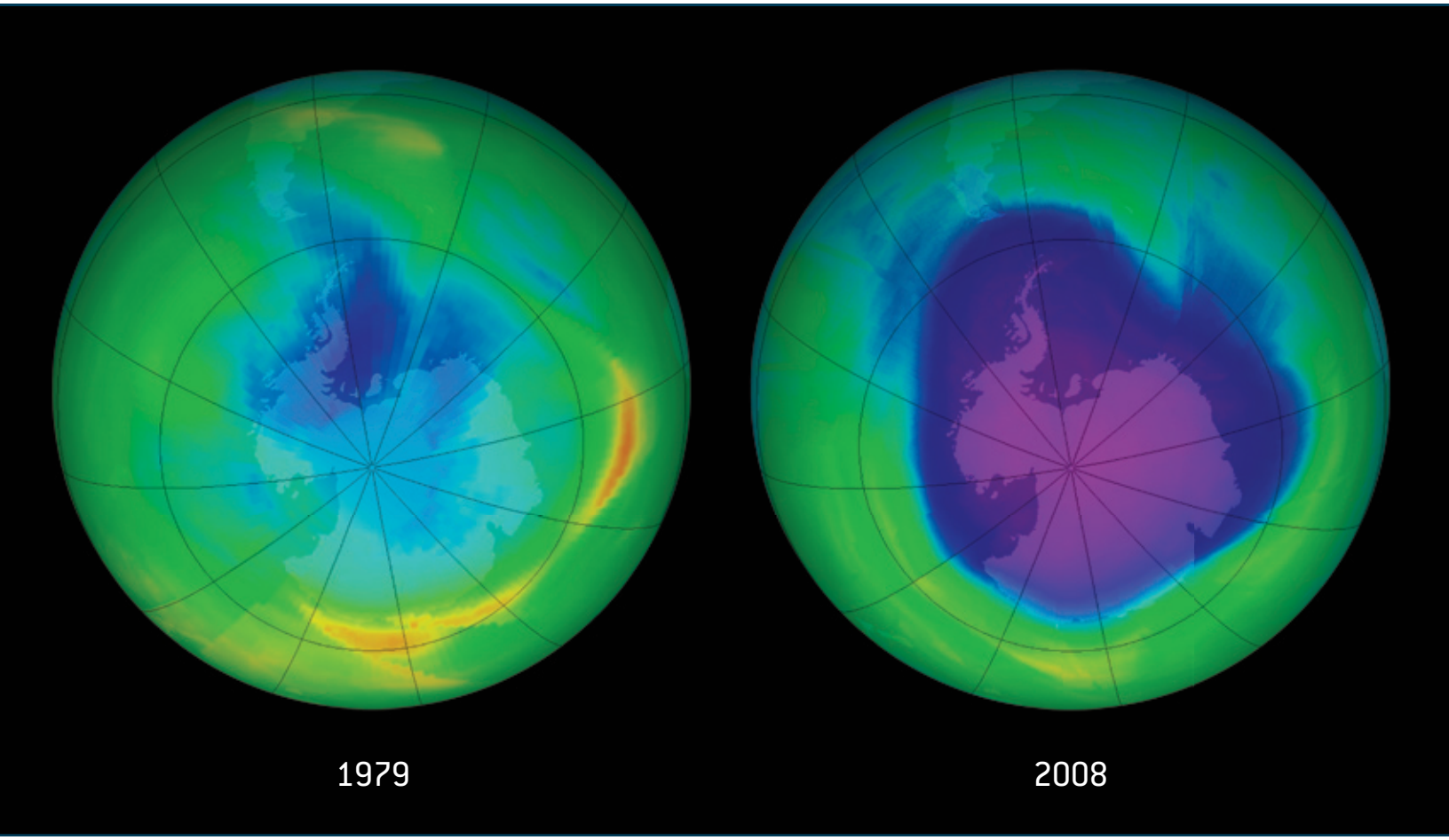
THE MONTREAL PROTOCOL IN 2010

DYNAMIC ACTION FOR OZONE AND CLIMATE PROTECTION

30TH MEETING OF THE OPEN-ENDED WORKING GROUP
OF THE PARTIES TO THE MONTREAL PROTOCOL ON
SUBSTANCES THAT DEPLETE THE OZONE LAYER

JUNE 14-18, GENEVA

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PREPARED BY THE ENVIRONMENTAL INVESTIGATION AGENCY
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Montreal Protocol on Substances that Deplete the Ozone Layer

30TH MEETING OF THE OPEN-ENDED WORKING GROUP OF THE PARTIES

The Montreal Protocol is at a crossroads in its efforts to restore Earth's ozone layer. In light of the escalating pace of global warming, controlling and minimizing the adverse climate impacts associated with the phase-out of ozone depleting chemicals has become obligatory. Recognizing this, the Multilateral Fund has approved numerous pilot projects to develop, demonstrate and commercialize technologies to transition directly from HCFCs to low Global Warming Potential (GWP) alternatives. Additionally the HCFC Funding Guidelines contain a 25% premium to maximize climate benefits of the HCFC phase-out, funding efforts are underway to recover, recycle and destroy Banks of ozone depleting substances, and proposals have been submitted to control the significant and dangerous climate impacts of HFCs.

The Parties have been praised for creating the most successful environmental accord in history, and as such should embrace every opportunity for taking decisive action to restore the ozone layer without exacerbating global warming. If they do not, the negative consequences stemming from climate change caused by ODS substitutes will eclipse the effort and achievement of arresting the destruction of the planetary ozone layer.

From its inception, the Parties to the Montreal Protocol have demonstrated a level of cooperation, commitment, and achievement without equal in world affairs. Now more than ever, the Parties need to advance their historic efforts for atmospheric protection by ensuring that the Montreal Protocol goes well beyond simply achieving 'climate neutrality' and instead becomes part of the global solution to climate change. During the 30th Meeting of the Open-ended Working Group (OEWG) the Parties have a rare and real opportunity to significantly contribute to that solution by demonstrating the leadership that has become a hallmark of the Montreal Protocol and a model of responsible world governance.

This briefing has been prepared to assist Parties in understanding the multiple issues being addressed at the OEWG and their importance in restoring the ozone layer and protecting global climate. The issues presented herein are in the same order that they will be addressed during the meeting.

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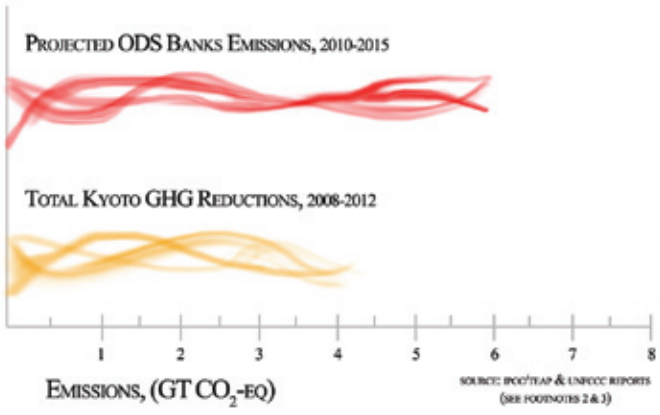
MANAGEMENT OF ODS BANKS

Many Ozone Depleting Substances (ODS) used during the last half-century are still in equipment, chemical stockpiles, foams, and other products (collectively referred to as "Banks") and are a major source of GHG emissions. Destroying ODS Banks under the Montreal Protocol can cost-effectively prevent the emission of 8.8 gigatonnes of carbon dioxide equivalents (Gt CO_2**e**) in the near-term (2-5 years) and mid-term (6-10 years) and an additional 9 Gt CO_2**e** or more thereafter. The majority of ODS emissions from easily recoverable Banks will occur in the next decade and will cancel out all of the GHG reductions achieved under the first commitment period of the Kyoto Protocol unless they are addressed.

Historically, the Montreal Protocol has only controlled production and consumption of ODS—not emissions. In addition, the Kyoto Protocol specifically limited its jurisdiction to GHGs that are not ODS in deference to the Montreal Protocol. The result is that under the current ozone and climate regimes, ODS in Banks exist in a regulatory void, unclaimed by either treaty.

