017 refers to Ms. Marta Pizano’s role as MBTOC Co-Chair only.
26. The parties may wish to consider nominating or renominating and appointing or reappointing co-chairs and members, as appropriate. In doing so, the parties may wish to consider the expertise currently needed by the Panel and its technical options committees, as set out in the “matrix of needed expertise” contained in annex 4 to the progress report and as posted on the Ozone Secretariat website.6

2. Continuing challenges

27. The Technology and Economic Assessment Panel addresses in its progress report a number of ongoing challenges it faces in discharging its functions with a view to bringing those challenges to the attention of the parties. Major issues include the identification and involvement of members with appropriate history, experience, technical expertise and time availability; attrition through retirement of members of the technical options committees; and the increased workload and time commitment this has required in recent years, which many members, given the voluntary nature of the work involved, are finding difficult or impossible to manage within the context of a full-time occupation.

28. The Panel suggests that the parties may consider the overall annual workload and support given to its members at the time of making decisions requesting the delivery of reports and information from the Panel.

3. Other matters

(a) Process agent uses

29. In paragraph 5 of decision XXII/8, the parties requested the Panel “to review in 2013, and every second year thereafter, progress made in reducing process agent uses and to make any additional recommendations to parties on further actions to reduce uses and emissions of process agents”. Twenty-five process agent uses were originally listed in table A of decision X/14; currently there are 14 such uses listed in table A of the most recent decision on process agent uses, decision XXIII/7, while associated limits of those uses are listed in table B of that decision.

30. The Panel’s Medical and Chemicals Technical Options Committee reviewed the submissions by parties on authorized process agent uses.8 Those submissions included information on controlled substances used as process agents, the quantities produced or imported for process agent applications, make-up quantities, levels of emissions and containment technologies to minimise emissions for those uses (volume 1, section 5.2.3). Based on the review of the Committee, the parties may wish to consider the following:

(a) Removing the following process agent uses from table A of decision XXIII/7:

(i) 10. Production of chlorinated polypropene;

(ii) 11. Production of chlorinated ethylene vinyl acetate (CEVA);

(iii) 12. Production methyl isocyanate derivatives.

(b) Removing the United States of America from the column of table A of decision XXIII/7 headed “Permitted parties” for process application “4. Production of chlorosulfonated polyolefin (CSM)” as the party has not reported this use for 2014 onwards.

(c) Revising table B of decision XXIII/7 to reduce the quantities of make-up, consumption and maximum emissions levels contained in that table when corresponding data are reported by the relevant parties.

31. Furthermore, the Technical Options Committee recommends that, in order to understand better the remaining eleven process agent applications, parties may wish to consider updating their information on process agent uses in the following:

(a) Current technology;

(b) Technology for reducing emissions;

(c) Actual emissions;

(d) Alternatives available for replacing controlled substances in these processes.

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8 China, European Union, Israel and United States of America.
32. The Committee suggests that such information be provided in time for inclusion in its next report to the parties in early 2018, in response to paragraph 7 of decision XVII/6.9

33. The Working Group may wish to consider the Panel’s progress report on process agents and make appropriate recommendations.

(b) Key messages from the Technology and Economic Assessment Panel

34. Furthermore, volume 1 of the Panel’s progress report highlights a number of other issues for the attention of the parties (see annex II), including updated information on the following matters:

(a) The status of currently used blowing agents in the foam sector, progress made thereon and associated needs (section 2);

(b) The availability of recovered, recycled or reclaimed halons (section 3);

(c) Uses and emissions of methyl bromide, along with concerns raised by the Methyl Bromide Technical Options Committee about the reporting of stocks; the continuing exemptions for certain critical uses; and emissions of methyl bromide from quarantine and preshipment uses (section 4);

(d) Feedstock uses of ozone-depleting substances (section 5.2.5);

(e) n-Propyl bromide, a substance not controlled under the Montreal Protocol (section 5.2.7);

(f) Laboratory and analytical uses of methyl bromide (section 5.2.8.1);

(g) The status of refrigerants and technology in the refrigeration, air conditioning and heat pumps sector (section 6).

Agenda item 6 (b)

Report by the Technology and Economic Assessment Panel on safety standards (decision XXVIII/4)

35. As set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/39/2, paras. 43–46), in decision XXVIII/4 the Twenty-Eighth Meeting of the Parties requested the Technology and Economic Assessment Panel to establish a task force on safety standards, including outside experts as needed, to:

(a) Liaise and coordinate with standards organizations, including the International Electrotechnical Commission (IEC), to support the timely revision of IEC standard 60335-2-40 and ensure that the requirements for the A2, A2L and A3 categories are revised synchronously using a fair, inclusive and scientifically sound approach;

(b) Submit to the Open-ended Working Group at its thirty-ninth meeting a report on safety standards relevant for low-GWP alternatives, including on the following:
   
   (i) Progress in the revision of international safety standards by IEC, the International Organization for Standardization (ISO) and other international standards bodies;

   (ii) Information concerning tests and/or risk assessments and their results relevant to safety standards;

   (iii) Assessment of the implications of international standards for the implementation of the decisions of the Meeting of the Parties to the Montreal Protocol on the accelerated phase-out of HCFCs and HFC control measures, and recommendations to the parties;

   (c) To provide relevant findings to the standards bodies.

36. In addition, in paragraph 4 of the decision, parties were invited to submit to the Ozone Secretariat by the end of 2016 information on their domestic safety standards relevant to the use of low-GWP flammable refrigerants. Submissions were received from the following parties: Andorra, Armenia, Barbados, Brazil, Burkina Faso, Cabo Verde, European Union, Iran (Islamic Republic of), Iraq, Italy, Jamaica, Japan, Malaysia, Maldives, Nigeria, Panama, Serbia, Singapore, United States of America, and United Kingdom.
The submitted information was shared with the Technology and Economic Assessment Panel for consideration in the preparation of the decision XXVIII/4 task force report. All submissions have been compiled in an information document for the thirty-ninth meeting of the Open-ended Working Group (UNEP/OzL.Pro.WG.1/39/INF/4).

