27th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer

Dubai, United Arab Emirates, 1-5 November 2015

# SOLVING THE GLOBAL CLIMATE CRISIS:

## Taking the first step with a Dubai Amendment on HFCs



environmental investigation agency

## ABOUT EIA

EIA is an independent campaigning organisation committed to bringing about change that protects the natural world from environmental crime and abuse. As part of our work, we have undertaken groundbreaking investigations into the illegal trade in ozone depleting substances (ODS) and have been closely involved in the international ozone and climate negotiations for well over a decade.

## ACKNOWLEDGEMENTS

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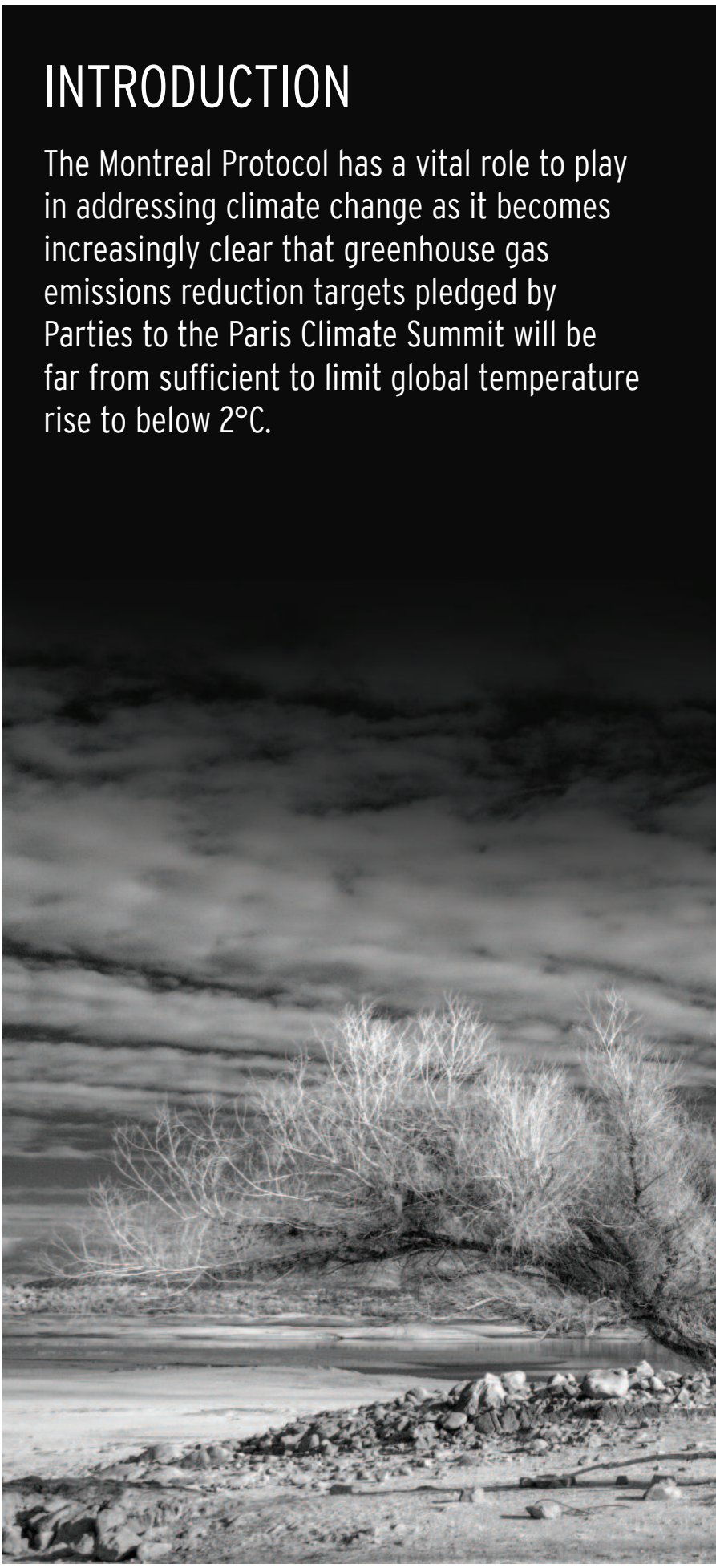
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Healing our ozone together

EIA congratulates the ozone family on the occasion of the 30th anniversary of the Vienna Convention for the Protection of the Ozone Layer.

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# INTRODUCTION

The Montreal Protocol has a vital role to play in addressing climate change as it becomes increasingly clear that greenhouse gas emissions reduction targets pledged by Parties to the Paris Climate Summit will be far from sufficient to limit global temperature rise to below 2°C.



In the build up to the 21st Conference of the Parties (CoP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015, the Montreal Protocol can provide critical momentum for the climate negotiations by reaching agreement in Dubai this November to regulate the production and consumption of hydrofluorocarbons (HFCs).