In discussing the climate benefits of destroying ODS Banks, it is often forgotten that their destruction has significant ozone benefits. According to the TEAP, end-of-life measures across all sectors have potential cumulative savings of around 300,000 ozone depletion potential (ODP) tonnes.[1] It was reported that simply destroying the most cost-effective Banks in refrigeration and air conditioning at end-of-life, starting in 2008, could have accelerated the return of the ozone layer by up to two years.[2] These ozone benefits must be accounted for when considering the cost of managing ODS Banks as they will save billions of dollars worldwide in health-care costs associated with skin cancer, eye cataracts, and other ozone-related ailments.

ODSs accumulate in Banks in three primary sectors: refrigeration, air conditioning and foams. According to the IPCC and TEAP, ODS Banks will contain approximately 16-17 Gt CO_2**e** across all sectors worldwide in 2010, consisting of 12 Gt CO_2**e** of CFCs and 4-5 Gt CO_2**e** of HCFCs.[3] Action to recover and destroy CFCs and HCFCs in refrigeration and air conditioning Banks represent one of the single most cost-effective climate mitigation opportunities. However, the window of opportunity to reap this double dividend for ozone and climate protection is rapidly closing.



There is speculation that the phase-out of production and consumption of traditional ODS (e.g., CFCs and halons) will result in greater recovery, recycling and reuse. However, there is no proof of this and historic efforts to recover ODS Banks have been minimal at best.

Traditionally, almost all of the funding needed to reduce ODS among Article 5 Parties has come through the MLF. However, financial assistance from international institutions is essential if Banks in Article 5 nations are going to be recovered, recycled and/or destroyed before they are emitted due to the substantial overall cost of destruction estimated by the TEAP.

Since ODS Banks harm both ozone and climate, funding for their collection and destruction can be obtained from both traditional sources and climate-dedicated financing, or as part of larger sustainable development projects utilizing numerous international sources. Potential sources of financing for Banks include, inter alia: direct MLF funding; incremental cost or co-financing from climate-mitigation funds, such as GEF or new financial transfer mechanisms under UNFCCC; co-financing from implementing agencies, such as UNDP and the World Bank; and carbon markets.

Unfortunately, the multi-year and project specific processes to obtain funding from international institutions means that the majority of easily recoverable Banks may be released before funds are fully mobilized. Therefore a clear need exists for significant near-term funding to prevent the release of these potent greenhouse gases. It is essential that adequate funding be included in the upcoming replenishment to recover, recycle and/or destroy Banks until other funding sources are secured.

Various methodologies to collect and destroy ODS banks have been developed. It is critical that the Montreal Protocol lend its expertise to ensuring these methodologies are as robust and efficient as possible. The MLF secretariat could be called upon to collaborate with various voluntary carbon markets in reviewing and commenting on ODS Banks methodologies.

RECOMMENDATIONS:

Parties should consider making additional climate funding contributions to the MLF to ensure ODS Banks are being recovered, recycled or destroyed.

Ensure that adequate financing for ODS banks is part of replenishment.

Request the MLF Secretariat to undertake take actions necessary to obtain additional funding and to enable Article 5 Parties to access climate mitigation funds and carbon markets.

TEAP REPORT ON HFC ALTERNATIVES

Summary of the 2010 TEAP Report on Assessment of HCFC Alternatives



CO_2 capsule system for supermarkets.

The "TEAP 2010 Report on its Assessment of HCFCs and Environmentally Sound Alternatives" (2010 TEAP Report") demonstrates that, with supportive regulation, sufficient HFC-free alternatives exist or are being commercialized to allow Article 5 counties to meet the reduction requirements in the HCFC phase-out and avoid the need to transition to HFC based technologies. Despite repeated descriptions of many current applications being "dominated" by HCFC or HFC use, it is abundantly clear that low-GWP alternatives are beginning to compete with traditional fluorinated compounds within virtually every major sector. Given the inherent difficulty in competing with and displacing established technologies and private industries, the degree of market penetration evidenced by systems utilizing low-GWP alternatives is clearly indicative of increasing global growth and availability for low-GWP alternatives, compounds and technologies. As the phase-outs of halons and CFCs were initiated with far less in the way of proven or theoretical options, it is certain that the direct transition from HCFCs to low-GWP alternatives is a viable and realistic prospect.

Pursuant to the accelerated HCFC phase-down, non-A5 countries as of January 1, 2010 have reduced 75% of their HCFC production and consumption, primarily by transitioning to HFCs.[4] The 2010 TEAP Report suggests that the remaining reductions can and should be made with non-HFC alternatives and that non-A5 countries should be investing and making appropriate regulatory changes to assist with the commercialization of low-GWP alternatives which can then be used by Article 5 countries in their phase-out of HCFCs.

The 2010 TEAP Report documents how, in some sectors such as domestic refrigeration and foam blowing, hydrocarbons are already the dominant HCFC alternative, and that in many other sectors low-GWP alternatives are available and beginning to penetrate the market. In still others sectors, the TEAP has indentified low-GWP alternatives that are expected on the market in the next 2 to 5 years. By transitioning directly to HFC-free alternatives, A5 counties can avoid being victims of yet another a time-limited technology, and non-A5 counties can avoid a substantial proportion of the cost of an HFC phase-down.

The TEAP's Task Force Decision XX/8 report, published in 2009, shows that stationary air-conditioning (AC) and commercial refrigeration dominate HCFC use in developing countries, and that by 2020 will account for over 92% of their estimated HCFC bank. Between 2015 and 2020 HCFC banks in developing countries will generally stabilize, however industrial refrigeration will increase by 14%.[5]

The 2009 TEAP Report also details expected increases in global HFC banks between 2015 and 2020 with the sharpest increases coming in foam (57%)[6] and fire protection (38%) sectors.[7] Use of the 2010 TEAP Report on its "Assessment of HCFCs and Environmentally Sound Alternatives" to prioritize transitions in these sectors to low-GWP alternatives could dramatically reduce these projected increases, as well as the attendant difficulties and expense involved in the eventual elimination of HFCs.

This section discusses key sectors where the use of available and developing technology will help countries avoid a transition to HFCs, summarizing and adding to information from the TEAP's 2010 Report. It also highlights low-GWP sectors that should be targeted for commercialization and regulatory support.

FOAM:

TEAP reports that hydrocarbons have been the preferred HCFC alternatives since the 1990s, with technology evolving to improve insulation performance. Hydrocarbons are now the most widely applied technology in polyurethane foam manufacture. Carbon dioxide (CO_2) is also noted as an established alternative to HCFCs, especially the use of supercritical CO_2 foam technology. Hydrocarbons, CO_2 and water are all proven foam blowing agents and are utilized in a broad range of formulations than have been adopted in Europe and Japan, where CO_2 and hydrocarbons are the primary blowing agents. It is worth noting that the Montreal Protocol's Executive Committee approved a supercritical CO_2 foam demonstration project in Colombia at

Sufficient low-GWP alternatives exist or are being commercialized to allow counties to meet the reduction requirements in the HCFC phase-out and avoid the transition to HFC technologies.

As the phase-outs of halons and CFCs were initiated with far less in the way of proven or theoretical options, it is certain that the direct transition from HCFCs to low-GWP alternatives is a viable and realistic prospect.

its 60th meeting to increase availability of low-GWP foam-blowing technologies.

COMMERCIAL REFRIGERATION: STAND ALONE UNITS

TEAP identified hydrocarbons and CO_2 as commercialized low-GWP alternatives to HCFCs, highlighting widespread use of these 'natural' refrigerants in equipment across Europe. Additional research has shown that they are also entering markets within developing countries with Unilever now having placed over 360,000 hydrocarbon based ice cream freezers globally including Latin America and Asia.[8] Additionally, long-term trials in Australia have shown a 9% reduction in energy use when compared with HFC cabinets.[9] Clearly this is a sector where HCFCs could easily be replaced with low-GWP alternatives.

COMMERCIAL REFRIGERATION: CONDENSING UNITS

The report highlights the use of hydrocarbons, CO_2 and recent designs using ammonia combined with CO_2. The 2010 TEAP Report estimates market penetration of HFC-free alternatives in developed countries to be about 7%, indicating that a considerable amount of HFC-free equipment is already available. There is also evidence to suggest that this figure is likely to significantly increase in the near future. UK food retailer Waitrose has committed to the use of HFC-free condensing systems in all new stores and will phase out use of HFCs completely by 2020.

