UNITED NATIONS

EP

UNEP/OzL.Pro.WG.1/43/3/Rev.1

Distr.: General
9 June 2021

Original: English

United Nations Environment Programme

Open-ended Working Group of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer
Forty-third meeting
Online, 22 and 24 May and 14–17 July 2021*
Item 12 of the provisional agenda**

Energy-efficient and low-global-warming-potential technologies (decision XXXI/7)

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

Note by the Secretariat

Energy efficiency

I. Introduction

1. In its decision XXXI/7, on continued provision of information on energy-efficient and low-global-warming-potential technologies, the Thirty-First Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer requested the Technology and Economic Assessment Panel to prepare a report for consideration by the Thirty-Second Meeting of the Parties addressing any new developments with respect to best practices, availability, accessibility and cost of energy-efficient technologies in the refrigeration, air-conditioning and heat-pump sectors as regards the implementation of the Kigali Amendment to the Montreal Protocol.

2. In response to that decision, the Technology and Economic Assessment Panel established a task force with a view to preparing the above-mentioned report in time for its consideration by the Thirty-Second Meeting of the Parties in 2020. Owing to the coronavirus disease (COVID-19) pandemic, it was decided that the Thirty-Second Meeting of the Parties would be held online, with a reduced agenda, and that issues related to energy efficiency would instead be included in the agenda of the forty-third meeting of the Open-ended Working Group of the Parties to the Montreal Protocol, scheduled to be held in July 2021.

3. Notwithstanding the situation, the Panel's task force prepared its report as had originally been planned in order to provide the parties with ample time to consider its findings before their formal discussions in July 2021. In that report, set out in volume 2 of the September 2020 report of the Technology and Economic Assessment Panel,[1] the task force indicated that it would provide an update report, if sufficient information became available before the forty-third meeting of the Open-ended

* Some agenda items will be discussed online and others will be deferred to a later date.

** UNEP/OzL.Pro.WG.1/43/1.

[1] https://ozone.unep.org/sites/default/files/assessment_panels/TEAP_dec-XXXI-7-TFEE-report-september2020.pdf.

Working Group. Accordingly, the information became available and the task force prepared its update report, set out in volume 4 of the 2021 report of the Technology and Economic Assessment Panel.[2] The report is available on the meeting portal of the forty-third meeting of the Open-ended Working Group[3] and on the online forum on energy efficiency set up by the Secretariat to facilitate the parties' consultations on the matter.[4] The executive summary of the report is set out in the annex to the present note as received by the Secretariat, without formal editing. A summary of the information provided in the report is set out in section II of the present note.

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

A. Energy-efficient technologies in the refrigeration, air-conditioning and heat-pump sectors for the implementation of the Kigali Amendment to the Montreal Protocol (decision XXXI/7)

4. The 2021 update report on the continued provision of information on energy-efficient and low-global-warming-potential technologies is the fifth in a series of reports prepared by the Panel in response to decisions of the Meeting of the Parties[5] since the adoption of the Kigali Amendment to the Montreal Protocol in 2016, addressing issues related to energy efficiency while phasing down hydrofluorocarbons (HFCs), and the cost and availability of low-global-warming-potential (GWP) technologies and equipment that maintain or enhance energy efficiency. As it has done for previous reports, the task force has restricted the scope of the document mainly to room air conditioners and self-contained commercial refrigeration equipment.

5. The structure of the 2021 update report is similar to that of the 2020 report, but its content has been expanded to include a discussion on modelling the benefits of enhancing energy efficiency while phasing down HFCs, and on a proposed draft framework to catalogue the diverse and extensive information compiled in recent Panel reports on energy efficiency.