HFCs are included among the seven greenhouse gases (GHGs) targeted by the UNFCCC but are primarily used as replacements for ozone-depleting substances (ODS) controlled under the Montreal Protocol. Despite their ostensible regulation under the Kyoto Protocol, over the past 25 years HFC emissions have grown from almost non-existent to nearly two per cent of all GHGs. Emissions of HFCs continue to grow faster than any other GHG and their growth is predicted to accelerate in the future.[1]

HFCs were introduced as non-ozone depleting alternatives to chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) and it is therefore the responsibility of the Montreal Protocol to address their growing contribution to climate change. The Montreal Protocol is already arguably the most successful climate agreement in history, having phased out CFCs resulting in emission reductions far outweighing those achieved by the Kyoto Protocol. If an ambitious amendment is adopted swiftly, it could prevent the consumption of more than 100 billion tonnes of carbon dioxide-equivalent ($CO_2e$) HFCs by 2050.[2]

At the 27th Meeting of the Parties (MoP), Parties have four amendment proposals to consider, offering a diverse range of options to phase down the production and consumption of HFCs.[3] These proposals build on previous proposals and numerous declarations from the Parties urging action on HFCs under the Montreal Protocol.[4]

The revised report from the Technical and Economic Assessment Panel (TEAP)[5] provides a stark warning that delaying conversion to climate friendly alternatives to HFCs in developing countries, even by a few years, will significantly increase both the climate impact of HFCs and the eventual cost to the Parties of tackling the HFC problem due to high growth rates in the refrigeration and air-conditioning sectors. It is also clear that there are no technical barriers to taking early action, with a multitude of viable, cost-effective and energy-efficient alternatives to almost all current HFC uses.

EIA therefore urges all Parties to agree an amendment at the 27th MoP in Dubai which mandates concrete ambitious HFC production and consumption reductions in non-Article 5 Parties and incentivises early action by Article 5 Parties to curtail HFC growth.



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## HFC AMENDMENT PROPOSALS

Four HFC amendment proposals have been submitted by: Canada, Mexico and the United States ("NA proposal"); Kiribati, Marshall Islands, Mauritius, the Federated States of Micronesia, Palau, Philippines, Samoa and Solomon Islands ("Island States proposal"); the European Union ("EU proposal"); and India ("India proposal").

EIA has compared these proposals using HFC consumption data for the refrigeration and air-conditioning (RAC) sector from the September 2015 TEAP report *Decision XXVI/9 Update Task Force Report – Additional Information on Alternatives to Ozone-Depleting Substances*[6] and HCFC consumption data (to calculate baselines) from the Ozone Secretariat website.[7] HFC consumption data for the foam sector, which represents a small percentage of global HFC consumption, is taken from the October 2014 TEAP report *Decision XXV/5 Task Force Report - Additional Information on Alternatives to ODS (Final Report)*, assuming the most ambitious mitigation scenario (MIT-2).[8]

TEAP investigates three mitigation scenarios for the RAC sector:

- **MIT-3:** Bans on the use of high-GWP chemicals enter into force in new manufacturing as of 2020, with an average GWP of replacement refrigerants of 300 for both refrigeration and stationary air-conditioning sectors;
- **MIT-4:** The same as MIT-3 with the exception that manufacturing conversion of stationary air-conditioning is delayed to 2025;
- **MIT-5:** The same as MIT-3 with the exception that manufacturing conversion of all RAC sub-sectors is delayed to 2025.

TEAP also considers manufacturing conversion periods: in non-Article 5 (non-A5) Parties, a three-year conversion period is assumed to take place prior to the 2020 ban on high-GWP refrigerants, whereas for A5 Parties TEAP assumes a six-year conversion period taking place after controls begin.

"Parties must therefore seek to insert ambition into the proposals for non-A5 Parties."



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### Non-A5 Parties must demonstrate climate ambition

HFCs are recognised as one of the 'low hanging fruits' of climate mitigation and, given the short atmospheric life of most HFCs, rapid early action will have a much needed impact on near-term climate change. Many non-A5 and A5 Parties are already taking steps to address them.

For example, in 2014, the EU adopted an HFC phase-down through the EU F-Gas Regulation, which will achieve a 79 per cent reduction in HFC consumption by 2030 from current levels.[9] The phase-down approach is also being considered by Australia,[10] while Canada is considering a combined approach of phase-down alongside prohibitions on specific HFC-containing products including RAC equipment.[11]

Japan and the US are taking a different approach. In Japan, starting in 2015, phase-down plans for different sectors will be developed founded on target GWP values based on the lowest GWP among the products in the market, taking into consideration safety, energy efficiency, affordability and other considerations. The first GWP target for room air-conditioning products is GWP 750 by 2018.[12] The US has listed various HFCs and HFC-containing blends as unacceptable under its SNAP program in various end-uses in the aerosols, foam blowing, and RAC sectors. For example, HFC-404A (GWP 3,922), widely used in refrigeration, will be prohibited in retrofit supermarket systems, condensing and stand-alone units starting July 2016; in new supermarket units starting January 2017; and in new remote condensing units starting January 2018.[13]

Several other countries, including Denmark, Norway, Poland and Slovenia, have imposed HFC taxes, which have proved effective in reducing HFC consumption.[14]

Given this progress, it is surprising that the proposed non-A5 schedules do not demonstrate more ambition. All four proposals fall far short of the TEAP MIT-3 scenario, which also aligns with the HFC phase-down that is already being implemented in the 28 Member States of the EU (see Figure 1). Parties must therefore seek to insert ambition into the proposals for non-A5 Parties by lowering the baseline and establishing more stringent reductions in the early years.