37. The executive summary of the decision XXVIII/4 task force report on safety standards for flammable low-GWP refrigerants is set out in annex III to the present addendum to the note by the Secretariat. It is presented as received from the task force, without formal editing by the Secretariat.

38. The report provides a detailed account of key information related to the following matters:
   (a) International safety standards applicable to air conditioning, refrigeration and heat pump systems and equipment;
   (b) General composition and working procedures of the international standards organizations, ISO and IEC;
   (c) Risk assessment and other technical work applicable to standards development;
   (d) Standards development and applicability to the air conditioning, refrigeration and heat pump sector;
   (e) Assessment of the implications of international standards for the implementation of the decisions of the Meeting of the Parties.

39. The task force draws a number of conclusions, noting that current international safety standards impose varying degrees of restriction on the application of certain medium and low-GWP alternatives, depending upon the type of refrigeration system and the location of refrigerant in the equipment. The task force also identifies four broad levels of constraints posed by the various international safety standards to flammable refrigerants:
   (a) The scope of the standard, which may exclude the refrigerant(s) either completely or above a certain quantity;
   (b) The technical requirements, which may prohibit charges above a certain quantity for a given type of system and/or place of installation;
   (c) Requirements prohibiting charges above a certain quantity in relation to a room size;
   (d) Requirements that are sufficiently onerous that equipment costs would be commercially prohibitive.

40. The task force makes a number of recommendations that the parties may wish to consider:
   (a) Funding and support for education and training of technicians handling and using flammable refrigerants;
   (b) Identifying what types of systems, equipment and applications are of national interest and determining whether technical limitations exist due to current safety standards;
   (c) Encouraging and supporting the participation of national experts at the national and international level, providing funding as and where necessary and endeavouring to ensure that such funding is guaranteed on a long-term basis;
   (d) Actively supporting technical and research activities and data gathering to contribute to new or improved requirements that reflect national interests;
   (e) Enabling rapid transfer of international standards for flammable refrigerants into national regulations; this would ensure that revisions of international standards under way would apply to the national standards and regulations of Article 5 parties (where applicable);
   (f) Setting up mechanisms to avoid delays in introducing lower GWP substances; for example, quota credits for early implementation in one sector to balance against another sector where implementation is expected to be slower;
   (g) Establishing ways to disseminate competence on safety standards within national programmes for the education of competent personnel for service and maintenance; currently, the cost of standards and guidelines is prohibitive for technicians and contractors in Article 5 parties.

10 This list of parties supersedes the list referred to in paragraph 46 of the note by the Secretariat (UNEP/OzL.Pro.WG.1/39/2).
41. The Working Group may wish to consider the information set out in the task force report and make appropriate recommendations.

Agenda item 7
Energy efficiency (decision XXVIII/3)

42. As set out in the note by the Secretariat (UNEP/OzL.Pro.WG.1/39/2, paras. 47–50), the Twenty-Eighth Meeting of the Parties invited parties to submit to the Ozone Secretariat by May 2017, on a voluntary basis, information on energy efficiency innovations in the refrigeration, air-conditioning and heat-pump sectors (decision XXVIII/3, para. 2).

43. By the time of preparation of the present note, the Secretariat had received submissions from the following parties: Armenia, Australia, Canada, China, Colombia, Egypt, El Salvador, Estonia, European Union, Ghana, Grenada, Guinea (on behalf of the African Group), Japan, Mexico, Morocco, Paraguay, Rwanda, Switzerland, United States of America and Viet Nam. The submissions have been compiled in an information note (UNEP/OzL.Pro.WG.1/39/INF/5), and have been shared with the Technology and Economic Assessment Panel for its consideration in the preparation of its report to the Twenty-Ninth Meeting of the Parties in November 2017. Any late submissions will also be sent to the Panel for its consideration in the preparation of the report.

44. The Working Group may wish to take into consideration the information included in the submissions received, during the deliberations of the parties on the present agenda item.
Annex I


Executive Summary

1. Mandate

Decision XXVIII/5 of the Twenty Eighth Meeting of the Parties (MOP-28) provided the terms of reference for the work of the Technology and Economic Assessment Panel (TEAP) to prepare a report for submission to the Twenty Ninth Meeting of the Parties, through the Open-ended Working Group at its 39th meeting in 2017, to enable the parties to take a decision on the appropriate level of the replenishment of the Multilateral Fund (MLF) for the triennium 2018-2020.

Soon after MOP-28, TEAP established a Replenishment Task Force (RTF), with members from TEAP and its Technical Options Committees (TOCs). Some members attended the 77th and 78th Executive Committee Meetings (ExCom-77 and -78) in order to take into account any relevant discussions and decisions taken at these meetings that could have potential implications in the preparation of this report. At ExCom-77, the Executive Committee approved in principle the stage II HCFC Phase-out Management Plans (HPMPs) for nine countries and this funding approved in principle was reflected into the “Adjusted business plan of the Multilateral Fund for 2017-2019 after the 77th meeting of the Executive Committee (29 Dec 2016)” (UNEP/OzL.Pro/ExCom/77/76), also referred to as the “Business Plan,” which served as a basis for this report.

