***Frequently Asked Questions:***
***Strengthening the Montreal Protocol by Accelerating the Phase-Out of HCFCs at the 20th Anniversary Meeting of the Parties***

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## INTRODUCTION

Strengthening the Montreal Protocol (MP) to accelerate the phase-out of HCFCs[1] will speed recovery of the ozone layer. It also will significantly reduce greenhouse gas (GHG) emissions, and delay reaching the tipping point for abrupt climate change—a tipping point that may be only 10 years away and that will lead to catastrophic and irreversible impacts that will hit hardest on the world's poor.[2]

After discussing the accelerated phase-out of HCFCs at the 27th Open-Ended Working Group (OEWG) 4-7 June 2007, the Parties recognized a "clear need to accelerate the timetable for the phase-out of ozone-depleting substances, in particular HCFCs."[3]

On June 7th the *G8 Summit Declaration* added further support, committing to "accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives,"[4] and noting that "Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security… [and] … could contribute to 80% of avoided greenhouse gases while substantially increasing security of supply."[5]

Accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives can be accomplished by structuring an adjustment to require the following measures:

- Advancing the baseline and freeze date for HCFCs, and instituting a step-down phase-out schedule;
- Managing the transition out of HCFCs to promote the replacement of HCFCs with substitutes and alternatives that have zero or low Global Warming Potentials (GWPs) and are used in lower quantities, leak less, and are easier to recover;
- Managing the transition to improve the energy efficiency of refrigeration and air conditioning equipment; and
- Promoting not-in-kind substitutes and product alternatives with low or zero impacts on both the ozone layer and the climate.

Various forms of these measures are incorporated in the six adjustments proposed in March 2007 to accelerate the phase-out of HCFCs, and are included in the *Co-Chair's Consolidated Issues Paper on Proposals for Accelerated Phase-Out of HCFCs* prepared at the OEWG in June 2007.[6]

Reaching consensus on the adjustment in September 2007 presents challenges for the Parties. But the history of the Montreal Protocol has been to meet such challenges with confidence, and to continuously strengthen and improve the treaty. Indeed, the first negotiations for the Montreal Protocol occurred in just three one-week sessions over a nine-month period, in a context with great uncertainty about the theory of ozone destruction and empirical confirmation that came too late to influence the negotiations, with no knowledge of substitutes or alternatives, and with no funding mechanism yet developed.[7]

What the Parties did have was leadership and confidence that they needed to take a precautionary approach to address a serious global problem. Against all odds, they succeeded in reaching consensus on what has become the world's most successful environmental treaty.

As the world celebrates the success of the Montreal Protocol at its 20$^{th}$ Anniversary this September, the Parties are considering strengthening the treaty further and in a way that protects both the ozone layer and the climate system. The challenge today is actually easier than past challenges faced by the Montreal Protocol, while the stakes are even higher—with the tipping point for abrupt climate change as close as ten years away. Agreeing on an adjustment that maximizes the available climate benefits will mark the first time that both developing and developed countries accept binding international commitments to mitigate climate change, as well as to protect the ozone layer.

Many Parties have raised important questions regarding the pending adjustments. This document attempts to provide answers and supporting citations to assist the Parties build the consensus needed for adjusting the MP to accelerate the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives.

## 1. What are the Ozone Benefits of Accelerating the Phase-out of HCFCs?

Accelerating the phase-out of HCFCs will reduce emissions by approximately 468,000 ODP tonnes in Article 5 (A5) Parties, according to the MP's Technical and Economic Assessment Panel (TEAP).[8] This can advance recovery of the ozone layer by up to 3.3 years, based on a mid-latitude assessment.[9]

The MP's Scientific Assessment Panel reported in 2006 that the recovery of the ozone layer to pre-1980 levels will be delayed by 15 years over Antarctica, to 2065, and by 5 years at mid-latitudes, to 2049, with the delay at mid-latitudes partly due to the high estimates of future production of HCFCs.[10] UNEP's 2007 *Synthesis Report* stated that an accelerated HCFC phase-out, as well as other measures, will contribute to a faster recovery of the ozone layer to pre-1980 levels, possibly advancing recovery to as early as 2035.[11]

The adjustments accelerating the HCFC phase-out will avoid the high growth projections for HCFC production and consumption in A5 Parties between now and the current consumption freeze required by the MP in 2016 at 2015 levels.[12] Estimates reported by the TEAP show that HCFC use otherwise could exceed 700,000 tonnes by 2015 – roughly five times more than its 1998 projection of just 163,000 tonnes by 2015.[13] The future is difficult to predict, of course, and the HCFCs growth predictions could be higher still.

The TEAP has stated that early planning for a transition out of HCFCs can increase efficiency and minimize costs.[14] In contrast, without the accelerated phase-out, which would move the base year and freeze date forward and institute a step-wise reduction schedule for A5 Parties, the high growth will delay ozone recovery and hinder or even prevent compliance with the current HCFC consumption freeze in A5 Parties in 2016 and the final phase-out in 2040.[15] Failure to accelerate the HCFC phase-out also will contribute significantly to climate change.

## 2. What are the Climate Benefits from Accelerating the Phase-out of HCFCs?

The potential climate benefits range from 17.5 to 25.5 GTCO2-eq. by 2050; the actual climate benefits will depend upon policy leadership and active management of the transition out of HCFCs to encourage use of zero or low GWP substitutes, and to increase energy efficiency.

### A. Potential Climate Benefits Range from 17.5 to 25.5 $GtCO_2$-eq. Between 2010 and 2050[16]

The TEAP calculates a potential climate benefit of greater than 18 billion tons of carbon dioxide equivalent ($GtCO_2$-eq.) between 2015 and 2050 for an accelerated phase-out of HCFCs, including 3.5 $GtCO_2$-eq. of avoided HFC-23 by-product emissions.[17]

Brazil's environment ministry calculates a potential climate benefit of 22 $GtCO_2$-eq. between 2010 and 2040[18], without including the additional 3.5 $GtCO_2$-eq. of avoided HFC-23 by-product emissions,[19] which would bring their total up to 25.5 $GtCO_2$-eq.

Dr. Guus Velders from the Netherlands Environmental Assessment Agency and co-authors calculate a potential climate benefit of 17.5 $GtCO_2$-eq. between 2010 and 2050,[20] including 3.5 $GtCO_2$-eq. of avoided HFC-23 by-product emissions.[21]

The U.S. EPA calculates a potential climate benefit of 17.5 $GtCO_2$-eq. between 2010 and 2030, and estimates an additional 0.18 $GtCO_2$-eq. for avoided HFC-23 by-product emissions, which would bring their total up to 17.68 $GtCO_2$-.eq.[22]

### B. Some of the Climate Benefits Are the Result of Eliminating the HFC-23 By-Product

Some of the climate benefits are the result of eliminating the HFC-23 by-product that otherwise would be produced during the production of HCFC-22. This in turn will eliminate the "perverse incentive" under the Kyoto Protocol's Clean Development Mechanism (CDM),[23] which allows HCFC-22 production facilities in developing countries that capture and destroy HFC-23 by-product emissions to earn credits under the CDM.[24] HFC-23 is a super GHG with a GWP of 11,700.[25] These CDM credits earn up to 10 times the cost of capturing and destroying HFC-23 emissions and are exceeding the sales revenue of HCFC-22,[26] effectively subsidizing the cost of producing HCFC-22 and driving its expanded use, including in applications where it has not been widely used or had already been replaced.[27]

The "perverse incentive" of HFC-23 destruction projects under the CDM was recognized by the *2007 G8 Summit Declaration*: "We will also endeavour under the Montreal Protocol to ensure the recovery of the ozone layer by accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives. In working together toward our shared goal of speeding ozone recovery, we recognize that the Clean Development Mechanism impacts emissions of ozone-depleting substances."[28]

### C. The Climate Benefits Actually Realized Will Depend Upon the Success of the Transition from HCFCs into Zero or Low GWP Substitutes and Alternatives

The climate benefits actually realized from accelerating the phase-out of HCFCs will depend upon policy leadership and active management to ensure the success of the transition from HCFCs into zero or low GWP substitutes and alternatives.[29]

However, even without policy leadership and active management of the transition, the net climate benefits are significant. According to the US EPA, a business-as-usual approach to the transition would result in a net climate benefit of 3.1 $GtCO_2$-eq.[30] This is significant when compared to the 5 $GtCO_2$-eq. reduction mandated by the Kyoto Protocol in its first commitment period (2008-2012).[31]

The actual net benefits will be far larger with policy leadership and active management of the transition. This is reinforced by the current availability of low GWP substitutes, the recent development of additional low GWP substitutes, the ban on high GWP HFCs in certain applications, the near certainty that there will be more stringent climate regulations in the future, and the successful history of earlier transitions under the Montreal Protocol. For further decision of the availability of low GWP substitutes and alternatives, *see* **Questions 3-5 and 10-12**, below.

Policy leadership and active management of the transition should promote the use of zero and low GWP substitutes and alternatives, more energy efficient equipment and products, and competition to drive further technological innovations.[32] For discussion on the proposed significant/superior environmental benefits provisions, *see* **Questions 11-13**, below. The policy leadership starts by sending a clear regulatory signal to industry to show that climate-friendly alternatives are needed and will have a market, making it imperative to take action in 2007 to signal the accelerated phase-out of HCFCs.[33]

Management of the transition also should include evaluating substitute chemicals and technologies using the TEAP's Life Cycle Climate Performance (LCCP).[34] An LCCP analysis measures both the direct climate impacts of a substitute chemical as well as the indirect climate impacts from equipment energy use and emphasizes the importance of energy efficiency.[35] For further discussion of LCCP, *see* **Question 11,** below.

According to the TEAP, "When the use of a specific technology creates an incremental energy saving, the reduction in $CO_2$ emissions from the energy use can far outweigh the direct emissions over the expected life of the product."[36] The *2007 G8 Summit Declaration* confirms that "Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce GHG emissions and enhance energy security."[37]

The TEAP notes that maximizing the climate benefits of the accelerated HCFC phase-out depends on active management of the transition out of HCFCs:

> The climate benefits of an accelerated HCFC phase-out depend not only on the selection of the earlier freeze date and phase-out schedule, but also on the choice of technology to replace HCFCs in insulating foam and refrigeration and air conditioning sectors where indirect emissions from energy are significant. … Since over 80% of the potential climate-related savings arise from the refrigeration sector, alternatives that result in lower GWP-weighted emissions (e.g. from a low GWP fluid or a less emissive design, or those that deliver sufficient efficiency improvements to offset their impacts) would be necessary to realise a significant proportion of this potential. Regulatory and/or fiscal incentives (e.g. the recent F-Gas regulation in the EU) can assist in creating an appropriate environment for such developments.[38]

Velders *et al.* discuss how the transition can be managed to achieve a large part of the potential climate benefits, emphasizing the importance of policy leadership, as well as the current and future availability of low GWP substitutes:

With proper regulatory and market incentives, some HCFCs used in non-refrigerant applications can be replaced by not-in-kind options with equal or better energy efficiency. In refrigerant applications, a worst-case scenario, in terms of contributions to climate change, would be to replace a large portion of HCFCs with HFCs (hydrofluorocarbons) that have similar or higher global warming potentials (GWPs) without improvements in refrigerant management practices and no improvements in energy efficiency of the equipment. Fortunately, improvements in refrigerant management practices are possible, existing "natural" refrigerants such as carbon dioxide and hydrocarbons can replace a portion of HCFC use and newly emerging low-GWP HFC blend refrigerants might replace a large, but now uncertain, additional portion of both HCFCs and HFCs used in current equipment if motivated by regulation and market forces. For example, within weeks of the EC regulation banning HFC-134a from new vehicle air conditioning, fluorocarbon manufacturers announced substitutes promising equivalent energy efficiency with GWP<150. The scenario presented here assumes that the climate contributions due to replacement refrigerants is minimized by technically-feasible measures to reduce refrigerant emissions and is offset by improvements in energy efficiency of the equipment.[39]

### D. Reducing Emissions Now Will Provide Additional Time To Develop and Implement Long-Term Solutions To Mitigate Climate Change

Reducing ODS emissions now will provide additional time to develop and implement long-term solutions to mitigate climate change and to begin adapting to its impacts.[40]

Already, the MP's phase-out of CFCs and other ODSs will have reduced GHG emissions by 135 $GtCO_2$-eq. between 1990 and 2010, delaying climate forcing by up to 12 years.[41] If pre-Montreal Protocol efforts to protect the ozone layer are included, which include voluntary reductions in CFCs and domestic regulations in the 1970s, the delay in climate forcing is 35 to 41 years.[42]

Maximizing the climate benefits of an accelerated HCFC phase-out will provide additional emissions reductions and further delay climate change by approximately 1.5 years.[43]

The further delay in climate forcing from accelerating the HCFC phase-out is critical for A5 Parties, who will be hardest hit by the impacts of climate change and least able to afford adaptation. Climate impacts include rising sea levels, coastal flooding, increased droughts and storms, spread of diseases, and decreased freshwater supply and agricultural production.[44]

NASA climate scientist Dr. James Hansen warns that we may have only 10 years before increasing atmospheric concentrations of GHGs reach the tipping point for abrupt, non-linear, and irreversible climate change that could trigger catastrophic rises in sea level and other devastating impacts.[45]

## 3. Are There Substitutes and Alternatives to HCFCs?

The *UNEP 2007 Synthesis Report* concludes that technically and economically feasible substitutes are available for almost all HCFC applications.[46]

A detailed discussion of many available substitutes and alternatives is provided in the *IPCC/TEAP Special Report: Safeguarding the Ozone Layer and Global Climate System* (2005).[47] The August 2007 TEAP Report on the accelerated HCFC phase-out also discusses the availability of HCFC substitutes and alternatives.[48] For further discussion of the availability low GWP substitutes and alternatives, *see* **Questions 3-5 and 10-12**, below.

