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Thirtieth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer
Quito, 5–9 November 2018

Issues for discussion by and information for the attention of the Thirtieth 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 Thirtieth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer (UNEP/OzL.Pro.30/2) largely contains information that has become available since the preparation of that note. The additional information is set out in section II of the addendum, which includes brief summaries of the issues addressed by the Technology and Economic Assessment Panel in its September 2018 report. It also includes information on the nomination of experts to the Panel submitted by parties to date.

2. The September 2018 report of the Technology and Economic Assessment Panel consists of the following five volumes:[1]

(a) Volume 1: Decision XXIX/4 Task Force Report on Destruction Technologies for Controlled Substances (addendum to the May 2018 supplemental report);

(b) Volume 2: Decision XXIX/8 on the Future Availability of Halons and Their Alternatives;

(c) Volume 3: Evaluation of 2018 Critical-Use Nominations for Methyl Bromide (final report);

(d) Volume 4: Response to Decision XXVI/5 (2) on Laboratory and Analytical Uses;

(e) Volume 5: Decision XXIX/10 Task Force Report on Issues Related to Energy Efficiency While Phasing Down Hydrofluorocarbons (updated final report).

* UNEP/OzL.Pro.30/1.

[1] Available on the Ozone Secretariat meeting portal at http://conf.montreal-protocol.org/meeting/mop/mop30/presession/SitePages/Home.aspx.

II. Overview of items on the agenda for the Thirtieth Meeting of the Parties to the Montreal Protocol

A. Kigali Amendment to the Montreal Protocol to phase down hydrofluorocarbons (item 4 of the provisional agenda for the preparatory segment)

(b) Destruction technologies for controlled substances (decision XXIX/4) (item 4 (b) of the provisional agenda for the preparatory segment)

3. As is mentioned in the note by the Secretariat (paras. 22–24), at its fortieth meeting the Open-ended Working Group of the Parties to the Montreal Protocol considered the report of the Technology and Economic Assessment Panel on destruction technologies for controlled substances requested by parties in decision XXIX/4. The report had been prepared by the Panel's task force on destruction technologies and was set out in two documents, a main report[2] and a supplemental report.[3] In accordance with the decision, the reports provided an assessment of the destruction technologies as specified in the annex to decision XXIII/12 with a view to confirming their applicability to hydrofluorocarbons (HFCs); and a review of any other technology for possible inclusion in the list of approved destruction technologies in relation to controlled substances. In addition, the reports had taken into account relevant information submitted by the parties.

4. Upon consideration of the Panel's reports by the parties, the task force agreed to provide additional information on the matter at the Thirtieth Meeting of the Parties, including on carbon dioxide (CO_2) emissions associated with the energy consumption of destruction technologies. In that regard, the task force prepared an addendum to its May 2018 supplemental report, a revised version of which is available on the meeting portal for the Thirtieth Meeting of the Parties.[4]

5. In its revised addendum report, the task force takes into account additional information submitted by five parties – Australia, Colombia, the European Union, Japan and the United States of America – and elaborates on the assessment of destruction technologies for which such information was provided, keeping the same assessment criteria as used in the previous reports. It also indicates the technologies for which data have been available to enable the assessment and those for which data are still missing.

6. On the basis of its review, the task force recommends for approval an additional technology for the destruction of HFC-23 (liquid injection incineration), which had previously been classified as "High potential".

7. In addressing CO_2 emissions associated with the energy consumption of destruction technologies, the task force considered the argon plasma arc technology, which is known to require significant energy consumption during operation. The aim was to determine whether the benefit of destroying HFCs outweighs the CO_2 emitted from the energy source required to operate such facilities. The evaluation has shown that despite the energy intensiveness of the argon plasma arc processes, destruction using this technology is still found to result in a significant greenhouse gas benefit.

8. The updated summary table of the task force's recommendations is presented in chapter 4 of the revised addendum to the May 2018 supplemental report and the associated findings of the assessment are summarized in appendix 1 to that report. The updated summary table and the assessment are reproduced in annexes I and II to the present addendum, respectively, without formal editing by the Secretariat.

9. The parties may wish to continue their discussions based on the updated information and make appropriate recommendations on the way forward, including a draft decision for consideration and possible adoption at the high-level segment.

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[2] http://conf.montreal-protocol.org/meeting/mop/mop30/presession/Background-Documents/TEAP-DecXXIX4-TF-Report-April2018.pdf and annex: submissions by parties in response to decision XXIX/4 on destruction technologies.

[3] http://conf.montreal-protocol.org/meeting/mop/mop30/presession/Background-Documents/TEAP-DecXXIX4-TF-Supplemental-Report-May2018.pdf and its corrigendum.

[4] Technology and Economic Assessment Panel, Sept. 2018, vol. 1: Decision XXIX/4 Task Force Report on Destruction Technologies for Controlled Substances (addendum to the May 2018 supplemental report – revision).

B. Future availability of halons and their alternatives (decision XXIX/8) (item 5 of the provisional agenda for the preparatory segment)

10. By decision XXIX/8, adopted by the Twenty-Ninth Meeting of the Parties in 2017, the Technology and Economic Assessment Panel was requested to explore the possibility of forming a joint working group with the International Civil Aviation Organization (ICAO) to develop and thereafter carry out a study to determine the current and projected future quantities of halons installed in civil aviation fire protection systems, the associated uses and releases of halons from those systems and any potential courses of action that civil aviation could take to reduce those uses and releases. The Panel was also requested to submit a report on the work of the joint working group, if established, before the Thirtieth Meeting of the Parties and the fortieth session of the Assembly of ICAO for consideration and potential future action.

11. Following its report at the fortieth meeting of the Open-ended Working Group on the progress of work on this matter (UNEP/OzL.Pro.30/2, paras. 34–37), the Panel's Halons Technical Options Committee submitted the requested report, which is available on the meeting portal for the Thirtieth Meeting of the Parties.[5] The information provided in the report is summarized in the following paragraphs:

(a) The aim of the informal working group, established under ICAO following a planning meeting in March 2018, is to respond to all the issues described in decision XXIX/8. The group includes representatives from commercial industry, civil aviation non-governmental organizations, the ICAO secretariat, the Halons Technical Options Committee and the Technology and Economic Assessment Panel;

(b) In order to obtain a more accurate calculation of the annual amount of halon 1301, the informal working group prepared a survey that was sent out by ICAO in June 2018 to all States with civil aviation halon 1301 service providers. ICAO is currently contacting individual companies to clarify the information provided or to obtain information from service provider companies that have not yet reported, in an attempt to obtain additional and more complete responses to the survey;

(c) On the basis of estimates of the worldwide supply and demand of halon 1301, eight scenarios have been modelled to estimate the availability of halon 1301 resources needed to service the existing aviation fleet, account for aviation growth through 2050, and service existing non-aviation applications such as oil and gas facilities, nuclear facilities, military applications (installed base and reserves) and marine (non-military) applications. Each scenario assumes various annual emission rates from all halon 1301 aviation applications (ranging from 2.3 to 15 per cent) and varying emission rates (between 0.1 and 5 per cent) for non-aviation sources;

(d) Results from this analysis show that the estimated available halon 1301 supply for replacing the amounts emitted from most of the existing fire protection systems in aviation and non-aviation applications as well as for new aviation demand is projected to run out by the years 2032 to 2054, depending on the initial total worldwide supply in 2018 and actual annual emission rates;

(e) The model used shows the importance of the effect of the civil aviation emission rate. In all eight scenarios, the high emission rate of 15 per cent lowers the run-out date significantly, falling between 2032 and 2035. The informal working group will continue its efforts to collect more accurate emissions data and, if the emission rate is proved to be high, will consider measures for reducing it.

12. The parties may wish to consider this information during their discussions under this agenda item at the preparatory segment and recommend a way forward as appropriate.

C. Issues related to exemptions under Articles 2A–2I of the Montreal Protocol (item 6 of the provisional agenda for the preparatory segment):

(a) Nominations for critical-use exemptions for methyl bromide for 2019 and 2020 (item 6 (a) of the provisional agenda for the preparatory segment)

13. As is mentioned in the note by the Secretariat (paras. 38–40), in 2018 two parties operating under paragraph 1 of Article 5 (Article 5 parties), Argentina and South Africa, submitted two nominations each for critical-use exemptions for methyl bromide for 2019, while two parties not so operating (non-Article 5 parties), Australia and Canada, submitted one nomination each for 2020 and 2019, respectively.

[5] Technology and Economic Assessment Panel, Sept. 2018, vol. 2: Decision XXIX/8 on the Future Availability of Halons and Their Alternatives.

14. The Methyl Bromide Technical Options Committee evaluated the nominations and presented its interim recommendations at the fortieth meeting of the Open-ended Working Group, during which bilateral discussions took place. Discussions continued thereafter between the nominating parties and the Committee on the information needed for any re-evaluation of the nominations in order for the Committee to make final recommendations for consideration by the Thirtieth Meeting of the Parties. Three parties, Australia, Canada and South Africa, requested the Methyl Bromide Technical Options Committee to reassess their nominations and provided additional information on the regulatory and technical issues related to their inability to use alternatives to methyl bromide.

15. In the light of the above, the Methyl Bromide Technical Options Committee prepared its final report recommending the full amounts nominated by Australia and Canada. South Africa revised its two nominations after the fortieth meeting of the Open-ended Working Group; the Committee recommended the full amount for one of those and a reduction for the other.

