

# Christian Aid briefing on hydrofluorocarbon (HFC) emissions

Achieving an ambitious outcome from the phase down of HFCs under the Montreal Protocol on Substances that Deplete the Ozone Layer

## Background

**Why is there a need to reduce short-lived climate pollutants (SLCPs) and hydrofluorocarbons (HFCs), and what is the potential for reducing emissions and avoiding global warming?**

In December 2015, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed to an ambitious goal of limiting global warming to well below 2°C, while pursuing efforts to keep temperature increases below 1.5°C. To achieve this goal, Parties must make the most of major opportunities to impact temperature trajectories. It is therefore essential to complement ambitious mitigation of carbon dioxide emissions (CO<sub>2</sub>) with swift action to reduce the other pollutants that are responsible for approximately 40-45% of global warming.<sup>1</sup>

These other pollutants, which include black carbon, methane, tropospheric ozone and HFCs, are described as 'short-lived climate pollutants' because their atmospheric lifetimes are many years (or decades) shorter than that of CO<sub>2</sub>. This shorter lifespan means that reductions in SLCPs are critical for slowing the rate of climate change, in order to protect vulnerable communities and regions most at risk from near-term impacts, and to avoid reaching tipping points that will lock in greater long-term global warming.

Phasing down HFC emissions is one of the most significant international opportunities to stall global warming in the first half of the 21<sup>st</sup> century. While HFCs have only caused about 1% of global warming since factory production began in 1990, the current

rate of production, consumption and emissions is increasing by 10-15% per year.<sup>2</sup> At this rate, doubling occurs every five to seven years.

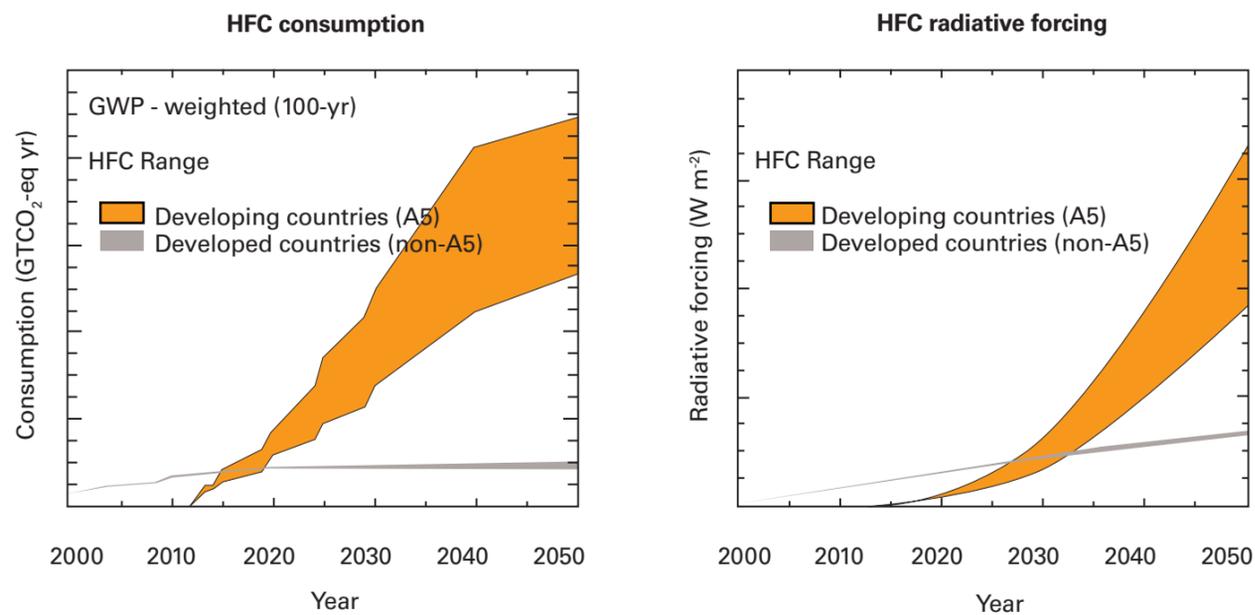
HFCs and other fluorinated gases are now, combined, the fastest-growing greenhouse gas in a number of countries with significant climate emissions, including the US, EU, Australia, China and India.<sup>3</sup> Developed countries have contributed the majority of global HFC emissions to date, but emissions from developing countries are beginning to represent a larger portion of total HFC emissions, due to rising temperatures, incomes, and consumption patterns. Figure 1, overleaf, shows the anticipated growth in HFCs if current trends continue. This continued growth would add up to 0.1°C to the global average temperature rise by mid-century, and 0.5°C by 2100.<sup>4</sup>

Experts estimate that a fast phase down of HFCs would prevent 100 billion tonnes (Gt) of CO<sub>2</sub>-equivalent emissions (CO<sub>2</sub>e) by 2050<sup>5</sup> and, when coupled with the co-benefits in energy-efficiency improvements for air conditioning, total mitigation could reach up to 200 Gt of CO<sub>2</sub>e by 2050<sup>6</sup> and avoid 0.5°C of warming by 2100.

This significant decrease in global warming translates to reducing impacts on vulnerable countries; for example, a recent study found that mitigating emissions of HFCs and other SLCPs could have significant impacts on sea-level rises (SLR) with the potential to decrease the rate of SLR by 24-50%, and to reduce cumulative SLR by 22-42% by 2100.<sup>7</sup>



**Fig 1: Projected growth in HFCs and climate forcing from emissions<sup>8</sup>**



### What is the solution?

Many countries have already begun to reduce their use of HFCs. Each of the top three global consumers of HFCs – China, the US and the EU – has announced new policies to reduce HFC emissions.