COMMERCIAL REFRIGERATION: CENTRALIZED SYSTEMS

The TEAP report shows that CO_2 is the preferred low-GWP alternative to HCFCs at low temperatures, but at medium temperature the options are less clear.

Although the report highlights the use of hydrocarbons, ammonia and CO_2 as medium temperature options, it fails to document the widespread commercialization of HFC-free systems across the globe. Additional research reveals that global retail giant Tesco has installed HFC-free systems in Thailand, Malaysia and Turkey, and has systems planned in Korea, Hungary and the US.[10] TEAP estimates market penetration of centralized systems in developed countries to be about 5%. Again, this is likely to rapidly increase as several UK supermarkets have recently announced ambitious HFC phase-out targets which will further increase the pace of technology change globally.[11]

FIRE PROTECTION:

The 2010 TEAP Report documents that carbon dioxide and inert gas systems account for approximately half of all new fixed systems. Leading U.S. systems manufacturers, (3-M, Tyco, et al.) have indicated that a complete changeover to low-GWP alternatives could be achieved within 18 months. For portable extinguishers, not-in-kind alternatives have been more popular due to lower prices. This is a sector where a transition to HFCs should not pose a significant challenge, given adequate financial and regulatory support

UNITARY AIR CONDITIONING:

The 2010 TEAP Report suggests that hydrocarbons can be broadly applied to equipment where the refrigerant charge is less than 1kg and draws attention to the fact that the low liquid density of hydrocarbons compared to HCFCs means that two to three times the cooling capacity is achievable for hydrocarbons systems that use the same charge size.

Global market data indicates that 70-80% of residential room air-conditioning systems would need hydrocarbon charges of less than 500g (in China this is as much as 88) based on a specific charge of approximately 100 g per kW of hydrocarbon refrigerant.[12]

An omission in the TEAP report is the production of hydrocarbon equipment underway in China and India. Both Godrej[13] and Gree[14] have found that for the same energy rating, the per unit cost is less than that for systems utilizing HCFC-22 and hydrocarbons (R-410a).[15] Additionally, the Australian company Benson produces air-conditioning units using hydrocarbons for the same price as those utilizing R-410a. There are currently significant regulatory barriers in many non-A5 countries that need to be reviewed and revised to allow greater application of these technologies.

The 2010 TEAP Report identifies HFC-32 as a possible alternative in the 'low' GWP alternative sector, despite the fact that it has a GWP of 600 which is clearly not 'low'. This somewhat arbitrary designation of HFC-32 as an "environmentally sound alternative" to HCFCs is unjustified given that viable truly low-GWP alternatives commercially exist in this sector. The



CO_2 refridgeration canister.

Multilateral Fund Secretariat has noted that HCFC-22 production could be converted to HFC-32 in the future,[16] which may explain the apparent interest in promoting HFC-32. However, this is clearly inappropriate in cases where low-GWP alternatives are already commercialized.

INDUSTRIAL REFRIGERATION:

Low-GWP substitutes are well established in this sector. Ammonia has been used for many years as an HCFC alternative across Europe, the United States and other non-A5 countries, and ammonia systems are in use in India and China. CO_2 is now emerging as an alternative where ammonia may not be feasible and has proven cost-effective when applied with integrated heating and cooling needs.

CHILLER AIR-CONDITIONING:

The 2010 TEAP Report highlights the use of various natural refrigerants in this sector, and points out that ammonia is used in process cooling in Europe. Hydrocarbons are used in chillers across Europe and in Indonesia, Malaysia and the Philippines. The Report limits the practical use of hydrocarbons chillers for comfort cooling to units of less than 300kW capacity.

Table of Low-GWP Alternatives to HCFCs

(from the: "TEAP 2010 Assessment of HCFCs and Environmentally Sound Alternatives")

Sector	Low GWP alternative in use	Energy efficiency of low GWP vs. high GWP normally used	Market Penetration of low GWP in developed countries	Timescale for low GWP commercialisation	Supplementary information
Domestic Refrigeration	HC-600a	Comparable to HFC	36% global and growing	N/A	
Commercial refrigeration: Condensing units	CO_2 HC-290	0 to -15% 0 to +5%	1 to 2% 3 to 5%	R-717 N/A	
Commercial refrigeration: Centralised systems	Amm CO_2 HC	All about +5%	2 to 5% / <1%	? N/A	Three major UK supermarket commit to HFC phase out. HFC-free stores in Malaysia, Thailand, Korea... Waitrose anticipate 10% energy savings. Explain their system
Industrial systems: Refrigeration	Amm CO_2 HCs	20% /0% /10%	40% / 0% / 0%	Air cycle, Water Vapour, Compression	Over 70% of UK supermarkets surveyed by EIA have either totally transitioned to ammonia or plan to in near future
Industrial systems: Heat pumps	Amm CO_2 HCs	10% /nA /nA	0% / N/A / N/A	N/A	
Industrial systems: AC	Amm CO_2 HCs	+20% / 0 / +10%	30% / 0% / 10%	N/A	
Chiller AC: Small	Hydrocarbons in systems <300 kW	Similar to 5% higher	< 2%	HFC-1234yf 5 years	
Chiller AC: Larger	R-717 (ammonia)	Similar	<2%	HFC-1234yf 5 years	
Chiller AC: Centrifugal	None			HFC-1234yf 5 years	
VEHICLE AC					
a) Passenger car and light truck				R-744 (CO_2) >5yrs, HFC-152a >3 years, HFC Blend w/ GWP ,150 >3 yrs, HFC-1234yf >2-3 years	
b) Bus				CO_2 >2-3 years	

Market data for 2009 and 2010 suggests that about 70-80% of the global chiller market is for air-cooled chillers of less than 350 kW capacity,[17] suggesting that hydrocarbons could be very widely applied in the future. This is supported by refrigeration companies that sell both hydrocarbon and HFC chillers, especially with regards to wide-scale placement of such systems. Despite the limitation in the 2010 TEAP Report, it has been confirmed that the use of chillers in excess of this capacity can also be widely applied.[18]

NATURAL REFRIGERANTS

In many areas, non-HFC, 'natural' alternative technology is commercially viable, further indicating the potential for leaping over HFCs and transitioning directly to low-GWP alternatives. However, as has been observed in developed countries, low GWP technologies often encounter difficulty penetrating established markets without policy interventions.

The 2010 TEAP Report does not fully document the commercial viability of natural refrigerants in all sectors and in some cases is unnecessarily pessimistic

Sector	Low GWP alternative in use	Energy efficiency of low GWP vs. high GWP normally used	Market Penetration of low GWP in developed countries	Timescale for low GWP commercialisation	Supplementary information
VEHICLE AC					
c) Rail				hermetic or half hermetic systems 1-2 years	
Foams: Polyurethane	HCs (not economical in smaller facilities) CO_2 Methyl formate	similar	HCs are global market leader	Methylal and HFC-1234ze	
Foams: Extruded Polystyrene	HCs CO_2 water		In Europe and Japan HCs and CO_2 are market leaders	HFC-1234ze	
Fire Protection: Fixed systems	CO_2 and inert gas		50%		
Fire Protection: Portable extinguishers	CO_2		Significant levels of acceptance		
INDUSTRIAL SYSTEMS					
a) Industrial refrigeration	Ammonia, carbon dioxide, HCs	+20/0/+10	80/10/2%	Air cycle, Water vapour Compression Timing unknown	
b) Industrial heat pumps	Ammonia, carbon dioxide, HCs	+10/NA/NA	5%/NA/NA	N/A	
c) Industrial AC	Ammonia, Carbon dioxide, HCs	+20/0/+10	30/0/10%	N/A	
TRANSPORTATION REFRIGERATION					
a) Vessels	Ammonia, Carbon dioxide	No data		Low-GWP, HFCs 10-15 years	
b) Trucks and trailer	Discontinuous systems (cryogenics, eutectics)	No data		R-744, HCs, low-GWP HFCs, 10-15 years	
c) Intermodal Containers	None	No data		R-744, low-GWP HFCs, Others, 10-15 years	



Hydrocarbon refridgeration canister.

about the use of natural refrigerants where they are currently being commercialized. In light of the significance of this report, a wider peer review process with increased transparency is in order.