Given that paragraph 4 of decision XXVIII/5 also asked the TEAP to consider “the need for additional resources to enable Article 5 parties to carry out initial activities related to the phase-down of HFCs,” the RTF considered it important to attend ExCom-78 which focused specifically on guidelines for funding the phase-down of HFCs. In paragraph 10 and other parts of decision XXVIII/2, parties outline the funding considerations for phasing down HFCs and request “the Executive Committee to develop, within two years of the adoption of the Amendment, guidelines for financing the phase-down of hydrofluorocarbon consumption and production, including cost-effectiveness thresholds, and to present those guidelines to the Meeting of the Parties for the parties’ views and inputs before their finalization by the Executive Committee.” In view of the fact that such funding guidelines to phase-down HFCs are still under discussion, several categories of listed eligible costs have not been considered in this report.

The RTF relied on existing cost guidelines under the MLF where available. The RTF noted the limitation in any estimate provided, where these remained under discussion in the Executive Committee (i.e., cost guidelines for HFC phasedown activities).

2. Total funding requirement 2018-2020 (Chapter 8)

The total funding requirement for the 2018-2020 triennium can be calculated by adding the following components:

- Funding for HCFC consumption phase-out activities which consists of existing commitments from approved in principle stage I and stage II HPMPs and new planned activities for stage II and later stage HPMPs;
- Funding for HCFC production phase-out;
- Funding for non-investment components and supporting activities;
- Funding for HFC phase-down enabling activities; and
- Funding for HFC-23 mitigation activities.

The estimated total funding requirement for the replenishment of the Multilateral Fund for the next triennium 2018-2020 is presented in Table ES-1 below.
The various components for funding are discussed below and the relevant elaborating chapters are indicated.

### 3 HPMP activities 2018-2020 (Chapter 3)

**Table ES-1 Total funding requirement for the replenishment of the MLF 2018-2020 (US$ million)**

<table>
<thead>
<tr>
<th>Total requirement for replenishment of the Multilateral Fund</th>
<th>2018-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPMP</td>
<td>391.91-491.85</td>
</tr>
<tr>
<td>HCFC Production</td>
<td>67.22</td>
</tr>
<tr>
<td>Non-investment and supporting activities</td>
<td>114.08-124.08</td>
</tr>
<tr>
<td>HFC phase-down enabling activities</td>
<td>21.5-44.2</td>
</tr>
<tr>
<td>HFC-23 mitigation</td>
<td>8.0-21.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>602.71-748.85</strong></td>
</tr>
</tbody>
</table>

**Table ES-2 Total funding requirement for HPMPs for the period 2018-2020 (including HPMP verification) taking into account HPMPs stage III mentioned in the business plan (US$ million)**

<table>
<thead>
<tr>
<th>Funding</th>
<th>2018-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-LVCs and LVCs HPMPs and HPMP verification</td>
<td>391.77-420.90</td>
</tr>
<tr>
<td>China HPMP stage III</td>
<td>0.0-70.81</td>
</tr>
<tr>
<td>LVCs HPMP stage III</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Grand total 2018-2020</strong></td>
<td><strong>391.91-491.85</strong></td>
</tr>
</tbody>
</table>

- Funding for HCFC consumption phase-out activities consists of existing commitments from stage I and stage II HPMPs and new planned activities for stage II and later stage HPMPs; it is estimated to be US$ 391.91-491.85 million for the period 2018-2020 (see Table 3-6).

- The total funding requirement for Non-LVCs and LVCs HPMPs and HPMP verification is estimated to be US$ 391.77-420.90 million for the triennium 2018-2020 (see Table 3-6), and is derived as follows:
  - Approved funding including calculation of planned activities for 2018-2020: the funding requirement for non-LVCs and LVCs for the triennium 2018-2020 is estimated at US$ 386.51 (see Table 3-3) and 16.16 million (see Table 3-4), respectively, a total of US$ 402.67 million;
  - Planned activities: Within the above total, US$ 108.89 million has been calculated for planned activities (see Table 3-3, 3-4). However, for the planned activities, there is significant uncertainty in the cost effectiveness of the yet to be approved (final) HPMP funding for non-LVC countries (US$ 97.10 million). Therefore a +/-15% range has been provided, i.e., US$ +/- 14.565 million;
  - Required funding for some countries to achieve the 35% reduction in HCFC consumption by 2020 plus some additional funding: US$ 1.90 million;

- In the business plan, US$ 70.809 million is allocated for the HPMP stage III plan for China in 2020. However, it remains unclear when it will be approved and how the different funding disbursements will then be planned (for which years) since it is likely to be dependent on the progress that will be made with the HPMP Phase II plan for China, which was recently approved in principle at ExCom-77. Accordingly, for the triennium 2018-2020 this report provides a range of US$ 0.0-70.81 million for the funding tranche in 2020 (see Table 3-6).

- The amounts for the HPMPs stage III for two LVC countries (Armenia and Moldova), as presented in the business plan, have been included at US$ 0.14 million (see Table 3-6).
4 HCFC production phase-out funding 2018-2020 (Chapter 4)

- The total amount calculated for China and DPR Korea for production phase-out amounts to US$ 67.22 million (see Table 4-1).
  - Only two countries, China and DPR Korea, are currently eligible to receive funding during the 2018-2020 triennium for production phase-out;
  - China’s progress report on stage I of its HCFC Production Phase-out Management Plan (HPPMP) indicates a reduction in production of at least 5,741 ODP tonnes and an additional reduction of idle capacity, with a total value of US$ 65.62 million for the period of 2018-2020;
  - DPR Korea is committed to phase out approximately 9.66 ODP tonnes of HCFC production by 2020. The funding estimated for this reduction is approximately US$ 1.6 million during the next 2018-2020 triennium.