16. The report of the Committee, containing detailed information on the final recommendations, is available on the meeting portal for the Thirtieth Meeting of the Parties.[6] The final recommendations are outlined in table 1 below. The reasons given by the Committee for not recommending the full nominated amounts for some parties are summarized in the footnotes to the table where relevant.

Table 1
Summary of the nominations for 2019 and 2020 critical-use exemptions for methyl bromide submitted in 2018 and final recommendations of the Methyl Bromide Technical Options Committee
(tonnes)*

Party	*Nomination for 2019*	*Final recommendation*	*Nomination for 2020*	*Final recommendation*
Parties not operating under paragraph 1 of Article 5 and sector				
1. Australia				
Strawberry runners			28.98	[28.98]
2. Canada				
Strawberry runners	5.261	[5.261]		
Subtotal	**5.261**	**[5.261]**	**28.98**	**[28.98]**
Parties operating under paragraph 1 of Article 5 and sector				
3. Argentina				
Strawberry fruit	27.1	[15.71][c]		
Tomato	44.4	[25.60][d]		
4. South Africa				
Mills	1.5[a]	[1.0][e]		
Structures	40.0[b]	[40.0]		
Subtotal	**113.0**	**[82.31]**		
Total	**118.261**	**[87.571]**	**28.98**	**[28.98]**

* Tonne = metric ton.

[a] Revised nomination from the 2 tonnes nominated originally.

[b] Revised nomination from the 45 tonnes nominated originally.

[c] The reduction in the nomination is based on the adoption of barrier films (e.g., totally impermeable film (TIF)) on one third of the nominated area, which results in a decrease in dosage rates recommended for the nomination from 26.0 to 15.0 g/m^2.

[d] The reduction in the nomination for the third year is based on the adoption of barrier films (e.g., TIF), which will decrease dosage rates recommended for the nomination from 26 to 15.0 g/m^2.

[e] The reduction in the revised nomination is based a reduction in the annual number of fumigations with an amount of methyl bromide sufficient for up to two fumigations per year per mill at 20 g/m^3 as a further transitional measure to allow time for the adoption and optimization of alternatives in an integrated pest management system, with phase-in of an alternative whole-site fumigant, sulfuryl fluoride, if desired.

17. In addition to the final recommendations on parties' critical-use nominations, the report of the Methyl Bromide Technical Options Committee recalls the reporting requirements under relevant decisions and includes information on trends in methyl bromide critical-use nominations and

[6] Technology and Economic Asessment Panel, Sept. 2018, vol. 3: Evaluation of 2018 Critical-Use Nominations for Methyl Bromide (final report).

exemptions for all nominating parties to date, and also on accounting frameworks for critical uses and stocks of methyl bromide.

18. The parties may wish to consider the report and final recommendations of the Methyl Bromide Technical Options Committee and adopt decisions as appropriate.

(b) Development and availability of laboratory and analytical procedures that can be performed without using controlled substances under the Protocol (decision XXVI/5) (item 6 (b) of the provisional agenda for the preparatory segment)

19. By decision XXVI/5, adopted by the Twenty-Sixth Meeting of the Parties in 2014, the Technology and Economic Assessment Panel was requested to report no later than 2018 on the development and availability of laboratory and analytical procedures that could be performed without using controlled substances under the Montreal Protocol. In response, the Panel's Medical and Chemicals Technical Options Committee has prepared the requested report[7] in time for consideration by the Thirtieth Meeting of the Parties.

20. The report, which builds on the Panel's previous work on the matter,[8] contains an analysis of available alternatives to laboratory and analytical uses of ozone-depleting substances as well as potential barriers to their adoption in Article 5 and non-Article 5 parties, and makes relevant recommendations. The focus is primarily on controlled substances already included in the global essential-use exemption for laboratory and analytical uses.[9] Although controlled substances in Annex C, Group I (hydrochlorofluorocarbons (HCFCs)), are not yet included under the global essential-use exemption (as control measures for 100 per cent reduction do not take effect in non-Article 5 parties until 2020), some information on the known laboratory and analytical uses of those substances is provided in the report. Annex F controlled substances (HFCs) are not considered in the report.

21. The report provides background information including the types of applications considered as laboratory and analytical uses; the criteria and procedures that permit the production and consumption of controlled substances beyond their production phase-out (set out in decision IV/25); the conditions for authorizing essential-use exemptions for laboratory and analytical uses and the requirement of annual reporting related to such uses (set out in decision VI/9); the adopted non-exhaustive illustrative list of categories and examples of laboratory uses (set out in annex IV to the report of the Seventh Meeting of the Parties, as indicated in para. 5 of decision VII/11); and various subsequent decisions that extended the global laboratory and analytical use exemption, excluded specific uses from it and/or requested the Panel to report on developments in alternatives to the use of controlled substances.

22. Trends in the production and consumption of ozone-depleting substance data for laboratory and analytical uses from 1996 to 2016 are also discussed in the report based on the data submitted by parties to the Ozone Secretariat in accordance with Article 7 of the Montreal Protocol. The trends show a reduction of total global production and consumption over the years, with global production decreasing from a peak value of 439 tonnes in 1998 to 151 tonnes in 2016. In 2016, the total production reported by non-Article 5 and Article 5 parties was 20.9 tonnes and 130 tonnes, respectively. Carbon tetrachloride has been the main controlled substance produced for these uses, while the annual production of other controlled substances has been relatively very small, varying from several kilograms to less than one tonne.

23. Furthermore, the report takes into account the work carried out by other institutions[10] and discusses the international and/or national standards applicable to laboratory and analytical uses and the barriers to their adoption.

24. The current review has shown that while most laboratory and analytical uses of ozone-depleting substances in non-Article 5 parties have ceased, in Article 5 parties the adoption of alternatives to ozone-depleting substances for laboratory and analytical uses is still under way. Article 5 parties face barriers such as adherence to standards still requiring the use of ozone-depleting

[7] Technology and Economic Assessment Panel, Sept. 2018, vol. 4: Response to Decision XXVI/5 (2) on Laboratory and Analytical Uses.

[8] Report of the Technology and Economic Assessment Panel, May 2008, vol. 1, Progress Report, pp. 54–62; Report of the Technology and Economic Assessment Panel, May 2009, vol. 1, Progress Report, pp. 51–60; Report of the Technology and Economic Assessment Panel, May 2010, vol. 2, Progress Report, pp. 53–57; Report of the Technology and Economic Assessment Panel, May 2011, vol. 1, Progress Report, pp. 51–54.

[9] The global essential-use exemption applies to controlled substances in Annexes A, B and C, Groups II and III, and Annex E, as relevant to the Article 2 control measures for Article 5 and non-Article 5 parties.

[10] International Organization for Standardization, ASTM International and the European Committee for Standardization, the Standardization Administration of the People's Republic of China and the United States Environmental Protection Agency.

substances and the resource-intensive process involved in the adoption of new standards with respect to costs and time.

25. With regard to the laboratory and analytical uses of HCFCs, the report notes that non-Article 5 parties are likely to require HCFCs for such uses, for example, to be used as analytical standards for the measurement of atmospheric levels of HCFCs and for research into and development of new substances. A number of laboratory and analytical uses for HCFCs are listed in the report, based on reported data, that may continue to require HCFCs after 2020 due to slow progress in moving to alternatives.

26. The Committee also suggests that parties may wish to consider action to facilitate the adoption of alternatives in Article 5 parties, such as establishing cooperation with standards organizations to facilitate and accelerate the development or revision of standards for the replacement of ozone-depleting substances in analytical uses; providing more comprehensive data; sharing information on alternatives and on the revision of standards that require the use of ozone-depleting substances; and providing support for the development and/or revision of standards, and for training, as required.

27. Furthermore, the Committee points out that any decision taken by parties to exclude a use from the global exemption would not prevent a party from nominating a specific use for an exemption under the essential uses procedure, as set out in decision IV/25.

Recommendations

28. On the basis of its review, the Committee recommends the removal of nine procedures from the global exemption for laboratory and analytical uses of ozone-depleting substances, listed in table 2. It also notes that the list of these procedures is shorter than the list of procedures that had been recommended by the Technology and Economic Assessment Panel in 2009, as reflected in the preambular text of decision XXI/6, in order to allow more time for the revision of old standards or the development of new standards and for the adoption of new standards in Article 5 parties.[11]

Table 2

Laboratory and analytical uses of ozone-depleting substances recommended by the Medical and Chemicals Technical Options Committee for removal from the global exemption of such uses

Ozone-depleting substance	*Laboratory and analytical use*
Methyl bromide	Laboratory uses as a methylating agent
Carbon tetrachloride	Reaction solvents
	A solvent for IR, Raman and NMR spectroscopy
	Grease removal and washing of NMR tubes
	Iodine partition and equilibrium experiments
	Determination of hydrocarbons in water, air, soil or sediment
	Determination of moisture and water
	Determination of iodine index
1,1,1-trichloroethane	Determination of bromine index

Abbreviations: IR – infrared radiation, NMR – Nuclear Magnetic Resonance.

29. The full Panel report on this matter is available on the meeting portal for the Thirtieth Meeting of the Parties.[12] The executive summary of the report is set out in annex III to the present addendum. The annex is presented as received from the Panel, without formal editing by the Secretariat.

