UNITED
NATIONS

EP

UNEP/OzL.Pro/26/INF/6

Distr.: General
4 November 2014

English only

United Nations
Environment
Programme

Twenty-Sixth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer
Paris, 17–21 November 2014
Item 4 (g) of the provisional agenda*

Montreal Protocol issues: proposed amendments to the Montreal Protocol

Proposed amendment to the Montreal Protocol submitted by Canada, Mexico and the United States of America: frequently asked questions

Note by the Secretariat

The annex to the present note contains information submitted by the Governments of Canada, Mexico and the United States of America. It is presented as received by the Secretariat, without formal editing.

* UNEP/OzL.Conv.10/1/Rev.1-UNEP/OzL.Pro.26/1/Rev.1.

Annex

Frequently Asked Questions

North American HFC Amendment Proposal

Submitted by the Governments of Canada, Mexico, and the United States of America
October, 2014

1. What scientific studies are available that discuss the effect of HFCs on the climate system, and also take into account measures including the Montreal Protocol and other treaties, policies, and legislation? What are the major findings of these studies?

There are many reliable peer-reviewed scientific reports and papers that provide information about the effect of HFCs and greenhouse gases on the climate system. Many of these scientific papers and articles also discuss the role that the Montreal Protocol and other policies measures have already and potentially can contribute to reducing emissions of potent greenhouse gases, with a particular focus on HFCs.

These studies have shown that, although HFCs currently constitute a small portion of total greenhouse gas emissions, HFCs are rapidly increasing in the atmosphere mostly due to increased demand for refrigeration and air conditioning, particularly in developing countries, and because they are substituting for ozone-depleting substances. If HFC use and emissions are left unchecked, they will have a significant impact on radiative forcing and the climate system. HFCs, unlike carbon dioxide which resides in the atmosphere for millennia, are short-lived climate pollutants (SLCPs) with average atmospheric lifetimes of 15 years. Decreasing HFC use and emissions can thus reduce the radiative forcing effect within a short time frame. Current research suggests that reducing HFCs now will alter the trajectory of global climate change over the coming decades. For example, recent studies have shown that replacing higher GWP HFCs with currently available low-GWP alternatives may prevent up to 0.5°C of warming by the end of the century, and that mitigating HFCs along with other short-lived climate pollutants now may also avoid up to 42% of projected sea level rise over this period. There is a growing consensus in the science and policy literature that any comprehensive climate action plan must include strategies for reducing SLCPs including HFCs, and that using existing policy frameworks provide the best means for taking near term action in parallel with ongoing efforts to address carbon dioxide.

Recent Reports (in reverse chronological order):

World Meteorological Organization (WMO), Assessment for Decision-Makers: Scientific Assessment of Ozone Depletion: 2014, Global Ozone Research and Monitoring Project - Report No. 56, Geneva, Switzerland, 2014. (http://www.esrl.noaa.gov/csd/assessments/ozone/)

United Nations Environment Programme (UNEP), HFCs: A Critical Link in Protecting Climate and the Ozone Layer, 2011. 36pp. (http://www.unep.org/dewa/Portals/67/pdf/HFC_report.pdf)

World Meteorological Organization (WMO), Science Assessment of Ozone Depletion: 2010, Global Ozone Research and Monitoring Project - Report No. 52, Geneva, Switzerland, 2011. (http://www.esrl.noaa.gov/csd/assessments/ozone/)

Recent Papers (in reverse chronological order):

Velders, G. J., Solomon, S., Daniel, J. S. (2014). Growth of climate change commitments from HFC banks and emissions, Atmos. Chem. Phys., 14, 4563-4572, doi: 10.5194/acp-14-4563-2014.

Shoemaker, J. K., Schrag, D. P., Molina, M. J., & Ramanathan, V. (2013). What Role for Short-Lived Climate Pollutants in Mitigation Policy? Science, 342(6164), 1323-1324, doi: 10.1126/science.1240162.

Hu, A., Xu, Y., Tebaldi, C., Washington, W. M., & Ramanathan, V. (2013). Mitigation of short-lived climate pollutants slows sea-level rise. Nature Climate Change. 3:730–734, doi: 10.1038/NCLIMATE1869.