5 Non-investment and supporting activities 2018-2020 (Chapter 5)

Table ES-3 Total funding requirement for non-investment and supporting activities for the triennium 2018-2020 (in US$ million)

<table>
<thead>
<tr>
<th>Non-investment and supporting activities</th>
<th>2018-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-investment</td>
<td></td>
</tr>
<tr>
<td>Institutional Strengthening (IS)</td>
<td>31.08</td>
</tr>
<tr>
<td>HPMP Preparation</td>
<td></td>
</tr>
<tr>
<td>HPMP stage II PRP costs</td>
<td>4.35</td>
</tr>
<tr>
<td>HPMP stage III PRP costs</td>
<td>4.35</td>
</tr>
<tr>
<td>HCFC Demonstration Projects</td>
<td>0.0-10.0</td>
</tr>
<tr>
<td>Subtotal non-investment activities</td>
<td>39.78-49.78</td>
</tr>
<tr>
<td>Supporting activities</td>
<td></td>
</tr>
<tr>
<td>UNEP CAP</td>
<td>34.80</td>
</tr>
<tr>
<td>Agency Core Unit costs</td>
<td>17.84</td>
</tr>
<tr>
<td>Secretariat and ExCom</td>
<td>20.16</td>
</tr>
<tr>
<td>Treasurer</td>
<td>1.50</td>
</tr>
<tr>
<td>Subtotal supporting activities</td>
<td>74.30</td>
</tr>
<tr>
<td>Total for non-investment and supporting activities</td>
<td>114.08-124.08</td>
</tr>
</tbody>
</table>

- The total estimated funding requirement for non-investment activities and supporting activities for 2018-2020 is estimated to be US$ 114.08-124.08 million;
- The adjusted Business Plan served as a basis for this report, noting that this plan was prepared by the MLF Secretariat based on information from the Implementing Agencies prior to the MOP-28 and was restricted to HCFCs;
- The total for non-investment activities for the triennium 2018-2020 is estimated to be US$ 39.78-49.78 million for 2018-2020 based on the following:
  - Institutional Strengthening (IS), IA core unit budget, CAP and Secretariat support figures have been calculated taking into consideration current ExCom decisions;
  - The report does not address any potential funding under these headings regarding new tasks related to the HFC phase-down;
  - IS funding is calculated on the basis of amounts already indicated in the business plan for the years 2018, 2019 and 2020;
  - HPMP preparation costs have been assumed to be similar to previous HPMP preparation costs, estimated at US$ 8.7 million for 2018-2020;
  - To calculate costs for non-investment activities, two opposite assumptions can be made: either (i) by 2017-2018, no further demonstration projects on the feasibility of specific low GWP options will be agreed; or, (ii) in the triennium 2018-2020 a similar amount of funding compared to past triennia will be needed for the demonstration
project window (about US$ 10 million). Therefore, a range of US$ 0-10 million is provided.

- Supporting activities (UNEP CAP, Core Unit, Secretariat and ExCom costs, Treasurer) have been determined on the basis of the previous funding agreements at US$ 74.30 million.

6 HFC phase-down enabling activities 2018-2020 (Chapter 6)

Table ES-4 Funding for HFC enabling activities (US$ million)

<table>
<thead>
<tr>
<th>HFC phase-down enabling activities</th>
<th>2018-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-investment projects (including project preparation and demonstration projects)</td>
<td>13.5-20.2</td>
</tr>
<tr>
<td>Investment projects</td>
<td>8.0-24.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21.5-44.2</strong></td>
</tr>
</tbody>
</table>

- The categories for enabling activities are as defined in paragraphs 10 of decision XXVIII/2 as capacity-building and training, institutional strengthening, Article 4B licensing, reporting, demonstration projects and development of national strategies;

- The HFC phase-down funding guidelines are still being discussed and developed by the Executive Committee, so the Task Force primarily used historical funding of the above activities related to stage I HPMPs as a basis for estimating the funding for HFCs for 2018-2020;

- Non-investment, enabling activities including project preparation and demonstration activities are estimated in the range of US$ 13.5-20.2 million;

- Investment projects have included conversion projects to low-GWP alternatives that were previously identified in the June 2014 TEAP Replenishment Task Force Report on the funding requirement for the MLF replenishment for 2015-2017; these previously identified conversion projects are estimated in the range of US$ 8-24 million;

- Combining these two categories provides a total requirement for the 2018-2020 triennium in the range of US$ 21.5-44.2 million;

- In the absence of new guidelines and methodologies on cost calculations for financing the phase-down of HFCs, at this time the Task Force did not consider funding for investment projects for subsequent triennia after the 2018-2020 triennium.

7 HFC-23 mitigation activities 2018-2020 (Chapter 7)

Table ES-5 Funding for HFC-23 mitigation activities for 2018-2020 (US$ million)

<table>
<thead>
<tr>
<th>HFC-23 mitigation</th>
<th>2018-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabling activities before 2020</td>
<td>0.8</td>
</tr>
<tr>
<td>Capital and operating costs (year 2020 only)</td>
<td>7.2-20.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8.0-21.5</strong></td>
</tr>
</tbody>
</table>

- Funding to enable compliance to obligations related to HFC-23 mitigation under the Kigali Amendment are assumed to start from the year 2020 onwards;

- Funding for the year 2020 falls in the 2018-2020 triennium;

- Many HCFC-22 production plants in Article 5 countries have incineration facilities that were either established since 2004 under the Clean Development Mechanism, or were constructed in recent years as a result of national subsidy or regulation programs;

- The total funding requirement for HFC-23 mitigation is estimated to be in the range of US$ 8.0-21.5 million for the 2018-2020 triennium based on the following:
  - The capital costs (per year) for several HCFC-22 production plants and a best estimate for the range of operational cost per kg of HFC-23 mitigated. The operational cost per kg for HFC-23 is substantial, but considerably less than many values published so far; here it is assumed at US$ 0.5-1.5 per kg of HFC-23 mitigated;
  - Enabling costs to prepare for full operation in 2020 have been estimated at US$ 0.8 million, in case certain facilities that were built but have not been active in recent years.
Projected funding estimates for the 2021-2023 and 2024-2026 triennia (chapter 9)