[11] Case studies presented in the 2009 Progress Report of the Technology and Economic Assessment Panel showed that most laboratory and analytical uses of ODS in non-Article 5 Parties had ceased. Alternatives were identified for almost all uses, and the list of methods for which alternatives were available was included in the preambular text of decision XXI/6. However, the parties refrained from adopting the removal of those uses from the global exemption as they were concerned about the potential impact any changes to the global exemption would have on Article 5 parties; at the time, Article 5 parties were subject to their 2010 phase-out obligations under the Montreal Protocol, after which the global exemption for laboratory and analytical uses would apply.

[12] Report of the Technology and Economic Assessment Panel, Sept. 2018, vol. 4: Response to Decision XXVI/5 (2) on Laboratory and Analytical Uses .

30. The parties may wish to consider the Panel's report on this issue during the preparatory segment and make appropriate recommendations on the way forward.

D. Issues related to energy efficiency while phasing down hydrofluorocarbons (decision XXIX/10) (item 8 of the provisional agenda for the preparatory segment)

Report by the Technology and Economic Assessment Panel on energy efficiency in the refrigeration, air-conditioning and heat-pump sectors (item 8 (a) of the provisional agenda for the preparatory segment)

31. By decision XXIX/10, adopted by the Twenty-Ninth Meeting of the Parties in 2017, the Technology and Economic Assessment Panel was requested to assess several issues related to maintaining and enhancing energy efficiency in the refrigeration, air-conditioning and heat-pump sectors (RACHP), including in high-ambient-temperature conditions, while phasing down HFCs under the Kigali Amendment to the Montreal Protocol in Article 5 parties. The Panel was also requested to provide an overview of the activities and funding provided by other relevant institutions, as well as definitions, criteria and methodologies used in addressing energy efficiency in those sectors. Furthermore, the Panel was requested to prepare a final report for consideration by the Open-ended Working Group at its fortieth meeting and thereafter an updated final report for consideration by the Thirtieth Meeting of the Parties, taking into account the outcome of the workshop on energy efficiency opportunities while phasing down HFCs (also requested by the decision), which was organized by the Secretariat in Vienna on 9 and 10 July 2018.

32. As is indicated in the note by the Secretariat (UNEP/OzL.Pro.30/2, paras. 49–53), at its fortieth meeting, the Open-ended Working Group considered the Technology and Economic Assessment Panel's task force report on energy efficiency while phasing down HFCs,[13] and provided further guidance to the Panel, in the form of 23 questions (reproduced in annex I to the note by the Secretariat) to be addressed in the Panel's updated final report.

33. In response to the parties' request, the Panel submitted its updated final report, available on the meeting portal for the Thirtieth Meeting of the Parties.[14] The report includes the Panel's response to the additional questions raised, including its summary of the energy efficiency workshop (annex C). An additional annex references the parts of the report where each question is addressed (annex D). The executive summary of the report is reproduced in annex IV to the present addendum. The annex is presented as received from the Panel, without formal editing by the Secretariat.

34. A summary of some of the salient points included in the additional information presented in the task force updated final report is set out in table 3 below. The points are listed under each question of the additional guidance to the Panel, taking into consideration the Panel's referencing set out in annex D to its report.

35. The parties may wish to consider the Panel's report on this issue during the preparatory segment and make recommendations on the way forward as appropriate.

E. Consideration of senior expert and other nominations by parties to the Technology and Economic Assessment Panel (item 13 of the provisional agenda for the preparatory segment)

36. Information on the status of the membership of the Technology and Economic Assessment Panel and its technical options committees was included in volume 3 of the Panel's May 2018 progress report[15] and was discussed at the fortieth meeting of the Open-ended Working Group. The issues expected to be considered under this agenda item by the Thirtieth Meeting of the Parties are highlighted in the note by the Secretariat along with the matrix of needed expertise prepared by the Panel, the list of Panel co-chairs and members whose membership expires at the end of 2018 and whose appointment requires a decision by the Thirtieth Meeting of the Parties, and extracts from the relevant terms of reference. (See UNEP/OzL.Pro.30/2, paras. 76–80 and annex II.)

[13] Report of the Technology and Economic Assessment Panel, May 2018, vol. 5: Decision XXIX/10 Task Force Report on Issues Related to Energy Efficiency While Phasing Down Hydrofluorocarbons.

[14] Report of the Technology and Economic Assessment Panel, Sept. 2018, vol. 5: Decision XXIX/10 Task Force Report on Issues Related to Energy Efficiency While Phasing Down Hydrofluorocarbons - updated final report.

[15] Available at http://conf.montreal-protocol.org/meeting/mop/mop30/presession/Background-Documents/TEAP-Progress-Report-May2018.pdf.

37. With regard to nominations to the Technology and Economic Assessment Panel, to date the Secretariat has received a submission from Algeria nominating Mr. Sidi Menad Si-Ahmed, currently a senior Panel expert, to continue serving in the Panel, and a submission from Colombia nominating Ms. Marta Pizano, currently co-chair of the Technology and Economic Assessment Panel, to continue serving in that role for an additional four years.

38. During the preparatory segment, the parties may wish to discuss the issue of Panel nominations further, taking into consideration the Panel's matrix of needed expertise.

Table 3

Summary of the Technology and Economy Assessment Panel response to the additional guidance by parties on issues related to energy efficiency

	Additional guidance[a]	*Addressed in section(s)*
1.	**More information on the heat-pump sector and CO_2 savings**	
•	Modelled scenarios with specific assumptions[b] suggest that energy efficiency improvements, through the use of efficient heat pumps, can range from 14 to 35 per cent, corresponding to CO_2 savings of 63 to 1080 carbon dioxide equivalence (CO_2eq), respectively.	2.5.3
2.	**Tabular presentation of funding sources**	
•	A mapping of funding sources for mitigation-focused cooling projects is presented in section 3.5 of the task force report, including nine major public categories and one philanthropic category. The information displayed comprises an overview of institutions under each category, examples of types of projects funded during the period 2014–2015, number of projects per year and funding provided per funding source averaged over the same period. The mapping shows that during 2014–2015 the largest funding source for mitigation-focused cooling projects was bilateral contributions from individual countries and institutions.	3.5
•	A mapping of public funding by recipient type (low, low-middle and upper-middle) is also presented, showing that the largest amount of funding during the period 2014–2015 had been allocated to low-income recipients.	
•	Additional mapping of public and philanthropic funding per type of project shows that the largest funding is related to HFC phase-down and cold chain projects.	
•	At present, the majority of large multilateral climate funds[c] operate in sectors other than RACHP, such as energy access, renewable energy transmissions/sectors and other related investment projects.	
•	Less than 0.1 per cent of Official Development Assistance (ODA)[d] projects in 2014 and 2015 (corresponding to $19 million) focused on cooling, indicating that there is extremely low international focus on cooling relative to other development topics.	
•	Consideration could be given to options for a new financial architecture by means of which resources for energy efficiency could flow more certainly and effectively.	
3.	**More information on opportunities and energy efficiency improvements in the mobile air-conditioning sector**	
•	There are several options for improving energy efficiency in the mobile air-conditioning sector focusing on vapour compression and on the whole system (e.g., thermal load reduction through reflective glazing and paints, higher efficiency fan motors and compressors, improved heat exchangers including liquid cooling). Depending on the option used, the reduction in energy demand and fuel consumption can be up to 35 and 5 per cent, respectively.	Annex A (A.4)

[a] Additional guidance to the Technology and Economic Assessment Panel on energy efficiency (UNEP/OzL.Pro.WG/1/40/7, annex III).

[b] Simulation of energy consumption used in heating a prototype small office building in three different climate regions using building energy simulation software, taking into account the impact of building insulation in those regions and the use of the required backup heating.

[c] Such as the Global Environment Facility (GEF), Climate Investment Fund (CIF) and Green Climate Fund (GCF).

[d] https://data.oecd.org/oda/net-oda.htm. Official development assistance (ODA) is defined as government aid designed to promote the economic development and welfare of developing countries. Loans and credits for military purposes are excluded.