CONCLUSION

The "TEAP 2010 Assessment of HCFCs and Environmentally Sound Alternatives" Report demonstrates that with supportive regulation, sufficient HFC-free alternatives exist or are being commercialized to allow Article 5 counties to meet the reduction requirements in the HCFC phase-out and avoid a transition to HFC-based technologies. Additionally, the Report indicates many emerging low-GWP technologies that would benefit from investment and regulatory changes in non-Article 5 countries. As the HCFC phase-out will likely take decades, having low-GWP alternatives for all sectors and sub-sectors is not critical to a smooth transition that avoids the use of high-GWP HFCs. The TEAP Report documents that additional alternatives are under development and will be commercialized during the multi-decade phase-out.

When the phase-out of CFCs, halons and carbon tetrachloride began, no obvious alternatives were available, however the pressure to change created huge market incentives for the development of alternatives and not-in-kind technologies. The same situation and opportunity is again present, and in point of fact, the transition has already begun. The MLF has funded numerous pilot projects to develop, demonstrate and commercialize low-GWP alternatives to HCFCs. The Montreal Protocol must seize this opportunity and work to avoid a wholesale transition into a time-limited, costly and climate damaging HFC stage that will result in further disruptions to industry during a subsequent and inevitable phase-out of HFCs. Embracing and moving directly to realize a low-GWP global landscape is the only rational and responsible course of action to Parties.

RECOMMENDATIONS:

The MLF should ensure that all Article 5 HCFC Phase-out Plans that are approved maximize the use of low-GWP alternatives.

Non-Article 5 countries should review and amend regulations that act as artificial barriers to low-GWP alternatives.

Parties should request an addendum to this report which takes into account a broader range of information regarding the current availability of environmentally sound, climate friendly alternatives to HCFCs and that also considers the key regulatory changes, that would advance the development and commercialization of non-HFC alternatives.

The TEAP should circulate an official call for data on low GWP alternatives currently in use.

Critique of Proposed Multi-level Definition of GWP

The TEAP Report launched an initial proposal to classify GWPs of GHGs as follows:

GWP < ~30	"VERY LOW-GWP" ("ULTRA-LOW")
GWP < ~100	"VERY LOW-GWP"
GWP < ~300	"LOW-GWP"
GWP < ~1000	"MODERATE-GWP"
GWP < ~3,000	"HIGH-GWP"
GWP < ~10,000	"VERY HIGH GWP"
GWP > ~10,000	"ULTRA-HIGH GWP"

The Report goes on to say that the ultimate choice of technology to phase out HCFCs will not be based on climate impact alone, but will also consider ozone depletion, health, safety, affordability and availability, as Decision XIX/6 requires. However, the report does not explain the purpose of the proposed classification system or how this system would be used when making technological or funding decisions.

It is of great concern that the TEAP's approach to GWP classification is a self-proclaimed unscientific approach. The acceptance of "moderate" GWP at <1000 and "low" GWP at <300, could be used to justify alternatives with significant climate impacts which will eventually need to be phased out and divert resources and regulatory efforts away from available low-GWP alternatives.

As demonstrated below, a transition to high or intermediate GWP alternatives will have limited benefits for climate and therefore all available resources should be dedicated to commercializing the alternatives in all sectors and subsectors that have the lowest GWP (taking into account ozone depletion, health, safety, and affordability). Clearly, the Montreal Protocol should commit its financial and technical resources to truly low-GWP alternatives so that redressing ozone depletion does not come at the expense of climate.

EIA is particularly concerned about the 'moderate' GWP demarcation of

approximately 1000. HFC-134a has a GWP of 1,400 and is being banned from use in mobile air-conditioning across Europe. However under the TEAP's classification this could be a 'moderate' GWP, which implies that its use is acceptable. Tacit acceptance of this categorization risks endorsing HFCs with GWPs that are by rational standards considered high and undesirable.

Irrespective of the TEAP's approach to GWP classification there is clearly a need to define what is meant by 'low' and 'high' GWP. A quote from a scientist in the report offers another way of addressing this; "It boils down to how much radiative forcing you are willing to tolerate".

Any definition of 'high' and 'low' GWP must take into account soaring refridgerant growth rates in developing countries. Figure 1 plots the carbon dioxide equivalent (CO_2**e**) impact of refrigerants with various GWPs. The CO_2**e** impact of Refrigerant 'A' consumption (GWP of 1800) in 2010 is given a value of one and is used as a baseline/index to which the CO_2**e** impacts of three other refrigerants with varying GWPs are compared. Figure 1. assumes continued refrigerant growth rates of 15% up to 2020, as documented in developing countries between 2002 and 2008.[19]

The graph compares the CO_2**e** impacts of adopting various refrigerants given current growth rates. The purpose is to assess how much benefit will be accrued from a reduction in GWP before the CO_2**e** impact exceeds 2010 emissions by the baseline/index for refrigerant 'A' with a GWP of 1800.

Using this tool it is apparent that based on current growth rates, an immediate reduction to a refrigerant with a GWP of 1000 in 2010 would allow just 4 years before CO_2**e** impacts levels return to baseline. For a refrigerant with a GWP of 600 it is 8 years. A significant difference is evident when a refrigerant with a GWP of 150 is used. In this case, baseline levels do not return until 2036, some 26 years later. Clearly there are significant and detrimental climate impacts associated with so-called "moderate" or "low" GWPs of 1000 and 300 respectively.

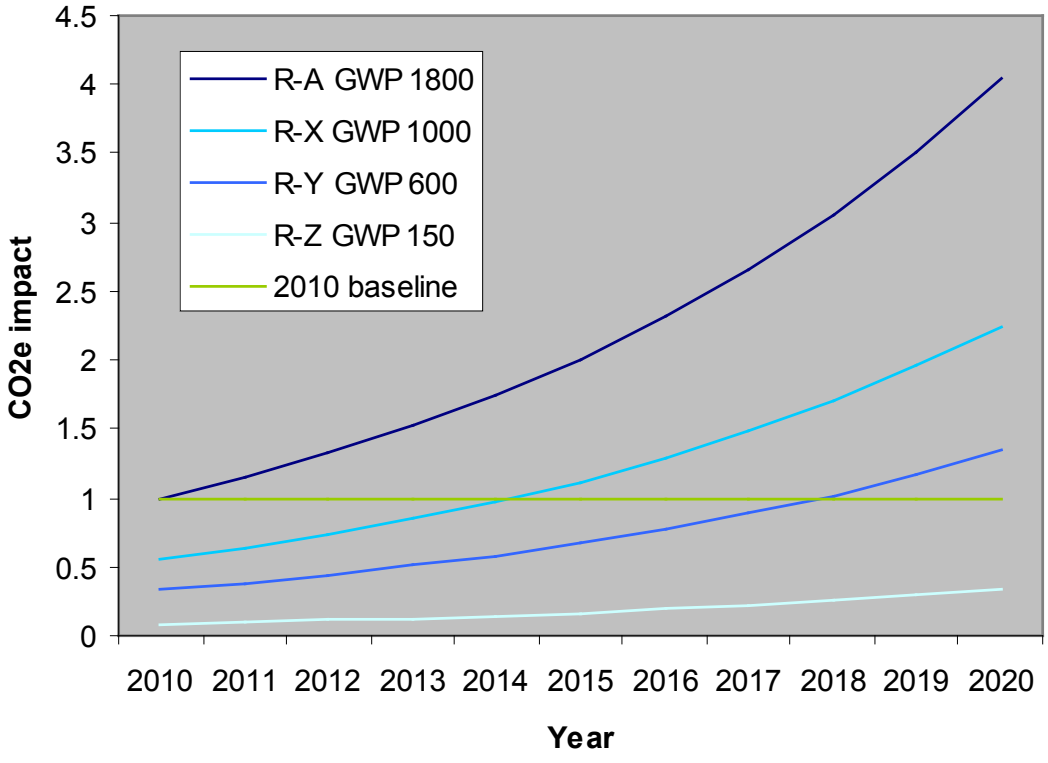
Since the 2007 accelerated HCFC phase-out, Parties have become increasingly committed to avoiding the widespread uptake of high-GWP HFCs where possible, as demonstrated by the Executive Committee's project approvals and funding guidelines. The Montreal Protocol should not miss this golden opportunity to drive clean technology development through the HCFC phase-out.