Table ES-6 Indicative funding requirements for the following two triennia 2021-2023 and 2024-2026 (US$ million)

<table>
<thead>
<tr>
<th>Funding requirement</th>
<th>2021-2023</th>
<th>2024-2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-LVCs HPMPs, agreed</td>
<td>148.0</td>
<td>82.2</td>
</tr>
<tr>
<td>Non-LVCs, HCFC phase-out activities planned after 2020</td>
<td>250.7-338.5</td>
<td>250.7-338.5</td>
</tr>
<tr>
<td>LVCs, HPMPs agreed</td>
<td>0.65</td>
<td>0.74</td>
</tr>
<tr>
<td>LVCs, HCFC phase-out activities planned after 2020</td>
<td>30.0</td>
<td>10.0-20.0</td>
</tr>
<tr>
<td>HCFC production phase-out (China)</td>
<td>65.6</td>
<td>65.6</td>
</tr>
<tr>
<td>Non-investment and supporting activities funding (including HPMP and HFC project preparation activities)</td>
<td>117.3-125.2</td>
<td>116.6-125.3</td>
</tr>
<tr>
<td>Demonstration projects (for HFC phase-down)*</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Investment projects for HFC phase-down*</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>HFC-23 mitigation**</td>
<td>21.6-62.1</td>
<td>21.6-62.1</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>634.8-771.0</td>
<td>548.5-695.5</td>
</tr>
</tbody>
</table>

* The amount for HFC phase-down activities for the two triennia has been filled in as “TBD”, in the absence of guidance for HFC phase-down projects.

** This assumes that the HFC-23 mitigation funding (as determined for 2020, minus the enabling activities) would continue during each year after 2020.

- For the triennium 2021-2023, funding in the range US$ 634.8-771.0 million has been estimated, with US$ 548.5-695.5 million estimated for the triennium 2024-2026. These estimates are largely based on known HCFC phase-down commitments;

- Estimated costs for planned HCFC funding is related to the amount of HCFCs that has not been addressed in agreed and planned activities through 2020. For this item the amounts of HCFCs not addressed through 2020 were considered, subtracting the amounts covered in multinational activities, while applying the current cost effectiveness factors from planned activities 2018-2020 (with their uncertainties);

- For non-investment activities a number of items could not be assessed (such as project preparation); IS funding was estimated as a range, varying from the current (2017-2020) funding level to a level that could be decided in 2020 by the Executive Committee (following decision 78/6);

- These projections do not include the funding requirements for HFC phase-down projects, since the guidance on costing is not yet available. These estimates can be updated in future when the appropriate guidance will be available. This will likely add a substantial amount to the estimated costs for the two future triennia;
Annex II

Technology and Economic Assessment Panel May 2017 Progress Report (Volume 1)

1.1. Key TEAP messages

TEAP presents the main findings contained in each of the TOC progress reports below.

1.1.1. Flexible and Rigid Foams Technical Options Committee (FTOC)

In non-A5 parties, fluorinated gas regulations now indicate precise dates for the phase-out of certain high global warming potential (GWP) hydrofluorocarbons (HFCs) in foam manufacture.

Article 5 parties face common challenges in phasing out remaining HCFCs while phasing down high-GWP HFC blowing agents.

High-GWP HFCs and hydrofluoro-olefins/hydrochlorofluoro-olefins (HFOs/HCFOs) are currently around 3 times as expensive as HCFCs. HFO/HCFO blown foams remain more expensive than high-GWP HFC foams due to the pricing of the blowing agent and required additives.

Decisions on transition may be delayed because the final formulations to optimize performance and cost are still not clear for all applications and geographies, and because of the currently limited availability of some low-GWP blowing agents in some regions.

Effective transitions will require continued communication between regulators, producers and users to facilitate capacity planning.

1.1.2. Halons Technical Options Committee (HTOC)

The decision XXVI/7 Availability of recovered, recycled or reclaimed halons working group conclusion remains that it is nearly indisputable that the world’s supply of halon 1301 will be exhausted well before civil aviation completes the transition to an alternative. Also given the lack of further progress by civil aviation to implement alternatives in the remaining halon 1301 applications, it becomes imperative to quantify more accurately the rate of increase of installed amounts and the resulting emissions from civil aviation.

While the decision XXVI/7 working group estimated this shortage to be in the 2035 timeframe, there are many unknowns that could change this date significantly, such as the rate of implementation of alternatives, the increase of installed amounts of halon as the global aircraft fleet increases, and the emissions from civil aviation.

Therefore, the parties may wish to consider continuing their efforts to work with the International Civil Aviation Organization (ICAO), and to request ICAO form a working group or similar body in conjunction with the HTOC to better estimate current and future civil aviation installed base and emissions and report back at the 31st Meeting of the Parties.

At the ICAO 39th Assembly in October 2016, Resolution 39-13 was approved that sets a date for the replacement of halons in the cargo compartments of newly designed aircraft in the 2024 timeframe. Owing to a delay in the commercialisation of 2-bromo-3,3,3-trifluoropropene (2-BTP) as an agent for use in hand-held extinguishers, an amendment was approved to Annex 6 of the Chicago Convention delaying the requirement for halon replacement in hand-held extinguishers on new production aircraft until 31 December 2018.