4. **More information on lessons learned from previous transitions in terms of additional energy efficiency gains and resources** • Low-global warming potential (GWP) refrigerants are expected to have an impact on system efficiency, which is likely to be within ±5 per cent of the baseline refrigerant(s) in terms of energy performance. Most of the improvement in energy efficiency in newly designed RACHP systems can be achieved through the optimization and use of new and advanced components, particularly compressors, heat exchangers and controls. • The direct benefits of the reduction of high-GWP refrigerants through the Kigali Amendment might be offset by the use of less energy efficient equipment. If the amendment results in the use of more energy efficient equipment, however, the total reduction of HFC emissions both from direct and indirect sources could double its benefits. • There is major potential for significant energy savings using equipment that is already on the market in the RACHP sectors. More ambitious standards, labels and other types of market-transformation policies (e.g., incentives, procurement or awards) would reduce the energy requirements of countries where energy is already at a premium. • Reduced energy demands through stringent minimum energy performance standards (MEPS) would decrease the required energy generating capacity. However, the introduction of overly stringent efficiency standards could inadvertently raise prices if not done carefully. In order to minimize the adverse impacts of market measures such as MEPS, these should be designed with a long-term goal in mind and at a schedule that is in line with the pace of technology development and investment cycles in the relevant sector. • The likely barriers to the adoption of energy efficiency measures fall under the following categories: technical, financial, market, information, institutional and regulatory, service competence, and other. For each category, the report lists mitigation measures for the short term and medium term.	2.1, 2.2.9
5. **Information on additional gains from improved servicing** • The benefits of maintenance are several including: reduced energy costs; improved safety by eliminating risks; better temperature control and thermal comfort for occupants; improved occupant productivity by maintaining a good indoor environmental quality; deferred capital expenditure for replacement and repair cost by extending the useful life of equipment; and compliance with regulations on minimum efficiency requirements for both new and existing buildings. Appropriate maintenance and servicing practices can curtail an up to 50 per cent reduction in performance and maintain the rated performance over the lifetime.	2.6.2
6. **Elaborate more on the design and criteria of RACHP units in particular with respect to safety, performance and the consequences of increasing the capacity of those units** • High-ambient-temperature (HAT) conditions can result in degradation of thermodynamic performance, especially under extreme conditions; at temperatures of up to 52°C the degradation of performance can be 10–15 per cent compared to that at 35°C, while the effect on energy efficiency can reach up to 20 per cent. As this level of temperature is usually reached on only a few days per year, the most likely impact on performance is the possible degradation of refrigerant during these higher temperatures. • Safety standards for the new refrigerants (that are mostly flammable), like ISO 5149, EN 378, IEC 60335-2-40 for air conditioners and heat pump systems and IEC 60335-2-89 for commercial refrigeration appliances, are available; the standard IEC 60335-2-89 is currently under revision to allow larger charges of flammable refrigerants. • Selecting the appropriate refrigerant for a specific application is a factor controlling the charge amount. RACHP systems designed for HAT conditions are expected to employ specific alternative refrigerants optimized for their conditions. • The increased size of the units needed to meet energy efficiency minimum requirements at HAT conditions would at their initial market introduction result in increased cost to the manufacturers which will be passed on to the consumer. The larger amounts of alternative refrigerant charge and the choice of system components could also result in increased costs.	2.2.2, 2.4.2

7. **Elaborate in a comprehensive way and provide clear comparison between HCFCs, HFCs and HFC alternatives with respect to performance, safety and costs** • References to studies on comprehensive analyses of the refrigerants currently in use in RACHP applications and their alternatives is provided, indicating two technology options to deal with the HFC phase-down: developing and designing new equipment to operate with natural refrigerants; and using low-GWP fluorinated refrigerants with minimal modification to original RACHP equipment. Each choice has its own strengths and weaknesses, including related to performance, long-term environmental impact and safety. • Opportunities to achieve higher efficiency only through the change of refrigerant with low-GWP blends beyond those currently known are limited. • Research studies conducted so far have concentrated on the performance of low-GWP alternative refrigerants compared to the presently used ozone-depleting substance and high-GWP HFC technologies, using available products with “soft optimization” of charge and expansion devices. Further research is needed to study the impact of full optimization of new products using low-GWP alternatives with changes to compressors, heat exchangers and other components. *See also response to question 6.*	2.1, 2.2.2
8. **Focus on the energy efficiency of the equipment in the RACHP sectors, avoiding duplication of work undertaken under other international entities such as the Intergovernmental Panel on Climate Change** *See response to questions 4, 6 and 7.*	2.2.2
9. **Look at measures taken in other regions (such as the European Union) in recent years and address the particular challenges faced by HAT countries** • HAT conditions impose additional challenges on the selection of refrigerants, system design and potential energy efficiency enhancement opportunities. System designs which maintain energy efficiency are affected by the refrigerant choice due to thermodynamic properties, safety requirements due to the increased charge, and component availability and cost. • Harmonization of MEPS among countries with similar usage and energy cost conditions across the same product categories can help with verification and compliance and can relieve the burden on States of developing new standards. • The effective implementation of energy efficiency policies for appliances and equipment relies on the use of accurate energy performance measurement standards and protocols. • In the case of residential air-conditioning equipment, representing one of the fastest-growing energy loads in HAT countries, MEPS and labelling programmes have proved to be a cost-effective policy tool for encouraging the reduction of average energy consumption in equipment without reducing consumer choice or triggering sustained increases in prices. A common testing standard for air conditioning has been implemented across the Association of Southeast Asian Nations (ASEAN) region as a means of reducing costs and improving trade. • In the European Union, air-conditioning units for its markets are subject to ecodesign requirements and are expected to save 11 TWh and nearly 5 million tonnes of CO_2 emissions annually by 2020, in addition to reducing costs. In that regard, the European Union has enacted regulations on energy labelling and harmonized standards for air conditioners and comfort fans.	2.2.2, 2.4.3, 2.4.4
10. **Request the Technology and Economic Assessment Panel to reach out to the various regions to better understand their particular circumstances** • The Technology and Economic Assessment Panel welcomes the opportunity to do so.	1.3, 2.3.2
11. **Report on what research and development is occurring, and its progress and outcomes, to address HAT challenges** • Research at HAT conditions conducted so far has shown the viability of some low-GWP alternatives to deliver comparable energy efficiency results to existing technologies. Further publicly financed research, as well as private-sector efforts, continue to focus on the optimization of design to achieve targeted efficiencies for those conditions. The status of relevant projects is discussed in the report.	2.4.5

12. **The Technology and Economic Assessment Panel to visit the regions to engage with stakeholders on the challenges of the regions in transitioning to higher energy efficiency refrigerants** • The Technology and Economic Assessment Panel welcomes the opportunity to do so.	1.3
13. **Calculate the life cycle of equipment per country/region and associated climatic conditions** • There are several methodologies that estimate total emissions during the life cycle of a system, the most common being total equivalent warming impact (TEWI) and life cycle climate performance (LCCP). Calculating life cycle emissions at the country or regional level would require several additional steps and assumptions, for example in terms of product lifetime, refrigerant choice and leakage, that extend beyond the considerations of the environmental benefits of energy efficiency. Additional information on sustainability and life cycle emissions will be included in the 2018 quadrennial assessment report of the Refrigeration, Air-conditioning and Heat Pumps Technical Options Committee. • Several scenarios are presented providing an indication of the range of benefits under different climate and local conditions. The results highlight the importance of local context, specifically hours of use and emissions factor for electricity generation. The effects of the local context are quantified for each equipment type by considering a range of site-specific conditions. For the same order of efficiency improvement, the environmental benefits of energy efficiency can vary by a factor of 1,000 depending on the hours of use and the emission factor for electricity generation.	2.5.2, 2.5.3
14. **Provide more information on specific economic benefits in terms of savings including to consumers, power plants, payback periods** • The most frequently cited benefits of energy efficiency are energy savings, cost and greenhouse gas savings and peak load reduction. Estimates show that the global reduction of peak load by an improvement in energy efficiency of 30 per cent for room air conditioning alone would abolish the need for around 1,400 peak load power plants of 500MW capacity by 2030 and around 2,200 peak load power plants by 2050. A transition to low-GWP refrigerants would further add to those savings. • In addition, the associated health benefits (such as avoided pollution and CO_2 emissions) could provide an additional 75–350 per cent to the direct energy-saving benefits of energy efficiency, while an even wider range of co-benefits is believed to be feasible.	2.8.1
15. **Reformulate the response of the Technology and Economic Assessment Panel to decision XXIX/10 to place it in the context of refrigerant transition** • The replacement of current baseline refrigerants requires the consideration of a number of issues, such as whether the performance of alternative substances is the same as or better than that of the substances they are replacing, compatible with other system components and safe. Consideration should also be given to equipment emissions over their lifetime; ensuring that technicians carrying out such replacements are qualified to do so; ensuring capacity-building of the national framework to support the transition to alternative substances; and associated conversion, equipment and operating costs. *See also response to questions 4 and 7.*	2.1, 2.1.1
16. **Provide further information on the following takeaway messages from the energy efficiency workshop:** – **The introduction of high energy efficiency technologies often creates an "initial price hump"** – **Refrigerant selection needs to be made in terms of energy efficiency, flammability and other relevant factors** – **Funds are available, but do not always flow effectively** • Newly introduced high efficiency technologies generally lead to an increased capital cost for the end user, thereby creating an important barrier to uptake. The introduction of a high efficiency technology is often characterized by an initial "price-hump", followed by price reductions as the new technology is adopted by many players in the market and integrated into commodity products as a result of energy efficiency policies. The scale and duration of a price hump can be minimized by the use of regularly updated MEPS together with financial support to encourage early movers. However, not all high efficiency opportunities create a price hump; some efficiency measures can be achieved with zero or even negative capital cost increments. • Refrigerant selection is based on numerous issues, including impact on equipment size and cost, on safety as well as on energy efficiency issues related to greenhouse gases and GWP. The impact of refrigerant selection on energy efficiency (between ±5 and ±10 per cent) is smaller than many other available energy efficiency measures. The choice of	Annex C