Because non-A5 Parties are required to phase-out of ozone-depleting substances (ODSs) in advance of A5 Parties, they will develop the superior substitutes and alternatives that will then be transferred to A5 Parties, with financial assistance from the Multilateral Fund (MLF). The European Union has already accelerated their phase-out of HCFCs, and other non-A5 Parties also are on track to phase-out HCFCs ahead of the MP's 2030 deadline—ensuring that feasible substitutes and alternatives will be field tested and perfected in non-A5 Parties before they are transferred to A5 Parties.

The accumulated expertise from past transitions out of CFCs and other ODSs will help facilitate the A5 Parties' transition out of HCFCs.[49] For example, manufacturers of refrigeration and air conditioning equipment now use "flexible" manufacturing processes that make it easier to accommodate transitions to different refrigerants (which may require changes to equipment such as different sizes or kinds of propellers, compressors, etc.). When the Montreal Protocol first mandated the phase-out of CFCs in 1987, very little was known about possible substitutes, and the transition was more difficult since manufacturers did not at that time have flexible processes and could only make one kind of propeller, compressor, and so on.

The MP does not restrict the use of recycled or stockpiled ODSs. For example, an air conditioning units using HCFC-22 can continue to be used after 2040 (the phase-out deadline in A5 Parties). It can be serviced with HCFC-22 produced prior to 2040 and obtained from stockpiles or from recycling even after 2040. (Individual countries, of course, can place domestic restrictions on ODS use after phase-out deadlines.)

The accelerated HCFC phase-out will not require retrofitting equipment, which is where the HCFC refrigerant is extracted from existing equipment and replaced with a substitute. Retrofitting is not necessary to comply with the phase-out, as existing equipment can be serviced with its original HCFC refrigerant until the final phase-out date. (Under the current non-A5 phase-out schedule for HCFCs, Parties must phase-out 99.5% of HCFC use by 2020, but then can use 0.5% of their baseline for servicing existing equipment until the current final phase-out in 2030. A similar "service tail" has been proposed for A5 Parties in several adjustments.)

Exemptions should be provided, or continuing use should be authorized, for existing uses where HCFCs offer the highest environmental benefits or are otherwise essential. The TEAP notes, for example, that technically and economically feasible substitutes have not yet been identified for some solvent, medical, and fire protection applications currently using HCFC-225.[50] As a result, the TEAP concludes that criteria for essential use exemptions or other types of exemptions need to be considered, noting that criteria for continued use of HCFCs in specific applications could take into account the climate impacts of available substitutes if they impose "unacceptable additional climate burdens."[51]

## 4. WHO WILL PAY FOR ACCELERATING THE HCFC PHASE-OUT?

Adjustments proposed by A5 Parties to accelerate the HCFC phase-out are explicitly subject to adequate financial assistance from the MLF.[52] Non-A5 Parties provide financial assistance to A5 Parties through the MLF to cover the incremental costs of compliance with the MP's control measures.[53]

Given the significant benefits of the accelerated HCFC phase-out to both the ozone and the climate, and the strong support from the G8, it is anticipated that non-A5 Parties will agree to replenish the MLF in 2008 at appropriate levels for the 2009-2011 cycle and beyond to implement the new HCFC control measures that accelerate the phase-out. Discussions at the OEWG generally supported this view.

Preliminary estimates indicate that accelerating the HCFC phase-out will cost between U.S. $3 and $5 billion over perhaps 20 years. When considering the costs of phasing-out HCFCs, it is important to note that throughout the history of the MP, per unit costs of phasing out ODS have fallen over time.[54]

The MLF's financial assistance to A5 Parties covers agreed incremental costs of a transition. This includes the difference in cost of any retooling of a manufacturing facility, tests, re-start, etc. In principle, this means that the MLF covers all costs that a user would want to have covered in order to be willing to make a transition. The eligible assistance for each project is decided through a process of detailed evaluation of project proposals in consultation with the implementing agencies and Parties. This process has been effective in the past.[55]

### 5. What Will It Cost To Replace HCFCs with Zero and Low GWP Substitutes and Alternatives?

To manage the transition out of HCFCs in a way that supports energy efficiency and climate change objectives, and that replaces HCFCs with zero and low GWP substitutes, donor countries may have to provide additional financial assistance to the MLF. Currently, most low GWP substitutes and alternatives are more expensive than existing high GWP chemicals and older, less energy efficient technologies,[56] but this is not expected to be the case as they are more widely used.

The manufacturing cost of chemicals depends largely on the feedstock material and the complexity of the process. New low GWP substitute chemicals are not likely to be more complicated than existing chemicals, and as a competitive market for low GWP substitutes develops and production occurs at a global scale, the costs do not necessarily need to be higher than existing refrigerants. Furthermore, manufacturers purchasing low GWP substitutes can mitigate any cost differences by reducing the amount of the chemical used, limiting emissions, and instituting greater recovery and recycling initiatives.

In addition, future climate regulation is expected to raise the costs of high GWP chemicals and technologies. In some cases, this may result in their outright prohibition. Future climate regulation will drive technological innovation and help lower the costs of low GWP substitutes and alternatives. Entities that make the transition out of HCFCs and into high GWP chemicals and technologies will risk having to make an extra transition to low GWP substitutes and alternatives.

For example, in 2006, the EU F-Gas regulation banned high GWP refrigerants (GWP greater than 150) in automobile air conditioning in new model cars by 2011. As a result, automakers and chemical manufacturers have been forced to make an early transition out of HFC-134a, which has a GWP of 1,430 and is used in nearly all vehicles worldwide. This has made existing low GWP substitutes such as $CO_2$, hydrocarbons, and HFC-152a more competitive and has driven efforts to address technical issues regarding their safety and energy efficiency. It also spurred the development of new low GWP substitutes. For more information on low GWP substitutes and alternatives, *see* **Questions 3-5 and 10-12**.

### 6. WHAT IS THE BEST WAY TO IMPLEMENT THE STRATEGIES TO MANAGE THE TRANSITION TO SUPPORT ENERGY EFFICIENCY AND CLIMATE CHANGE OBJECTIVES?

The strategies for managing the transition to support energy efficiency and climate change objectives can be implemented by all the Parties, and the MLF, based on LCCP.

There are several steps the Parties can take to prevent a transition to high GWP chemicals and older, less energy efficient technologies. These include:

- Directing the TEAP, in conjunction with the IPCC, to develop specific methodologies for LCCP analyses of HCFCs and existing substitutes and alternatives to identify the most climate-friendly options;
- Revising the MLF's cost-effectiveness criteria to require that all projects use low GWP substitutes and alternatives and the most energy efficient equipment available;
- Adjusting Article 2F, paragraph 7 to apply to all Parties as a binding commitment and to cover both HCFCs and HCFC substitutes and alternatives;
- Encouraging new industry-government partnerships to stimulate technological innovation and speed superior products to market worldwide; and
- Exploring additional sources of funding for the MLF, such as the CDM, revolving funds, and other options, that could eventually be used to supplement existing funding for the transition out of HCFCs (recognizing that it will take time to develop and implement these supplemental options and that the ozone and climate benefits of an accelerated HCFC phase-out will be lost if the adjustment is delayed).

The MP has prioritized non-ozone-related environmental concerns in the past when it avoided the use of highly toxic chemicals as substitutes for ODSs used in solvent applications. In that case, the Parties evaluated available substitutes for ODS solvents and ruled out those with highly toxic properties.

### 7. WHAT IS THE IMPACT ON THE MLF IF THE HCFC PHASE-OUT IS ACCELERATED?

Failure to agree to accelerate the HCFC phase-out this year will have adverse impact on the MLF.

A5 Parties receive financial assistance in 2009-11 from the MLF to make the transition out of HCFCs only if the Parties agree to adjust the MP. The current freeze year 2016 is too distant to require MLF finance HCFC projects in the 2009-2011 MLF replenishment cycle. (*See* **Question 7A**, below.) In addition, the Parties also must change current MLF rules that prohibit funding for facilities that had already received funding to transition into HCFCs or were established after July 1995. (*See* **Question 7B**, below). Further, the current lack of intermediate control measures between 2016 and 2040 may make donors reluctant to contribute for the HCFC phase out in the immediate future.

Without an accelerated HCFC phase-out, A5 Parties could be forced by market pressures to make the transition out of HCFCs ahead of the 2040 phase-out deadline and to do so without financial assistance. The EU, U.S., and Japan – which are key export markets for HCFC-based equipment produced in A5 Parties – are already making the transition out of HCFCs. These non-A5 Parties are expected to ban imports of HCFC-based equipment well before A5 Parties are required to phase-out of HCFCs in 2040.

The accelerated HCFC phase-out is an opportunity for A5 Parties to make this transition with financial assistance and into substitutes and alternatives that will be competitive in the global market beyond 2040.

### A. Why Does Financial Assistance Depend on Adjusting the MP to Place a New HCFC Control Measure in the 2009-2011 MLF Replenishment Cycle?

The MLF is replenished in three-year cycles, and the funds are contributed for each cycle only to the extent of the needs of the A5 Parties to implement control measures.

In 2008 the Parties will determine the MLF's replenishment for the 2009-2011 cycle. Under the status quo, the next major control measure is not until the 2016 freeze in HCFC consumption. Generally, MLF-funded projects begin about three years before the control measure takes effect, which for the HCFC consumption freeze in 2016 would be in 2013 – two years after the next replenishment cycle ends.

As a result, without the accelerated HCFC phase-out, there will no major control measures active during the 2009-2011 cycle. This leaves the estimated replenishment at about U.S. $33 million per year, which is significantly lower than earlier cycles of about U.S. $150 million per year.

By moving the base year and freeze date forward to occur during the 2009-2011 cycle, the accelerated HCFC phase-out makes it possible to maintain current levels of funding and avoid a drop-off.

A drop-off in funding for the MLF may make it difficult to restore higher levels of funding in future cycles. A drop-off in funding for the 2009-2011 cycle could even lead to the premature shut down of the MLF and the transfer of its tasks to some other financial institution. Shutting down the MLF risks losing the institutional and political expertise of the MLF as well as the national ozone units and networks that the MLF supports, which are critical to ensuring compliance with the MP, keeping recovery of the ozone layer on track, and delaying further climate change.

It also is important to agree on an accelerated HCFC phase-out this year, in 2007, so that when the Parties negotiate the MLF's 2009-2011 replenishment next year, in 2008, they can calculate the full cost of the new HCFC control measures.

### B. What Other Changes to the MLF Are Required to Ensure Funding for the Accelerated HCFC Phase-out?

Adjustments proposed by A5 Parties condition the accelerated HCFC phase-out on the availability of appropriate levels of financial assistance to make the transition out of HCFCs.

The proposals by Argentina-Brazil and Mauritius expressly require changing current MLF rules that prohibit funding for facilities that had already received funding to transition out of CFCs and into HCFCs or were established after July 1995.[57]

This MLF rule was based in part on the assumption that under the existing A5 deadline of 2040 for phasing-out HCFCs, nearly all HCFC-based equipment and products would already have reached end-of-life and been replaced by superior substitutes and alternatives.