**FIGURE 1:** HFC CONSUMPTION IN NON-A5 PARTIES IN THE PROPOSED AMENDMENTS TO THE MONTREAL PROTOCOL, COMPARED WITH TEAP'S MIT-3 SCENARIO AND THE 2014 EU F-GAS REGULATION

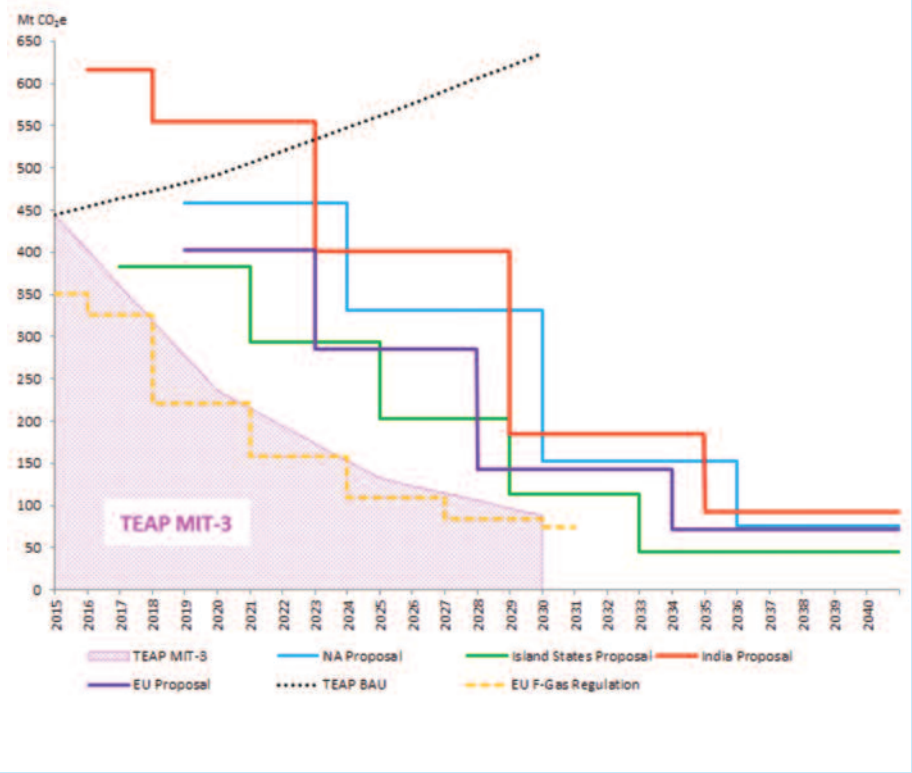



**TABLE 1:** BASIC ELEMENTS OF THE NON-A5 AMENDMENT PROPOSALS AND THE EU F-GAS REGULATION WITH CALCULATED BASELINE AND POTENTIAL HFC CONSUMPTION REDUCTIONS[15]

| PROPOSAL | ISLAND STATES | NORTH AMERICA | EUROPEAN UNION | INDIA | EUROPEAN UNION F-GAS REGULATION |
|---|---|---|---|---|---|
| **Baseline** | 100% HFC (2011-2013) + 10% of the HCFC baseline | 100% HFC (2011-2013) + 75% HCFC (2011-2013) | 100% HFC (2009-2012) + 45% "Allowable" HCFC (2009-2012) | 100% HFC (2013-2015) + 25% HCFC (2013-2015) | 100% HFC (2009-2012) |
| **Calculated Baseline** | 451 Mt $CO_2e$ | 509 Mt $CO_2e$ | 474 Mt $CO_2e$ | 617 Mt $CO_2e$ | 351 Mt $CO_2e$ |
| **Reduction Schedule** | 2017 – 85%<br>2021 – 65%<br>2025 – 45%<br>2029 – 25%<br>2033 – 10% | 2019 – 90%<br>2024 – 65%<br>2030 – 30%<br>2036 – 15% | 2019 – 85%<br>2023 – 60%<br>2028 – 30%<br>2034 – 15% | 2016 – 100%<br>2018 – 90%<br>2023 – 65%<br>2029 – 30%<br>2035 – 15% | 2015 – 100%<br>2016 – 93%<br>2018 – 63%<br>2021 – 45%<br>2024 – 31%<br>2027 – 24%<br>2030 – 21% |
| **Cumulative Consumption Reductions 2015-2030 (HFC-23 Excluded)** | 3,863 Mt $CO_2e$ | 2,245 Mt $CO_2e$ | 3,210 Mt $CO_2e$ | 1,898 Mt $CO_2e$ | N/A |

"Since A5 Parties are still primarily relying on HCFCs, there is a time-limited opportunity for them to 'leapfrog' dead-end HFC technologies."

## Proposals for A5 Parties must encourage leapfrogging where possible

TEAP estimates almost 300 per cent growth in demand for high-GWP HFCs in A5 Parties during 2015-30.[16] Since A5 Parties are still primarily relying on HCFCs, there is a time-limited opportunity for them to 'leapfrog' dead-end HFC technologies and undertake a one-time transition from HCFCs to low-GWP alternatives, i.e. those with GWP 150 or less.

The MIT-3 scenario may appear challenging, but it is achievable with a large-scale transition to currently available low-GWP technologies in new equipment. Figure 2 compares the current proposals for A5 Parties against the MIT-3 scenario. All four proposals are achievable under the MIT-3 scenario as far as 2030 (the date to which TEAP modelled MIT-3), with the NA proposal most closely approximating feasible ambition.

## Baselines

According to EIA's calculations, the baselines in the four proposals range from 757 Mt $CO_2e$ in the NA proposal to 2,233 Mt $CO_2e$ in the India proposal, an almost three-fold increase in HFC consumption. Current (2015) HFC consumption is estimated by TEAP to be 548 Mt $CO_2e$.[18]

The year and level of the baseline are critically important for ensuring a smooth and effective phase-down. EIA believes Parties should set baselines near to the year of the agreement, rather than relying on historical or future baselines. This allows for accurate data gathering, avoiding problems with historical baselines while also avoiding unnecessary growth up to the baseline, which would occur with a baseline set far into the future, as in the India Proposal.