refrigerant can lead to possible changes of efficiency. Several examples show that lower-GWP alternatives deliver better energy efficiency than the high-GWP refrigerants they replace (e.g., R-290 and HFC-32 replacing R-410A in small air-conditioning equipment and R-744, R-448A and R-449A replacing R-404A in supermarket refrigeration). • The uptake of energy efficiency measures is slow owing to a lack of understanding of how to improve energy efficiency, poor design and selection of equipment, a lack of monitoring and analysis of performance as well as narrow financial analysis that does not value the multiple benefits of energy efficiency improvements. • A key barrier for many funding bodies is the relatively small size of many RACHP efficiency projects, which makes the transaction cost high from the perspective of investors. Investment via bulk purchase schemes or energy service companies can facilitate financial flows by identifying solutions for overcoming barriers, taking on technical risks and aggregating large numbers of small projects in order to reduce transaction costs for banks and other investors. • For larger equipment, utility demand-side management programmes can overcome some of the barriers to investment in energy efficiency. Utility companies can provide both technical expertise and financing and can monetize the financial benefits of reducing peak demand on the electricity grid.	
17. **Quantify the context/site-specific impacts of environmental benefits of energy efficient equipment, as mentioned in the Technology and Economic Assessment Panel report** *See response to question 13.*	2.5.3
18. **Provide a matrix of technical interventions to energy efficiency and associated costs** • A matrix of possible technical interventions aimed at improving energy efficiency and associated costs is provided in table 2.14 of the task force report. Energy efficiency can be improved by up to 50 per cent while costs can vary from zero to low, low-medium and medium-high, depending on the type of the equipment, the equipment components and the type of technical intervention carried out.	2.8.6
19. **Elaborate on the criteria and methodologies of the relevant funding institutions noted in decision XXIX/10** • Criteria, methodologies, financial modalities and other related aspects of funding institutions are discussed in chapter 3 of the report. The task force has expanded that chapter to include such information for additional institutions such as the Climate Investment Fund (CIF), the regional development banks,[e] the European Investment Bank, the United States Agency for International Development (USAID) and the Canadian International Development Agency (CIDA).	3.3.1, 3.3.2, 3.3.3, 3.4, 3.6
20. **Elaborate on the capacity-building and servicing requirements for low-GWP alternatives** • In the servicing sector, the use of low-GWP refrigerants requires capacity-building and training initiatives to address specific issues related to installation, operation and maintenance of low-GWP-refrigerant-based equipment. • The main characteristics of the low-GWP refrigerants that require capacity-building and technician training are flammability, toxicity, higher pressure and blends with temperature glide.	2.7.2
21. **Explore the possibility of district cooling, green building codes and hydrocarbons in commercial applications as options for energy efficiency (as is demonstrated in the United Arab Emirates)** • The long-term sustainability in performance and viability of technology options and requirements depends on the technological environment, MEPs and labelling programmes, while district cooling and green building codes are additional ways of realizing energy efficiency improvements. • District cooling systems reduce power demand by 55–62 per cent in comparison to conventional air-conditioning systems and consume 40–50 per cent less energy. A number of national, regional and international codes (such as the Green Building Codes) have been developed and are in use globally for new buildings and for retrofitting existing buildings. Several building certification schemes exist around the world and at least 84 countries worldwide are known to have schemes covering air-conditioning systems. Examples show that certified green buildings result in 40–50 per cent energy savings and 20–30 per cent water savings compared to conventional buildings. Energy efficiency in buildings will play a critical role in reducing carbon emissions in the power generation sector.	2.3.1, 2.3.3, Annex A (A.3)

[e] The African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, and the Inter-American Development Bank.

• Hydrocarbons in commercial applications provide a long-term sustainable solution for various RACHP applications, offering equal or higher energy performance compared to the baseline refrigerant equipment.	
22. **Provide information on increased energy demand to produce the same amount of cooling in HAT countries due to the projected rise in temperature** • The worldwide demand for cooling energy in 2100 is predicted to increase by over 70 per cent owing to a combination of climate change and income growth, with most of this increased demand occurring in the tropical regions. The need for increased space cooling owing to climate change in HAT conditions is projected to be within a range of 10–30 per cent in 2100. The above estimates would probably increase if other factors that have an effect on cooling capacity and energy efficiency, such as ambient temperature, urban heat island and changes in atmospheric pollution, were included. Meanwhile, measures such as shading, vegetation, increased thermal insulation, increased thermal mass, better windows and building materials and cool roofs, could mitigate the above-mentioned effects and reduce their estimated impacts.	2.4.6
23. **Technology and Economic Assessment Panel to consider visiting the United Arab Emirates to view the district cooling, green-cooling and hydrocarbon projects to inform its updated final report** • The Technology and Economic Assessment Panel welcomes the opportunity to do so.	1.3

Annex I

Recommendations for list of approved destruction technologies

The existing list of approved destruction technologies is shown in the table below in green. Recommendations relevant to this assessment are shown in the table below in red (for the assessment of approved destruction technologies for their applicability to HFCs and any other technologies for possible inclusion on the list of approved destruction technologies). This table ***replaces*** recommendations presented in the previous April 2018 and May 2018 TFDT reports.

Technology	**Applicability**										
	Concentrated Sources									**Dilute Sources**	
	Annex A		**Annex B**			**Annex C**	**Annex E**	**Annex F**			**Annex F**
	Group 1	**Group 2**	**Group 1**	**Group 2**	**Group 3**	**Group 1**	**Group 1**	**Group 1**	**Group 2**		**Group 1**
	Primary CFCs	**Halons**	**Other CFCs**	**Carbon Tetrachloride**	**Methyl Chloroform**	**HCFCs**	**Methyl Bromide**	**HFCs**	**HFC-23**	**ODS**	**HFCs**
DRE*	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	95%	95%
Cement Kilns	Approved	Not Approved	Approved	Approved	Approved	Approved	Not Determined	High Potential	High Potential		
Gaseous/Fume Oxidation	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	Recommend for Approval	Recommend for Approval		
Liquid Injection Incineration	Approved	Approved	Approved	Approved	Approved	Approved	Not Determined	Recommend for Approval	Recommend for Approval		
Municipal Solid Waste Incineration										Approved	High Potential
Porous Thermal Reactor	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	Recommend for Approval	High Potential		
Reactor Cracking	Approved	Not Approved	Approved	Approved	Approved	Approved	Not Determined	High Potential	High Potential		
Rotary Kiln Incineration	Approved	Approved	Approved	Approved	Approved	Approved	Not Determined	High Potential	High Potential	Approved	
Argon Plasma Arc	Approved	Approved	Approved	Approved	Approved	Approved	Not Determined	Recommend for Approval	High Potential		
Inductively coupled radio frequency plasma	Approved	Approved	Approved	Approved	Approved	Approved	Not Determined	Unable to Assess	Unable to Assess		
Microwave Plasma	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	Unable to Assess	Unable to Assess		
Nitrogen Plasma Arc	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	Recommend for Approval	Recommend for Approval		

Technology	**Applicability**										
	Concentrated Sources									**Dilute Sources**	
	Annex A		**Annex B**			**Annex C**	**Annex E**	**Annex F**			**Annex F**
	Group 1	**Group 2**	**Group 1**	**Group 2**	**Group 3**	**Group 1**	**Group 1**	**Group 1**	**Group 2**		**Group 1**
	Primary CFCs	**Halons**	**Other CFCs**	**Carbon Tetrachloride**	**Methyl Chloroform**	**HCFCs**	**Methyl Bromide**	**HFCs**	**HFC-23**	**ODS**	**HFCs**
DRE*	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	99.99%	95%	95%
Portable Plasma Arc	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	High Potential	Unable to Assess		
Chemical Reaction with H_2 and CO_2	Approved	Approved	Approved	Approved	Approved	Approved	Not Determined	Recommend for Approval	Recommend for Approval		
Gas Phase Catalytic De-halogenation	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	High Potential	High Potential		
Superheated steam reactor	Approved	Not Determined	Approved	Approved	Approved	Approved	Not Determined	High Potential	High Potential		
Thermal Reaction with Methane	Approved	Approved	Approved	Approved	Approved	Approved	Not Determined	Unable to Assess	Unable to Assess		
Electric Heater	Not Determined	Not Determined	Not Determined	Not Determined	Not Determined	Not Determined	Not Determined	High Potential	High Potential		
Fixed Hearth Incinerator	Unable to Assess										
Furnaces	Unable to Assess										
Thermal Decay of Methyl Bromide	Not Determined	Not Determined	Not Determined	Not Determined	Not Determined	Not Determined	High Potential	Not Determined	Not Determined		
Air Plasma Arc	Unable to Assess										
Alternating Current Plasma	Unable to Assess										
CO_2 Plasma	Unable to Assess										
Steam Plasma	Unable to Assess										
Catalytic Destruction											Unable to Assess
Chlorination/De-chlorination to Vinylidene Fluoride	Not a destruction technology										
Solid Alkali Reaction	Unable to Access										

*DRE - Destruction & Removal Efficiency

Annex II

Summary assessments for each destruction technology listed in annex I

1. Assessment of approved destruction technologies for applicability to HFCs

1.1 Thermal Oxidation

1.1.1 Cement Kilns

DRE (99.998%) and dioxin/furans data meet the performance criteria for the destruction of HFC-134a. Other emissions data were either unavailable or did not meet performance criteria. **Cement Kilns are recommended as *high potential* for applicability to HFCs destruction, including HFC-23**.

1.1.2 Gaseous/Fume Oxidation

Gaseous/Fume Oxidation is recommended for *approval* for applicability to HFCs destruction, including HFC-23, using HFC-23 data as a proxy for other HFCs.

1.1.3 Liquid Injection Incineration

DRE (99.995%) and emissions data are available that meet all of the performance criteria for HFC-134a destruction. Data were also available for HFC-23 destruction that meet all of the performance criteria. **Liquid Injection Incineration is recommended for *approval* for applicability to HFCs destruction, including for HFC-23.**

1.1.4 Municipal Solid Waste Incineration

No data from HFC destruction were available to the 2018 TFDT, and dioxins/furans emissions were higher than the performance criteria for ODS destruction, as noted in the 2002 TFDT report. **Municipal Solid Waste Incineration is recommended *as high potential* for applicability to destruction of dilute HFC sources (except for HFC-23), specifically for the destruction of HFC blowing agents in foam**.