Current MLF rules need to be revised so that facilities that received funding to transition out of CFCs and into HCFCs will be eligible to receive funding to transition out of HCFCs.[58] Additional revisions would be required to provide any additional funding needed to capture the maximum climate benefits. For a discussion on additional funding for climate benefits, *see* **Questions 4, 5, and 7**.

### 8. CAN THE PARTIES ACCELERATE THE HCFC PHASE-OUT BY ADJUSTMENT?

Yes. Changes to the phase-out schedule of controlled substances under the MP have historically been done by adjustment.[59]

Amendments are only required to add or remove a substance from one of the MP's annexes, or to change another part the MP other than the control schedule for an already-controlled substance.

### 9. DOES THE MONTREAL PROTOCOL CURRENTLY REQUIRE THE PARTIES TO TAKE INTO ACCOUNT THE CLIMATE BENEFITS OF PROTECTING THE OZONE LAYER?

Yes, although greater clarity and increased financial assistance are needed to maximize the climate benefits of the Montreal Protocol.

The MP includes requirements to avoid non-ozone environmental impacts. The control measures on HCFCs in Article 2F state in sub-paragraphs 7 (a) and (c) that the use of HCFCs should be "limited to those applications where more environmentally suitable alternative substances or technologies are not available" and that HCFCs "are selected for use in a manner that minimizes ozone depletion, in addition to meeting other environmental, safety and economic considerations."[60]

Furthermore, in the MP the Parties agreed to eliminate the use of ODSs through actions based on "developments in scientific knowledge, taking into account technical and economic considerations......"[61] "Developments in scientific knowledge" include the link between ozone depletion and climate change. This is acknowledged in the MP, which states that the Parties are "[c]onscious of the potential climatic effects of emissions of these substances [ODS]."[62]

Gases that are regulated by the MP are explicitly excluded from the UN Framework Convention on Climate Change and the Kyoto Protocol. The exclusion was made with knowledge that many of the MP gases have high GWPs and can substantially contribute to climate change. This places the responsibility on the Parties to the Montreal Protocol to maximize the climate benefits of protecting the ozone layer.[63] Parties to the Montreal Protocol are obliged to account for climate impacts in protecting the ozone layer.

This also is supported by the TEAP, the IPCC, and the MP's Science Assessment Panel. The TEAP noted the climate impacts from the use of ODSs and from the energy use of ODS-based equipment.[64] The *IPCC/TEAP Special Report* observed that "[o]ptions chosen to protect the ozone layer could influence climate change. Climate change may also indirectly influence the ozone layer."[65] The *Scientific Assessment Panel 2006 Report* noted that climate change is likely to influence and potentially harm the recovery of the ozone layer.[66]

Requiring the MP to promote energy efficiency and climate change objectives also is supported by *Agenda 21*, which calls on Parties to "[r]eplace CFCs and other ozone-depleting substances, consistent with the Montreal Protocol, recognizing that a replacement's suitability should be evaluated holistically and not simply based on its contribution to solving one atmospheric or environmental problem."[67]

The 2007 *G8 Summit Declaration* further affirms that "We will also endeavour under the Montreal Protocol to ensure the recovery of the ozone layer by accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives."[68]

## 10. How Can Parties Accelerate the Phase-out of HCFCs in a Way that Supports Energy Efficiency and Climate Change Objectives?

Accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives would be done in two ways. First, the HCFC phase-out should be accelerated as fast as possible. Second, the transition should be actively managed to ensure that HCFCs are replaced with zero or low GWP substitutes and alternatives, in a way that maintains a competitive playing field and drives technological innovation, including improvements in equipment energy efficiency.

This can be accomplished by evaluating available substitute chemicals and technologies using the TEAP's LCCP.[69] An LCCP analysis measures the direct climate impacts of a substitute chemical as well as the indirect climate impacts from equipment energy use—which can far outweigh the direct impacts of refrigerant emissions on the climate.[70]

Managing the transition to support energy efficiency and climate benefits should include the following measures:

### A. Replacing HCFCs with Zero or Low GWP Substitutes and Alternatives

HCFCs must be replaced with zero or low GWP substitutes and alternatives. DuPont, Honeywell, and Ineos recently announced the development of new low GWP refrigerants that can achieve comparable energy efficiency to existing HCFC and HFC refrigerants.[71]

In addition, Mack McFarland of DuPont testified before the House Oversight and Government Reform Committee on May 23rd that DuPont intends to adapt its low GWP substitutes to replace high GWP HFCs in refrigeration, A/C, and other applications.[72] A Honeywell representative at the OEWG said: "Tell us the GWP you want and we'll develop the chemicals to rapidly replace HCFCs." Other industry representatives have indicated that the current proposals for accelerating the phase-out of HCFCs may under-estimate the ability of industry to quickly provide superior substitutes and alternatives at modest prices.[73]

The new low GWP substitutes are emerging in response to the clear regulatory signals sent by the EU's accelerated HCFC phase-out, which eliminated most uses of HCFCs by 2004 (with the exception of a "service tail" for servicing existing equipment). This was followed by additional EC regulations banning the use of HFC-134a and other substitutes with a GWP greater than 150 in automobile air conditioning by 2011.[74] In response to this regulation, several chemical manufacturers developed new low GWP substitutes for automobile air conditioning that achieve comparable or better energy efficiency in automobiles than HFC-134a.[75] Similar rapid technology innovation is expected under an accelerated HCFC phase-out.

Low GWP substitutes, such as hydrocarbons, carbon dioxide, and ammonia (which has zero GWP), are commercially available and have been used as replacements for HCFCs in air conditioning and refrigeration. Use of these substitutes raise some flammability or toxicity concerns, and in some cases are not yet as energy efficient as HCFC and high GWP HFC refrigerants.

### B. Improving the Energy Efficiency of Refrigeration and Air Conditioning Equipment

The energy efficiency of refrigeration and air conditioning equipment must be improved. Improvements in energy efficiency are expected to accompany a transition out of HCFCs, as HCFC-based equipment is replaced with superior designs. This was the past experience with other phase-outs. With clear regulatory signals to the market to drive technology innovation, this is expected to be the case here as well.[76]

When energy efficiency is improved, reduction in GHG emissions from decreased fossil fuel energy use far outweigh the direct emissions over the life of the product or equipment.[77] "Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security," according to the 2007 *G8 Summit Declaration,*[78] which also notes that "The global potential for saving energy … could contribute to 80% of avoided greenhouse gases while substantially increasing security of supply."[79]

In addition to improving energy efficiency, the next generation of equipment that replaces HCFC-based equipment is likely to use smaller refrigerant charge sizes and be designed to minimize leaks, which will reduce fugitive emissions during equipment lifetime. Other improvements can facilitate greater recovery of used refrigerant at equipment end-of-life and prevent it from being emitted into the atmosphere.

### C. Promoting **Not-in-kind Substitutes and Product Alternatives**

Not-in-kind substitutes and product alternatives must be promoted. In addition to new low GWP substitutes, the MP's history suggests that zero or low GWP substitutes and alternatives also will be available. Under the MP, 80% of CFCs and other ODSs were replaced with non-fluorocarbon substitutes and alternatives (or contained and recycled).[80]

The 80% success rate was the result of strict phase-out deadlines in non-A5 Parties that drove the development and diffusion of superior environmental substitutes and alternatives, including not-in-kind chemical substitutes, product alternatives (e.g. roll-on deodorant instead of spray), manufacturing-process changes, conservation, and doing without.[81] For example, HCFCs used as foam-blowing agents can be replaced by existing substitutes and alternatives that have zero climate impacts.[82]

## 11. What is Life Cycle Climate Performance?

A LCCP analysis[83] measures both the direct climate impacts of the substitute chemical as well as the indirect climate impacts from energy use, which emphasizes the importance of energy efficiency.[84]

This is critical. According to the TEAP, when energy efficiency is improved, the reduction in GHG emissions from decreased energy use can far outweigh the direct emissions over the life of the product or equipment: "When the use of a specific technology creates an incremental energy saving, the reduction in $CO_2$ emissions from the energy use can far outweigh the direct emissions over the expected life of the product."[85]

For example, the *IPCC/TEAP Special Report* notes that "the major portion of LCCP [for chillers] is the indirect warming associated with energy consumption. Direct warming…amounts to between 0.2 and 3 percent of the total LCCP."[86]

The 2007 *G8 Summit Declaration* further emphasizes that "Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security. … [and] could contribute to 80% of avoided greenhouse gases while substantially increasing security of supply."[87]

## 12. How are Energy Efficiency and Climate Benefits Addressed by the "Superior Environmental Benefits" Provision?

All of the proposed adjustments submitted by A5 Parties to accelerate the HCFC phase-out address energy efficiency and climate change objectives by allowing continued use of HCFCs that provide greater energy efficiency or other "superior/significant environmental benefits" over existing substitutes and alternatives.

The superior/significant environmental benefits provision implements the existing requirement of the MP to address climate change. It is designed to manage the transition to promote energy efficiency and climate benefits by allowing continued use of HCFCs in applications that provide improved energy efficiency or other environmental benefits, as determined by LCCP analysis.[88]

This provision also ensures a competitive playing field to continue driving technological innovation to produce the next generation of ODS substitutes and alternatives that are ozone- and climate-friendly, both in terms of the direct impacts of the chemicals used and in terms of energy efficiency to reduce the indirect impacts from GHG emissions.

The 2007 *G8 Summit Declaration* emphasizes that "Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security."[89] When energy efficiency is improved, the reduction in GHG emissions from decreased energy use can far outweigh the direct emissions over the life of the product or equipment.[90]

The continued use of an HCFC will be allowed under this provision only until superior substitutes and alternatives are developed. A TEAP review process will be required to evaluate new substitutes and alternatives using LCCP and to recommend the eventual phase-out of HCFCs in uses under this provision, taking into account product life-cycles as appropriate.

An illustration is provided by the TEAP's review of HCFC-123 in large-building air conditioners (known as chillers), which it notes should continue due to its 13.5% advantage in energy efficiency over HFC-134a,[91] which is a high GWP substitute included as one of the six greenhouse gases under the Kyoto Protocol, and currently the alternative refrigerant used in chillers.[92]

The Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee concluded in its 2006 Assessment that:

> Energy efficiency is the primary environmental consideration for chillers. While refrigerants each have a Global Warming Potential (GWP) relative to $CO_2$, refrigerants do not contribute directly to global warming unless they are released to the atmosphere. Properly-maintained chillers of modern design emit very little of their refrigerant charge during operation. The dominant global warming effect caused by chiller operation is the $CO_2$ emitted in the combustion of fossil fuels generating the electricity to drive them. High annualized chiller efficiencies reduce global warming proportionally.[93]

In addition to inferior levels of energy efficiency, HFC-134a is a potent GHG with a GWP of 1,430,[94] and operates at a high pressure, so it is more likely to leak into the atmosphere.[95]

HCFC-123 has a relatively low GWP of 76,[96] a low ODP of 0.02.[97] It is liquid at room temperature and operates in chillers at low pressure. This means that if there is a leak, air leaks in rather than the refrigerant leaks out.[98] As a result, emissions of HCFC-123 are near zero and its impact on the ozone layer is negligible.[99]

Under the superior/significant environmental benefits provision, the continued use of HCFC-123 or any other HCFC would be conditioned on the destruction of [200%] of the ODP from ODS banks, resulting in additional benefit to the ozone layer and to the climate system.

Continued use of HCFC-123 until a better performing substitute is developed will ensure competition to drive technology innovation to identify the next generation of chiller refrigerants and designs.

Other HCFCs that may be eligible for consideration include HCFC-124 and HCFC-225 in niche applications for which no superior alternatives are available:[100]

- HCFC-124 is blended with ethylene oxide and used to sterilize surgical and other medical instruments.[101]

- HCFC-225 is used as a solvent for cleaning oxygen systems and removing exotic lubricants, such as krytox, from aerospace applications.[102]

- HCFC-123 has also been used to replace halon 1211 in portable fire extinguishers.[103]

Alternatively, the Parties could consider a global superior environmental benefits essential use exemption for HCFCs in specific applications, similar to the global laboratory and analytical essential use exemption. This would allow global use of an HCFC in a specific application until [2050] (e.g. HCFC-123 in chillers with near-zero emissions and energy efficiency advantages over existing substitutes) until superior substitutes are developed, subject to periodic review, and taking into account equipment life spans.