Velders, G. J., Fahey, D. W., Daniel, J. S., McFarland, M., & Andersen, S. O. (2009). The large contribution of projected HFC emissions to future climate forcing. Proceedings of the National Academy of Sciences, 106(27), 10949-10954, doi: 10.1073/pnas.0902817106.

Molina, M., Zaelke, D., Sarma, K. M., Andersen, S. O., Ramanathan, V., & Kaniaru, D. (2009). Reducing abrupt climate change risk using the Montreal Protocol and other regulatory actions to complement cuts in CO2 emissions. Proceedings of the National Academy of Sciences, 106(49), 20616-20621, doi: 10.1073/pnas.0902568106.

Jackson, S. C. (2009). Parallel pursuit of near-term and long-term climate mitigation. Science, 326((5952), 526-527, doi:10.1126/science.1177042.

In addition to these studies, United States EPA studies can be found at:

United States Environmental Protection Agency (EPA), Benefits of Addressing HFCs under the Montreal Protocol, 24 pp., July 2014. (http://www.epa.gov/ozone/downloads/Benefits_of_Addressing_HFCs_under_the_Montreal_Protocol-July2014MASTER_REV4.pdf)

2. How would adoption of an amendment impact UN Framework Convention on Climate Change (UNFCCC) obligations?

The proposed amendment would have no effect on the UNFCCC's inclusion of HFCs. Article III of the proposed amendment makes this explicit. Article 31(3)(a) of the Vienna Convention on the Law of Treaties provides that the interpretation of a treaty should take into account subsequent agreements between the parties regarding the interpretation of the treaty. Article III serves as a subsequent agreement regarding the interpretation of the UNFCCC and Kyoto Protocol. In particular, it makes clear that the proposed amendment would not exclude HFCs from the coverage of the relevant provisions of the UNFCCC and the Kyoto Protocol. It further states that Parties would continue to apply those provisions for as long as they remain in force. The amendment, therefore, does not alter obligations under those agreements. It supports, complements, and enhances the UNFCCC by achieving significant climate mitigation benefits.

3. Do HFCs fit within the scope of the Montreal Protocol, and what is the procedure for a Montreal Protocol amendment?

Either treaty can be amended to include a phase-down in HFCs. Article 2(2)(b) of the Vienna Convention includes language that applies to the Vienna Convention and the Montreal Protocol, and states that "Parties shall . . . co-operate in harmonizing appropriate policies" associated with controlling ozone-depleting substances. One way the Parties may cooperate in "harmonizing their policies" with regard to phasing out CFCs and HCFCs is to specify how that transition should be accomplished -- for example, by specifying which alternatives the Parties will, or will not, move to. Because HFCs are primarily alternatives to CFCs and HCFCs, the Parties may agree to "harmonize their policies" in moving away from CFCs and HCFCs to avoid the use of HFCs. This is something Montreal Protocol Parties have already done by agreeing to provide an incentive through the Multilateral Fund to transitions to low-GWP alternatives and thereby avoiding the use of HFCs in some cases.

The procedure for amending the Montreal Protocol calls for a Party to present a proposed amendment at least six months before a Meeting of the Parties. The Meeting of the Parties can adopt an amendment that has been proposed, and which may include specific provisions related to its entry into force. The North American HFC Amendment Proposal includes provisions in Article IV of the proposal that set out entry into force requirements for countries that have deposited an instrument of ratification, approval, or acceptance.

4. How does the amendment proposal support the basic objective of the Montreal Protocol and the Vienna Convention?

The Montreal Protocol has a long history of considering HFCs and their growth as alternatives to ozone-depleting substances, as is evident by the following decisions:

- MOP Decision X/16 (1998): convened a workshop, in collaboration with UNFCCC, with the view to assisting establishment of and providing information on HFCs and PFCs and potential ways to limit their emissions,
- MOP Decision XIV/10 (2002): called on TEAP to collaborate with IPCC to develop report: Safeguarding the Ozone Layer and the Global Climate System; Issues Related to HFCs and PFCs,
- MOP Decision XIX/6 (2007): called on the Multilateral Fund Executive Committee (ExCom) to give priority to substitutes and alternatives that minimize other impacts to the environment, including on the climate, taking into account global warming potential (GWP) and other factors,
- MOP Decision XX/8 (2008): called for a report and workshop on high-GWP alternatives, principally HFCs, to ODS,
- ExCom Decision 60/44 (2010): allowed for up to a 25% funding increment, above cost-effectiveness thresholds, when needed for climate benefits, mainly to avoid selection of high-GWP HFCs,
- MOP Decision XXIV/7 (2012): requested the TEAP to update information on ODS alternatives and technologies, and identify the opportunities for the selection of environmentally sound alternatives to HCFCs.
- MOP Decision XXV/5 (2013): requested the TEAP to prepare a report to provide an update on information on alternatives to ODS, and assessing whether such alternatives are environmentally sound;
- MOP Decision XXV/5 (2013): convened a workshop, back to back with the thirty-fourth meeting of the Open-ended Working Group, to continue discussions on hydrofluorocarbon management.

The proposed amendment builds on the historical experience of the Montreal Protocol with respect to sectors that use HFCs, and complements the current activities of the Protocol. The Vienna Convention explicitly requires Parties to "co-operate in harmonizing appropriate policies" related to the phaseout of ozone-depleting substances. The amendment would help manage the phaseout of ozone-depleting substances in a more environmentally-friendly fashion.

5. What are the factors that are effecting the adoption of low-GWP alternatives, including HFOs, hydrocarbons, ammonia and carbon-dioxide?

The current market penetration of non-fluorinated and low-GWP fluorinated compounds varies by sector and location based on a variety of factors. In many cases, the speed of deployment is increasing. Particular care needs to be taken in the deployment of substances that are flammable or toxic. Revised standards are still needed in some applications for the use of flammable substances. Decisions on refrigerant are driven by many considerations, including availability of relevant standards, ability to deploy safely in a given situation, system costs, reliability, energy efficiency and other issues.

The 2010 TEAP Assessment Report, TEAP's response to Decision XXIII/9 in the 2012 Progress Report, TEAP's response to Decisions XXIV/7 in the 2013 in the Progress Report and TEAP's response to Decision XXV/5 in the 2014 Progress report, make the following comments concerning the air-conditioning and refrigeration sectors:

- In commercial refrigeration stand-alone equipment, hydrocarbons (HCs) and R-744 (CO_2) are gaining market shares in Europe and in Japan; they are replacing HFC-134a, which is the dominant choice in most countries.
- In many developed countries, R-404A and R-507A have been the main replacements for HCFC-22 in supermarkets; however, because of their high GWP a number of other options are now being introduced. Indirect systems are the most effective option for emissions reductions in new centralized systems for supermarkets. In two stage systems in Europe, R-744 is used at the low-temperature level and HFC-134a, R-744 and HCs at the medium temperature level.
- In industrial refrigeration, R-717 (ammonia) and HCFC-22 are still the most common refrigerants; R-744 is gaining in low-temperature, cascaded systems though the market volume is small.
- In unitary (air-to-air) air-conditioning, HFC blends, primarily R-410A, but to a limited degree

also R-407C, are still the dominant near-term replacements for HCFC-22 in air cooled systems. HC-290 is also being used to replace HCFC-22 in low charge split system, window and portable air-conditioners in some countries. Most Article 5 countries are continuing to utilise HCFC-22 as the predominant refrigerant in air-conditioning applications.

Non-fluorinated options are increasingly being considered for both small charge and larger charge applications. Hydrocarbons are being used in vending machines, reach-in coolers, room air-conditioners and other small charge applications. HFC-32 is also being used in some air-conditioning applications.

Flammable refrigerants can be safely used where equipment has been specifically designed to operate safely using them. Safety standards are evolving allowing for increased use of non-fluorinated options; however, additional revisions to safety standards are necessary to ensure the safe use of certain refrigerants across the globe.

Recent announcements by private–sector companies indicate that many of the refrigeration equipment manufacturers are transitioning their lines to low-GWP options over the next several years. This includes the food cold chain applications, foams used in household refrigerators and insulation, as well as other applications.