RECOMMENDATIONS:

Parties should reject the TEAP's arbitrary attempt to develop a range of GWP classifications.

Any classification of GWP values must recognize the need to significantly reduce GWP (preferably to near zero) in order to compensate for future growth.

The current simple low-GWP v. high-GWP classification should be retained.



PROPOSALS FOR AN HFC AMENDMENT

Spiraling HFC production, consumption and emissions must be addressed as a matter of urgency. Updated HFC projections indicate that without further regulation, future emissions of high-GWP HFCs will be much greater than previously anticipated. Recent research estimates that HFC emissions will reach between 5.5-8.8 gigatonnes of carbon dioxide equivalent (Gt CO_2**e**) by 2050.[32] These projections use similar modeling to the Intergovernmental Panel on Climate Change (IPCC) emission scenarios, where growth is based on gross domestic product (GDP) and population trajectories. However, this research adds a valuable new dimension as it incorporates recent information on replacement patterns of HCFCs by HFCs, as well as HCFC and HFC consumption growth in developing countries.

There is a critical need to rapidly stabilize atmospheric CO_2 concentrations in order to reduce the catastrophic risks of global climate change. While the requisite CO_2 target levels are a matter of debate, there appears to be growing consensus that at a minimum, stabilizing atmospheric CO_2 concentrations at 450ppm is necessary by 2050. Under business as usual scenarios, by 2050 HFC emissions will equal 19% of the emissions from all of the other major greenhouse gases. Consequently, if left unchecked HFC use will prove fatal to domestic and international efforts to arrest and reverse global climate change by negating anticipated reductions in CO_2 and other GHG emissions.

The need for urgent action to curtail high-GWP HFC emissions is especially critical in Article 5 countries where soaring market demand for refrigeration and air-conditioning is triggering a corresponding rise in consumption of HFCs. Setting a clear schedule to transition directly from HFCs to low-GWP alternatives now will ensure that these nations do not invest in an HFC cul-de-sac, requiring far more costly and difficult mitigation efforts in the future.

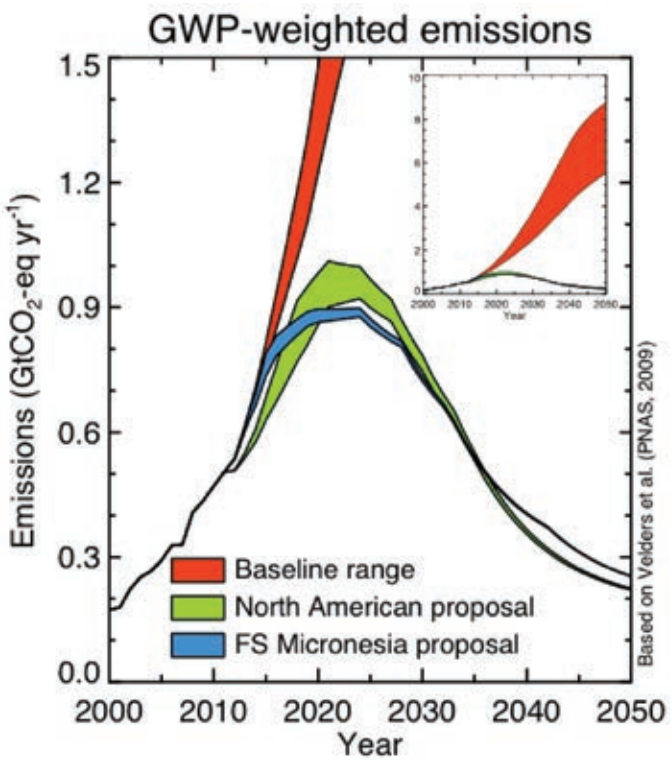
As HCFCs are progressively phased out in developing countries, HFCs are set to become the dominant substitutes, and estimated to replace over 75% of historic HCFC consumption unless the Montreal Protocol acts to transition into low-GWP alternatives. Research released in June 2009 (Velders, et al.) is even more dire, anticipating HFC consumption in developing countries overtaking that of developed countries before 2020.

It is imperative to avoid the transition to high-GWP HFCs by creating a framework that uses the Montreal Protocol to facilitate low-GWP substitutes and technology transfer to developing countries. The Montreal Protocol's Executive Committee must be immediately directed to stop funding projects utilizing high-GWP HFCs where more environmentally suitable alternatives exist. A clear framework needs to be established to phase out high-GWP HFCs and prevent HFC emissions in developing countries from soaring at precisely the time that global greenhouse gas (GHG) emissions need to be curtailed.

Two Amendment proposals have been filed: one by Canada, Mexico and the United States, the other by the Federates States of Micronesia. Both would implement a phase-down of HFCs and facilitate the transition to low-GWP alternatives. There are slight differences in the details of how the amendment proposals will impact the production and consumption of HFCs that are best depicted in the graph below.

RECOMMENDATIONS:

Parties should immediately adopt an amendment to regulate production and use of HFCs under the Montreal Protocol and undertake an immediate phase-out of HFCs with a schedule requiring strong initial commitments by developed/ Article 2 countries.



The North American proposal and the Micronesian proposal are similar; both decrease the cumulative (2013-2050) direct GWP_{100yr}-weighted consumption of HFCs to 21-22 Gt CO_2**e** from 146-231 Gt CO_2**e** for a total of approximately 125 to 209 Gt CO_2**e** in mitigation. This is equivalent to a reduction from projected annual emissions of 5.5 to 8.8 Gt CO_2**e**/yr in 2050 to less than 0.3 Gt CO_2**e**/yr. (The reference scenarios for calculating the effects of the proposals are from Velders, et al. (PNAS 2009) without any updates.)

Source: IGSD

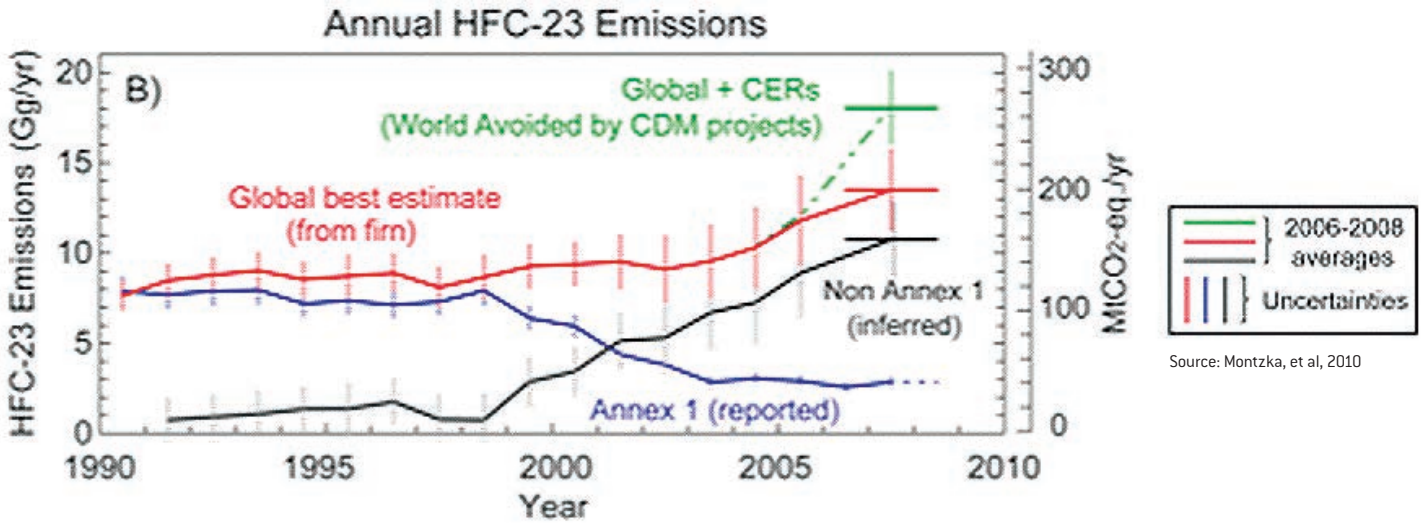
HCFC-22/HFC-23 PRODUCTION AND EMISSIONS

In 2003, under the UNFCCC's Clean Development Mechanism (CDM), the first of nineteen existing contracts was finalized to pay HCFC-22 manufacturers in developing (non-Annex 1/Article V) nations for HFC-23 destruction.