### 13. Are there any Ozone Impacts from Continued Use of HCFCs Under the Superior Environmental Benefits Provision?

Continued use of HCFCs under this provision will not have any adverse impact on the ozone layer; rather it will provide a net ozone benefit. This is because the continued use of any HCFC is conditioned on the destruction of ODS banks in the amount of [200%] of the ODP tonnes of the amount of HCFC proposed for continued use. As a result, any continued use of HCFCs under this provision will have a positive impact on the ozone layer.

### 14. Are there Other Measures that can be Taken Under the Montreal Protocol to Do Still More to Mitigate Climate Change?

Yes. There are several other measures that the Parties can take that will mitigate climate change, including the "practical measures" developed as part of the Ozone Secretariat's Workshop on the IPCC/TEAP Special Report held in July 2006.[104] The TEAP calculates that an accelerated HCFC phase-out plus the "practical measures" identified by the Ozone Secretariat Workshop can result in cumulative emissions reductions of about 1.25 million ODP tones and 30 Gt-$CO_2$-eq.[105]

In particular, banks of CFCs other ODS represent a significant threat to the ozone layer and the climate. Approximately 7.4 Gt$CO_2$-eq. of CFCs currently contained in banks of existing equipment and products is expected to be released into the atmosphere between 2002 and 2015.[106] There will be additional significant emissions beyond 2015 as more CFC and HCFC-based equipment reaches end-of-life.[107] (An immediate step is to include emissions from banks of HFC substitutes in future estimates of banks.)

Banks are defined as ODSs contained in existing equipment (air conditioners and refrigerators), products (e.g. foam insulation), and stockpiles (e.g. the military stockpiles various chemicals for specialized uses). These exist in both A5 and non-A5 Parties.

Emissions of CFCs and other ODSs from banks could be avoided by creating greater incentives for their recovery and destruction. In addition to the destruction offset that is part of the "superior environmental benefits" provisions, this should include allowing destruction credits to carry forward for more than one year, to be traded between Parties, and to transfer among chemical groups, where the destruction of an amount of one chemical, for example, CFCs, would allow the production or consumption of an equal amount, on an ODP-weighted basis, of an ODS from another chemical group, for example, HCFCs.[108] It could include programs to encourage greater recovery and recycling or destruction, such as Refrigerant Reclaim Australia.[109]

The Parties also could begin to phase-out of the use of ODS as feedstocks, especially considering that nearly half of all HCFC-22 production is for feedstock applications.[110] Feedstocks are not subject to MP controls, because when HCFC-22 is used as a feedstock to make another chemical, it is in theory completely destroyed, resulting in zero emissions. In practice, there are some emissions. An additional concern with feedstocks is that the continued use of HCFC-22 means continued by-product emissions of HFC-23. Also, as long as HCFC-22 is being produced, there is a risk it will find its way via the black market into banned applications after its phase-out.

The MP also should strengthen its compliance efforts by building on work already underway in the Secretariat, UNEP OzonAction's compliance assistance program, and elsewhere, to promote an ambitious capacity building program.[111] This can be accomplished by linking with the Green Customs Initiative of UNEP and the International Network for Environmental Compliance & Enforcement. A much more aggressive effort is warranted by the combined ozone and climate benefits from strict compliance.

Under Decision XVII/16, the Parties to the Montreal Protocol requested a feasibility study for developing systems for monitoring transboundary movements of ODSs. The study proposed options for monitoring systems that could help reduce illegal trade in ODSs, which has become a worldwide problem as the phase-out of CFCs and other ODSs has progressed.[112] To combat illegal trade, the study made a series of recommendations, including a proposal to set up a global ODS tracking system that builds on current licensing and reporting systems and includes cross-checking of licenses and quotas in a centralized manner.[113]

## 15. Could the Montreal Protocol's Regulatory Structure Be Applied to Other Sources of Climate Change, such as Some of the GHGs Regulated by the Kyoto Protocol?

The MP's experience in successfully combating the global atmospheric problem of ozone depletion offers several lessons that may be useful for current and future efforts to combat climate change.

The MP's success is attributed to extraordinary leadership by governments, industry, and international and non-governmental organizations to support increasingly strict phase-out deadlines and dynamic and collaborative efforts to develop superior substitutes and alternatives – many of which not only proved to be less costly than anticipated but also lowered costs by improving energy efficiency and driving technology innovation that led to superior products and equipment.

Its success also is linked to its scientific and technical assessment panels, its dynamic decision making process that has continued to strengthen and add control measures based on new scientific, technical, and economic developments, its global network of experienced ozone officers, its dedicated funding mechanism that provides financial assistance to A5 Parties to facilitate the transition to ODS substitutes and alternatives, and its ability to maintain a competitive playing field to drive continuous technology innovation.

The MP also has balanced the obligations of A5 and non-A5 Parties in a way that is recognized as fair and equitable, based on the principle of common but differentiated responsibilities, and the commitment of full incremental funding through the MLF's dedicated funding mechanism.

The following are insights from the MP that may be of value to those negotiating the post-2012 climate regime:

- A5 Parties accepted hard phase-out deadlines, after non-A5 Parties accepted earlier phase-out deadlines, where the non-A5 Parties would be required to develop and perfect superior substitutes and alternatives, and to provide financial and technical assistance to A5 Parties through the MLF, the Global Environment Facility, and bilateral donor agencies to facilitate transitions out of ODSs and into leading edge technology.

- The MLF provided financial assistance to establish permanent and well trained "ozone units" in every A5 Party linked in dynamic networks to facilitate the rapid transfer of experience and information on good practices. The ozone units provided stability and continuity on ozone issues for each Party.

- The TEAP and its Technical Options Committees are not limited to previously published scientific literature; they include broad participation from industry experts to allow the immediate transfer from the field to the policy arena of cutting edge ideas and developments.

Finally, some of the non-$CO_2$ gases included under the Kyoto Protocol, in particular HFCs and PFCs, are used in applications virtually identical to the applications CFCs and other ODSs were used in before being phased-out by the MP. The post-2012 climate negotiations may wish to consider whether these chemicals would be more effectively and efficiently regulated under the MP. They also may wish to consider the design and structure of the MP's regulatory approach when developing the regime for other non-$CO_2$ gases.

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[*] This FAQ will appear in the forthcoming *The Montreal Protocol: Celebrating 20 Years of Environmental Progress – Ozone Layer and Climate Protection* (Cameron May 2007) and was prepared as a supplement to the authors' article in Chapter 13 of the book, entitled *Strengthening the Montreal Protocol: Insurance Against Abrupt Climate Change*, published in SUSTAINABLE DEVELOPMENT LAW & POLICY (March 2007), *available online* in English, Spanish, French, Chinese, and Arabic at http://www.igsd.org/. The comments and suggestions of the outside expert reviewers are gratefully acknowledged.

[1] UNEP/TEAP, *Response to Decision XVIII/12: Report of the Task Force on HCFC Issues and Emissions Reduction Benefits Arising from Earlier HCFC Phase-out and other Practical Measures* (August 2007), at 13 ("All types of measure have a potential role to play, particularly in stimulating early emissions savings, but it is clear that the single biggest contributor to cumulative emissions savings both in terms of ozone and climate is an accelerated HCFC phase-out.") [hereinafter TEAP Accelerated HCFC Phase-Out Task Force Report].

[2] Dr. James Hansen, of the NASA Goddard Institute for Space Studies, argues that "[p]ositive climate feedbacks and global warming already 'in the pipeline' due to climate system inertia together yield the possibility of climate 'tipping points' . . . such that large additional climate change and climate impacts are possible with little additional human-made forcing. Such a system demands early warnings and forces the concerned scientist to abandon the comfort of waiting for incontrovertible confirmations." *Scientific Reticence and Sea Level Rise*, ENVIRON. RES. LETT. 2 (2007). James Hansen, *Climate Catastrophe*, New Scientist (28 July 2007), Dr. Hansen raises specific concerns regarding melting ice sheets and rising sea levels:

> The current rate of sea level change is not without consequences. However, the primary issue is whether global warming will reach a level such that ice sheets begin to disintegrate in a rapid, non-linear fashion on West Antarctica, Greenland or both. Once well under way, such a collapse might be impossible to stop, because there are multiple positive feedbacks. In that event, a sea level rise of several metres at least would be expected. . . . The palaeoclimate record contains numerous examples of ice sheets yielding sea level rises of several metres per century when forcings were smaller than that of the business-as-usual scenario. For example, about 14,000 years ago, sea level rose approximately 20 metres in 400 years, or about 1 metre every 20 years.

There is growing evidence that the global warming already under way could bring a comparably rapid rise in sea level. . . . The findings in the Antarctic are the most disconcerting. Warming there has been limited in recent decades, in part due to the effects of ozone depletion. The fact that West Antarctica is losing mass at a significant rate suggests that the thinning ice shelves are already beginning to affect ice discharge rates.

So far, warming of the ocean surface around Antarctica has been small compared with the rest of the world, as models predict, but that limited warming is expected to increase. The detection of recent, increasing summer surface melt on West Antarctica raises the danger that feedbacks among these processes could lead to non-linear growth of ice discharge from Antarctica. . . .

Ocean warming and thus melting of ice shelves will continue even if $CO_2$ levels are stabilised, because the ocean response time is long and the temperature at depth is far from equilibrium for current forcing. Ice sheets also have inertia and are far from equilibrium. There is also inertia in human systems: even if it is decided that changes must be made, it may take decades to replace infrastructure.

The threat of large sea level change is a principal element in my argument that the global community must aim to restrict any further global warming to less than 1 °C above the temperature in 2000. This implies a $CO_2$ limit of about 450 parts per million or less. Such scenarios require almost immediate changes to get energy and greenhouse gas emissions onto a fundamentally different path. . . .

The broader picture strongly indicates that ice sheets will respond in a non-linear fashion to global warming – and are already beginning to do so. There is enough information now, in my opinion, to make it a near certainty that business-as-usual scenarios will lead to disastrous multi-metre sea level rise on the century time scale.

[3] UNEP, *Report of the Twenty-Seventh Meeting of the Open-ended Working Group of the Parties to the Montreal Protocol*, UNEP/OZL.Pro.WG.1/27/9 (18 June 2007), at 25. *See also, Stockholm Group 3rd Meeting Report* (6 Feb. 2007), at 4 ("An accelerated phase-out of HCFCs is both possible and necessary, in light of the availability of alternatives, concerns over compliance, and the costs of late transitioning out of HCFCs.") [hereinafter *Third Stockholm Group Meeting*].

[4] G8 Summit in Heiligendamm, Germany, *Growth and Responsibility in the World Economy, Summit Declaration* (7 June 2007), at paragraph 59 ("We will also endeavour under the Montreal Protocol to ensure the recovery of the ozone layer by accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives. In working together toward our shared goal of speeding ozone recovery, we recognize that the Clean Development Mechanism impacts emissions of ozone-depleting substances.") [hereinafter *G8 Summit Declaration*]. *See also,* U.S.-Japan Joint Statement on Energy Security, Clean Development, and Climate Change, 27 April 2007. ("We will also endeavor under the Montreal Protocol to ensure the recovery of the ozone layer to pre-1980 levels by accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives.") [hereinafter U.S.-Japan Joint Statement]. U.S.-EU Summit Statement on Energy Security, Efficiency, and Climate Change, 30 April 2007 ("We also commit under the Montreal Protocol to seek to speed up the recovery of the ozone layer by accelerating the phase-out of HCFCs. We will weigh the impact of our proposals on climate change and energy efficiency. In working together toward our shared goal of speeding ozone recovery, we recognize that the Clean Development Mechanism impacts emissions of ozone-depleting substances.") [hereinafter U.S.-EU Summit Statement].

[5] *G8 Summit Declaration*, *supra* note 4, at paragraphs 46 and 62 ("46. This year we have focussed our discussions on energy efficiency in order to make an effective contribution towards meeting global climate and energy security challenges. Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security. ... 62. The global potential for saving energy is huge. According to the International Energy Agency, successfully implemented energy efficiency policies could contribute to 80% of avoided greenhouse gases while substantially increasing security of supply."). *See also* Stephen Pacala and Robert Socolow, Stablization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies, 305 Science 968 (13 August 2004) at 968-69 ("Improvements in efficiency and conservation probably offer the greatest potential to provide wedges [to reduce climate emissions] . . . A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years. It thus represents a cumulative total of 25 GtC of reduced emissions over 50 years.") [hereinafter Pacala & Socolow].