6. Introducing its report, the task force provides a summary of the key findings of the previous reports, including the importance of harnessing energy efficiency solutions during the HFC phase-down, as these could double the climate benefits derived from the timely implementation of the Kigali Amendment, and the importance of access to cooling in meeting many of the Sustainable Development Goals. In addition, previous reports had shown that many energy-efficient technical innovations in refrigeration and air conditioning using lower-GWP refrigerants were available and being implemented, and that in some regions and sectors it was possible and beneficial for parties to leapfrog from HCFCs directly to lower-GWP refrigerants and higher energy efficiency. Furthermore, minimum energy performance standards, already introduced in some parties operating under paragraph 1 of Article 5 (Article 5 parties), would need to take into account the transition to lower-GWP refrigerants. Combined finance from multilateral organizations could drive best practice in delivering energy efficiency gains during the HFC phase-down in those parties.

7. The task force also highlights the progress made in the operationalization of the Kigali Amendment, noting the number of parties that had ratified the Amendment at the time of preparation of the report (120 as at 19 May 2021), and the support provided to Article 5 parties under the Multilateral Fund for the Implementation of the Montreal Protocol by 2020 in that regard. Funding of $34 million[6] has already been provided for enabling activities, project preparation and investment projects to inform the ongoing discussions on the HFC cost guidelines and finance fast-start activities.

8. The salient aspects of a number of useful recent reports are also provided, highlighting the environmental and development benefits of energy-efficient and climate-friendly cooling.

[2] https://ozone.unep.org/system/files/documents/TEAP-EETF-report-may2021.pdf.

[3] https://ozone.unep.org/meetings/43rd-meeting-open-ended-working-group-parties-montreal-protocol/pre-session-documents.

[4] https://online.ozone.unep.org/t/energy-efficient-and-low-gwp-technologies/94.

[5] Decisions XXVIII/3, XXIX/10, XXX/5 and XXXI/7.

[6] Including projects funded by the additional, voluntary contributions amounting to over $ 25.5 million from a group of donor countries to finance fast-start activities for the implementation of the HFC phase-down.

B. Update for 2021 on new refrigerants

9. With regard to new refrigerants, the task force notes that since the publication of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee 2018 assessment report,[7] one new single-component refrigerant (iodofluorocarbon IFC-13I1, GWP=1) and eight new refrigerant blends have received a designation or classification from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) of standard 34, and/or from the International Organization for Standardization (ISO) of standard ISO 817. Research into the chemical stability and the (low) chronic toxicity of IFC-13I1 is ongoing.

10. Most of the lower-GWP alternatives available on the market have different degrees of flammability, ranging from lower to higher flammability. Experts have worked together to address this challenge by developing new safety standard requirements.[8] These new revised safety standards will enable increased refrigerant charge size for flammable refrigerants in equipment. Numerous research activities are under way to pave the way for the safe use of flammable refrigerants.

11. In room air conditioning, both natural and lower-GWP fluorinated refrigerants are now widely available to replace most high-GWP refrigerants, and it is possible to leapfrog to lower-GWP options in many regions. While more than 50 per cent of the globally produced air-conditioning units now use refrigerants with no ozone-depleting potential, in Article 5 parties locally produced room air conditioners predominantly use HCFC-22 and remain relatively inefficient. The lack of high performance HCFC-22-based compressors combined with more stringent minimum energy performance standards in some Article 5 parties is starting to favour the move towards the use of HFC technologies. However, where minimum energy performance standards have not yet integrated the future HFC phase-down schedule, the switch tends to be towards high-GWP refrigerants, in particular R-410A.

12. Lower-GWP refrigerants comprise: HFC-32, with a GWP of 675, already introduced in many countries around the world as an energy-efficient lower-GWP refrigerant; blends involving low-GWP HFCs, hydrofluoroolefins (HFOs), hydrochlorofluoroolefins (HCFOs) or iodofluorocarbon (IFC), with GWPs ranging from 100 to 750 and varying degrees of flammability; and hydrocarbons (HCs), with GWP ranging from 1 to 20, such as HC-290, with use currently limited to small-capacity room air conditioners and portable or window air conditioners due to its higher flammability. Mitigation factors enabling the use of flammable refrigerants such as HC-290 involve the employment of qualified installers trained in the safe use of such refrigerants and the update of relevant safety standards.