1.1.5 Porous Thermal Reactor

Data for HFC-23 destruction were not available for this assessment. **Porous Thermal Reactor is recommended for *approval* for applicability to HFCs destruction except for HFC-23. Porous Thermal Reactor is recommended as *high potential* for applicability to HFC-23 destruction.**

1.1.6 Reactor Cracking

No emission data for particulates were available for assessment against the performance criteria. **Reactor Cracking is recommended as *high potential* for applicability to HFCs destruction, including HFC-23**.

1.1.7 Rotary Kiln Incineration

The May Supplemental Report documented that the 2018 TFDT had several follow-up discussions with various technology owners after the April 2018 TFDT Report, including with an operator of Rotary Kilns. The operator did not have test data relating to the destruction of HFCs. A compliance test report was provided relating to the destruction of carbon tetrachloride and tetrachloroethylene using multiple sets of conditions. DRE, CO, dioxins/furans, particulates and HCl emissions met the performance criteria for destruction of these surrogate refractory halogenated organic chemicals. The relevant facility continuously monitors pH (for acid control), carbon monoxide, carbon injection (for dioxide/furans production), opacity (for control of particulates) and temperature (for DRE control) for destruction of all substances including HFCs. Feed rates are also controlled of various substances to further control emissions. This technology is also in compliance with local regulatory requirements.

Additional data provided by another operator of Rotary Kilns for the Addendum Report relates to the destruction of another surrogate refractory halogenated organic chemical, sulfur hexafluoride (SF_6), which has high thermal stability[1]. The DRE for SF_6 destroyed using this technology was reported to be higher than 99.99%.

Additional information provided for the Addendum Report notes that those facilities (related to the DRE data provided for SF_6) have continuous monitoring of chlorinated dioxins/furans, with measured levels meeting local regulatory requirements (0.01-0.08 ng ITEQ/Nm^3) (also well within the assessment criteria used by TEAP). Other pollutants (HF/HCl, CO, particulates) are also monitored continuously and meet local regulatory requirements. At the time of completion of the Revision to the Addendum Report, the 2018 TFDT had yet to receive information verifying the destruction of HFCs. Data were also available from the 2002 TFDT report related to particulate and dioxins/furans emissions that meet the performance criteria for ODS destruction.

In the absence of data for HFC destruction, and with DRE and emissions data for the destruction of surrogate refractory halogenated organic chemicals (SF_6, carbon tetrachloride, tetrachloroethylene, ODS) that meet the performance criteria, according to the assessment criteria used by TEAP, **Rotary Kiln Incineration remains recommended as *high potential* for applicability to HFCs destruction, including HFC-23**.

1.2 Plasma Technologies

1.2.1 Argon Plasma Arc

DRE (99.994%) and emissions data are available that meet all of the performance criteria for HFC destruction except for HFC-23. For HFC-23 destruction, DRE and emissions data meet the performance criteria except for CO, which did not meet the performance criteria. Therefore, **Argon plasma arc is recommended for *approval* for applicability to HFCs destruction except for HFC-23, and as *high potential* for HFC-23 destruction.**

1.2.2 Inductively coupled radio frequency plasma

Due to insufficient data for HFC destruction applicability being available, **the 2018 TFDT is *unable to assess* Inductively Coupled Radio Frequency Plasma for applicability for HFCs destruction.**

1.2.3 Microwave Plasma

Due to insufficient data for Hbeing available, **the 2018 TFDT is *unable to assess* Microwave Plasma for applicability for HFCs destruction**.

[1] Philip H. Taylor & John F. Chadbourne (1987), “Sulfur Hexafluoride as a Surrogate for Monitoring Hazardous Waste Incinerator Performance”, *Journal of Air Pollution Control Association (JAPCA)*, 37:6, 729-731, DOI: 10.1080/08940630.1987.10466260. http://dx.doi.org/10.1080/08940630.1987.10466260. | [Accessed Oct. 11 2018].

1.2.4 Nitrogen Plasma Arc

DRE (99.99%) and emissions data are available that meet all of the performance criteria for HFC destruction, including for HFC-23. Therefore, **Nitrogen Plasma Arc is recommended for *approval* for applicability to HFCs destruction, including HFC-23.**

1.2.5 Portable Plasma Arc

While DRE, HF, and CO emissions meet the performance criteria for HFCs destruction, data were not available for particulates and dioxins/furans emissions for HFCs destruction. No emissions data were available for HFC-23 destruction. **Portable Plasma Arc is recommended as *high potential* for applicability to HFCs destruction except for HFC-23. The 2018 TFDT is *unable to assess* Portable Plasma Arc for applicability for HFC-23 destruction.**

1.3 Conversion (non-incineration) technologies

1.3.1 Chemical Reaction with H_2 and CO_2

Refrigerants are reclaimed to saleable purity of refrigerants before processing. All gases from the processes are recycled back into the reactor. These process features suggest that only DRE should be relevant for the assessment, and thus meets the performance criterion. **Chemical Reaction with H_2 and CO_2 is recommended for *approval* for HFC destruction including HFC-23.**

1.3.2 Gas Phase Catalytic De-halogenation

No dioxins/furans emissions data for HFCs destruction were available to the 2018 TFDT. The 2002 TFDT report noted that the TFDT believed that the dioxins/furans emissions would be comparable to those from rotary kilns, although also had no actual emissions data available. **Gas Phase Catalytic De-halogenation is recommended as *high potential* for applicability to HFCs destruction, including HFC-23.**

1.3.3 Superheated steam reactor

In the absence of emissions data demonstrating that it meets the performance criteria for particulates, **Superheated Steam Reactor is recommended for *high potential* for applicability to HFCs destruction, including HFC-23.**

1.3.4 Thermal Reaction with Methane

Due to insufficient data being available at the time of writing, **the 2018 TFDT is *unable to assess* Thermal Reaction with Methane to confirm its applicability to HFCs destruction**.

2 Assessment of any other technology for possible inclusion in the list of approved destruction technologies in relation to controlled substances

2.1 Thermal Oxidation

2.1.1 Electric Heater

The available emissions data applies to HFCs destruction. Particulate emissions that meet the performance criteria were unavailable. No information was provided to indicate whether other controlled substances (CFCs, etc.) have been destroyed using this technology. **Electric Heater is recommended as *high potential* for HFCs destruction, including HFC-23.**

2.1.2 Fixed Hearth Incinerator

Due to insufficient data being available, **the 2018 TFDT is *unable to assess* Fixed Hearth Incinerators** for possible inclusion on the list of approved destruction technologies.

2.1.3 Furnaces Dedicated to Manufacturing

Due to insufficient data being available, **the 2018 TFDT is *unable to assess* Furnaces Dedicated to Manufacturing** for possible inclusion on the list of approved destruction technologies.

2.1.4 Thermal Decay of Methyl Bromide

In the absence of measured brominated dioxin/furan emissions, and with all other emissions and technical capacity meeting the performance criteria, **Thermal Decay of Methyl Bromide is recommended as *high potential* for methyl bromide destruction.**

2.2 Plasma technologies

2.2.1 Air Plasma Arc

Due to insufficient data being available, **the 2018 TFDT is *unable to assess* Air Plasma Arc** for possible inclusion on the list of approved destruction technologies.

2.2.2 Alternating Current Plasma (AC Plasma)

Due to insufficient data being available, **the 2018 TFDT is *unable to assess* AC Plasma Arc** for possible inclusion on the list of approved destruction technologies.

2.2.3 CO_2 Plasma

Due to insufficient data being available, and no data that meets the performance criteria, **the 2018 TFDT is *unable to assess* CO_2 Plasma Arc** for possible inclusion on the list of approved destruction technologies. The 2002 TFDT reported emissions data for dioxins/furans for the destruction of ODS that meets the performance criterion, and emissions data for particulates that do not meet the criterion.

2.2.4 Steam Plasma Arc

The 2018 TFDT has been unable to contact the technology owner. Due to insufficient data being available, **the 2018 TFDT is *unable to assess* Steam Plasma Arc** for possible inclusion on the list of approved destruction technologies.

2.3 Conversion (or non-incineration) technologies

2.3.1 Catalytic Destruction

Due to insufficient data being available, **the 2018 TFDT is *unable to assess* Catalytic Destruction** for possible inclusion on the list of approved destruction technologies.

2.3.2 Chlorination/De-chlorination to Vinylidene Fluoride

This technology is part of a chemical manufacturing process and is not a destruction n process.

2.3.3 Solid Alkali Reaction

Due to insufficient data being available, **the 2018 TFDT is *unable to assess* Solid Alkali Reaction** for possible inclusion on the list of approved destruction technologies.

Annex III

Response to Decision XXVI/5(2) on Laboratory and Analytical Uses

Executive summary

Laboratory and analytical uses of controlled substances have included: equipment calibration; extraction solvents, diluents, or carriers for specific chemical analyses; inducing chemical-specific health effects for biochemical research; as a carrier for laboratory chemicals; and for other critical purposes in research and development where substitutes are not readily available or where standards set by national and international agencies require specific use of the controlled substances.