[6] UNEP, *Co-Chairs' Consolidated Issues Paper on Proposals for Accelerated Phase Out of HCFCs*, Distributed 6 June at the OEWG during Contact Group discussing proposals to accelerate the phase-out of HCFCs. *See also* UNEP, *Draft Decisions and Proposed Adjustments*, UNEP/OzL.Pro.19/3 (10 June 2007).

[7] Sherwood Rowland and Mario Molina, *The CFC-Ozone Puzzle: Environmental Science in the Global Arena*, The John H. Chafee Memorial Lecture on Science and the Environment, Presented at the National academy of Sciences, Washington, DC (7 Dec. 2000), excerpted from Chapter 1; Mostafa Tolba with Iwona Rummel-Bulska*, The Story of the Ozone Layer*, GLOBAL ENVIRONMENTAL DIPLOMACY: NEGOTIATING ENVIRONMENTAL AGREEMENTS FOR THE WORLD, 1973-1992, at 55-88 (MIT Press 1998), excerpted from Chapter 2; Richard Benedick, *The Improbable Montreal Protocol: Science, Diplomacy, and Defending the Ozone Lawyer Policy*, Case Study Prepared for the 2004 Policy Colloquium of the American Meteorological Society (2004), excerpted from Chapter 3.

[8] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 7 ("The scenario with a 15 year advance in phase-out of HCFCs (Scenario 2) delivers the most potential for ODS emissions abatement. For refrigeration alone, cumulative savings could be 468,000 ODP tonnes to 2050. The least effective ODS emissions abatement scenario arises from freezing at 2012 without an earlier phase-out date (Scenario 3), where cumulative savings over a comparative period are estimated to be about 75,000 ODP tonnes. However, this should not preclude the consideration of an earlier freeze, possibly in combination with other measures."). An ODP ton is the total amount of an ozone-depleting substance (ODS) multiplied by the ozone depletion potential (ODP) of the substance. For example, HCFC-22 has an ODP of 0.055, so 100 tons of HCFC-22 equals 5.5 ODP tonnes.

[9] TEAP Accelerated HCFC Phase-Out Task Force Report, supra note 1, at 12 ("Evaluations using the approach previously adopted by the Science AssessmentPanel to assess the influence of factors on ozone recovery (return to 1980 levels of EESC) show that accelerated HCFC phase-out can advance ozone recovery by up to 3.3 years based on a mid-latitude assessment.").

[10] WMO/ UNEP, Science Assessment Panel of the Montreal Protocol on Substances that Deplete the Ozone Layer, *Scientific Assessment of Ozone Depletion: 2006, Executive Summary* (18 August 2006), at 21 ("The date when equivalent effective stratospheric chlorine at midlatitudes returns to pre-1980 levels is no calculated to be 2049, for the case of global compliance with the Montreal Protocol with no significant exceptions. This date is about 5 years later than projected in the previous (2002) assessment. This projected later date primarily results from (i) an increase in CFC-11 and CFC-12 emissions due to the larger recent estimates of amounts currently contained in equipment and products (banks) and (ii) an increase in HCFC-22 emissions due to larger estimated future production. … The return to pre-1980 conditions of equivalent effective stratospheric chlorine for the Antarctic vortex is projected to occur around 2065, more than 15 years later than the return of midlattitude equivalent effective stratospheric chlorine to pre-1980 levels. This projected later recovery is because, unlike previous Assessments, we now recognize that the age of air is greater in the Antarctic lower stratosphere, which affects the amount of ozone-depleting gases available for ozone depletion. …" ) [hereinafter 2006 Scientific Assessment].

[11] UNEP, Open-ended Working Group of the Parties to the Montreal Protocol, *Synthesis Report*, UNEP/OzL.Pro.WG.1/27/3 (22 Feb. 2007), at 3 ("Furthermore, if the Parties were to eliminate all emissions of ozone-depleting substances soon after 2006, it would advance by about 15 years (from 2050 to 2035) the global ozone layer recovery to pre-1980 levels (often used as a benchmark for ozone recovery") [hereinafter *Synthesis Report*].

[12] 2006 Scientific Assessment, *supra* note 10, at 21 ("The date when equivalent effective stratospheric chlorine at midlatitudes returns to pre-1980 levels is now calculated to be 2049…." partly due to the extremely high estimates of future production of HCFCs.).

[13] UNEP, *1998 Assessment Report of the Technology and Economic Assessment Panel* (Oct. 1998) ("HCFC global consumption is expected to decrease from 412 to 163 ktonnes between the years 1998 and 2015, respectively."). *See also* TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 25; UNEP, IPCC/TEAP, *Special Report: Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydroflurocarbons and Perfluorocarbons*, Technical Summary (2005), at 81 ("In developing countries, the production of HCFC-22 for both feedstock and nonfeedstock uses has grown rapidly in recent years; over the period 1997−2001, production for commercial (or nonfeedstock) uses grew linearly at 20 ktonnes yr-1 and feedstock use grew at 4.1 ktonnes yr-1. Projected at these rates until 2015, the total global requirement for HCFC-22 would become about 730 ktonnes yr-1 − about 40% of which would be for feedstock − compared with a total of 470 ktonnes yr-1 in the year 2000.") [hereinafter IPCC/TEAP Technical Summary].

[14] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 13 ("Recognising that early planning for transition can increase efficiency and minimise costs, there is a strong case for setting policy and regulatory frameworks as soon as possible. Additional regional incentives might include the limitation of exports of HCFC containing products to those regions that have already phased-out and the introduction of supportive funding

mechanisms. These mechanisms could also be extended to the implementation of the other *'practical measures'*, where co-financing may be available from the voluntary market in recognition of the climate benefit accruing.").

[15] *Third Stockholm Group Meeting*, *supra* note 3, at 4-5 ("An accelerated phase-out of HCFCs is both possible and necessary, in light of the availability of alternatives, concerns over compliance, and the costs of late transitioning out of HCFCs. . . Given the concerns over projected HCFC production and consumption levels by 2015 as well as compliance with the 2016 freeze date by developing countries, an earlier freeze date should be considered to avoid increased production of HCFCs.").

[16] Baselines for HCFC consumption and emissions vary among these calculations. The phase-out schedule and time period also vary. The MP's climate benefits are due to the fact that, in addition to depleting the ozone layer, many CFCs, HCFCs, other ODS, and their substitutes are potent GHGs that are thousands or, in some cases, tens of thousands of times more powerful at warming the planet than carbon dioxide. *See* UNEP, IPCC/TEAP, *Special Report: Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydroflurocarbons and Perfluorocarbons*, Summary for Policymakers (2005), at 3-4 ("Because ODSs cause depletion of the stratospheric ozone layer, their production and consumption are controlled under the Montreal Protocol and consequently are being phased out, with efforts made by both developed and developing country parties to the Montreal Protocol. Both the ODSs and a number of their substitutes are greenhouse gases (GHGs) which contribute to climate change. Some ODS substitutes, in particular hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), are covered under the UNFCCC and its Kyoto Protocol. Options chosen to protect the ozone layer could influence climate change. Climate change may also indirectly influence the ozone layer. Halocarbons, and in particular ODSs, have contributed to positive direct radiative forcing and associated increases in global average surface temperature."), at 5 ("The total positive direct radiative forcing due to increases in industrially produced ODS and non-ODS halocarbons from 1750 to 2000 is estimated to be $0.33 \pm 0.03$ W m–2, representing about 13% of the total due to increases in all well-mixed greenhouse gases over that period."), at 6 ("The combined $CO_2$-equivalent emissions of CFCs, HCFCs and HFCs derived from atmospheric observations decreased from about $7.5 \pm 0.4$ $GtCO_2$-eq per year around 1990 to $2.5 \pm 0.2$ $GtCO_2$-eq per year around 2000, equivalent to about 33% and 10%, respectively, of the annual $CO_2$ emissions due to global fossil fuel burning."), at 8 (listing GWPs of key ODSs) [hereinafter IPCC/TEAP Summary for Policymakers].

[17] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 8 ("Cumulative savings in climate terms from ODS emissions reductions are potentially in excess of 18 billion tonnes $CO_2$-eq for the period to 2050 when phase-out is advanced by 15 years (Scenario 2). 3.5 billion tonnes $CO_2$-eq of this is attributable to avoided HFC-23 emissions, assuming that no HFC-23 mitigation strategy is otherwise in place (as is modelled by the baseline scenario).")

[18] Brazilian Ministry of Environment, Powerpoint, *Benefits for the Protection of Ozone Layer and Climate of the Brazilian-Argentinean Proposal*, Fourth Meeting of the Stockholm Group (3 June 2007).

[19] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 8 ("3.5 billion tonnes $CO_2$-eq of this is attributable to avoided HFC-23 emissions, assuming that no HFC-23 mitigation strategy is otherwise in place (as is modelled by the baseline scenario).").

[20] Guus J. M. Velders, *et al.*, *Climate Benefits of an Accelerated HCFC Phase-out: Addendum* (2007), refer to Appendix 2 ("In the baseline scenario, the total emission of all ODSs from 2010 to 2050 is 37 $GtCO_2$-eq with the largest contribution from the HCFCs of 27 $GtCO_2$-eq. In the accelerated scenario the total emission of HCFCs decreases by 14 $GtCO_2$-eq to reach a smaller total of 13 $GtCO_2$-eq for the period 2010-2050. To this potential emission reduction can be added a reduction in the emissions of HFC-23, which is an unwanted by-product of HCFC-22 production. These calculated emission reductions depend on the HCFC production in the baseline scenario. In a scenario with larger HCFC production in developing countries in 2015 than used here, the effect of an accelerated phase-out will be larger than estimated above.") [hereinafter Velders *Addendum*].

[21] Velders *Addendum, id*. The Velders estimate is 14 $GtCO_2$-eq., plus avoided emissions from eliminating the HFC-23 by-product which the TEAP has estimated at 3.5 GtCO2-eq. ("In the baseline scenario, the total emission of all ODSs from 2010 to 2050 is 37 $GtCO_2$-eq with the largest contribution from the HCFCs of 27 $GtCO_2$-eq. In the accelerated scenario the total emission of HCFCs decreases by 14 $GtCO_2$-eq to reach a smaller total of 13 $GtCO_2$-eq for the period 2010-2050. To this potential emission reduction can be added a reduction in the emissions of HFC-23, which is an unwanted by-product of HCFC-22 production. These calculated emission reductions depend on the HCFC production in the baseline scenario. In a scenario with larger HCFC production in developing countries in 2015 than used here, the effect of an accelerated phase-out will be larger than estimated above."). *See also* Guus J. M. Velders, *et al*., *The Importance of the Montreal Protocol in Protecting Climate*, 104 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 4814 (2007), refer to Chapter 16 [hereinafter Velders, *et al*].

[22] The U.S. EPA report was prepared by ICF. *See* U.S. EPA, *Changes in HCFC Consumption and Emissions from the U.S. Proposed Adjustments for Accelerating the HCFC PhaseOut* (June 2007) at 8, Table 3-5. Option 7 shows

the largest potential reduction in HCFC emissions at 4,770 million metric tons of carbon-equivalent (MMTCE). This is converted into carbon dioxide-equivalent ($CO_2$-eq.) by multiplying by 44/12. Option 7 also shows avoided HFC-23 by-product emissions at -50 MMTCE. [hereinafter EPA Analysis].

[23] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 110 ("Accelerated HCFC-22 phase-out is not expected to have any significant bearing on HFC-23 emissions in the first contracted period of the CDM.").

[24] UNEP, *Supplement to the IPCC/TEAP Report* (Nov. 2005), at 7 [hereinafter IPCC/TEAP Supplement]. *See also* Env't Investigation Agency, *Turning Up the Heat: Linkages Between Ozone Layer Depletion and Climate Change: The Urgent Case of HCFCs and HFCs* (Aug. 2006) [hereinafter *Turning Up the Heat*].

[25] IPCC/TEAP Summary for Policymakers, *supra* note 16, at 8.