13. In commercial refrigeration installations, low-charge and low-leak designs are already being used as alternatives to larger central systems in several countries and regions, operating with low-GWP refrigerants such as R-744, HC-600a and HC-290, while lower-GWP HFO blends are being applied in smaller charge commercial systems.

C. Refrigerant cost considerations

14. The cost of the refrigerant is typically 1 to 3 per cent of the cost of the air-conditioning equipment. However, the servicing costs of top-up refrigerant can be a substantial and recurrent hidden cost.

15. For typical room air-conditioning applications, when all factors pertaining to system design and refrigerant charge are taken into consideration, the use of HFC-32 is currently more cost-effective than R-410A or HC-290. However, in several regions the single component HFC-32 price is significantly higher than that of R-410A, and this price differential has been cited as a barrier to more widespread introduction of HFC-32 equipment. The price of HFC-32 will probably come down over time. Lessons learned from previous refrigerant transitions have shown that whereas upfront production costs tend to increase, these are offset by improved product efficiency, production process improvements and economies of scale.

16. Although self-contained units using lower-GWP flammable refrigerants have been widely adopted for mini-split and split air conditioners, the use of such refrigerants involves several barriers pertaining to safety concerns, lack of qualified servicing technicians, restrictive standards and regulations such as local building codes, transportation codes and cost. Coordination between relevant

[7] https://ozone.unep.org/sites/default/files/2019-04/RTOC-assessment-report-2018_0.pdf.

[8] With regard to International Electrotechnical Commission (IEC) standards, IEC 60335-2-89 has recently increased the charge levels for flammable refrigerants, which is expected to have a positive impact on the use of all lower-GWP flammable refrigerants; IEC 60335-2-40 is under revision and a committee draft for vote includes provisions for increased flammable refrigerant charge.

bodies is needed to reduce these barriers but this seems to be a difficult task. Establishing technician certification schemes for handling flammable refrigerants is also deemed necessary as these are important in reducing leakage rates and improving safety. In Article 5 parties, developing the skills of technicians for safe installation and servicing of flammable refrigerants represents a significant additional cost compared to less flammable refrigerants.

17. In general, strong regulatory and market signals encourage manufacturers to scale up their production, which results in lower prices and increased experience with and confidence in the technology at hand, therefore driving adoption.

D. Update for 2021 on energy-efficient technologies for room air conditioning and self-contained commercial refrigeration

18. The task force report elaborates on the latest developments in energy-efficient technologies for room air conditioning and self-contained commercial refrigeration, including providing summary tables outlining the impact that various technological improvements can have on improving maximum potential energy efficiency and the associated incremental operating and capital costs.

19. In room air conditioning, technological improvements for various components (e.g., compressors, heat exchangers, electronic expansion valves) may individually lead to a maximum potential energy efficiency improvement of up to 35 per cent, but can reach 50 per cent in some cases when specific improvements are applied synergistically. However, several technical barriers continue to slow the adoption of such energy efficiency measures, including a lack of technical know-how and of manufacturing capacity. To this end, the task force notes that the Global Cooling Prize, awarded in April 2021, showed that with innovative design in room air conditioners it is technically and economically feasible to reduce their climate impact by five times compared with baseline technologies, while limiting the cost to about twice the baseline cost when manufactured at scale.

20. In self-contained commercial refrigeration, energy efficiency gains of up to 33 per cent can be achieved through improvements in various energy efficiency technology options, such as high-performance insulated glazing units for doors, and the use of high-efficiency compressors and smart controllers.

21. Incremental operating and capital costs for these technologies may vary widely. Such costs are provided in the task force report for the specific technology options for both air conditioning and commercial refrigeration.