The U.S. EPA's Significant New Alternatives Policy (SNAP) program (http://www.epa.gov/ozone/snap/index.html) has listed as acceptable various alternatives that could result in increased market penetration of low-GWP alternatives in North America and elsewhere. These include:

- hydrocarbons for use in stand-alone commercial freezers and domestic refrigeration;
- CO_2, HFO-1234yf and HFC-152a for motor vehicle air conditioning;
- CO_2 for vending machines;
- CO_2 for transport refrigeration;
- Solstice 1233zd for various foam blowing and air-conditioning applications;
- HFO-1336mzz(Z) for various foam blowing applications;
- R-450A (an HFC/HFO blend) for various refrigeration applications, and
- additional alternatives for fire suppression

6. Have non-Article 5 Parties chosen non-HFC alternatives in meeting HCFC reduction steps?

Based on national circumstances, countries have designed their HCFC phaseout plans differently. In Canada and the United States, the approach is based on 'worst first' or higher ozone depleting potential (ODPs) first approach. In the United States, this resulted in early transitions in foam sectors, starting with flexible foams in 1993-1994 and rigid foams in 2003-2004. Roughly half of the foam blowing sectors in the United States moved entirely to non-fluorinated compounds, at a time when the availability of low-GWP alternatives was much more limited as compared to today. The United States also similarly focused on the non-medical aerosol sector first in the early 1990s and also saw a majority of the transition to non-fluorinated options. Many U.S. manufacturers in the aerosol sector moved directly from CFCs to non-fluorinated options in the late 1970s.

For the refrigeration and air-conditioning sector, most of the transition initially went to HFCs. This was for a variety of reasons, the limited availability of alternatives at the time, safety concerns with using flammable refrigerants, and because the HFCs were produced to have many of the same characteristics as the ODS. Some refrigeration sectors with smaller charge sizes transitioned directly to hydrocarbons. A second transition is beginning from HFCs to either lower GWP fluorinated options or non-fluorinated options. For unitary air-conditioning and larger charge sizes the majority of the transition has been and continues to be to high-GWP HFCs. However, there are several options now under either development or investigation that will likely be able to replace a portion of that end use in the near future.

Japan and the European Union have also undertaken efforts to control HFCs. The Japanese Cabinet recently revised its fluorocarbon regulations to support a transition to climate-friendly alternatives. The revised regulations call on: producers to reduce their climate impact by manufacturing fluorocarbons with lower greenhouse effects and recycling a certain amount of used fluorocarbons; manufacturers of equipment using fluorocarbons to transition to non-fluorinated or low-global warming potential alternatives by certain target years set for each category of product; requests users of commercial air conditioning and refrigeration units using fluorocarbons to properly manage such units and prevent the leakage of fluorocarbons, and requests certain users to annually report any leaks; and sets up a registration and permission system for servicing technicians and recycling/reclaiming operations.

The European Union's regulations on fluorinated greenhouse gases have been in place since 2006 and cover stationary equipment with a specific directive on mobile air conditioners. The European Union has recently

revised regulations to include an EU-wide HFC phasedown, specific end use bans, and GWP thresholds for certain applications. These regulations go into effect January 1, 2015.

On June 25, 2013, President Obama announced the Climate Action Plan that will keep "the United States of America a leader, a global leader in the fight against climate change." As part of his plan, President Obama directed EPA to use its authority through the SNAP Program "to encourage private-sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives." In the summer of 2014, the U.S. EPA proposed two new rules under the Significant New Alternatives Policy (SNAP) program that would smooth transition to climate-friendly alternatives to HFCs by expanding the list of acceptable alternatives and also limiting use of some of the most harmful HFCs where lower risk alternatives are available. In October 2014, EPA added another set of climate-friendly alternatives to the SNAP acceptable list.

In September 2014 during the United Nations Climate Summit, Canada announced that it will publish a Notice of Intent to regulate HFCs that will outline the proposed scope of the regulatory measures for HFCs and launch stakeholder consultations. Taking domestic regulatory action on HFCs will reduce and limit harmful HFC emissions.