[26] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 6 ("Monies flowing from the sale of Certified Emission Reductions (CERs) could be up to 10 times higher than the costs of mitigation and, under expected future carbon prices, will exceed the sales revenue for the HCFC-22 itself."). Michael Wara, *Is the Global Carbon Market Working?*, NATURE (8 Feb. 2007), at 595-96 ("HFC-23 emitters can earn almost twice as much from CDM credits as they can from selling refrigerant gases — by any measure a major distortion of the market. The distortion exists because it is extremely cheap to cut HFC-23 emissions from these facilities."). IPCC/TEAP Supplement, *supra* note 24, at 7 ("Although mitigation of HFC-23 release is technically possible and economically attractive under the UNFCCC Clean Development Mechanism (CDM), the availability of funds through the sale of CDM credits obtained from the reduction of HFC-23 emissions could provide a perverse incentive for the continuation or expansion of HCFC-22 production in Article 5(1) countries in order to generate such credits."). *See Turning Up the Heat*, *supra* note 24, at 9 ("The cost of destroying the HFC-23, however, is very low (around $0.20 per mt), allowing for extremely high profits."). *See States and Trends of the Global Carbon Market 2006 (Update: January 1 – September 30, 2006*, WORLD BANK (2006) at 11 ("HFC-23 destruction projects continued to dominate with 52% of all project-based volumes transacted in 2006 (down from 64% in 2005, see Figure 6). The authors are aware of additional large transactions at advanced stages, so the remainder of the year should see the HFC-23 share remaining the same or even rise. Many buyers are keenly aware of the stiff competition for and the finite availability of this asset class beyond this year. …"). The HFC-23 projects also are squeezing out projects from developing countries involving renewable energy and energy efficiency and driving down the price of carbon credits in the European Union's Emissions Trading System, further reducing investment in needed energy reform. Finally, they may be canceling the benefit for the climate, by driving increased production of HCFC-22.

[27] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 6 ("In extreme cases, it might even be possible that low HCFC-22 prices encourage the re-introduction of the chemical into foam applications in which it has already been replaced or as an aerosol propellant, where it has not been used widely before, or into other applications where environmentally superior technology is widely available.").

[28] Refer to endnote 4.

[29] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 5, 8 ("The climate benefits of an accelerated HCFC phase-out depend not only on the selection of the earlier freeze date and phase-out schedule, but also on the choice of technology to replace HCFCs in insulating foam and refrigeration and air conditioning sectors where indirect emissions from energy are significant. … Since over 80% of the potential climate-related savings arise from the refrigeration sector, alternatives that result in lower GWP-weighted emissions (e.g. from a low GWP fluid or a less emissive design, or those that deliver sufficient efficiency improvements to offset their impacts) would be necessary to realise a significant proportion of this potential. Regulatory and/or fiscal incentives (e.g. the recent F-Gas regulation in the EU) can assist in creating an appropriate environment for such developments.").

[30] EPA Analysis, *supra* note 22, at 12. ("This analysis is based on broad assumptions that have been applied to developed and developing countries without further disaggregation by country; consequently, the results of this analysis should be interpreted as rough approximations of the impact of each policy option. … Lastly, this analysis was developed with all assumptions deliberately chosen to provide conservative results (i.e., to not over estimate climate and ozone benefits of each Option); therefore, certain considerations that imply greater benefits associated with adopting any of these policy options could be made when reviewing the results."). Option 3 shows the largest net benefit to the climate, at 850 MMTCE, which has been converted into $CO_2$-eq. The calculations of net climate benefits is based on assumptions "deliberately chosen to provide conservative results."

[31] The required emissions reduction under the Kyoto Protocol is -5.8 percent of its baseline of 18.4 $GtCO_2$-eq. or -0.97 $GtCO_2$-eq $yr^{-1}$ by 2008–2012. UNFCC, *Key GHG Data: Highlights from Greenhouse Gas Emissions Data for 1990-2003* (Nov. 2005). This translates to an aggregate emissions reduction of 5 $GtCO_2$-eq. Correspondence with Dr. Guus J.M. Velders. The actual emissions reduction under Kyoto Protocol is expected to be about 10 $GtCO_2$-eq., if avoided emissions based on a business-as-usual trajectory of 6% growth over that timeframe is considered. Velders, *et* al*,* supra note 21, at 4818 ("The adopted $CO_2$-equivalent emission reduction target is -5.8% (range of -10% to -8% for the individual countries), corresponding to 0.97 $GtCO_2$-eq $yr^{-1}$ by 2008–2012. Because most

countries would normally have had increasing greenhouse gas emissions after 1990, it can be argued that the emission reduction necessary to achieve the agreed Kyoto target must be calculated from a business-as-usual scenario between the 1990 baseline and 2008–2012. Projections have total greenhouse gas emissions of Annex-1 parties increasing by 6% (1.06 $GtCO_2$-eq. $yr^{-1}$) above the 1990 value by 2010. The 6% value reflects large increases in developed countries (e.g., United States of America, 32%; Spain, 47%) offsetting large decreases for countries with economies in transition (e.g., Russia, -19%; Estonia, -57%). Therefore, an arguably more realistic estimate of the greenhouse gas emission reduction that will have occurred by meeting the first Kyoto Protocol target is found by combining the 5.8% decrease and 6% increase for a total of -2 GtCO2-eq. $yr^{-1}$.").

[32] Refer to endnote 29.

[33] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 60, 77 ("In summary development and introduction of new low-GWP alternatives, the application of HFC blends and the use of e.g. hydrocarbons would require external drivers, and not pure market mechanisms and competition. This makes the signalling of future policy on HCFCs the most important determinant in promoting the development and use of the most environmentally acceptable alternatives.").

[34] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 8, 18 ("The most appropriate control scenarios are likely to arise out of a consideration of the cumulative ODS emissions saved, the LCCP-based climate benefits that can be derived and the cost of transition. … Accordingly, a holistic lifecycle approach is required for a comparative analysis using the principles of life cycle assessment (LCA), applied to climate-specific issues. Life Cycle Climate Performance (LCCP) incorporates these principles, and was used extensively for the assessment of ODS alternatives.").

[35] UNEP, *The Implications to the Montreal Protocol of the Inclusion of HFCs and PFCs in the Kyoto Protocol*, HFC and PFC Task Force of the Technology and Economic Assessment Panel (Oct. 1999), at 36-38 ("The Life-Cycle Climate Performance (LCCP), which evolved from the earlier concept of "Total Equivalent Warming Impact (TEWI)," calculates the cradle-to-grave climate impact of direct and indirect greenhouse gas emissions including inadvertent emissions from chemical manufacture, energy embodied in components, operating energy, and emissions at the time of disposal or recycle. The calculated LCCP must be tailored to account for location for specific electrical generation efficiency and power mix and is sensitive to assumptions of the system lifetime, emissions losses, and the integration time interval used in the calculation of global warming potential (GWP) of greenhouse gases. Energy efficiency is often the most important strategy for reducing primary energy demand and its emissions. The concept of Life-Cycle Climate Performance (LCCP) is intended to provide a rationale way of assessing only those environmental aspects affecting climate (i.e. only a sub-segment of item (a)) [of Decision V/8 requesting each Party " … to give consideration in selecting alternative substitutes … to: Environmental aspects …"]. The aim of LCCP is to provide a reproducible methodology for climate impact assessment. LCCP relates to a defined system and provides a comparative measure rather than one that has any absolute significance. … The total impact on climate of any technology results from a combination of the "direct" emissions of greenhouse gases from the system throughout its life cycle and the "indirect" emissions of greenhouse gases associated with the energy used or saved by the system. … When the use of a specific technology creates an incremental energy saving, the reduction in $CO_2$ emissions from the energy use can far outweigh the direct emissions over the expected life of the product.") [hereinafter 1999 TEAP Task Force Report]. *See also* UNEP, IPCC/TEAP, *Special Report: Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydroflurocarbons and Perfluorocarbons* (2005), at 205 [hereinafter IPCC/TEAP Special Report].

[36] 1999 TEAP Task Force Report, *supra* note 35, at 36-38 ("When the use of a specific technology creates an incremental energy saving, the reduction in $CO_2$ emissions from the energy use can far outweigh the direct emissions over the expected life of the product.").

[37] *G8 Summit Declaration*, *supra* note 4, at paragraph 46. *See also* Pacala & Socolow, *supra* note 5, at 968-69 ("Improvements in efficiency and conservation probably offer the greatest potential to provide wedges [to reduce climate emissions] . . . A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years. It thus represents a cumulative total of 25 GtC of reduced emissions over 50 years.").

[38] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 5, 8.

[39] Velders, *et al*., Climate Benefits of an Accelerated HCFC Phase-Out: Addendum, refer to Appendix II.

[40] Donald Kaniaru, Raj Shende, Scott Stone, & Durwood Zaelke, *Strengthening the Montreal Protocol: Insurance Against Abrupt Climate Change*, 7 SUSTAINABLE DEVELOPMENT LAW & POLICY 3 (2007) at 4 ("But sea levels do not need to rise by seven meters to cause global catastrophe: a 1.5 meter rise would threaten 36,000 square miles of land along the U.S. Atlantic and Gulf Coasts with flooding, as well as causing devastation to vulnerable low-lying island and coastal States. The fallout from this or other abrupt climate change events could destabilize the world's social and governance institutions, which at the very least would undermine efforts to reduce GHG emissions and at

worst could provoke global military conflicts. In any scenario, untold millions would suffer. The GHG reductions achievable under the Montreal Protocol offer critical low-cost insurance against abrupt changes to the climate, effectively buying the world more time to get the Kyoto Protocol's global carbon market running effectively and efficiently, and to agree on the post-Kyoto regime.") [hereinafter Kaniaru, *et al*.]. *See also* Steve Connor, *supra* note 28 ("In an interview with the *Independent*, Jim Hansen, who was one of the first scientists to warn of climate change in scientific testimony to the US Congress in 1988, claimed that we have less than 10 years to begin to curb carbon dioxide emissions before global warming runs out of control and changes the landscape forever. . . . 'We just cannot burn all the fossil fuels in the ground. If we do, we will end up with a different planet. I mean a planet with no ice in the Arctic, and a planet where warming is so large that it's going to have a large effect in terms of sea level rises and the extinction of species'....").

[41] 135 $GtCO_2$-eq. between 1990 and 2010 is an aggregated total, including direct and indirect effects. The per year reduction is 11 $GtCO_2$-eq. $yr^{-1}$ between 1990 and 2010. Velders, *et* al*,* supra note 21, at 4818 (calculating a 7-12 year delay due to the GHG reductions from the MP's phase-out of CFCs and other ODS from 1990 to 2010), and noting that the discovery by Rowland and Molina in 1974 that ODSs were destroying the ozone layer provided an "early warning" that altered what otherwise would have been a steady annual increase in ODS production and use, and as a result delayed climate change by 35-41 years, assuming a 7% annual growth rate), excerpted *supra* Chapter 15; *See also,* Statement of Dr. Guus Velders on *Dual Benefits of the Montreal Protocol: Protecting Ozone Layer and Climate*, Hearing on "Achievements and Opportunities for Climate Protection under the Montreal Protocol," U.S. House Committee on Oversight and Government Reform (May 23, 2007), at 2.

[42] Velders, *et* al*,* supra note 21, at 4817 (showing that the altered trajectory of ODS use delayed climate change by 35-41 years, assuming a 7% annual growth rate.).

[43] Correspondence with Dr. Guus J.M. Velders, on file with the authors.

[44] IPCC, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers (Feb. 2007), at 5-8 ("Widespread decreases in glaciers and ice caps have contributed to sea level rise. . . Average arctic temperatures increased at almost twice the global average rate in the past 100 years. . . Mid-latitude westerly winds have strengthened in both hemispheres since the 1960s. . . More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics. . . The frequency of heavy precipitation events has increased over most land areas. . .). Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Current State and Trends, Volume 1* (2005), at 379 ("An increase in frequency and severity of floods and droughts has been noted in some areas. . . global warming is projected to increase threats to human health. . . expansion of areas of potential transmission of malaria and dengue. . . an increase in frequency of disturbance by fire and insect pests is projected. . . further increase in frequency and extent of coral reef bleaching is projected, along with loss of coastal wetlands and erosion of shorelines. . . Diversity in ecological systems is expected to be affected by climate change and sea level rise, with an increased risk of extinction of some vulnerable species. . . Projected climate change would exacerbate water shortages and water-quality problems in many water-scarce areas of the world. . ."). *See* Velders, *et al*., *supra* note 21, at 4818. Durwood Zaelke, Oran Young, & Scott Stone, *After 'The Day After Tomorrow': What Will Society Learn from the Inevitability of Rapid Climate Change Events*, NATIONAL STRATEGY FORUM REVIEW, Fall 2006, at 17 ("But even a 1.5 meter rise would threaten 36,000 square miles of land along the Atlantic and Gulf Coasts with flooding."). James Hansen, *A Slippery Slope: How Much Global Warming Constitutes 'Dangerous Anthropogenic Interference"?* 68 Climate Change 269 (2005) at 276 (". . . global warming of more than 1° C above today's global temperature would likely constitute "dangerous anthropogenic interference" with climate.").