E. Availability and accessibility

22. Addressing the availability of high-energy-efficiency products with lower-GWP refrigerants for manufacturers,[9] the task force notes, among other things, that such technology is available for both room air conditioning and self-contained commercial refrigeration. The main challenge is how to build capacity in Article 5 parties to exploit these improvements and make them both accessible and affordable. This involves giving local manufacturers time to absorb the technology, while developing a common framework of reference standards that considers both energy efficiency and HFC phase-down; building a national regulatory, compliance and verification framework infrastructure; and developing local technician training programmes.

23. The accessibility of high-energy-efficiency products with lower-GWP refrigerants[10] for end-users can vary between regions, adjacent countries and even between districts within a country. It is influenced by multiple factors including the local supply chain; the regulatory environment (e.g., minimum energy performance standards, energy labels harmonized with Montreal Protocol

[9] "Availability" is, as defined in the task force report, the ability of the industry to manufacture products with new technologies of lower-GWP refrigerants and higher efficiency. Availability is controlled by the manufacturers and is related to technology. The factors affecting availability of products that are manufactured locally are summarized as: the ability of the industry in a country to absorb new technologies; technical capabilities needed to implement the technology; scalability of operations; and barriers such as intellectual property rights and patents.

[10] "Accessibility" is, as defined in the task force report, focused on the consumer and varies with location within a region, country, or even district within a country. Some of the factors which affect accessibility include: supply chain; importers and suppliers for parts and refrigerants; presence of local manufacturing and/or assembly; regulations affecting energy efficiency and safety; collaboration with energy departments on integrated minimum energy performance standards; service sector capacity and quality; electricity quality, reliability and price; affordability; acceptability and preferences; and presence or absence of laboratories and certification and verification bodies.

requirements, safety and flammability standards, building codes, certification schemes, trade policies); consumer affordability and return on investment; and servicing, including the availability of spare parts and refrigerants, trained technicians, quality and reliability of power supply, and logistics pertaining to transport, storage and handling of equipment.

24. According to the task force, harmonizing and implementing ambitious minimum energy performance standards and fully integrating them with HFC phase-down plans is the single most important method for improving accessibility for high energy efficiency/low-GWP equipment in Article 5 parties. Accessibility for technology receivers can be improved by increasing technology awareness, contractor training, affordability, kick-starting market interest, ensuring the enforcement of standards through inspection and penalties; and removing electricity subsidies to make consumers aware of both the importance of energy efficiency and the burden on the government. Significant technology producers with large export markets could be encouraged to produce high energy efficiency/low-GWP equipment by receiving advance warning that their export markets are introducing challenging minimum energy performance standards or similar market transformation policies requiring a combination of high energy efficiency and low-GWP HFCs. Market forces will ensure that such producers automatically respond and position themselves to supply the best available technology for local use and export.

25. Working with the electricity supply industry is also deemed by the task force to be important in helping consumers to recognize the benefits of high energy efficiency/low-GWP equipment, which include a reduction in lifetime energy consumption and cost; a reduction both in direct carbon dioxide (CO_2) emissions through the use of a lower-GWP refrigerants and in indirect CO_2 emissions through reduced energy use; and a reduction in electrical peak demand.

F. Case studies on best practices

26. The task force report presents recent case studies to illustrate best practices related to phasing down high-GWP refrigerants and increasing energy efficiency in the refrigeration, air-conditioning and heat-pump sectors. In so doing, the report elaborates on the institutional arrangements, capacities and capabilities, and regulatory environments needed to facilitate such a transition. These case studies indicate that market penetration of low-energy-efficiency equipment in Article 5 parties will put them in a long-lasting, economically disadvantaged position due to loss of valuable electricity capacity from other uses and the need to build more generating capacity. Such a development could be avoided through support for the development of policies and regulations to expedite transition to low-GWP and higher-energy-efficiency equipment. Countries that primarily import refrigeration, air-conditioning and heat-pump equipment have an opportunity to build capacity to quickly prioritize imports of more energy-efficient products alongside the HCFC phase-out and in preparation for the HFC phase-down. Cooperation between senior energy efficiency officials and ozone officers has proved to be of utmost importance in expediting the coordinated adoption of refrigerant policies with the revision of minimum energy performance standards and labels.