Consistent with the approach suggested in the North American Proposal to amend the Protocol to address HFCs, Parties can continue to use national approaches to determine the best way to meet the GWP-based obligations. It is not necessary to transition all sectors at the same time, and it may be advisable to wait for the development and commercialization of additional alternatives in some sectors. Approaches used by many non-Article 5 Parties to meet the HCFC freeze, the 35% reduction, and more recently the 75% reduction, have not required addressing all subsectors at the same time. Likewise, Article 5 Parties have used various approached and addressed various subsectors in their HPMPs to meet their HCFC freeze in 2013 and to prepare for the 10% reduction in 2015. Parties could therefore:

(1) address sectors and subsectors where non-fluorinated and low-GWP fluorinated options exist first,
(2) incorporate the use of technology to reduce charge sizes, and
(3) improve maintenance and servicing practices to ensure the overall reduction in HFC consumption.

7. How would technical and financial support be provided for the North American Amendment? How much would the amendment cost, and could the TEAP make an estimate of its costs?

The North American HFC Amendment Proposal would rely on the same successful financial and technical support model used to implement the Montreal Protocol to date. Financial support is provided to meet the agreed incremental cost of implementation in accordance with Article 10 of the Montreal Protocol. We anticipate that assistance would continue to be provided to build and maintain national-level capacity through institutional strengthening and regional capacity assistance networking.

The cost of the amendment itself will depend on the cost of implementation and incremental costs over the next three decades as the amendment itself would be implemented. Cost estimates would be made under normal procedures under the Protocol, meaning that the TEAP would be requested to provide estimates of agreed incremental costs for Article 5 Parties to comply with their HFC targets in the context of three-year replenishment periods. Should Parties be interested, they could request the TEAP to provide an overall estimate of the total incremental costs associated with various phase-down options. However, any such global estimate would be subject to significant uncertainty, given that it is impossible to know the cost of alternative technologies over the next 30 years, particularly in view of the fact that new technologies are continuously being developed. In response to Decision XXV/V the TEAP developed two mitigation approaches by applying existing regional policy measures to other countries. This is the first information the TEAP provided on potential costs for reducing use of HFCs. While the information may be helpful, it is not equivalent to a cost analysis for implementing the amendment. Other sources of information include background material developed by the European Union in support of the F-Gas revised rule and international marginal abatement cost curves published by U.S. EPA in 2013.[1]

[1] *Global Mitigation of Non-CO_2 Greenhouse Gases: 2010 – 2030 (September 2013) (EPA Report 430R13011) Available at: http://www.epa.gov/climatechange/Downloads/EPAactivities/MAC_Report_2013.pdf*

"Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases: Final Report" prepared for the European Commission in September 2011 Available at: Available online at: http://ec.europa.eu/clima/policies/f-gas/docs/2011_study_en.pdf

This would be determined when considering the estimated incremental costs of complying with the obligations in the various HFC-consuming sectors, based on the Parties' list of categories of incremental costs (adopted at the 4th Meeting of the Parties) and specific cost guidelines developed by the ExCom, as per usual practice.

8. Are there alternatives available in every sector, and where is there information on alternatives?

Our amendment proposal recognizes commercially available alternatives may not yet exist today for all HFC applications and utilizes a gradual phase-down mechanism with a plateau. Options for replacing HFCs with either lower-GWP HFCs or non-HFCs today are similar in many ways to the situation faced in 1987 for CFC replacements and faced when the Parties agreed to phase out HCFCs. In those cases and now, alternatives were known for many, but not for all, end-use applications. We do see a number of sectors and applications where alternatives are already available, or have been commercialized and are being implemented now and in the next few years.

It is clear, even today, that HFC use can be reduced or avoided for a number of end uses. The TEAP notes in its 2010 Assessment Report and the 2012 and 2013 Progress Reports that technically and economically feasible substitutes are available for ODS and that the suite of known alternatives includes many low- GWP options. Increasingly, information on alternatives is available from a range of other sources. At the request of Parties (decisions XXIV/7 and XXV/5), TEAP provided feasibility studies that consider the proposed reduction steps and the potential to meet those steps based on alternatives that are either commercialized or under development. Such studies consider: (1) more specificity on low-GWP fluorinated and non-fluorinated options, including associated safety issues, (2) performance under various climatic conditions, such as high ambient temperatures, and (3) a focused description of specific subsectors.