A low-GWP chemical being commercialised for solvent, foam-blowing and refrigerant applications, HCF0-1233zd(E), was submitted by the manufacturer and has received US Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) program listing as acceptable for fire protection in total flooding applications in 2016. However, the manufacturer has subsequently decided not to proceed further with its listing as a total flooding agent in the International Organization for Standardisation (ISO) and the National Fire Protection Association standards, which would have been required prior to its use in this application in countries (e.g., Australia, EU, South Africa, US, etc.) that adopt such standards.
1.1.3. **Methyl Bromide Technical Options Committee (MBTOC)**

Article 7 data indicate that 99% of controlled uses have been phased out, and Critical Use Nomination (CUN) amounts of MB requested in 2017 have decreased to about 300 tonnes. However, MBTOC has identified a discrepancy of around 15,000 tonnes between top-down and bottom-up comparisons of emissions and production/consumption. Parties may wish to consider investigating this apparent discrepancy.

Some parties have expressed concerns over difficulties in interpreting the categories of MB uses between controlled and exempt uses. Parties may wish to consider requesting MBTOC to provide clear examples of the allocation of MB between controlled and exempt uses under the provisions of the Montreal Protocol. Subsequently parties may wish to consider providing assistance.

MBTOC is concerned that the official reporting of stocks under the present decisions is only a requirement for those parties that submit CUNs and thus an unknown amount of stocks may be held and/or used by parties who do not submit a CUN. MBTOC is further concerned that the continuous granting of exemptions over many years for strawberry runners may, in and of itself, become a potential barrier for the adoption of technically and economically feasible alternatives.

Nearly all the MB used for quarantine and pre-shipment (QPS) is emitted to the atmosphere as recapture systems are either impractical or not being used. This is offsetting the benefit gained by the phasing out of controlled uses. Parties may wish to consider controlling the use of MB for those uses of QPS for which proven alternatives are available.

1.1.4. **Medical and Chemical Technical Options Committee (MCTOC)**

The global transition away from chlorofluorocarbon (CFC) metered dose inhalers (MDIs) is almost completed.

Based on the information reported by parties on the use of controlled substances under exemptions as process agents, parties may wish to consider changes to Tables A and B of decision XXII/7, and that additional information be provided by parties.

In 2015, total production of ODS for feedstock uses was 1,084,101 tonnes, representing a total of 375,488 ODP tonnes. The range of ODS emissions from feedstock uses is estimated as 5,421 to 21,682 tonnes, or 1,877 to 7,510 ODP tonnes for 2015.

Parties may wish to consider providing MCTOC with production data for n-propyl bromide in order that global production quantities could be collated and reported.

There is a wide range of alternatives available for methyl bromide when used as a methylating agent, and an insignificant volume of methyl bromide used in this and other laboratory and analytical applications. TEAP plans to report further on this topic if and when parties make available new and different information.

Parties may wish to consider nominating experts to MCTOC, in particular for destruction technologies and laboratory and analytical uses. In addition, parties may wish to consider providing any relevant new information on destruction technologies.

1.1.5. **Refrigeration, Air Conditioning and Heat Pumps technical Options Committee (RTOC)**

Research and development to improve the performance of refrigeration and air conditioning (RAC) equipment containing low-GWP and zero-ozone depletion potential (ODP) refrigerants continues to make strong progress.

The charge limit of flammable refrigerants in the US has increased from 57 to 150 g. Use of HC-600a for new domestic appliances continues to grow.

Transcritical carbon dioxide (CO$_2$) systems using technical improvements such as ejector, sub-cooling and parallel compression have started to be installed in supermarkets to increase energy efficiency.

The production of HFC-32 air-to-air conditioners continues in Japan, Southeast Asia and Australia and is beginning in Europe. In India, production of HC-290 split air conditioners continues, and in China production lines are being converted to HC-290.

HFO-1234yf has been identified as main HFC-134a replacement for mobile air conditioning systems. R-744 is also an alternative, which is under evaluation for heat pumps on pure electric vehicles.

Considering not-in-kind (NIK) technologies, units using magnetocaloric refrigeration are in beta testing at three sites.
Annex III

Report by the Technology and Economic Assessment Panel on safety standards relevant to low-GWP alternatives (decision XXVIII/4)

Executive summary

ES.1 Introduction

In response to decision XXVIII/4, this report provides the following information from TEAP:

- The progress in the revision of International safety standards relevant for flammable low-GWP alternatives by the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO) and other International Standards bodies.
- Information on risk assessments and their relevance to safety standards.
- The implications of International Standards for the implementation of the decisions of the Meeting of the Parties to the Montreal Protocol on the accelerated phase-out of HCFCs and HFC control measures, and gives recommendations to the parties.

In Sections ES2, ES3, ES4, ES5 and ES6, highlights and technical summaries of the report’s five main chapters are provided. Section E7 includes the concluding remarks and the recommendations to parties.

ES.2 International Standards for R/AC&HP equipment (Chapter 2)

- There are four different types of safety standards: basic safety standards, group safety standards, product safety standards, and standards containing safety aspects.
- Within the R/AC&HP sector, there are currently nine main safety standards that cover whole systems, appliances, and products. Five are product safety standards and four are group safety standards.
- If a product safety standard is available for the specific product or equipment of interest, then it should be used in preference to a group safety standard. However, unless national legislation mandates a particular product safety standard, then the choice is voluntary.
- International safety standards do not override national legislation, however, safety standards are commonly referenced or copied into national legislation.
- Whilst the standards discussed are International Standards, these are seldom used directly. Most countries will adopt a standard nationally or regionally. For national adoption, many countries will include national modifications or deviations. In some instances national legislation may conflict with the text within the International Standard.
- The standards discussed in this chapter do not cover all aspects of the lifecycle. For example, the competences of the service technicians are especially important for the safety throughout the life cycle. To address the full lifecycle, the use of safety standards needs to be supplemented with a risk assessment.
- Standards are often expensive, complex and not available in the local language, and therefore cannot serve as a direct source of knowledge for technicians and contractors.
- Compliance with safety standards plays an important role when substantiating that the safety of a system is according to recognized good practice. This is important for companies for managing the legal risk associated with selling systems or services associated with systems.
- Since many enterprises operate internationally, there is a preference for the requirements of a standard to be universal, with national variations kept to the minimum.
ES.3 General composition and working procedures of International Standards (Chapter 3)

Important considerations on how and why ISO and IEC standard procedures are effective, however, also encounter limitations, include:

- Issues related to the global relevance of the International Standards.
- The working procedures and the formal stages for international standard developments.
- Opportunities for stakeholders to participate in the different standardization committees and working groups.
- Expert standardization work is time-consuming and expensive and often limited to large market participants, since sophisticated engineering knowledge and safety statistics are required.
- In some parties, expert participation in standardization committees is limited and/or expensive.