[45] *See* Hansen, *supra* note 2. *See also* James Hansen *Why We Can't Wait*, THE NATION (7 May 2007).

[46] *Synthesis Report*, *supra* note 11, at 6 ("Technically and economically feasible substitutes are available for almost all applications of HCFCs, although transitional costs remain a barrier for smaller enterprises, particularly in developing countries."). *See also Third Stockholm Group Meeting*, *supra* note 3, at 5 ("Alternatives exist for HCFCs in all applications. To capture climate benefits in transitioning out of HCFCs, alternatives should be evaluated in terms of their cumulative environmental impacts, such as under Life Cycle Analysis and Life Cycle Climate Performance, which would consider both direct impacts based on a substance's GWP and indirect impacts such as by-product emissions and GHG emissions from energy consumption."). *See also* Stephen Andersen and K. Madhava Sarma, *Industry Response to the Montreal Protocol: What a Difference a Treaty Makes!,* PROTECTING THE OZONE LAYER: THE UNITED NATIONS HISTORY, at 201-02 (Earthscan 2002), refer to excerpt in Chapter 4.

[47] *See* IPCC/TEAP Technical Summary, *supra* note 13, at 51-77.

[48] *See* TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 66-84.

[49] *See Third Stockholm Group Meeting*, *supra* note 3, at 8 ("It was also noted that some developing countries are in a different position now than they were 20 years ago when the decision was made to phase-out CFCs, enabling them

to play a different role in the further implementation of the Montreal Protocol and helping to create a new paradigm for protection of the ozone layer.").

[50] *See* TEAP HCFC Take Force Report, *supra* note 1, at 78-82.

[51] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 112 ("There are several specialist applications of HCFCs for which no technically or economically viable alternatives currently exist. This could impact both developed and developing countries as HCFC phase-out dates approach. Consideration will need to be given as to how such situations should be managed and whether continued use should be allowed in an otherwise accelerated framework through the application of an Essential Uses provision or other mechanism. The permissible criteria for the granting of such essential uses will need further consideration and could, in principle, extend to climate protection where alternatives would impose unacceptable additional climate burdens.").

[52] The Parties have conditioned other changes to the MP on the MLF providing financial assistance. *See* UNEP, *Report of the Ninth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer*, UNEP/OzL.Pro.9/12 (25 Sept. 1997), Decision IX/5: Conditions for control measures on Annex E substance in Article 5 Parties, at 25. ("The Ninth Meeting of the Parties decided in Dec. IX/5: 1. That, in the fulfilment of the control schedule set out in paragraph 8 *ter* (d) of Article 5 of the Protocol, the following conditions shall be met: (a) The Multilateral Fund shall meet, on a grant basis, all agreed incremental costs of Parties operating under paragraph 1 of Article 5 to enable their compliance with the control measures on methyl bromide. All methyl-bromide projects will be eligible for funding irrespective of their relative costeffectiveness. The Executive Committee of the Multilateral Fund should develop and apply specific criteria for methyl-bromide projects in order to decide which projects to fund first and to ensure that all Parties operating under paragraph 1 of Article 5 are able to meet their obligations regarding methyl bromide .…"). For more information on the MLF *see* Ralph Luken and Tamas Groff, *The Montreal Protocol's Multilateral Fund and Sustainable Development*, Policy Paper for the United Nations Industrial Development Organization (2004), excerpted in Chapter 7.

[53] Montreal Protocol on Substances that Deplete the Ozone Layer, Article 10 (3) ("The Multilateral Fund shall: … Meet, on a grant or concessional basis as appropriate, and according to criteria to be decided upon by the Parties, the agreed incremental costs . . ..").

[54] DeCanio, Stephen J., and Catherine S. Norman, *Economics of the 'Critical Use' of Methyl Bromide under the Montreal Protocol*, Contemporary Economic Policy (2005) Vol. 23, at 376-393.

[55] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 83 ("Owing to MLF projects, by 1999 the consumption of CFCs by Article 5 Parties was falling even before their first mandatory freeze date in 2000.").

[56] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 60 ("Costs for alternatives, such as HFC blends or low GWP alternatives if applicable are generally are a factor of 3-8 higher than HCFC-22 (at US$ 1-2).").

[57] Experts have suggested that the rule prohibiting funding for facilities established after July 1995 should not apply to HCFCs since it was put into place only with CFCs in mind.

[58] Note that there were uses of HCFCs that pre-date the Montreal Protocol entering into force (i.e. where there was no earlier transition out of CFCs), and these would be eligible for MLF funding in any event.

[59] *See* UNEP, *The Montreal Protocol Control Schedule and its Evolution* (Oct. 2002) (discussing the substances controlled under the Montreal Protocol and the date and matting when each Amendment and/or Adjustment was agreed upon).

[60] Montreal Protocol on Substances that Deplete the Ozone Layer, Article 2F: Hydrochlorofluorocarbons, paragraph 7(a) and (c) ("7. As of 1 January 1996, each Party shall endeavour to ensure that: (a) The use of controlled substances in Group I of Annex C is limited to those applications where other more environmentally suitable alternative substances or technologies are not available; (b) The use of controlled substances in Group I of Annex C is not outside the areas of application currently met by controlled substances in Annexes A, B and C, except in rare cases for the protection of human life or human health; and (c) Controlled substances in Group I of Annex C are selected for use in a manner that minimizes ozone depletion, in addition to meeting other environmental, safety and economic considerations.").

[61] Montreal Protocol, Preamble, *available at* http://www.unep.org.OZONE/pdfs/Montreal-Protocol2000.pdf ("Aware that measures taken to protect the ozone layer from depletion should be based on relevant scientific knowledge, taking into account technical and economic considerations. . .") [hereinafter Preamble].

[62] Preamble, *id*.

[63] Kaniaru, *et al., supra* note 40, at 7 ("This is further supported by the exclusion of gases regulated by the Montreal Protocol from the UN Framework Convention on Climate Change and the Kyoto Protocol. The exclusion was made with knowledge that many of these gases have extremely high GWPs and that their emissions can substantially contribute to climate change, thereby placing additional responsibility on the Parties to the Montreal Protocol to minimize the climate impacts of ODS substitutes.").

[64] 1999 TEAP Task Force Report, *supra* note 35**,** at 13 ("The impacts on climate of any technology results from the "direct" emissions of greenhouse gases and the "indirect" emissions from the generation of energy used over the expected life of the product. . ..").
[65] IPCC/TEAP Summary for Policymakers, *supra* note 16, at 3-4.
[66] *See* 2006 Scientific Assessment, *supra* note 10, at ch. 5. *See also* Mark P. Baldwin, *et al.*, *How Will the Stratosphere Affect Climate Change?*, Science 1576 (15 June 2007), at 1577 ("The changes to temperature and circulation in the lower stratosphere over the past ~25 years seem to have been driven primarily by changes in ozone-depleting substances and ozone depletion. They can thus be expected to reverse as the ozone layer recovers. This reversal may obscure, or even alter, the climate-change signal from other greenhouse gases. Therefore, studies attempting to explain and predict climate change must account for the combined effects of climate change and ozone recovery.").
[67] UN Conference on Environment and Development, *Agenda 21*, at Section 9.24 (June 1992).
[68] Refer to endnote 4.
[69] Refer to endnote 34.
[70] Refer to endnote 35.
[71] *Synthesis Report*, *supra* note 11, at 6. ("Several low Global Warming Potential (GWP) refrigerant candidates (one with an ozone depleting ingredient --CF3I) are claimed to provide comparable energy efficiency to HFC-134a in vehicle air conditioning. Development of these low-GWP refrigerants may also have major future consequences for (new) refrigerant choices in other sectors and applications. . ..").
[72] Statement of Mack McFarland before the Committee on Oversight and Government Reform, U.S. House of Representatives (23 May 2007). ("[W]here other low GWP refrigerants can be used safely, efficiently and in compliance with local regulations they should be chosen. In this regard DuPont intends to extend our innovative low GWP technologies under development to other applications currently using HFCs, including other refrigerant applications and foam expansion agents for insulating materials.").
[73] *See* McFarland Testimony, *id*; *See also* Gilbert Bankobeza, *Compliance Incentives Under the Montreal Protocol,* OZONE PROTECTION: THE INTERNATIONAL LEGAL REGIME, at 16-25 (2005), excerpted in Chapter 7.
[74] UNEP, *2006 Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee*, 2006 Assessment, at 3, 12 ("Since the recently adopted EU F-Gas Regulation will ban HFC-134a and other refrigerants with GWPs exceeding 150 in new vehicle models by 2011, the industry will be forced to make a second refrigerant change in mobile air conditioning. Several candidates continue to be evaluated, including $CO_2$ and R-152a as well as new low-GWP refrigerants, some of which may have low ODPs. Development of these low-GWP refrigerants also may have future consequences for the refrigerant choices in other applications. … In early 2006, several chemical companies (others will likely follow) have each announced a new refrigerant blend to replace HFC-134a in Europe. One is an azeotropic blend of CF3I and 1,1,1,2-tetrafluoropropene. Two other formulations have not been publicly released. Since then, due to safety and cost issues of R-744 and R-152a, German carmakers have collectively asked for, and formally organised, a co-operative effort to assess the new candidates with a focus on selecting a replacement for HFC-134a during the second half of 2007. The SAE and Japanese Automobile Manufacturers Association are assisting this effort.") [hereinafter 2006 RTOC Report]; See also Rajendra Shende, *From Montreal To Kyoto: The Refrigeration Industry's Journey towards Sustainability*, Paper for the 22nd International Institute of Refrigeration, International Congress of Refrigeration, in Beijing (21-27 Aug. 2007).
[75] 2006 RTOC Report, *supra* note 31. *See also,* McFarland Testimony, *supra* note 72 ("Today DuPont and others are developing the next generation of high performance non-ozone depleting compounds with low global warming potentials (GWPs). … In February of 2006 we announced that we had identified low GWP, non-ozone depleting alternatives for HFC-134a used in mobile air conditioning. The leading candidates have GWPs on the order of only 3% that of HFC-134a and can meet the requirements of the European Union fluorinated gases directive that will phase out the use of HFC-134a in new car models beginning in 2011. It is our intent to leverage these non-ozone depleting, low GWP technologies to other applications that currently rely on higher GWP products, including other refrigerant applications and foam expansion agents for insulating materials. Our goal is to provide ever more environmentally sound practices to the market. … [W]here other low GWP refrigerants can be used safely, efficiently and in compliance with local regulations they should be chosen. In this regard DuPont intends to extend our innovative low GWP technologies under development to other applications currently using HFCs, including other refrigerant applications and foam expansion agents for insulating materials.").
[76] *See, e.g.,* 2006 RTOC Report, *supra* note 31, at 146 ("Today's average chillers use 20% less electricity than the average of chillers produced just two decades ago, and the best chiller today uses less than 65% of the electricity of the average 1976 chiller. Building owners typically can pay back the investment cost of replacing an old CFC chiller in three to five years (or less) in many regions that require cooling for more than three months a year. Replacement chillers integrated with building retrofits can pay for themselves in as little as two or three years, with a typical