## Grace periods

The four proposals contain large variations in the grace period offered to A5 Parties, ranging from two to 15 years. Given the proliferation of low-GWP technologies, A5 Parties are in the position to leapfrog directly to low-GWP technologies such as natural refrigerants in almost all sectors and much of this can be achieved through adequate funding of HCFC phase-out management plans (HPMPs). A short grace period will assist A5 Parties to capitalise on this opportunity rather than making a transition from HCFCs to high-GWP HFCs and then embarking on a second costly transition further down the road. This is particularly important in the air-conditioning sector, where a transition to HFC-410A will increase both direct emissions due to the higher GWP of HFC-410A and indirect emissions through energy efficiency penalties.

**FIGURE 2:** HFC CONSUMPTION IN A5 PARTIES IN THE PROPOSED HFC AMENDMENTS TO THE MONTREAL PROTOCOL COMPARED TO TEAP'S MIT-3 SCENARIO

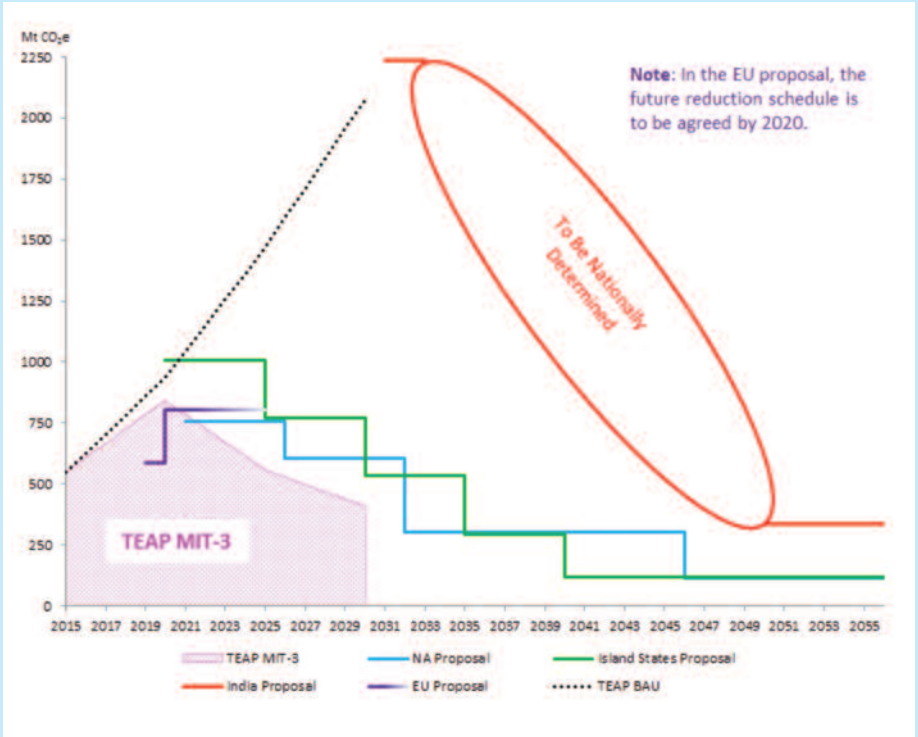


**TABLE 2:** BASIC ELEMENTS OF THE A5 AMENDMENT PROPOSALS WITH CALCULATED BASELINE AND POTENTIAL HFC CONSUMPTION REDUCTIONS[17]

| PROPOSAL | ISLAND STATES | NORTH AMERICA | EUROPEAN UNION | INDIA |
|---|---|---|---|---|
| **Baseline** | 100% HFC (2015-2017) + 65% HCFC (Baseline) | 100% HFC (2011-2013) + 75% HCFC (2011-2013) | 100% HFC (2015-16) + 100% HCFCs (2015-16) | 100% HFC (2028-2030) + 32.5% HCFC (2028-2030) |
| **Calculated Baseline** | 1,184 Mt $CO_2e$ | 757 Mt $CO_2e$ | 1,360 Mt $CO_2e$ (note this allowance for HCFC consumption) | 2,233 Mt $CO_2e$ |
| **Reduction Schedule** | 2020 – 85%<br>2025 – 65%<br>2030 – 45%<br>2035 – 25%<br>2040 – 10% | 2021 – 100%<br>2026 – 80%<br>2032 – 40%<br>2046 – 15% | Freeze of combined HCFC and HFC $CO_2e$ consumption in 2019<br>Reduction schedule to be negotiated by 2020 | 2031 – 100%<br>Nationally Determined Reduction Schedule<br>2050 – 15% |
| **Cumulative Consumption Reductions 2015-2030 (HFC-23 Excluded)** | 7,045 Mt $CO_2e$ | 8,641 Mt $CO_2e$ | 5,890 Mt $CO_2e$ | No reductions before 2030 |

TEAP's data shows clearly that the climate impact and costs are considerably increased if manufacturing conversion is delayed for just five years *(see section on finance)*. This underscores the climate and financial benefits of early action.

## Reduction steps

The Island States and NA proposals put forward a freeze and reduction schedule with steps that are clearly achievable under the MIT-3 scenario.

India proposes a late freeze in 2031, which actually exceeds the consumption predicted in a business-as-usual (BAU) scenario. India also proposes that reduction steps should be nationally determined by A5 Parties five years in advance of each five-year period. EIA does not support nationally determined steps as it would add considerable complexity for the implementation of the phase-down under the existing Multilateral Fund (MLF) system and uncertainty in terms of future consumption reductions and costs. Substantial flexibility on a national level already exists under the process of national HPMPs.