By purchasing Certified Emissions Reduction credits (CERs) generated from capturing and incinerating HFC-23, developed (Annex 1/non-Article V) nations that are Kyoto signatories can offset their own GHG emissions. HFC-23 destruction has produced over half of all the CERs issued to date and similarly absorbed over half of all annual spending for emissions offsets. Of the more than 407,036,000 CERs issued since 2003, 213,930,000 or 52.4% have been generated from HFC-23 destruction.[23] At an average price of €15/$20 per unit, payments for HFC-23 CERs over this seven-year period will exceed €3.2 billion/$4 billion US.

Despite this prodigious investment, the atmospheric concentration of HFC-23 has increased during this time, primarily as a result of venting at non-CDM plants in developing countries.[24] It is estimated that approximately 89% of vented HFC-23 from non-CDM facilities in developing countries originates within China.[25] China is believed to have 6 to 9 non-CDM HCFC-22 facilities with additional non-CDM plants located in Russia, Mexico, Venezuela and possibly elsewhere. Emissions of HFC-23 from developing countries averaged approximately 8.3Gg/122.8 MMt CO_2**e** from 2007-2009, while developed countries emissions from the same period averaged approximately 2.8 Gg/32.8 MMt CO2 eq.[26]

CDM projects will destroy an estimated 8.0 Gg/118.4 MMt CO_2**e** in 2009, however this amount still represents less than half (approx. 43%) of global HFC-23 emissions.[27] While CDM activity prevented an effective doubling of HFC-23 emission rates from 2000-2002 to 2006-2008, the extravagant methodology makes HFC-23 destruction twice as profitable as sales of the corresponding amount of HCFC-22 by paying manufacturers more than 2 to 5 times what it costs to actually destroy HFC-23.[28] The issue at hand however is that the CDM is insufficient to the challenge of eliminating HFC-23 emissions — no new destruction projects are allowed and no apparent prospects exist within the UNFCCC process for timely mitigation of outstanding HFC-23 emissions.



Source: Montzka, et al, 2010



HCFC-22 Canisters.

Source: EIA

HCFC-22 production and HFC-23 production, emissions and incineration for developing countries and global total. Sources of HCFC-22 production date are indicated by footnote letters 'a'-'c' following the numerical data.

Year	Developed countries dispersive $CHClF_2$ prod. (Gg)	Developed countries feedstock $CHClF_2$ prod. (Gg)	Developing countries dispersive $CHClF_2$ prod.[b] (Gg)	Developing countries feedstock $CHClF_2$ prod.[b] (Gg)	Developed countries (UNFCCC) CHF_3 emissions [c] (Gg)	Developing countries CHF_3 prod. from dispersive $CHClF_2$ prod. (Gg)	Developing countries CHF_3 prod. from feedstock $CHClF_2$ prod. (Gg)	CDM "non-released" CHF_3 (Gg)	CDM $CHF_3/CHClF_2$ co-production ratio (%)	Global bottom-up CHF_3 emissions (Gg/yr)
1990	214 [a]	107 [a]	7	0	7.9	0.27	0.00	–	3.74	8.2
1991	237 [a]	118 [a]	10	7	7.7	0.39	0.26	–	3.69	8.3
1992	246 [a]	123 [a]	22	11	7.9	0.81	0.41	–	3.65	9.1
1993	241 [a]	120 [a]	33	11	8.0	1.19	0.38	–	3.60	9.6
1994	220 [b]	120 [b]	42	12	7.2	1.50	0.43	–	3.56	9.1
1995	296 [b]	122 [b]	32	22	7.4	1.14	0.76	–	3.51	9.3
1996	237 [b]	156 [b]	37	22	7.1	1.27	0.75	–	3.46	9.1
1997	234 [b]	170 [b]	44	20	7.3	1.50	0.67	–	3.42	9.5
1998	257 [b]	171 [b]	32	18	7.9	1.07	0.62	–	3.37	9.6
1999	237 [b]	169 [b]	84	17	6.4	2.81	0.57	–	3.33	9.8
2000	225 [b]	164 [b]	117	23	6.0	4.04	0.79	–	3.47	10.8
2001	195 [b]	152 [b]	126	29	4.4	3.67	0.84	–	2.90	8.9
2002	183 [b]	156 [b]	140	35	3.8	4.59	1.15	–	3.27	9.5
2003	164 [b]	165 [b]	171	44	2.8	5.60	1.44	0.036	3.27	9.8
2004	142 [b]	205 [b]	229	60	3.0	7.15	1.86	0.151	3.12	11.9
2005	160 [b]	187 [b]	272	78	2.9	7.42	2.14	0.351	2.73	12.1
2006	92 [b]	202 [b]	313	91	2.6	9.31	2.72	1.384	2.98	13.3
2007	141 [b]	198 [b]	361	112	2.8	10.57	3.29	6.310	2.93	10.3
2008	118 [b]	174 [b]	330	171	2.8	9.63	4.99	7.301	2.92	10.1
2009	– –	– –	–	–	–	–	–	8.000	2.94	–

(a) McCulloch (2004).
(b) UNEP (2010).
(c) Montzka et al. (2010).

Source: Miller, et al. 2010, in review at ACPD, http://www.atmos-chem-phys-discuss.net/papers_in_open_discussion.html

DECISION PROPOSAL ON NON-CDM HFC-23 PRODUCTION

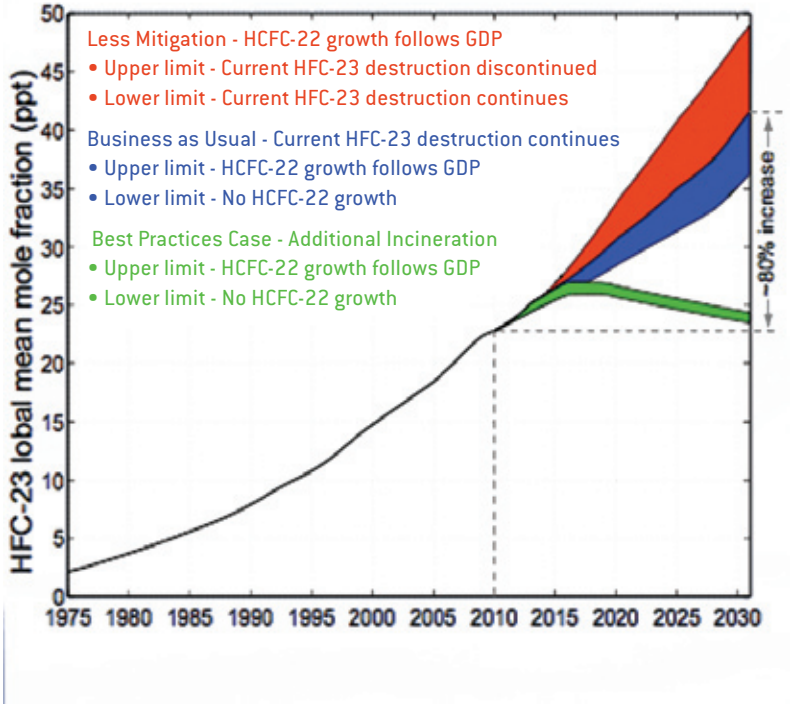
In April 2010, Canada, Mexico and the U.S.A. submitted a decision proposal to the Montreal Protocol "to address uncontrolled HFC-23 byproduct emissions to avoid impacts on the climate system from their release". Recognizing previous decisions (e.g., X/16, XVIII/12 and the 2007 accelerated HCFC phase-out) by the Montreal Protocol relating to climate impacts, and special reports by the Technological and Economic Assessment Panel (TEAP) concerning HFC-23 byproduct emissions, the North American Proposal represents a superior opportunity for facilitating a timely and critical adjunct to international mitigation efforts. HFC-23 (Trifluoromethane or CHF3) or is one of the most potent greenhouse gases (GHG) ever produced. It has a 100-year global warming potential (GWP) of 14,800 and persists in the atmosphere for 260-270 years.[20] Produced almost exclusively as a by-product of HCFC-22 manufacture, HFC-23 has limited utility and historically was generally vented into the atmosphere.