ES.4 Risk assessments and other technical work applicable to standards development (Chapter 4)

- The development of safety standards should be based on systematic consideration of refrigerant releases resulting in hazards, use and application characteristics of the R/AC&HP equipment, and the implications of the measures so as to minimise the likelihood of detrimental consequences to persons and property.
- ISO and IEC publish guidelines on how safety hazards should be handled when developing standards and a large part of this is through risk assessment approaches. When developing safety standards, the relevant literature can help to shape the requirements.
- When assessing the flammability aspects of refrigerants, the general areas of interest are: flammability characteristics, release/leakage characteristics, dispersion behaviour of leaked refrigerant, potential sources of ignition, consequences of ignition including formation of decomposition products and risk mitigation systems/functions, as well as the combination of these within overall risk assessment.
- The published literature these areas is fairly extensive and is increasing as interest in flammable alternative refrigerants grows. In addition to the material specifically related to R/AC&HP, there is a large body of literature related to general flammability risk of hydrocarbons.
- Many of the topics in the published literature are being taken into account in the development of amendments and revisions of the applicable standards.
- However, the value of technical literature can be limited by the subjective opinions of the participants involved in standards development which play a role in achieving consensus. Nevertheless, the evolution of understanding of the technical concepts related to flammability in R/AC&HP equipment should be reflected by improvements in the proposed requirements.
- Whilst the consequences of ignition of higher flammability substances such as hydrocarbons have been widely studied for many decades, work on fluorinated substances classed as A2L is in its infancy. As new research is carried out, understanding of their behaviour is evolving rapidly.
- Whilst small-scale experiments have previously shown that the severity of certain primary consequences of ignition is strongly dependent upon the relatively low laminar flame speed, some large/full scale experiments have yielded “unexpected” behaviour such as rapid pressure build-up and turbulent burning, which are indistinguishable over a range of laminar flame speeds. Accordingly it may be necessary to carry out more thorough investigations into unanticipated consequences. There are now several research projects planned which address some of these topics.
ES.5 Standards development and applicability to R/AC&HP sector (Chapter 5)

Chapter 5 describes the representation of countries in the committees responsible for R/AC&HP standards, as well as liaison and working groups (WG). A progress summary of the activities under the various standards is provided, where it concerns developments applicable to alternative refrigerants.

- At ISO and IEC level, there are at least five technical subcommittees responsible for the relevant safety standards, with working groups who are developing the major amendments and/or revisions of the safety standards that are concerned with alternative refrigerants.

- IEC SC61C is responsible for IEC 60335-2-24 (domestic refrigeration) and IEC 60335-2-89 (commercial refrigeration appliances). WG4 is developing an amendment to IEC 60335-2-89 to increase the charge limits for flammable refrigerants; it has 30 members from 16 parties (three are from Article 5 parties).

- IEC SC61D is responsible for IEC 60035-2-40 (air conditioners and heat pumps). WG9 is developing an amendment for extended applicability of A2L refrigerants; it has 32 members from 13 countries (two are from Article 5 parties). WG16 is developing an amendment for increasing allowable charge (relative to room size) for A2 and A3 refrigerants; it has 27 members from 12 countries (three are from Article 5 parties).

- ISO TC86 SC1 is responsible for ISO 5149 (the horizontal standard for all R/AC&HP systems). WG1 is working on a revision, which is hoped to include improvements for all flammable refrigerants; it has 52 members from 12 countries (one is from an Article 5 party). One non-industry NGO is joining with 4 experts.

- ISO TC22 SC34 is responsible for ISO 13043, but does not have any activities related to revising the standard (although it only addresses one flammable low GWP refrigerant, HFO-1234yf, and one other low GWP, R-744).

- ISO TC104 SC2 is responsible for ISO CD 20854, a new safety standard for reefer container using flammable refrigerants, describing requirements for design and operation.

- The projected publication dates for these amendments and standards is uncertain due to the nature of the process, but depending upon the WG, changes are expected between 2018 and 2030 for the horizontal standards and between 2018 and 2025 for product standards.

- Irrespective of the tasks of the WGs, most of these standards are subject to continuous improvements through regular (at least annual) amendments, albeit at a smaller scale.

- Relatively few stakeholders participate in the process for R/AC&HP safety standards, and an even smaller number effectively dominate the SC (Subcommittee) and WG activities. This is because of the way the standards development rules have evolved, as well as the onerous investment costs and resources needed for active participation.

- However, there are several options for interested parties to actively participate in relevant national committees and SCs, ranging from commenting on proposals and voting positions, participating in SC meetings, contributing to WGs, carrying out background technical work, etc. However, in some parties, membership of national committees can also be prohibitively costly or can be restricted and thus active participation in standard development may effectively be closed to some stakeholders.

ES.6 Assessment of the implications of International Standards for the implementation of MOP decisions (Chapter 6)

Chapter 6 presents an assessment of the implications of the International Standards for the implementation of the decisions of the meeting of the parties to the Montreal Protocol on the accelerated phase-out of HCFCs and HFC phase-down control measures.