The European Union advances a different approach for A5 Parties, a variation of the tried and tested 'start and strengthen' approach of the Montreal Protocol, which seeks to limit the growth of HFC consumption in A5 Parties and ensure the impact of the HCFC phase-out is at least climate neutral in the near term. The EU proposes a freeze of combined HFC and HCFC consumption, on a $CO_2e$ basis, while maintaining the existing HCFC phase-out schedule. This means that, until a reduction schedule is in place, as HCFCs are phased out an equivalent amount of HFC consumption (on a $CO_2e$ basis) is allowed. Parties can increase their allowable HFC $CO_2e$ consumption through accelerating the HCFC phase-out and through transitioning to alternatives with a lower GWP than the HCFCs they replace. The EU proposes to negotiate a reduction schedule by 2020.

## End point

The NA and India proposals envisage a phase-down to 15 per cent of baseline, while the Island States propose 10 per cent. The EU proposal includes a final step for HFC production of 15 per cent in 2040 but does not include a final step for HFC consumption under the HFC-HCFC basket. The reason for this is unclear, given that in 2040 the HFC/HCFC basket will comprise exclusively HFC consumption (as the HCFC phase-out will be complete). For practical purposes it makes sense to match the final step for HFC production to allowable consumption.

"TEAP's data shows clearly that the climate impact and costs are considerably increased if manufacturing conversion is delayed for just five years."

## CONTROLLED SUBSTANCES

### HFC-23 by-product destruction

It is well known that the production of HCFC-22 results in the by-production of HFC-23 (GWP 14,800). It is less well known that HCFC-22 is a feedstock for the production of HFC-1234yf, HFC-32 and HFC-125,[19] which are key components in 38 of the 40 HFC blends identified by TEAP in its latest report.[20] This includes many of the HFC blends being offered as 'solutions' to high-GWP HFCs, such as the Opteon line of HFC blends being marketed by Chemours (formerly DuPont).[21] Feedstock uses of HCFCs have grown from around 284,000 tonnes in 2003 to more than 686,000 tonnes in 2013.[22]

Three of the amendment proposals (EU, Island States and NA) contain provisions requiring HFC-23 by-product destruction. These provisions alone will prevent at least 12.6 Gt $CO_2e$ of HFC-23 emissions through 2050, making it one of the most cost-effective mitigation measures.[23]

**BELOW:**
HCFC-22 is a feedstock for a number of HFCs, which in turn are key components of many HFC blends.




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Moreover, because of the Clean Development Mechanism (CDM), many HCFC-22 production facilities are already equipped with destruction technologies, making it even more cost-effective.[24]

India's proposal explicitly rules out control by the Montreal Protocol (although HFC-23 is listed as a "controlled substance" in Annex G), instead suggesting that research should be undertaken to convert HFC-23 into useful products, although no other details are provided.

The ever-growing use of HCFC-22 as feedstock is problematic given the associated HFC-23 by-production and the fact that availability of cheap feedstock HCFC-22 creates opportunities for illegal trade for emissive uses as the HCFC phase-out progresses. EIA is opposed to the continued use of HFC-23, given its incredibly high GWP and the fact that climate-friendly alternatives are available for all current uses of HFC-23. Parties should instead be seeking alternative feedstock options that do not produce such damaging by-products and do not increase the risk of illegal trade in controlled substances.

### Unsaturated HFCs

The NA, EU and India proposals offer an incomplete list of controlled substances, identifying only 19 of the 22 known HFCs.[25] In contrast, the Island States proposal includes unsaturated HFCs, namely HFC-1234yf, HFC-1234ze and HFC-1336mzz. EIA supports the inclusion of so-called "HFOs" as it ensures these chemicals are subject to Article 7 reporting and Article 4B licensing.[26] This is critical to assist with compliance and enforcement of the amendment, in particular since HFC-1234yf and HFC-1234ze are components in 36 of the 40 HFC blends identified by TEAP in its latest report.[27]

In the Montreal Protocol, there are several precedents for excluding a category of chemicals from controls on production and consumption but otherwise listing them as a controlled substance for purposes of Article 7 reporting and Article 4B licensing. For example, ODS feedstocks are controlled substances and are subject to licensing and reporting requirements but are not subject to phase-out controls.[28]
A similar approach was also taken in the EU F-Gas Regulation, where unsaturated HFCs were excluded from the HFC phase-down but included in reporting requirements.[29]



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## EXEMPTIONS

Some Parties have put forward the concepts of exemptions and "exceptional measures" as a response to concerns that low-GWP alternatives to HFCs will not be available in all sectors and for all Parties as needed, particularly countries with high ambient temperature conditions. While both of these concepts have been utilised by the Montreal Protocol, other tools are available to alleviate these concerns and it is not necessary to include such measures within the adopted amendment at this time.[30]

TEAP's most recent reports have made clear that technically proven, environmentally sound and cost-effective low-GWP alternatives to HFCs have been commercialised in most sectors.[31] This contrasts sharply with the lack of available alternatives to CFCs in nearly every sector at the time the Montreal Protocol was agreed in 1987 that led to the inclusion of an exemption process within the CFC phase-out.[32]