return on investment of 20 to 35% in locations with high seasonal cooling loads and/or high electricity prices. Generally, the added cost of the highest efficiency chillers is paid back through energy savings alone.").
[77] Refer to endnote 36.
[78] *G8 Summit Declaration*, *supra* note 4, at paragraph 46. *See also* Pacala & Socolow, *supra* note 5, at 968-69 ("Improvements in efficiency and conservation probably offer the greatest potential to provide wedges [to reduce climate emissions] . . . A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years. It thus represents a cumulative total of 25 GtC of reduced emissions over 50 years.").
[79] *G8 Summit Declaration*, *supra* note 4, at paragraph 62. *See also* Pacala & Socolow, *supra* note 5, at 968-69.
[80] Velders, *et al*., *supra* note 21, at 4817 ("It is important to note that 80% of ODSs that would be used today without the Montreal Protocol have been successfully phased out without the use of other fluorocarbons. Instead, this ODS use was eliminated with a combination of 'not-in-kind' chemical substitutes, product alternatives, manufacturing-process changes, conservation, and doing without.").
[81] Velders, *et al*., *supra* note 21, at 4817.
[82] HCFC-22 and, in particular, HCFC-141b, are used as foam blowing agents in the manufacture of insulating materials and other products. It is possible to make foam without use of either HCFCs or HFC substitutes, and any loss of per unit efficiency can be compensated by making the foam thicker. *See, e.g., 2006 Report of the Rigid and Flexible Foams Technical Options Committee*, 2006 Assessment (2006), at 17 ("The replacement of HCFC-141b with cyclopentane [GWP=11] is the most likely next step in developing countries.").
[83] Refer to endnote 34.
[84] Refer to endnote 35.
[85] Refer to endnote 36.
[86] IPCC/TEAP Special Report, *supra* note 35, at 285.
[87] G*8 Summit Declaration*, *supra* note 4, at paragraphs 46 and 62 ("46. This year we have focussed our discussions on energy efficiency in order to make an effective contribution towards meeting global climate and energy security challenges. Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security. ... 62. The global potential for saving energy is huge. According to the International Energy Agency, successfully implemented energy efficiency policies could contribute to 80% of avoided greenhouse gases while substantially increasing security of supply."). *See also* Pacala & Socolow, *supra* note 5, at 968-69 ("Improvements in efficiency and conservation probably offer the greatest potential to provide wedges [to reduce climate emissions] . . . A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years. It thus represents a cumulative total of 25 GtC of reduced emissions over 50 years.").
[88] Refer to endnote 35.
[89] *G8 Summit Declaration*, *supra* note 4, at paragraph 46. *See also* Pacala & Socolow, *supra* note 5, at 968-69 ("Improvements in efficiency and conservation probably offer the greatest potential to provide wedges [to reduce climate emissions] . . . A wedge represents an activity that reduces emissions to the atmosphere that starts at zero today and increases linearly until it accounts for 1 GtC/year of reduced carbon emissions in 50 years. It thus represents a cumulative total of 25 GtC of reduced emissions over 50 years.").
[90] Refer to endnote 36.
[91] IPCC/TEAP Special Report, *supra* note 35, at 281 (reporting 9% advantage in energy efficiency). *See also* Trane Press Release (16 December 2005) ("Trane announced today a new technological advancement for its EarthWise™ CenTraVac™ chillers establishing a 13.5 percent energy efficiency advantage over other best performing chillers. The new chillers reach energy efficiency of 0.448 KW/ton, based on the Air-Conditioning and Refrigeration Institute (ARI) standard rating conditions, which is significantly better than the best chiller as documented in the recently published IPCC/TEAP Report on Safeguarding the Ozone Layer and the Global Climate System – Issues Related to Hydrofluorocarbons and Perfluorocarbons."). *See also,* 2006 RTOC Report*, supra* note 31, at 160-161 ("HCFC-123 is the most efficient refrigerant for water chillers other than CFC-11 and HCFC-141b, both of which have significantly higher ODP and higher GWP. Its similar properties permitted HCFC-123 to replace CFC-11 in new and existing chillers without extensive modifications of equipment. There was no other replacement with these characteristics, so HCFC-123 was critical to the transition away from CFCs in the centrifugal chiller sector. HCFC-123 refrigerant is offered in new centrifugal water chillers from approximately 700 to 15,000 kW. HCFC-123 has a very low overall impact on the environment because of its low ODP, very low GWP, very short atmospheric lifetime, very low emissions in current chiller designs, and highest theoretical cycle efficiency of all current options /Cal00, Cal06a, Cal06b/ (sic). Published studies /Cal97, Cal99/ (sic) have shown that use of HCFC-123 in chillers would have imperceptible impact on stratospheric ozone while offering significant advantages in theoretical efficiency, thereby lowering greenhouse gas emissions from associated energy use /Cal06a/ (sic).").

[92] UNEP, *2002 Report of the Refrigeration, Air-Conditioning and Heat Pumps Technical Options Committee* (Jan. 1, 2002), at 120-121 ("Refrigerant HCFC-123 has a favourable overall impact on the environment that is attributable to five factors: (1) a low ODP, (2) a very low GWP, (3) a very short atmospheric lifetime, (4) the extremely low emissions of current designs for HCFC-123 chillers and (5) the highest efficiency of all current options /Cal98/, /Cal00/ (sic). HCFC-123 became a key replacement for CFC-11 due to its similar properties to CFC-11, which permitted it to replace CFC-11 in new and existing chillers without extensive modification of equipment or equipment rooms. There was no other replacement with these characteristics, so HCFC-123 was critical to the transition away from CFCs in the chiller sector. Although subject to production phase-out by 2020 for use in new equipment under the US Clean Air Act, HCFC-123 remains the most efficient refrigerant for water chillers. Published studies /Cal97, Cal98/ (sic) have shown that continued use of HCFC-123 in chillers would have imperceptible impact on stratospheric ozone while offering significant advantages in efficiency, thereby lowering greenhouse gas emissions from associated energy use. Based on integrated assessments, considering the tradeoffs between negligible impacts on stratospheric ozone and important benefits in addressing global warming, these studies recommend consideration of a phase-out exemption for HCFC-123.") [hereinafter 2002 RTOC Report].
[93] 2006 RTOC Report, *supra* note 74, at 146 ("Energy efficiency is the primary environmental consideration for chillers. While refrigerants each have a Global Warming Potential (GWP) relative to $CO_2$ (see Chapter 2, Refrigerants), refrigerants do not contribute directly to global warming unless they are released to the atmosphere. Properly-maintained chillers of modern design emit very little of their refrigerant charge during operation. The dominant global warming effect caused by chiller operation is the $CO_2$ emitted in the combustion of fossil fuels generating the electricity to drive them. High annualised chiller efficiencies reduce global warming proportionally.").
[94] Intergovernmental Panel on Climate Change, *The Physical Science Basis: Technical Summary* (2007) at 33.
[95] 2002 RTOC Report, *supra* note 92, at 118 ("The relative condensing pressures at 38 °C are 0.145 MPa for HCFC-123, and 0.963 MPa for HFC-134a. The lower pressure refrigerant (HCFC-123) is usable in centrifugal chillers from 350 to 15,000 kW; while the higher pressure refrigerant (HFC-134a) is usable in the chillers up to 30,000 kW."). *See also* DeCanio, *supra* note 64, at 41-44.
[96] IPCC/TEAP Summary for Policymakers, *supra* note 16, at 8.
[97] IPCC/TEAP Special Report, *supra* note 35, at 125. *See also* 2002 RTOC Report, *supra* note 92, at 120-121 ("Refrigerant HCFC-123 has a favourable overall impact on the environment that is attributable to five factors: (1) a low ODP, (2) a very low GWP, (3) a very short atmospheric lifetime, (4) the extremely low emissions of current designs for HCFC-123 chillers and (5) the highest efficiency of all current options /Cal98/, /Cal00/ (sic).").
[98] 2002 RTOC Report, *supra* note 92, at 118 ("The relative condensing pressures at 38 °C are 0.145 MPa for HCFC-123, and 0.963 MPa for HFC-134a. The lower pressure refrigerant (HCFC-123) is usable in centrifugal chillers from 350 to 15,000 kW; while the higher pressure refrigerant (HFC-134a) is usable in the chillers up to 30,000 kW.").
[99] James M. Calm & David A. Didion, *Trade-Offs in Refrigerant Selections: Past, Present, and Future*, REFRIGERANTS FOR THE 21[ST] CENTURY, PROCEEDINGS OF THE ASHRAE-NIST CONF. (1997) ("A detailed analysis for R-123 shows that its use in chillers, at current emissions rates for converted and new equipment, has a negligible impact on the ozone layer. Its peak impact, with phase-out as scheduled under the Montreal Protocol, amounts to approximately 0.002% of the total CBL [chlorine-bromine loading] from all sources, natural and anthropogenic. Continued use of R-123 as a refrigerant would barely increase the 0.002% peak, and the average CBL impact through 2050 would be approximately 0.001%."). *See also,* Donald Wuebbles and James Calm, *An Environmental Rationale for Retention of Endangered Chemicals*, 278 SCIENCE 1090 (Nov. 1997), at 2.
[100] *See* TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 66-84.
[101] *See, e.g.*, UNEP, 2006 Report of the Medical Technical Options Committee, 2006 Assessment, at 36 ("EO/HCFC mixtures (10 per cent by weight EO in a mix of HCFC-124 and HCFC-22) are virtual drop-in replacements for the 12/88 mixture using CFC, and were introduced as transitional products for sterilization in those countries that employed 12/88 extensively.").
[102] The TEAP notes that substitutes exist for HCFCs in nearly all applications, with concern over substitutes for some solvent, medical and fire protection applications for HCFC-225. *See* TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 78-82. *See also* 2006 Report of the Chemicals Technical Options Committee, 2006 Assessment, at 43 ("HCFC-225ca/cb use has always been directed to niche applications in precision cleaning and as a carrier solvent. Major sales occur in Japan and USA respectively (around 2,000 t in 2002).").
[103] UNEP/TEAP, HCFC Task Force Report, (2003) at 66 ("HCFC-123 is being sold as a halon 1211 alternative primarily for portable fire extinguishers used in telecommunication facilities, computer rooms, office buildings, retail facilities, libraries, art galleries, warehouses, industrial facilities, rail cars, automobiles, automobile racing, delivery trucks, long- and short-haul trucks, power generation plants, commercial shipping, pleasure craft, airport gates and airport ramps.").

[104] UNEP, *Report of the Ozone Secretariat Workshop on the IPCC/TEAP Special Report*, UNEP/OzL.Pro/Workshop.2/2 (7 July 2006). *See also* K. Madhava Sarma, *Strengthening the Montreal Protocol: The Step-by-Step Approach for the Montreal Protoco*l (2006), refer to Chapter 14.
[105] TEAP Accelerated HCFC Phase-Out Task Force Report, *supra* note 1, at 10 ("The most advanced accelerated HCFC phase-out schedule combined with all other practical measures provides cumulative ozone-related savings of nearly 1.25 million ODP tonnes (see Figure ES-8) and in excess of 30 billion tonnes $CO_2$-eq of potential climate protection (see Figure ES-9).").
[106] IPCC/TEAP Supplement, *supra* note 24, at Annex.
[107] Emissions from banks of HFC substitutes used in refrigeration and air conditioning equipment also will be emitted, as HFCs have been among the leading substitutes for CFCs.
[108] Velders, *et al*., *supra* note 21, at 4818 (". . . parties to the Montreal Protocol have considered options to further mitigate ozone depletion while incident ally reducing climate forcing. Some import ant examples are the following: (i) further acceleration of the HCFC phase-out (8, 41) and use of low-GWP substitutes; (ii) collection and destruction of ODSs contained in ‘‘banks’’ of old refrigeration, air conditioning equipment, and thermal insulating foam products (8, 42, 43); and . . .").
[109] *See* Refrigerant Reclaim Australia, *at* http://www.refrigerantreclaim.com.au ("Refrigerant Reclaim Australia (RRA) is the product stewardship organisation for the Australian refrigeration and air conditioning industry. RRA is a not-for-profit organisation created to work nationally with industry to share the responsibility for, and costs of, recovering, reclaiming and destroying surplus and unwanted refrigerants. RRA's aim is to improve the industry's environmental performance by reducing the level of emissions of refrigerants through its take-back program. Since established in 1993, RRA has become part of the industry fabric. Created by industry, for industry, RRA is a best-practice, producer responsibility organisation. RRA: adopts a co-regulatory approach, which produces positive environmental outcomes; operates efficiently through one coordinated scheme, saving industry members time, money and effort; and provides rebates for contractors who recover and return refrigerant (around $1.3 million in 2005/2006)."). *See also* H.R. 3448, The Global Climate and Ozone Layer Protection Act of 2007 (introduced by Congressman Henry A. Waxman and providing for a similar program to promote greater recovery and recycle/destruction of used refrigerants). The bill also recognizes the climate benefits of the Montreal Protocol to date and includes a sense of Congress resolution directing the U.S. to negotiate with other Parties to maximize the climate benefits of the accelerated HCFC phase-out, "by focusing on the climate impacts of ozone depleting substances and their substitutes, and on the energy efficiency of equipment in which such substances and their substitutes are used."
[110] Under the Montreal Protocol, uncontrolled and unlimited quantities of ODS can be used and emitted in feedstock, process agent, quarantine and preshipment, and laboratory and analytical uses. In addition, limited quantities are allowed for use in applications decided as critical or essential.
[111] *See* Bankobeza, *supra* note 73, excerpted Chapter 7.
[112] Chatham House & Env't Investigation Agency, *ODS Tracking: Feasibility Study on Developing a System for Monitoring the Transboundary Movement of Controlled Ozone-Depleting Substances Between the Parties* (Sept. 2006).
[113] Chatham House, *id*. at 6.