The TEAP's findings indicate the most promising options to reduce HFC consumption include:

- Transition to low-GWP or no-GWP substances in many applications;
- Implementing new technologies with lower HFC charge size; and,
- Changing various processes and handling procedures to reduce consumption during the manufacture, use, servicing, and disposal of products that contain or use HFCs.

In addition, information on substitutes reviewed by EPA can be found at: http://www.epa.gov/ozone/snap/index.html.

U.S. EPA has developed seven factsheets about alternatives in the following sectors: 1) Commercial Refrigeration, 2) Domestic Refrigeration, 3) Transport Refrigeration, 4) Motor Vehicle Air-Conditioners (MVAC) 5) Unitary Air-Conditioning 6) Construction Foams and 7) Non-Medical Aerosols. These can be found at: http://www.epa.gov/ozone/intpol/mpagreement.html

Technology conferences held in Bangkok in July 2012 and 2013, adjacent to the 32nd and 33rd Open-Ended Working Group meetings, explored available and emerging ozone and climate protection technologies (http://www.bangkoktechconference.org/). In Montreal, on the margins of an ExCom meeting in December 2012, a technology forum was held that focused specifically on the commercial refrigeration sector. The reports of the forum and the 2012 technology conference include extensive information on alternatives to ODS and HFCs, and are available through the web site of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (http://www.unep.org/ccac/Actions/HFCAlternativeTechnologyandStandards/tabid/104667/Default.aspx). The Ozone Secretariat hosted a workshop immediately prior to OEWG-26 in July 2014 as called for in Decision XXV/5. The objective of the workshop was to enable an open discussion to take place on the various aspects of HFC management in order that all the concerns of the parties may be expressed and the various views and situations of the parties clarified and considered. The report can be found at: http://conf.montreal-protocol.org/meeting/workshops/hfc_management/report/default.aspx.

In addition, numerous other industry forums have considered availability of viable alternatives – including conferences in China, the UAE, Austria, and many other locations. Industry representatives have highlighted that an agreement to a global phasedown of HFCs would increase innovation.

Transition is underway in a variety of sectors including for motor vehicles and commercial refrigeration. Car manufacturers and suppliers have evaluated several refrigerant options for new car (and truck) air-conditioning systems including R-744, HFC-152a and HFC-1234yf, all with GWPs below the EU MAC Directive regulatory threshold of 150. It is anticipated that by the end of 2014 there will be 3 million motor vehicles using HFO-1234yf on the road. The rapid uptake of alternatives in motor vehicles is expected to continue. The use of hydrocarbons or blends of hydrocarbons has been considered but to date has not yet received support from any major vehicle manufacturers. A few manufacturers are continuing to develop R-744 (CO2) systems; however, those are not commercially available at this time.

Supermarket centralized systems is a subsector where significant focus has been on a combination of changing refrigerant fluids, improving designs, and improving servicing practices. Secondary loop systems that chill glycol, brine or R-744, and systems cascaded with direct expansion R-744 systems, are available globally and reduce the use of HFCs significantly. The secondary glycol, brine and R-744 systems are made by most major manufacturers. The cascade R-744 system has many installations in Europe and several in the United States and is made by multiple manufactures in both these locations. Supermarkets in Australia are incorporating R-744 cascade and transcritical refrigeration systems to meet their target reductions in CO2eq emissions. Shifting from HFCs to R-744 has reduced their total carbon footprint, including energy use, by 25%. In Europe many transcritical R-744 systems and ammonia/R-744 cascade systems have been installed with many more being prepared for installation. The United States has recently seen R-744 cascade systems installed as well as a few transcritical systems including one system in Atlanta, Georgia which is a much warmer climate than were previous systems were installed. At the same time, In Canada, at least 70 supermarkets have already converted there already is a greater focus on to R-744 cascade or transcritical systems.

Adoption of the amendment will send a strong signal to the private sector and markets that climate-friendly alternatives are needed in HFC-using sectors, Sending such a signal spurs innovation and investment in alternatives. Taken together, alternative chemicals, new technologies, and better process and handling practices can reduce HFC consumption in both the near and long term in a way that will allow countries to implement an orderly HFC phase-down.