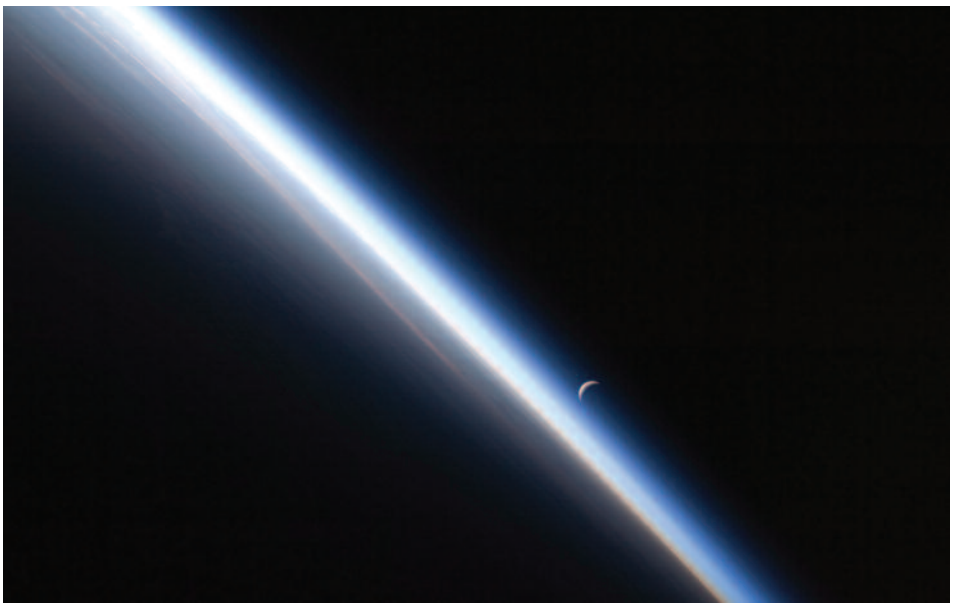
In addition, the proposed control measures for HFCs are a phase-down not a phase-out, with all four proposals anticipating some HFC use indefinitely into the future, varying from 10-15 per cent of the baseline. In practice, this portion of the HFC baseline is a built-in exemption that is larger than the essential-use exemptions relied upon by Parties during the CFC phase-out.[33]

It is also possible for Parties to take a 'wait and see' approach and address the issue of essential-use exemptions as the HFC phase-down progresses, as was done with the accelerated HCFC phase-out agreement.[34] In this way, Parties will not stifle technological progress by relieving the regulatory pressure of the Montreal Protocol, which has almost always resulted in alternatives being made available before the Parties needed to resort to an exemption process.

EIA urges the Parties to adopt an amendment that does not contain essential-use exemptions or exceptional measures at this time but leaves the issue open for discussion in the future.

**ABOVE:**
Arctic sea ice, a habitat vital to the survival of polar bears, is disappearing due to climate change.

"Addressing energy efficiency alongside HFCs would roughly double emissions savings resulting from an HFC phase-down."



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## FINANCE

A5 Parties need to be assured of adequate financing, technology transfer and capacity building to leapfrog to energy efficient low-GWP technologies.

Parties should encourage innovative improvements to the financial mechanism to maximise the climate benefits of an HFC phase-down. Addressing energy efficiency alongside HFCs would roughly double emissions savings resulting from an HFC phase-down.[35] The Green Cooling Initiative estimates the RAC sector will account for 13 per cent of global GHG emissions by 2030, primarily (over 70 per cent) due to energy consumption.[36]

Any amendment should also be able to accommodate the desire of A5 Parties to achieve a transition to low-GWP alternatives in a single step through the HCFC phase-out by leapfrogging HFCs and transitioning to no- and low-GWP alternatives. This decreases the financial assistance through MLF required of donor countries in the long term while providing much-needed additional climate mitigation in the short term.

TEAP's September 2015 report demonstrates that a five-year delay will result in a "huge increase" in costs. For manufacturing conversion, costs increase from around $2.3 billion under MIT-3, which starts in 2020, to around $3.2 billion under MIT-5, which starts in 2025 (see Table 3).[37] Approximately 75 per cent of this increase is from stationary air-conditioning, underscoring the importance of early conversion to low-GWP technologies in this sector.[38] For servicing, the five-year delay results in costs that are "much higher … in particular after 2025 until somewhere in the 2030s."[39] When spread out over four triennia, servicing costs increase from $40-60 million per triennium under MIT-3 to $100-150 million per triennium under MIT-5.[40]

The conclusion in the latest TEAP report is unambiguous: starting A5 manufacturing conversion by 2020, particularly in the stationary air-conditioning sector, will reduce costs by over $1.2 billion compared to a five-year delay.

**TABLE 3:** ESTIMATED TOTAL MANUFACTURING CONVERSION AND SERVICING COSTS IN A5 PARTIES UNDER TEAP SCENARIOS MIT-3 AND MIT-5

| TYPE | CONVERSION COSTS (US$ millions) | | |
|---|---|---|---|
| | MIT-3 | MIT-5 | Difference |
| MANUFACTURING CONVERSION | 2,300 ± 310 | 3,220 ± 430 | 920 |
| SERVICING SECTOR | 160 - 240 | 400 - 600 | 300 |
| **TOTAL** | **2,500 ± 350** | **3,720 ± 530** | **1,220** |

# CONCLUSIONS & RECOMMENDATIONS

The 27th Meeting in Dubai is a chance for the Parties to the Montreal Protocol to demonstrate that governments around the world have the political will to take bold action to avert a climate catastrophe. A global agreement under the Montreal Protocol to address HFCs could prevent the consumption of more than 100 billion tonnes of $CO_2e$ HFCs by 2050. This would achieve significant near-term climate change mitigation and potentially catalyse far-reaching action at the Paris Climate Conference. EIA offers the following recommendations in consideration of the amendment proposals submitted to the 27th MoP.