Decision IV/25 establishes criteria and procedures that permit the production and consumption of controlled substances beyond their production phase-out, in relation to the control measures under Article 2. Under decision VI/9, parties authorised an essential use exemption for laboratory and analytical uses for the first time, according to conditions established at the 6th meeting of the parties. These conditions authorise essential use production for laboratory and analytical purposes only if the controlled substances are manufactured to high purity and supplied in re-closable containers and in small quantities: this became known as the global essential use exemption.

Paragraph 2 of decision XXVI/5 requests the Technology and Economic Assessment Panel (TEAP) to report on the development and availability of laboratory and analytical uses that can be performed without using controlled substances (within the context of extending the global essential use exemption until the end of 2021). This report forms TEAP's response to decision XXVI/5.

The global essential use exemption applies to controlled substances in Annex A, B, C Groups II and III, and Annex E, as relevant to the Article 2 control measures for Article 5 and non-Article 5 parties. This report limits its focus primarily on controlled substances already included under the global essential use exemption for laboratory and analytical uses. It provides some information on the known laboratory and analytical uses of Annex C Group I. Annex F controlled substances are not included in this report.

In 2016, the global production of all reported controlled substances for laboratory and analytical uses was relatively small (151 tonnes). Carbon tetrachloride is the main controlled substance produced for these uses (more than 99.9 per cent); the production of other controlled substances is relatively very small. Reported total production in non-Article 5 parties was 21 tonnes (about 14 per cent of the reported global total) in 2016. Article 5 parties began reporting production data for LAUs in 2009, with a gradual overall decrease in reported production, from a peak of 257 tonnes in 2010 to 130 tonnes (about 86 per cent) in 2016.

TEAP reported in detail in 2008, 2009, 2010 and 2011 on the availability of alternatives for laboratory and analytical uses of ozone-depleting substances. This report considers available alternatives, and potential barriers to their adoption, in Article 5 and non-Article 5 parties.

A review of standards for analytical procedures has been undertaken; the major standards related bodies were considered in this review. Difficulties and/or complexities in adopting the alternatives may be creating greater barriers for Article 5 parties.

Recommendations have been made based on currently available information and building on the previous reviews (see Chapter 4).

Parties may wish to consider removing the procedures listed in the table below from the global exemption for laboratory and analytical uses of ODS, at a date to be determined by parties.

Table ES.1

Recommendation of laboratory and analytical procedures to be removed

ODS Type	Procedures
Methyl bromide	Laboratory uses as a methylating agent
Carbon tetrachloride (CTC)	Reaction solvents
CTC	A solvent for IR, Raman and NMR spectroscopy
CTC	Grease removal and washing of NMR tubes
CTC	Iodine partition and equilibrium experiments
CTC	Determination of hydrocarbons in water, air, soil or sediment
CTC	Determination of moisture and water
1,1,1-trichloroethane (TCA)	Determination of bromine index
CTC	Determination of iodine index

In addition, parties may wish to consider recalling that any decision taken to exclude a use from the global exemption would not prevent a party from nominating a specific use for an exemption under the essential uses procedure, as set out in decision IV/25.

Parties may wish to consider establishing cooperation with standards organisations, to facilitate and accelerate the development or revision of standards for the replacement of ODS in analytical uses.

Parties may also wish to consider providing:

- more comprehensive data (e.g. on consumption);
- sharing information on alternatives and on the revision of standards that use ODS;
- possible support for the development and/or revision of standards, and/or training, where needed.

Many standards still require the use of small quantities ODS. There may come a point when the continued exclusion of specific laboratory and analytical uses on a case by case basis from the global exemption creates potential confusion for practitioners and regulators. Monitoring of, and adherence to, specific authorised uses of ODS in laboratory and analytical applications may become increasingly challenging as the exclusion list expands.

Annex IV

Decision XXIX/10 Task Force report on issues related to Energy Efficiency while phasing down hydrofluorocarbons (updated final report)

Executive summary[1]

At their 29th Meeting, parties requested the Technology and Economic Assessment Panel (TEAP) to report to the 40th Open-ended Working Group (OEWG-40) on issues related to energy efficiency (EE) while phasing down hydrofluorocarbons (HFCs), as outlined in Decision XXIX/10. Decision XXIX/10 requests, in relation to maintaining and/or enhancing energy efficiency in the refrigeration and air-conditioning and heat-pump (RACHP) sectors, an assessment of:

- Technology options and requirements including
  - Challenges for their uptake;
  - Their long-term sustainable performance and viability; and
  - Their environmental benefits in terms of CO2eq;
  - Capacity-building and servicing sector requirements in the refrigeration and air-conditioning and heat-pump sectors;
- Related costs including capital and operating costs;

The decision also requested TEAP to provide an overview of the activities and funding provided by other relevant institutions addressing EE in the RACHP sectors in relation to maintaining and/or enhancing energy efficiency while phasing down HFCs under the Kigali Amendment.

Finally, Decision XXIX/10 requested the Secretariat to organise a workshop on EE opportunities while phasing-down HFCs at hydrofluorocarbons at OEWG-40, and, thereafter, for TEAP to prepare an updated final report for the 30th Meeting of the Parties (MOP-30) to the Montreal Protocol, taking into consideration the outcome of the workshop.

In response to Decision XXIX/10, TEAP established the Decision XXIX/10 Task Force, which included TEAP and Technical Options Committees members as well as outside experts. EE is a broad topic of major importance for the environment, economics and health, and there is an enormous amount of published literature and reviews. In preparing its response to the decision, the Task Force referenced information provided in earlier TEAP reports (e.g., Decision XXVIII/3 Working Group Report – October 2017) and examined updated, available research and studies. Outside expert members of the Task Force provided relevant information from their own research and of work done by their colleagues and organisations for consideration in this report.

This report is organised, following the format requested in Decision XXIX/10, into an introduction and two main chapters. Chapter 2 deals with the technology opportunities related to maintaining or enhancing EE during the phasedown of HFCs. Various aspects of the EE opportunities in the RACHP sector were considered. Chapter 2 also considered the other topics requested from the decision including the long-term sustainability and viability of the technology opportunities, consideration of high ambient temperature conditions, climate benefits from adopting the RACHP EE measures, and consideration of related capital and operating costs. Chapter 3 examines other financial institutions where these may intersect with support for realizing EE goals in the RACHP sectors during the phasedown of HFCs. Contained in two annexes are information about the different challenges to the technology uptake in the RACHP sectors and examples of relevant projects funding or financing. Two additional annexes provide a summary of the workshop organised by the Secretariat and the guidance to the TEAP from the OEWG-40 contact group for consideration in the updated final report to MOP-30. For ease of reference, updates to the May 2018 Decision XXIX/10 Task Force Report are highlighted in grey throughout this updated September 2018 final report.

Below are summaries of the various sections of the report.

Energy efficiency in RACHP sectors in the context of refrigerant transition

Low GWP refrigerants are expected to have an impact on the system efficiency, which is likely to be within ±5% of the baseline refrigerant(s) in terms of energy performance. Refrigerant blends can be

[1] The new information included in the updated final report appears highlighted in grey.

valuable in optimising system performance, balancing between coefficient of performance (COP), volumetric capacity, flammability, and GWP.

The large majority of the improvement in EE in newly designed RACHP systems can be achieved through the optimisation and use of new and advanced components, particularly compressor, heat exchanger and controls

The Kigali Amendment to the Montreal protocol focused primarily on developing a timeline to phase down high global warming HFCs to avoid direct contribution of up to 0.5°C of total global warming by 2100. However, the direct benefits of the reduction of high GWP refrigerants during the phase down might be offset by the use of less energy-efficient equipment. On the contrary, if this amendment resulted in the use of more energy-efficient equipment, the total reduction of greenhouse gases emissions both from direct and indirect sources, could double that.

Technology opportunities and challenges to maintain and/or enhance energy efficiency of new RACHP equipment

Technology research and development, and the studies to assess those technologies, are progressing to support compliance with the Kigali amendment.

By using a rigorous integrated approach to RACHP equipment design and selection, the opportunities to improve EE or reduce energy use can be maximised. This approach includes:

- Ensuring minimisation of cooling/heating loads;
- Selection of appropriate refrigerant;
- Use of high efficiency components and system design;
- Ensuring proper install, optimised control and operation, under all common operating conditions;
- Designing features that will support servicing and maintenance.

While the benefits of higher EE, such as savings in energy, operating cost to the consumer, peak load and GHG emissions are widely recognised, many barriers to the uptake of more efficient equipment continue to persist. There are a number of common challenges that apply to all types of RACHP equipment. There are also certain market and sector-specific issues that are presented in further detail. Broadly, these barriers can be classified into the following categories: financial, market, information, institutional and regulatory, technical, service competency and others. Ways to overcome the barriers, and estimates of the length of time needed to introduce alternatives are presented.

Technologies resulting in efficiency improvement opportunities available for high-GWP refrigerants may be applicable to low-GWP refrigerants as well.

The largest potential for EE improvement comes from improvements in total system design and components, which can yield efficiency improvements (compared to a baseline design) that can range from 10% to 70% (for a "best in class" unit). On the other hand, the impact of refrigerant choice on the EE of the units is usually relatively small – typically ranging from +/- 5 to 10%. Furthermore, there are also a wide variety of co-benefits of EE in addition to avoided peak load. Various examples cited the following benefits: avoided mortality caused by energy poverty, avoided morbidity caused by energy poverty, reduced days of illness, comfort benefits, avoided SOx, NOx and particulate matter emissions, and avoided CO_2 emissions in addition to direct economic benefits, such that these additional co-benefits were 75%-350% of the direct energy-savings benefits of energy efficiency in the cases reviewed.