9. To what extent is energy efficiency considered in the amendment proposal?

Historically, with each of the transitions from ODS, we have seen improved energy efficiency. As manufacturers seek to redesign equipment, direct and indirect contributions to climate change can be considered together. In addition, several of the newer low-GWP alternatives (e.g., foam blowing agents) have the potential to improve energy efficiency.

The TEAP reported in the 2010 Assessment Report and the 2012 and 2013 Progress Reports that lower GWP HFC non-fluorinated options are increasingly used in most sectors, with emphasis on optimizing system efficiency and reducing emissions of high Global Warming Potential (GWP) refrigerants.

While energy efficiency is not directly included in the amendment proposal, the proponents consider improving energy efficiency while transitioning away from high GWP HFCs as an important co-benefit of the proposal. There are a number of ways for countries to ensure energy efficiency is improved, including by adopting energy efficiency standards for appliances. UNEP, UNDP, the World Bank, UNIDO, and other institutions have been working with countries in recent years to ensure continued progress in efficiency even as we change refrigerants in various sectors.

10. How do countries calculate a GWP-weighted baseline? How does the amendment allow for some continued use of HFCs?

- **How much R-410A would be permitted compared to HFO-1234yf or similar alternatives?**
- **Does transition from HCFC-22 to HFC-32 fit within the amendment?**

The baselines in the North American Proposal and the compliance steps for the phase-down are weighted based on GWPs.

Article 5 Parties: The baseline is calculated on a GWP-weighted basis, based on 40% of production and consumption of HCFCs respectively plus 100% of production and consumption of HFCs respectively averaged over 2011-2012. The HCFC portion of the formula was used recognizing that HCFC consumption may represent the majority of fluorinated chemical consumption in many Article 5 countries, while the HFC portion recognizes that for some countries, HFC use is rising to meet both domestic and export markets. Since HCFC production and consumption is reported to the Ozone Secretariat on an annual basis, Article 5 countries can use this same information for the years 2008-2010 and develop the average for both consumption and production respectively. This would involve converting ODP tonnes for consumption or production of each substance to metric tonnes and then to GWP-weighted tonnes. Countries with HFC production and consumption would need to collect such information. The GWP-weighted tonnes would then be added together for each country to establish an overall baseline.

The baseline for Article 5 Parties is calculated based on historical HCFC and HFC production and consumption respectively. Based on analysis to date, it appears likely that on a global basis the baseline will be greater than the actual consumption of HFCs for Article 5 Parties for the first year when an obligation would apply for

those Parties. This would allow Article 5 Parties to transition some of their HCFC consumption to HFC consumption, while still complying with initial control measures.
Given that many applications have not yet transitioned out of HCFCs, it is envisioned that a certain amount of HFCs will be phased in over the next few years, but that the total resulting HFC consumption in Article 5 Parties will likely still be less than the calculated baseline for these Parties. In other words, consumption of HFCs is likely to be lower than the established baseline even accounting for growth.

Non-Article 5 Parties: The baseline is calculated from a combination of HFC plus 85% of HCFC consumption and production respectively, averaged over 2008-2010. Since HCFC production and consumption is reported to the Ozone Secretariat on an annual basis, non-Article 5 countries can use this information for the years 2008-2010. Since these countries are also Annex 1 countries under the UNFCCC, these countries report information concerning their HFC emissions each year. This information is generally derived from consumption and production, and these countries often have additional domestic requirements for reporting of production and consumption information. The non- Article 5 countries can combine the information on HCFCs and HFCs using the formula above for both consumption and production respectively.