G. Modelling the benefits of enhancing energy efficiency while phasing down HFCs

27. In its update report the task force underscores the importance of quantifying the costs and benefits of maintaining and/or enhancing energy efficiency while phasing-down HFCs, acknowledging the difficulties involved, as estimates depend on numerous variables such as equipment efficiency, use patterns, climate conditions, quality of equipment maintenance and a country's electricity pattern. Furthermore, modelling of costs is also challenging as estimates are based on evolving market conditions and proprietary data.

28. Outlining the key features of a number of modelling tools currently available, the task force then uses the "HFC + energy outlook model"[11] to demonstrate possible outputs. That model, developed to provide an in-depth analysis of both HFC phase-down and energy efficiency improvements, incorporates data from all refrigeration, air-conditioning and heat-pump market sectors and can assess historic and future refrigerant- and energy-related greenhouse gas emissions on an annual basis between 2000 and 2050.

[11] The model was created by the European Partnership for Energy and the Environment, a European refrigeration, air-conditioning and heat pumps trade association, with support from the United Nations Environment Programme. Originally designed in 2018 to assess the HFC phase-down under the Kigali Amendment to the Montreal Protocol, the model has recently been developed further to integrate the assessment of energy use and the related indirect greenhouse gas emissions.

29. The outputs of the model are available for a single country or can be integrated into a larger region with the possibility to derive worldwide estimates, and can be presented at different levels of detail, such as by main market sector, by technology type or by gas type. Key outputs include estimates of annual consumption of each type of refrigerant; refrigerant emissions during operation and end-of-life; refrigerant banks, gas in equipment reaching end-of-life, gas recovered and reused; annual energy consumption; indirect emissions from energy used; and estimates of peak electricity demand.

30. Early model outputs suggest, amongst other things, that there are substantial benefits in reducing the total cumulative greenhouse gas emissions from earlier action to prevent the increase in HFC use. Combining faster phase-down of HFCs and improving efficiency yields substantial additional benefits in reducing the total cumulative emissions. There is a large potential to reduce both direct (by more than 90 per cent) and indirect (by more than 98 per cent) emissions by 2050, compared to a business-as-usual scenario. Transitioning to the use of heat pumps is important in terms of the abatement of fossil fuel emissions from heating. In addition, the model identifies the mix of measures and associated benefits from addressing both refrigerant-related and energy-related greenhouse gas emissions.

31. The task force notes that individual parties could be encouraged to utilise outputs from such modelling as part of their HFC phase-down plans. It also suggests that parties may wish to consider asking the Panel to develop a detailed regional and global model to further assess the integration of energy efficiency and HFC phase-down measures.

H. Draft framework for outputs from previous reports by the Technology and Economic Assessment Panel task force

32. The task force notes that on the basis of its recent reports on energy efficiency it has compiled information on climate funding agencies, technology options, costs, availability, accessibility and best practices for maintaining and/or enhancing energy efficiency in the refrigeration and air-conditioning and heat-pump sectors while phasing down HFCs under the Kigali Amendment.

33. In order to structure the compiled information more clearly, and to assist parties to use the information in their future planning, the task force proposes a draft framework to catalogue the information into four option and cost groups related to capacity-building, the servicing sector, manufacturing and not-in-kind technologies. It therefore suggests that parties could consider requesting the Technology and Economic Assessment Panel to develop this proposed framework further in future reports, to assist in understanding the benefits and costs of improving energy efficiency during the HFC phase-down.

34. In conclusion, the task force advises that given the rapid technological developments in the last five years and the increasing worldwide availability of highly energy-efficient equipment operating with low-GWP refrigerants for most market sectors, it is possible to consider, in the right regulatory and financial environment, an accelerated timeline for the Kigali Amendment and the integration of energy efficiency.