## PROPOSALS FOR NON-A5 PARTIES:

- Parties should demonstrate leadership through an ambitious non-A5 reduction schedule for HFCs in line with TEAP's MIT-3, starting within two years of an agreement under the Montreal Protocol
- All non-A5 Parties should take immediate unilateral steps to address HFCs and demonstrate the efficacy of low-GWP HFC-free technologies, particularly in the refrigeration and air-conditioning sectors
- Non-A5 Parties should commit to expanding financing, technology transfer and capacity building to enable A5 Parties to maximise one time transitions from HCFCs to low-GWP technologies

## PROPOSALS FOR A5 PARTIES:

- Parties should avoid setting the baseline too high or too far into the future to avoid encouraging unnecessary HFC growth in advance of the reduction schedule
- The grace period for A5 Parties should be short in order to promote leapfrogging of HFCs to low-GWP technologies
- The baseline and phase-down steps should closely align with TEAP's MIT-3 scenario, which relies on low-GWP technologies identified by TEAP as available for use and is validated through its close relation to the EU F-Gas Regulation phase-down
- The HFC phase-down steps should be aligned with the accelerated HCFC phase-out steps (i.e. in 2020, 2025 and 2030) in order to allow a coordinated sectoral approach under the MLF and to maximise leapfrogging
- If a two-stage process is considered (e.g. as in the EU proposal), a clear timeline and the criteria upon which the phase-down schedule will be based should be established at the first stage
- HFC consumption should be phased down in line with HFC production to avoid creating opportunities for illegal trade in HFCs