Recent investigations have documented that the atmospheric concentrations of HFC-23 have increased by 55% since 1990.[21] HFC-23 emissions arise primarily from over-fluorination of chloroform during HCFC-22 production. The recent global emission increases are attributed to rapidly increasing HCFC-22 production in developing countries since reported HFC-23 emissions from developed countries decreased over this period. The emissions of HFC-23 from plants not covered by the CDM countries during 2006-2008 averaged 11±2 Gg/yr HFC-23 (160±30 $MtCO_2$**e**/yr) and are larger than the 6.3 and 7.3 Gg/yr of HFC-23 destroyed during 2007 and 2008 respectively in United Nations Framework Convention on Climate Change Clean Development Mechanism ("UNFCCC" and "CDM") projects.[22] These uncontrolled emissions of HFC-23 from HCFC-22 facilities will continue and substantially exacerbate global climate change unless the Montreal Protocol acts.

The Decision Proposal is aimed at developing an environmentally and economically responsible approach to managing HCFC-22 production both for dispersive and feedstock use that mitigates the greatest possible amount of uncontrolled HFC-23 by-product, i.e., emissions vented from plants not covered by the CDM. As such, it does not address, overlap or in any way conflict with HFC-23 abatement efforts covered by the UNFCCC or the CDM.



HCFC-22 Canisters. Source: EIA



The Business as Usual scenario (upper limit) **predicts an 80% increase in HFC-23 abundance by 2030**. The upper limit of a Less Mitigation scenario assumes that the 7-year CDM projects are not renewed for the full potential of 21 years. The Best Practices scenario assumes that the CDM plants continue to incinerate HFC-23 even after project/contract expiration and that additional incineration is installed globally to reduce emissions to virtually zero.

The difference between the Business as Usual upper limit and the Best Practices scenarios represents a 2012-2030 integrated destruction of 215 ktonnes of HFC-23. Due to the high $HFC\text{-}23_{100yr}$ value of 14,800, this is the equivalent to 3.2 billion tonnes of CO_2 not emitted to the atmosphere, a quantity equal to 11% of the annual global CO_2 emissions of 2007.

Energy Information Administration, International Energy Outlook 2010, www.eia.doe.gov/oiaf/ieo/index.html, (2010).

DECISION PROPOSAL ON NON-CDM HFC-23 PRODUCTION

In order to start the process of controlling the emissions of HFC-23 that are not covered by the CDM, the North American Proposal requests that:

- the Executive Committee to review and update data on HCFC-22 production facilities located in Article 5 nations including location, production capacity and whether the HCFC-22 lines have ongoing projects under the CDM and the end dates of these projects, and present the findings by the 31st OEWG Meeting;
- the Executive Committee to develop estimates of the incremental costs, including capital costs and operational costs, associated with the destruction of HFC-23 emissions from HCFC-22 facilities located in Article 5 nations;
- the Executive Committee to formulate guidelines for funding projects to collect and destroy HFC-23 during the production of HCFC-22, including production for feedstock, by the 64th Meeting of the Executive Committee;
- as a matter of urgency, the Executive Committee to facilitate the formulation and implementation of projects to eliminate HFC-23 emissions from HCFC-22 production for facilities or production lines that are not under the CDM;
- the TEAP, in consultation with the Science Assessment Panel, to conduct a study of the costs and benefits from implementation of HFC-23 control measures by facility or production line, excluding those associated with existing CDM projects, and to prepare a report 60 days before the 31st Meeting of the OEWG.

Preliminary estimates indicate that assumption of all uncontrolled HFC-23 emissions would require $60-100 million for initial installation of incinerators,[29] and annual payments covering the incremental costs of destruction in the amount of approximately $25-30 million US.[30] Such an effort would be technically and fiscally consistent with the Montreal Protocol's past activities, and more so given the certainty of additional contributions by donor countries, the World Bank and others. CDM spending for abatement of a lesser quantity of HFC-23 will total approximately one US$1 billion in 2010.

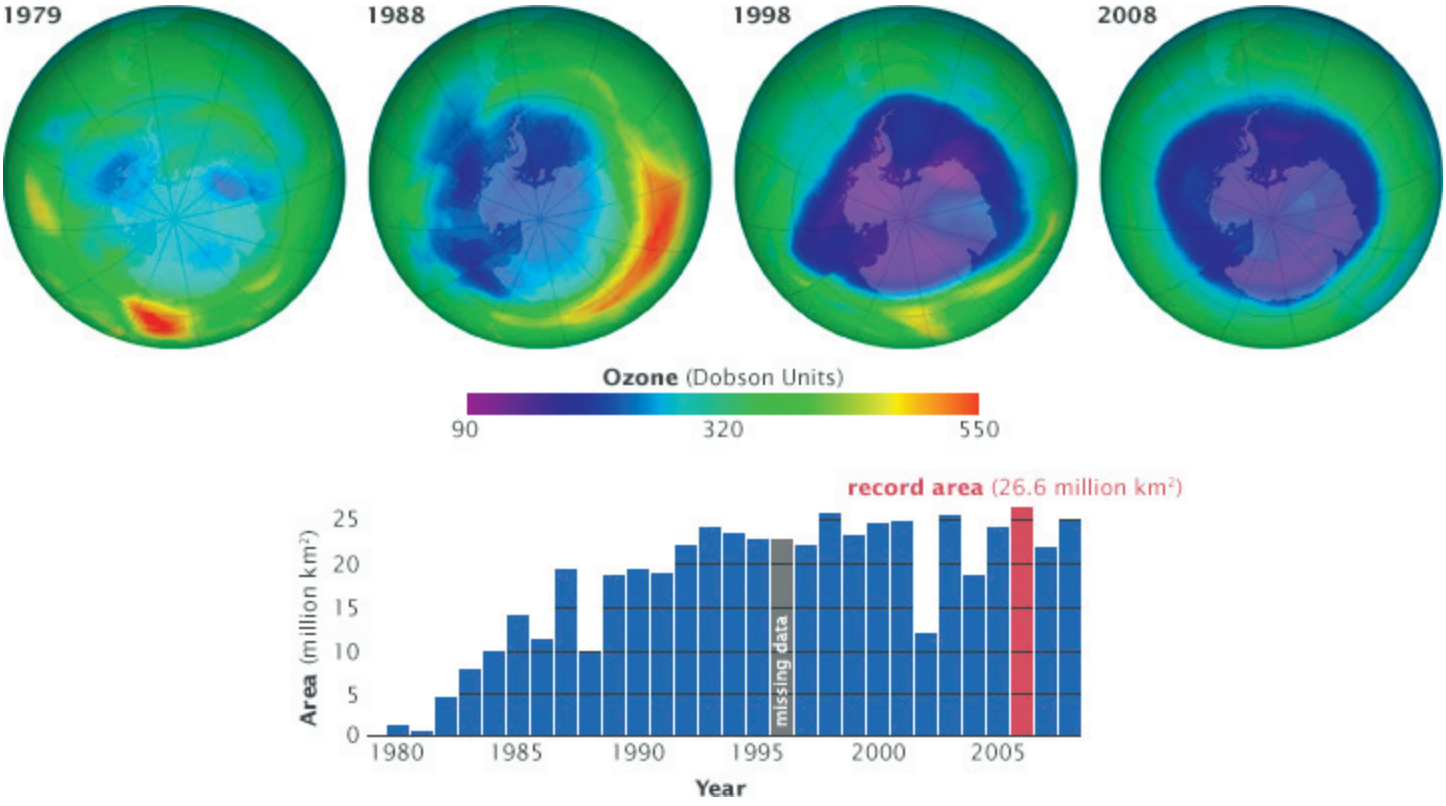
EIA strongly recommends the Parties to act immediately to address uncontrolled emissions of HFC-23 as it is the direct by-product of HCFC-22 and produced as an unintended consequence of the Montreal Protocol's efforts to phase out ozone deleting substances. Given all of the historic decisions aimed at ensuring that the Montreal Protocol's actions are done in the most environmentally conscious way possible, the Parties must act to control HFC-23 emissions as a matter of urgency.

RECOMMENDATION:

Support immediate adoption of the North American Decision Proposal for non-CDM HFC-23 destruction.