Annex

Report by the Technology and Economic Assessment Panel (May 2021) Volume 4

Decision XXXI/7: Continued provision of information on energy-efficient and low-global-warming-potential technologies

EXECUTIVE SUMMARY

1. The Montreal Protocol has proved to be effective for the protection of the ozone layer, and at the same time has made a substantial contribution to avoiding emissions of powerful greenhouse gases, complementing the global efforts of the UN Framework Convention on Climate Change (UNFCCC).

2. The Parties to the Montreal Protocol have an opportunity through the Kigali Amendment to further contribute to significant mitigation of climate impacts by improving energy efficiency of refrigeration and air conditioning and heat pump (RACHP) equipment during the phase-down of high GWP refrigerants.

3. In the context of the Climate Emergency, demand for cooling is increasing rapidly. If unmanaged, this will result in a cycle of increasing global warming through greater emissions from fossil-fuelled energy consumption combined with the emissions of high GWP refrigerants.

4. This year, both the MOP of the Montreal Protocol and the COP of UNFCCC will discuss matters related to the cooling sector. Cooling underpins all five themes chosen for UNFCCC COP-26. One COP-26 initiative aims to double efficiency standards in four product categories including room air conditioners and refrigerators. It specifically cites the Montreal Protocol in the context of opportunities to work collaboratively with the broader climate and energy communities and leveraging the Protocol's years of experience working with the cooling sector. As efficient cooling gains traction at COP-26, there is likely to be substantial "pull through" to benefit from the synergies with HFC phase-down under the Montreal Protocol.

5. Reports from TEAP, UNEP, International Energy Agency (IEA), Kigali Cooling Efficiency Program (K-CEP), Climate and Clean Air Coalition (CCAC) and other institutions all emphasise the opportunity to mitigate global warming from a coordinated transition to lower GWP HFC and higher efficiency cooling. Recent initiatives such as the Cool Coalition, the twinning programme for senior energy and environment officials from A5 parties, and government leadership on developing national cooling plans, all support this initiative.

6. The TEAP Energy Efficiency Task Force (EETF) continues to identify technical improvements to increase equipment energy efficiency (EE) and cost such as sensors, controls, variable speed drives and condenser precooling.

7. In general, new equipment using lower GWP alternatives has higher efficiency than the equipment it replaces.

8. The Global Cooling Prize awarded in April 2021, showed that it is technically and economically feasible with innovative design in room air conditioners to potentially achieve five times lower climate impact with a cost that is close to twice that of the baseline technology when manufactured at scale. The winners have developed units using higher performance components and lower or ultra-low GWP refrigerants.

9. The EETF has confirmed it is possible to jump from HCFCs directly to lower GWP options in many sectors in different regions whilst maintaining/enhancing energy efficiency.

10. The coordination of energy efficiency with the implementation of HCFC phase out and HFC phase-down enables industry to explore the synergies related to redesigning equipment and retooling manufacturing lines, in which the MLF and the implementing agencies have great experience. A good example is the adoption of a national cooling plan and revised energy efficiency standards for room AC in China which has coincided with an over 30% decrease in the weighted-GWP of domestic sales between 2015 and 2020 as manufacturers recognize the benefits of redesigning their products for both energy efficiency and refrigerant transition (Case study 1.3). The in-depth knowledge of RACHP technologies held within the "Montreal Protocol family" can strongly enable this combined reduction of direct and indirect GHG emissions.

11. Availability (as defined in Section 3.2): Technology and refrigerants are now widely available to replace most high GWP HFCs, with both natural and lower GWP fluorinated refrigerants options covering key market sectors. This is supported by the numerous best practice case studies presented in this report.

12. Accessibility (as defined in Section 3.2): Access to high EE / lower GWP products is improving, although it remains limited in many A5 parties and even in some non-A5 parties.