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# REFERENCES


1. Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment Report: Climate Change 2013 - The Physical Science Basis, (2013) at Ch. 8.3.2.4.2, available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf.
2. The NA Proposal estimates that, if adopted by the Parties, it would reduce or avoid 90 – 111.5 Gt CO2-e emissions from BAU by 2050.
3. All four proposals are available at: http://conf.montreal-protocol.org/meeting/mop/mop-27/presession/SitePages/Home.aspx
4. The first amendment proposal to control HFC production and consumption under the Montreal Protocol was submitted by Micronesia (Federated States of) and Mauritius in 2009. From 2009-11, a growing number of Parties signed declarations in support of regulating HFCs under the Montreal Protocol. See e.g. Report of the 23rd Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Bali Declaration on Transitioning to Low Global Warming Potential Alternatives to Ozone Depleting Substances, (25 Nov. 2011) (signed by 105 Parties), available at: http://conf.montreal-protocol.org/meeting/mop/23mop/report/English/MOP-23-11-COP-9-7E.pdf
5. TEAP (2015). Decision XXVI/9 Update Task Force Report. Additional Information on Alternatives to Ozone-Depleting Substances. Hereafter referred to as TEAP (2015). Available at: http://conf.montreal-protocol.org/meeting/mop/mop-27/presession/SitePages/Home.aspx
6. TEAP (2015).
7. See Ozone Secretariat, Data Reporting, available at: http://ozone.unep.org/en/data_reporting.php and Pers. Comm. Ozone Secretariat.
8. TEAP (2014). Decision XXV/5 Task Force Report: Additional Information to Alternatives on ODS (Final Report) pp33, 40, 55, 63. Available at: http://conf.montreal-protocol.org/meeting/mop/cop10-mop26/presession/SitePages/Home.aspx
9. See http://ec.europa.eu/clima/policies/f-gas/legislation/index_en.htm
10. http://carbon-pulse.com/australia-proposes-quota-system-to-phase-down-hfc-emissions/
11. See p6 of UNEP/OzL.Pro.27/11 Updated summary of the information submitted by parties on their implementation of paragraph 9 of decision XIX/6 to promote a transition from ozone-depleting substances that minimizes environmental impact (decision XXV/5, paragraph 3) available at http://conf.montreal-protocol.org/meeting/mop/mop-27/presession/English/MOP-27-11E.pdf
12. See p7 of UNEP/OzL.Pro.27/11 ibid
13. See final rule available at http://www.gpo.gov/fdsys/pkg/FR-2015-07-20/pdf/2015-17066.pdf
14. Shecco (2013) Guide: HFC taxes & fiscal incentives for natural refrigerants in Europe, and p16 UNEP/OzL.Pro.27/11
15. Baselines and consumption reductions were calculated based on best available data HFCs in RAC sector TEAP (2015), foam sector TEAP (2014) and HCFC data from the Ozone Secretariat (see Ref 6)
16. TEAP (2015), p4.
17. Baselines and consumption reductions were calculated based on best available data HFCs in RAC sector (TEAP 2015, see Ref 5), foam sector (TEAP 2014, see Ref 7) and HCFC data from the Ozone Secretariat (see Ref 6)
18. BAU data from TEAP (2015) for RAC sector & TEAP (2014) for foams
19. E.g Touchdown Consulting, Feedstock Uses of ODS: Information Paper on Feedstock Uses of Ozone-Depleting Substances (December 2012), pp. 25 and 57 (HCFC-22 is a feedstock of HFC-32); United Kingdom Department of Energy and Climate Change, UK Greenhouse Gas Inventory 1990 to 2012: Annual Report for Submission under the Framework Convention on Climate Change (NIR) (April 2014), pp. 315-316 (HFC-23 emitted during the production of HFC-125 due to impurities in the feedstock); U.S Patent Application No. 2014/0343331 A1, Process to Manufacture 2-Chloro-1,1,1,2-Tetrafluoropropoane (HCFC-244bb) (published on 20 November 2014), p. 6 (HCFC-22 is a potential feedstock for HCFC-244bb); U.S. Patent Application No. 2010/00036179 A1, Process to Manufacture 2-chloro-1,1,1,2,-tetrafluoropropane (HCFC-244bb) (published 11 February 2010), ("HCFC-244bb is an intermediate in the production of 2,3,3,3-tetrafluoropropene-1 (HFO-1234yf)") p. 1.
20. TEAP (2015), pp. 18-19.
21. Compare TEAP (2015), pp. 18-19 with DuPont, Opteon Refrigerants (undated), p3 available at https://www.chemours.com/Refrigerants/en_US/assets/downloads/k26492_Opteon_refrigerants.pdf
22. UNEP/OzL.Pro/ImpCom/55/2 Information provided by parties in accordance with Articles 7 and 9 of the Montreal Protocol on Substances that Deplete the Ozone Layer, p66
23. United Nations Environment Programme, Proposed Amendment to the Montreal Protocol Submitted by Canada, Mexico and the United States of America (April 30, 2015), OzL.Pro.WG1/36/3, p5.
24. Environmental Investigation Agency, Two Billion Tonne Climate Bomb: How to Defuse the HFC-23 Problem (June 2013), available at https://eia-international.org/wp-content/uploads/EIA_HFC-23_report_0613_Final.pdf
25. United Nations Environment Programme, Proposed Amendment to the Montreal Protocol Submitted by Canada, Mexico and the United States of America (April 30, 2015), OzL.Pro.WG1/36/3, p. 10 (Annex F); United Nations Environment Programme, Proposed Amendment to the Montreal Protocol Submitted by the European Union and its Member States (April 30, 2015), OzL.Pro.WG1/36/5, p. 15 (Annex F); United Nations Environment Programme, Proposed Amendment to the Montreal Protocol Submitted by India (April 30, 2015), OzL.Pro.WG1/36/4, p. 9 (Annex F).
26. Montreal Protocol Decision VII/30.
27. Technology and Economic Assessment Panel (TEAP), Decision XXVI/9 Update Task Force Report: Additional Information to Alternatives on ODS (September 2015), pp. 18-19.
28. Montreal Protocol on Substances that Deplete the Ozone Layer, Article 1(4); see Decision I/12A (clarification that the definition includes all bulk chemicals and the instances when a controlled substance ceases to be considered a bulk chemical); Decision IV/12(1) (clarification on when insignificant quantities of bulk chemicals will be considered outside the definition of controlled substance); see also Decisions I/12B, IV/12A, VII/30 and IX/28
29. Regulation (EU) No 517/2014, Articles 2(2) and 15 (scope of the HFC phase-down does not include unsaturated HFCs) with Regulation (EU) No 517/2014, Articles 2(1) and 19 (scope of reporting includes unsaturated HFCs).
30. UNEP Ozone Secretariat, Montreal Protocol provisions and experience addressing policy-related challenges (June 2015) (providing a brief history of the use of Essential Use Exemptions and other exceptional measures under the Montreal Protocol), available at: http://conf.montreal-protocol.org/meeting/oewg/oewg-36/presession/SitePages/Home.aspx
31. TEAP October 2014 Report; TEAP June 2015 Report.
32. K.M. Sarma & S.O. Andersen, Protecting the Ozone Layer: The United Nations History (UNEP 2002), pp.98, 187-233, 381-90 (reviewing the state of alternatives to CFCs at the time the Montreal Protocol was signed in 1987); E. Parson, Protecting the Ozone Layer: Science and Strategy (Oxford Univ. Press 2003), pp. 173-96 (same); R.E. Benedick, Ozone Diplomacy: New Directions in Safeguarding the Planet (2d. ed. Harvard Univ. Press 1998), pp. 16-17. 98-135 (same).
33. Essential-Use Exemptions for CFCs have been largely limited to meter-dosed inhalers (MDIs) which comprise only a fraction of global CFC consumption across all sectors. See TEAP, Volume 1 Progress Report (June 2015) at pp. 22 – 27 (review the history and current status of Essential-Use Exemptions for MDIs), available at: http://conf.montreal-protocol.org/meeting/oewg/oewg-36/presession/SitePages/Home.aspx; see also UNEP Ozone Secretariat, Essential-Use Information – Submissions By Parties (up-to-date) (data detailing the history of exemptions across all sectors and chemicals regulated by the Montreal Protocol), available at: http://ozone.unep.org/en/essential-use-information-submissions-parties
34. Report of the 19th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Decision XIX/6 – Adjustments to the Montreal Protocol with regard to Annex C, Group I, substances (hydrochlorofluorocarbons) (September 2007) at ¶12 ("To agree to address the possibilities or need for essential use exemptions, no later than 2015 where this relates to Article 2 Parties, and no later than 2020 where this relates to Article 5 Parties").
35. Nihar Shah *et al.*, Energy Efficiency Benefits in Implementing Low Global Warming Potential Refrigerants in Air Conditioning (some preliminary results), (presented in April 2015 at the 35th OEWG in Bangkok, Thailand), at Slide 15, available at: http://conf.montreal-protocol.org/meeting/oewg/oewg-35/pubs/Observer%20Publications/The%20Efficiency%20Opportunity%20Presentation.pdf
36. See https://www.giz.de/expertise/downloads/giz2015-en-rac-sector-indcs.pdf
37. TEAP (2015) p. 64.
38. TEAP (2015) p. 65 (Table 6-16 comparing MIT-3, MIT-4 and MIT-5).
39. TEAP (2015) p. 65.
40. TEAP (2015) p. 65.





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