- For non-Article 5 parties in relation to decision XXVIII/1, the first 10% reduction by 2019 may be largely achieved by a reduction of controlled substance consumption combined with a conversion in non-R/AC&HP sectors, implying that little change in the selection of refrigerant types is needed in the short term. The usual process is that National Standards and regulations map onto the International Standards. However, a small number of countries have more
stringent regulations than the international safety standards for flammable refrigerants. Such regulations may inhibit the local implementation of certain lower GWP alternatives.

- Accelerated revision of National Standards (and regulations) will facilitate the use of lower GWP refrigerants and assist non-Article 5 and Article 5 parties in achieving the agreed freeze and phase-down steps under decision XXVIII/1.

- Given the typical 5-year lead time for product development, in the case of non-Article 5 parties in relation to issues under decision XXVIII/1, international safety standards to be published in 2019-2020 will play an important role in the development of national regulations which should be applicable by 2024.

- Attention should be paid to the prescribed reduction percentages as these should be added to the market growth (in %, expressed in CO2-eq.) as of the freeze year, yielding the total reduction required in a control step year. On the other hand, actions including reuse, recovery and destruction are likely to have a positive impact on achieving the reduction percentage targets. These aspects are linked to the feasibility of achieving the required reductions in the different sectors within the context of the refrigerant choice and its safe application in the revised International Standards and national regulations.

- For Article 5 parties and the future reduction steps under decision XXVIII/1, it is difficult to predict the aggregated HFC consumption levels during the period 2019-2024, with the accelerating technical developments in the different sectors (such as foam blowing, fire protection, technical aerosols and R/AC&HP). National regulations applicable by 2029 will have resulted from International Standards developed by 2024, with the possibility of several revisions of the current international safety standards.

- Article 5 parties with not yet converted R/AC&HP equipment manufacturing activities may be required to switch to HFC alternatives to comply with decision XIX/6. Currently, only HFC-32, HC-290 and possibly some of the new low and medium GWP A2L HFC/HFO blends are available options. Some Article 5 parties may find HFC-32 and the A2L HFC/HFO blends to be interim options since resulting GWP based consumption levels may affect their future compliance with decision XXVIII/1. HFC-32, the HFC/HFO blends and HC-290 are all flammable to a certain degree, where current standards limit their application in larger than e.g. 5 kW room AC and multi split systems. Handling flammable refrigerants in Article 5 countries also requires significant quality improvement for manufacture, installation, service and end-of-life. Currently there are some gaps in addressing these aspects in the International Standards, particularly for the installation, service and end-of-life.

- A number of AC applications have a risk assessment combined with additional mitigation to allow the refrigerant charges needed. Work is ongoing in the standardisation organisations to allow the refrigerant charges needed provided a series of forms of mitigation are implemented. The timing of these updates and especially the speed of acceptance of these updates in national legislations will affect which technologies will be available to replace high-GWP refrigerants.

- A challenging question is when revisions of International Standards, which are currently underway (that will apply to the 40% reduction to be achieved in 2024 for non-Article 5 parties), will then have been transferred to Article 5 parties’ National Standards and regulations. This would enable flexibility in the refrigerant choice for these parties with early selection of low GWP alternatives that could contribute to a lower CO2-eq. total consumption and to a lower freeze level.

ES.7 Concluding remarks and recommendations to parties

- The current international safety standards impose varying degrees of restriction on the application of certain medium and low-GWP alternatives, depending upon the type of refrigeration system and the location of refrigerant in the equipment. Whilst it is “technically feasible” to use almost all class A flammable refrigerants in all applications, the critical issue is whether or not a given alternative can be used in a safe and cost-effective way using state-of-the-art system architectures.

- Broadly, there are four levels of constraints that the various international safety standards pose to flammable refrigerants: (i) the scope of the standard excludes the refrigerant(s) totally, or above a certain quantity; (ii) the technical requirements prohibit charges above a certain (absolute) quantity for a given type of system and/or place of installation; (iii) the requirements
prohibit charges above a certain quantity in relation to a room size; and (iv) the requirements are sufficiently onerous that equipment costs would be commercially prohibitive. The severity of each level of constraint varies according to refrigerant, type of application and location of refrigerant in the equipment.

- Generally, the most critical situations concerning restrictions are:
  - A2 and A2L refrigerants in domestic refrigeration,
  - all flammable refrigerants in commercial refrigeration appliances,
  - A2 and A3 refrigerants in commercial refrigeration systems,
  - A2 and A3 refrigerants in small air conditioning and heat pump appliances and systems,
  - all flammable refrigerants in large air conditioning appliances, and
  - all flammable refrigerants (except HFO-1234yf) in MAC systems.

Parties may wish to consider:

- Funding and support for education and training of technicians handling and using flammable refrigerants
- Identifying what types of systems/equipment/applications are of national interest and determine whether technical limitations exist due to current safety standards.
- Encouraging and supporting national experts’ participation at national and international level. Provide funding as and where necessary and try to ensure such funding is guaranteed on a long-term basis (recognising that effective interventions in the standards development process normally take many years).
- Actively supporting technical and research activities, data gathering, etc. to help contribute to new and/or improved requirements that reflect the national interests.
- Enabling rapid transfer of International-Standards for flammable refrigerants into national regulations. This would ensure that revisions of International Standards underway will apply to Article 5 parties’ National Standards and regulations (where applicable). In this way the flexibility in the refrigerant choice for these parties could be improved, and this may then contribute to lower CO2-eq. HFC consumption and to a lower (future) freeze level.
- Setting up mechanisms to avoid delays in introducing lower GWP substances e.g., quota credits for early implementation in one sector to balance against another sector where implementation is expected to be slower.
- Establishing ways to disseminate competence on safety standards within their programs for the education of competent personnel for service and maintenance. Currently the cost of standards and guidelines is prohibitive for technicians and contractors in Article 5 parties.