13. Improved availability and accessibility to high EE/lower GWP products in A5 parties could be achieved sooner by:

(a) faster ratification of the Kigali Amendment,

(b) progress in operationalising the Kigali Amendment,

(c) enabling individual Parties for fast action,

(d) supporting policies designed to improve accessibility, e.g., tackling market barriers affecting the end consumer,

(e) adopting ambitious and progressive energy performance standards across regions that are appropriately harmonized and coordinated with HFC phase-down strategies (e.g., U4E model regulations),

(f) coordinating multi-agency funding for A5 enterprise conversions for both high EE and lower GWP refrigerants.

14. A5 parties creating a large installed base of low EE equipment, will be economically disadvantaged, as valuable electricity capacity is lost from other uses and because of the need to build more generating capacity. The economic disadvantage could last for decades due to the long product lifetimes of cooling equipment. Support for the development and enforcement of policies and regulations to avoid the market penetration of low efficiency RACHP equipment could stop environmentally harmful dumping and limit these economic impacts.

15. Individual parties could consider adopting a fast mover status, with ambitious synergistic regulation for the HCFC phase out and HFC phase-down with progressive EE improvement.

16. One facet of governmental cooperation that has proven absolutely essential is the coordination between senior energy efficiency officials and ozone officers. This expedites the further transition to lower GWP and higher EE equipment by the coordinated adoption of refrigerant policies with broad energy efficiency policies including the revision of minimum energy performance standards (MEPS) and labels. In contrast, the implementation of ambitious MEPS alone can undermine the HFC phase-down by encouraging improved EE of cooling equipment, but with the use of high GWP refrigerants, especially in countries that are primarily equipment receivers.

17. Integrated modelling of the direct (refrigerant-related) GHG emissions and indirect (energy-related) GHG emissions from refrigeration, air-conditioning and heat pump (RACHP) markets provides valuable insights into the importance of linking improvements in energy efficiency with the HFC phase-down. A number of modelling tools are available and in development. Early outputs from the “HFC + Energy Outlook Model” suggest:

(a) indirect energy-related GHG emissions represent around 70% of total GHG emissions from the RACHP sector,

(b) there are substantial benefits from earlier action to prevent the increase in high GWP HFC use in reducing the total cumulative emissions,

(c) combining faster phase-down of high GWP HFCs and improving efficiency provides substantial additional benefits in reducing the total cumulative emissions,

(d) there is a large potential to reduce both direct (>90%) and indirect emissions (>98%) by 2050, compared to a business-as-usual scenario,

(e) how to identify the measures that yield the greatest benefits through addressing both the refrigerant-related and the energy-related GHG emissions,

(f) transitioning to the use of heat pumps is important in terms of the abatement of fossil fuel emissions from heating.

18. Individual Parties could be encouraged to utilise outputs from such modelling as part of their HFC phase-down planning process.

19. Parties may wish to consider asking TEAP to develop a detailed regional and world model to further assess the integration of energy efficiency and HFC phase-down measures.

20. This report builds on the 2018 report in response to Decision XXIX/10 and subsequent EETF reports in response to Decision XXX/5 and Decision XXXI/7. The TEAP EETF has compiled information on relevant funding agencies, technology options, costs, availability, accessibility, and best practices for maintaining and/or enhancing energy efficiency in refrigeration, air-conditioning and heat pump (RACHP) sectors while phasing down HFCs under the Kigali Amendment.

21. As part of this update and to assist parties with future planning, the EETF has proposed a draft framework to catalogue the diverse and extensive information that has been compiled in these reports and to assist Parties' understanding. This framework considers options related to capacity-building, servicing sector, manufacturing and not-in-kind alternatives.

22. Parties may wish to consider asking TEAP to further develop the draft framework to assist the Parties as they move forward to operationalise the Kigali Amendment.

23. An overarching conclusion of the EETF is that during the last five years, technology has developed rapidly. There is now availability of high EE/lower-GWP equipment for most market sectors. These technologies are increasingly accessible worldwide. Market examples suggest that it is possible in the right regulatory and financial environment to consider an accelerated timeline for the Kigali Amendment and the integration of energy efficiency.