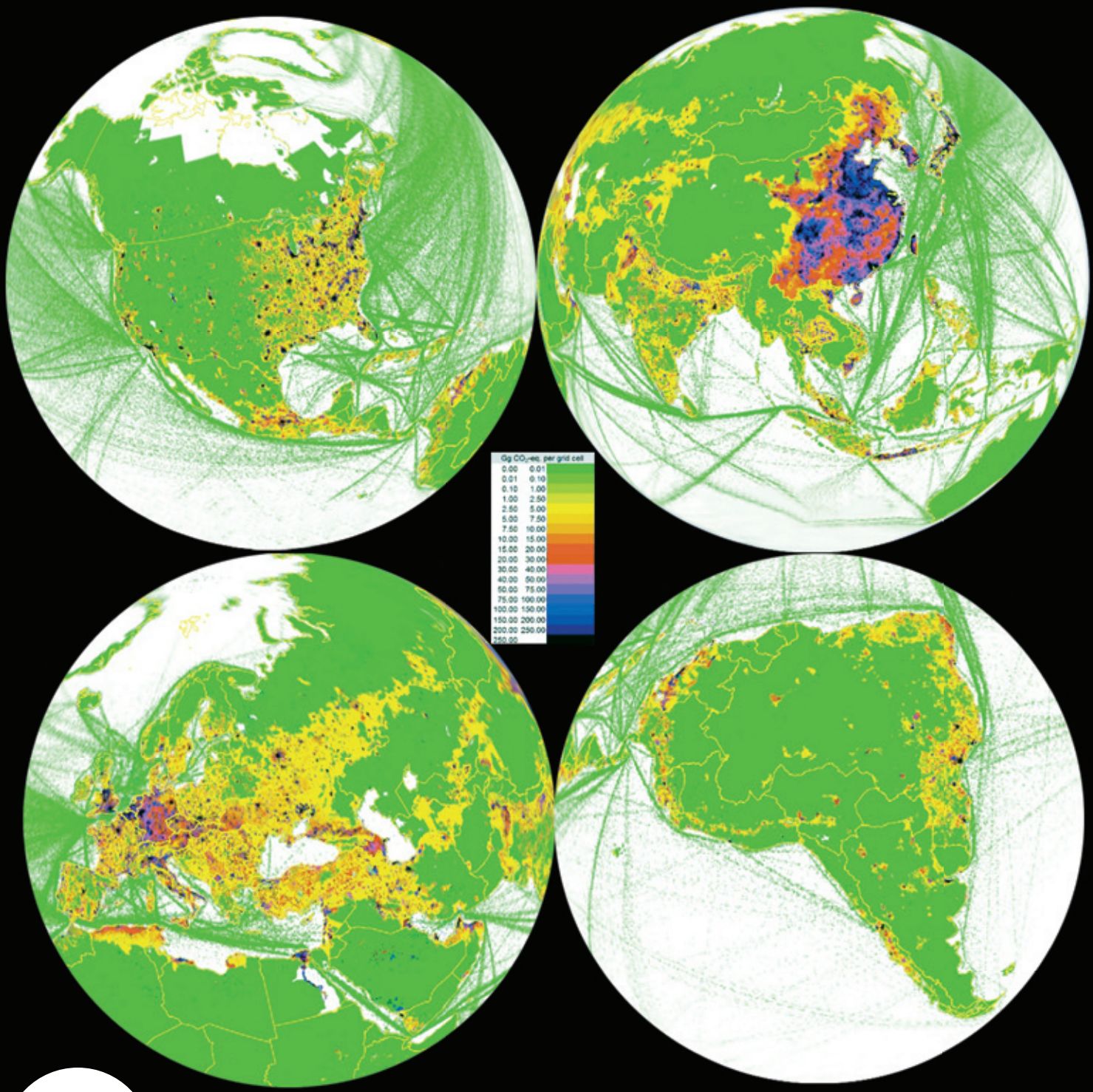
Source: EIA/Ezra Clark



ENDNOTES

1. See Kyoto Protocol to the United Nations Framework Convention on Climate Change ("UNFCCC"), opened for signature March 16, 1998, U.N. Doc FCCC/CP/1997/7/ Add.1, 37 I.L.M. 22 (1998) at Annex A (omitting ODSs from regulation)
2. See UNEP, Technology and Economic Assessment Panel, Supplement to the IPCC/TEAP Report at x (2005), available at http://ozone.unep.org/teap/Reports/TEAP_Reports/teap-supplement-ippc-teap-report-nov2005.pdf (hereinafter TEAP Supplement).
3. See Intergovernmental Panel on Climate Change, IPCC/ TEAP Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons 9, 43-44 (2005) note, at 9 (giving estimates of CFC and HCFC banks from 2002-2015).
4. Montreal protocol Decision XIX/6
5. TEAP (2009) "Task Force Decision XX/8 Report" Data derived from Annex 5 Table A5-5
6. TEAP (2009) "Task Force Decision XX/8 Report" Data derived from Annex 4
7. TEAP (2009) "Task Force Decision XX/8 Report" Data derived from Annex 3 Table A3-4
8. Information from Unilever Foods UK. (December 2008)
9. http://www.unilever.co.uk/sustainability/casestudies/ climate-change/new-ice-cream-cabinets-cut-impact-on-climate-change.aspx
10. Information given from Tesco to EIA (2009)
11. Environmental Investigation Agency (2010) Chilling Facts II: The Supermarket Refrigeration Scandal continues
12. Building Services Research and Information Association (2009) World Air Conditioning Report 50570/A. and Building Services Research and Information Association (2008) Minisplits China Report 6608001/2B
13. Personnel communication, GTZ Proklima, Eschborn, May 2010
14. GTZ-prokilma International presentation at the Joint West Asia and South Asia Network Meeting, May 2009 http://gtz.de/de/dokumente/en-gree-ac-unit-hydrocarbons.pdf
15. Benson UK pricelist 2009
16. Multilateral Fund Secretariat (2009) "Further Elaboration and Analysis of Issue Pertaining to the Phase-out of HCFC production Sector (Decision 56/64(a) and (b))" UNEP/OzL. Pro/ExCom/57/61
17. Building Services Research and Information Association (2009) World Air Conditioning Report 50570/A. Data derived from Table D1.
18. (Personal communications; Earthcare, GTZ Proklima, May 2010)
19. Ozone Secretariat Data reporting, HCFC consumption in Article 5 countries.
20. See, http://en.wikipedia.org/wiki/Global_warming_potential
21. S.A. Montzka, L. Kuijpers, M.O. Battle, M. Aydin, K. Verhulst, E.S. Saltzman, D.W. Fahey, Recent increases in global HFC-23 emissions, *Geophysical Research Letters*, December 2009.
22. Miler, et al.2010, in review at ACPD, http://www.atmos-chem-phys-discuss.net/papers_in_open_discussion.html, HFC-23 Emissions Trend response to HCFC-22 Production and Recent HFC-23 Abatement Measures, June 2010
23. www.uneprisoe.org CDM Pipeline overview accessed 25th May 2010
24. Id, 22
25. Id, 22
26. Id. 22
27. Id. 22
28. Based on the 3% HFC-23/HCFC-22 ratio used by the CDM
29. One tonne of HCFC-22 has a market price of $US1000-2000. One tonne of HCFC-22 will produce around 0.03 tonnes of HFC-23 (based on the 3% ratio used in the CDM) which represents 444 CO_2**e** tonnes and therefore 444 CERs. At today's market price this is worth $5,772, as much as five times higher than the value of the HCFC-22
30. Personal communications with Honeywell, et al. estimating cost per incinerator of $7 million US.
31. Based on actual destruction costs of $0.20 US/$CO_2$**e** tonne for the 2006-2008 11.2 Gg average annual HFC-23 emissions.
32. Velders, et al., PNAS, 2009.

GHG EMISSIONS FROM PRODUCTION OF GOODS AND ENERGY.



GHG emissions at local levels from 1970-2005 and by main emission sources in the year 2005. The shown grid size is a tenth of a geographical degree of latitude by the same extension in longitude, or simplified, a circa 10 km x 10 km square, roughly the size of central Paris. Data used in the visualization come from the Joint Research Center JRC and the Netherlands Environmental Assessment Agency´s (PBL) Emission Database for Global Research (EDGAR), and its dataset released in May 2009 (EDGAR v4.0). http://edgar.jrc.ec.europa.eu/index.php

Data: SIO, NOAA, U.S. Navy, NGA, NEBCO
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