In response to the question on providing specific examples, what follows is a baseline calculation for an Article 5 Party, in the simplified case where HCFC consumption comprises only HCFC-22 and HFC consumption comprises only HFC-134a:

1) Average 2011-2012 HCFC Consumption = 10 ODP tonnes
2) Divide by ODP to convert to actual metric tonnes = 10 ODP tonnes/0.055 = 181.82mt
3) Multiply by GWP = 181.82 mt * 1,810 = 329,091 mt of CO2 equivalent (Note – 1,810 is the100-year GWP for HCFC-22)
4) Average 2011-2012 HFC Consumption = 100 tonnes
5) Multiply by GWP = 100 mt * 1,430 = 143,000 mt of CO2 equivalent (Note – 1,430 is the 100-year GWP for HFC-134a)
6) Multiply each factor by their respective factors as shown in the formula and add. 329,091 * 40% + 143,000 * 100% = 274,636 mt of CO2 equivalent. This is the cap.
7) Cap Amount for Each Substance - In response to the question of how this would convert to caps for other substances, the table below provides equivalent tonnes of other substances related to this baseline of 274,636 mt of CO2-equivalent. This amount is calculated by dividing the CO2-equivalent tonnes by the GWP of each substance.

GWP Weighted Cap Amount			**Cap Equivalent Amount (metric tonnes)**			
			GWP = 1,810	**GWP =1,430**	**GWP =2,088**	**GWP = 675**
Year	**% of Baseline**	**metric tonnes CO_2eq**	**HCFC-22***	**HFC-134a**	**R-410A**	**HFC-32**
2020	100%	274,636	152	192	132	407
2025	70%	192,245	106	134	92	285
2031	40%	109,855	61	77	53	163
2045	15%	41,195	23	29	20	61
*The North American Proposal does not prescribe limits on HCFC-22. Those limits are set by the HCFC phasout schedule (e.g., consumption is zero in 2045).						

The table above illustrates the differences in the equivalent amounts of various substances when weighting by GWP. In this particular example, a low-volume consuming country with a 2011-2012 average consumption of **181.8 mt (10 ODP tonnes of HCFC-22) of HCFCs and 100 mt of HFC-134a** would be allowed to consume **41,195 mt CO2eq** of HFCs after 2045, corresponding to for instance 29 **mt of HFC-134a**,.

With respect to the question on continuing use of HFC-32, a couple of examples illustrate how the transition can take place under a GWP-weighted phase-down schedule. The GWP of HCFC-22 is 1,810, while many blends, such as R-410A have higher GWPs (the GWP of R-410A has a GWP of 2,087.5). In contrast, HFC-32 has a GWP of 675, so a transition from HCFC-22 to HFC-32 gives an intrinsic GWP-weighted reduction of roughly two-thirds relative to a transition to R-410A (additional benefits of reduced charge size and increased energy efficiency are not accounted for here). This means that countries that are moving to HFC-32 (e.g. Indonesia) are likely to be significantly below their baseline cap calculated by the formula in the proposed amendment, even if there is significant growth. HFC/HFO blends with HFC-32 as a component are under evaluation. Such blends will have GWPs even less than 675. So, for example, the actual metric tonnes that could be used of a blend with a GWP of 400 is far greater than R-410A.

11. What sectors and continued uses could be included within the 15% ending plateau?

The North American Proposal to address HFCs under the Montreal Protocol sets a plateau of 15% of the calculated baseline. It does not specify for which uses HFCs can continue to be used, and instead leaves that decision to Parties based on national circumstances.

The plateau level is proposed recognizing that for some subsectors (e.g., Metered Dose Inhalers) the continued use of HFCs (e.g., HFC-134a) may continue beyond the date when the plateau is reached for certain uses. Each country will have the flexibility to decide what uses and what mix of substances it chooses to continue to allow within the 15% GWP-weighted amount. Consumption of high-GWP HFCs in niche applications may continue during the 15% plateau while a large number of subsectors could continue to rely on low-GWP HFCs or no-GWP alternatives. A variety of HFCs will be necessary to service a legacy fleet including both low- and high-GWP HFCs. The gradual phasedown and plateau allows for such servicing to occur uninterrupted. Parties could continue to use a mix of HFCs with a greater focus on lower-GWP HFCs within their mix. It is expected that 15% is representative of a limited number of applications for which there are currently no clear low-GWP alternatives.

Given the phase-down is GWP-based, no specific HFC or sector or substance is targeted by the proposal. It would be up to each country to decide, based on their circumstances, what types of uses they may want to fit within the 15% plateau.