Long-term sustainable performance and viability

In assessing consideration of long-term sustainable performance and viability (of technology options and requirements in the context of maintaining or exceeding energy performance), it was necessary for the Task Force to define the terms and timeframes for this assessment. The Task Force interpreted the term "long-term" for RAHCP technologies to mean for a period of up to 15 years, which is consistent with previous assessments of this term used and reported by the TEAP.

For the phrase " sustainable performance and viability" (over the 15-year "long-term" timeframe), the Task Force looked to assess whether or not the options and requirements for technology that are commercially available today and being commercially developed for the nearer term (which include zero or low-GWP refrigerants - single chemicals and blends, and compatible equipment/hardware), would be anticipated to at least meet EE needs (i.e., would be viable) and whether or not they would remain viable over the next 15 years, including considerations for servicing.

Therefore, the relevant aspects that will impact the long-term sustainment of performance are expected to be as follows:

- Technological environment,
- Minimum Energy Performance Standards (MEPS) and labelling programmes.

While the challenge of researching and finding sound, technical solutions is important, in some cases it may be even more important to ensure engagement with the customer and the industry and consideration of issues of the whole supply chain in order to ensure that the process of putting those technologies to practical use is not jeopardized.

District cooling and Green Building Codes are additional ways to realise EE improvements.

High ambient temperature (HAT) considerations

A HAT environment imposes an additional set of challenges on the selection of refrigerants, system design, and potential EE enhancement opportunities.

At HAT, system designs which maintain energy efficiency are affected by the refrigerant choice due to thermodynamic properties, safety requirements due to the increased charge, and component availability and cost.

Research at HAT conditions done so far has shown the viability of some low-GWP alternatives to deliver comparable EE results to existing technologies. Further financed research, as well as private sector efforts, continue to focus on the optimisation of design to achieve targeted efficiencies for those alternatives.

The rise of outdoor temperatures due to climate change pose specific challenges for refrigeration and air conditioning (RAC) equipment, especially in HAT conditions.

Environmental benefits in terms of CO_2eq

Over 80% of the global warming impact of RACHP systems is associated with the indirect emissions generated during the production of the electricity used to operate the equipment (indirect), with a lower proportion coming from the use/release (direct emissions) of GHG refrigerants where used.

The environmental impact of improving system efficiency is a factor of the type of equipment, how many hours and when it is used (influenced by ambient temperature and humidity conditions), and the emissions associated with generating power, which vary by country.

Climate and development goals are driving governments to adopt policies to improve the EE of equipment. In the RACHP sector, a holistic approach is important for reducing equipment energy consumption. Reducing cooling/heating loads present the best opportunity to reduce both indirect emission through lower consumption of electricity and direct emissions through the reduction of the refrigerant charge associated with the load.

For the purposes of this report, the approach and examples presented consider only the indirect CO_2eq environmental benefit from energy efficient technologies in the RACHP applications related to a single unit of equipment.

Servicing sector requirements

The present concern in most Article 5 countries in the HCFC phase-out process is to train technicians on the use of new refrigerants. EE aspects require additional training and further awareness.

Some EE degradation over the life time of equipment is inevitable; however, there are ways to limit the degradation through improved design and improved servicing which include both installation and maintenance.

The impact of proper installation, maintenance, and servicing on the efficiency of equipment and systems is considerable over the life time of these systems while the additional cost is minimal.

The benefits of proper maintenance are considerable. Appropriate maintenance and servicing practices can curtail up to 50% reduction in performance and maintain the rated performance over the lifetime.

Other benefits include reduced energy cost, improved safety by eliminating risks, better temperature control and occupant comfort, and compliance with regulations.

Capacity-building requirements

There are enabling activities such as capacity building, institutional strengthening, demonstration projects, and national strategies and plans that help to bridge Montreal Protocol activities under the Kigali Amendment and EE. A number of enabling activities supported by the other funds, such as the

Kigali Cooling Efficiency Programme and the Global Environment Facility, have advanced both ozone depletion and EE goals.

Additional enabling activities under the Kigali Amendment can bridge the current Montreal Protocol activities with those destined towards EE and serve as examples of potential synergy between HFC phasedown and EE opportunities.

In the servicing sector, the use of low-GWP refrigerants requires capacity building and training initiatives to address the specific issues related to installation, operation and maintenance of low-GWP refrigerant based equipment.

Costs related to technology options for energy efficiency

EE can bring multiple economic benefits. The most frequently cited benefits of EE are energy, cost and greenhouse gas (GHG) saving and, for space cooling, peak load reduction. In addition, there is a reduction in the morbidity and mortality caused by energy poverty, reduced days of illness, improved comfort, reduced pollution and avoided CO_2 emissions.

A summary is presented of methods developed by various countries with established market transformation programs for promoting EE including MEPS programs and labelling programs.

It should be noted that the presented methodology offers a “snapshot” of the cost of efficiency improvement at any given time and will tend to provide a conservative (i.e. higher) estimate of the cost of efficiency improvement. In actual practice, the prices of higher efficiency equipment have been found to decline over time in various markets as higher efficiency equipment begins to be produced at scale. This applies especially for small mass-produced equipment where manufacturers quickly absorb the initial development costs and try to get to certain “price points” that help them sell their equipment.

Retail price of products is not an adequate indicator for the costs of maintaining or enhancing EE in new equipment due to:

- bundling of various non-energy related features with higher efficiency equipment,
- variation of manufacturer’s skills and know-how,
- variation in manufacturer’s pricing, marketing and branding strategies, and
- the idea that efficiency can be marketed as a “premium” feature.

Rigorous cost analysis may be needed to fully understand the impact of EE improvements. These types of analyses are relevant when setting MEPS as several EE levels need to be evaluated compared with the baseline. These studies can take more than 1 year to conclude for a single product category. As such, in this report we would like to refer parties to the corresponding methodologies and present simplified examples based on products already introduced on the market.

A matrix of possible technical interventions aimed at improving EE and associated costs is provided.

Global market for EE and funding

The market for energy efficiency is growing, with global investment in EE increased by 9% to US$ 231 billion in 2016.

Among end users, buildings still dominate global EE investments accounting for 58% in 2016.

EE investment in the building sector increased by 12% in 2016 with US$ 68 billion in incremental EE investment in the building envelope in 2016, US$ 22 billion in heating, ventilation and air conditioning (HVAC), US$ 28 billion in lighting, and US$ 2 billion in appliances.

The majority of large multilateral climate funds operate in sectors other than RACHP, such as energy access, renewable energy transmissions and other related investment projects.

Multilateral funds have a key role in providing grant funding to fill gaps in public finance.

At this point, most large multilateral climate related funds such as the Global Environment Facility (GEF), Climate Investment Fund (CIF), and Green Climate Fund (GCF), focus on energy access and renewable energy sectors and not on RACHP.

Less than 0.1 percent of Official Development Assistance (ODA)[2] projects in 2014 and 2015 are focusing on cooling, indicating that there is extremely low international focus on cooling relative to other development topics.

In spite of the low level of funding for cooling/RACHP sectors, there are numerous financial resources for project implementation in the field of EE in general. In addition to funding institutions that provide resources in the form of directed grants, there are financing institutions that provide project funding support through mechanisms, such as, loans, green bonds or other instruments. Moreover, private capital is an additional source through companies who might be interested to finance project implementation against investment payback.

Broad consideration of the various potential interested stakeholders, opportunities for partnerships with shared goals, and options for co-financing would be important to planning for potential projects related to EE in the RACHP sector while phasing down HFCs. To emphasise this issue, the Vienna EE Workshop finance panel report (para 29) [3] stated: "It is generally held that, while sufficient funds are available to support EE measures, *these do not flow effectively*. It was suggested that a catalogue of funding opportunities be developed as an information source for parties."

Taking into consideration the request from the EE Workshop, the Task Force prepared a catalogue of funding opportunities. However, based on preliminary analyses, the Task Force considers that this mapping exercise is insufficient alone, without some consideration of potential options for a new financial architecture by which resources for EE could flow more certainly and effectively.

There is a need to address the barriers against coordination with existing financial organisations (e.g., The GEF, GCF, CIF, etc.) with a view to having strategic focal areas introduced with earmarked financial windows/flows, and within a streamlined timeframe designed to meet MP targets and EE objectives in the phasedown of HFCs.

Given the significant financial resources potentially available related to EE in general and the currently low level of funding to projects specific to the RACHP sector, parties may wish to consider:

- Developing appropriate liaison with the main funding institutions with shared objectives, in order to investigate the potential for increasing the volume and improving the streamlining of processes that either currently don't exist or for which there are only low levels of funding being made available to the RACHP sector. The aim would be to enable timely access to funding for MP related projects and activities which integrate EE into the RACHP sector transitions, and the HFC phasedown.
- Investigating funding architectures that could build on and complement the current, familiar funding mechanisms under the MP and if deemed appropriate, establishing clear rules, regulations, and governance structures for any such new funding architecture that could enable the current MP funding processes to most effectively bridge to other financial resources.

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[2] https://data.oecd.org/oda/net-oda.htm. Official development assistance (ODA) is defined as government aid designed to promote the economic development and welfare of developing countries. Loans and credits for military purposes are excluded.

[3] A Workshop Report was presented to OEWG 40 (UNEP/OzL.Pro.WG.1/40/6/Rev.1) (www.ozone.unep.org)