China announced it would strengthen management of HFCs as part of plans to implement energy conservation and emissions reduction targets within its *12<sup>th</sup> Five-Year Plan*.<sup>9</sup> The EU's 'F-Gas Directive' will phase down HFCs by 79% below 2009-2012 levels by 2030.<sup>10</sup> In the US, the Environmental Protection Agency has issued a rule either banning or restricting various high-global warming potential HFCs in specific uses.<sup>11</sup> In addition, its largest state, California, passed a law requiring a 25% reduction in F-gas emissions by 2020, and is in the process of moving forward on a strategy to reduce HFC emissions by 40% by 2030.<sup>12</sup>

At the international level, the *Montreal Protocol on Substances that Deplete the Ozone Layer* provides a ready tool for phasing down global emissions. It is a well-respected international treaty, regarded by many as the most effective international environmental agreement to date. During 25 years of its successful implementation,

the *Montreal Protocol* has been repeatedly strengthened to cover phase out of nearly 100 ozone-depleting substances – and the ozone layer has begun to recover.<sup>13</sup> Because these ozone-destroying chemicals also cause global warming, the *Montreal Protocol* has already made a tremendous contribution to climate protection, reducing greenhouse gas (GHG) emissions by a net 135 billion tonnes of CO<sub>2</sub>e emissions in the 20 years leading up to 2010.

For comparison, this is about five times more than the *Kyoto Protocol* annual emissions reductions target for the first commitment period.<sup>14</sup> According to an alternative statistic from the Institute for Governance & Sustainable Development's *Primer on Hydrofluorocarbons*,<sup>15</sup> attributed to *Atmospheric Chemistry and Physics*:<sup>16</sup> 'As CFCs and HCFCs are also greenhouse gases, between 1990 and 2010, the *Montreal Protocol* reduced CO<sub>2</sub>e emissions nearly 20 times more than the 5-10 Gt CO<sub>2</sub>-e reduction goal of the first commitment period of the *Kyoto Protocol*.'

The structure of the *Montreal Protocol* makes it an attractive tool for addressing HFC emissions. Parties have already experienced significant success

using the agreement to phase out ozone-depleting substances in the relevant industrial sectors. Panels within the *Montreal Protocol* have in-depth understanding of all the sectors it finances, and detailed knowledge of technical options, and the protocol supports institutional strengthening for developing countries. The transparent structure and scheduled phase out of chemicals under the *Montreal Protocol* also catalyses faster commercialisation of alternatives at competitive prices, and allows time for innovation and orderly market adjustment.

Global confidence in the *Montreal Protocol* is apparent from the fact that it has universal membership. It is structured to enable effective embodiment of the principle of 'common-but-differentiated responsibilities'. Developing countries, known in this context as 'Article 5 Parties', take on mitigation activities after a grace period and with funding provided for agreed incremental costs of their phase-out activities.

Funds are provided by developed countries, known as 'Non-Article 5 Parties', through the Multilateral Fund (MLF). Since its inception, the MLF has approved more than US\$3.3bn<sup>17</sup> to support in excess of 6,800 projects and activities. Benefits of these funds extend beyond ozone and climate protection. They have helped catalyse rapid, cost-effective transformation of a range of industries, including the air-conditioning, refrigeration, industrial cleaning, fire-fighting, aerosol, and fumigation sectors.<sup>18</sup>

### The context and status of the Montreal Protocol negotiations

In 2009, the Federated States of Micronesia was the first Party to propose an HFC-phase down amendment under the *Montreal Protocol*. This proposal was soon followed by one from the US, Canada and Mexico, and within six years, there were five proposals on the table, submitted by 95 Parties.<sup>19</sup>

Momentum toward a phase-down amendment began to build in earnest in 2013. That year, there were numerous bilateral and multilateral statements

about using the expertise and institutions of the *Montreal Protocol* to phase down production and consumption of HFCs, while also recognising that HFCs were within the scope of the UNFCCC and its *Kyoto Protocol* for accounting, and reporting, of emissions.

Crucial developments that year included the MLF's executive committee agreeing to provide China with US\$385m for the entire elimination of its industrial production of HCFCs by 2030;<sup>20</sup> agreement between the presidents of China and the US that their countries would work together on HFC phase down under the *Montreal Protocol*; and a G20 Leaders' Declaration supporting complementary initiatives to the UNFCCC, which specifically mentioned phasing down HFCs under the *Montreal Protocol*. The following year, there were similar statements by Indian Prime Minister Narendra Modi, the G7 leaders, and state partners of the Climate and Clean Air Coalition.<sup>21</sup> Importantly, at the end of that year, the 26<sup>th</sup> Meeting of the Parties (MOP) to the *Montreal Protocol* agreed to an MLF replenishment of slightly over US\$500m for 2015-2017.<sup>22</sup>

Statements progressed to more concrete action in 2015, when 95 Parties submitted four proposals, and a conference room paper, supporting an HFC phase-down amendment under the *Montreal Protocol*. These included an updated proposal from the US, Mexico and Canada, and new proposals from India, the 28 member states of the EU, the Federated States of Micronesia with seven other Pacific Island States, plus an informal proposal, in the form of a conference room paper, from the 54 members of the Africa Group. (Details of these proposals can be found on page 6 of this briefing, under 'The proposed way forward'.)

The MOP in December 2015 culminated in agreement on the *Dubai Pathway on Hydrofluorocarbons*, under which Parties agreed 'to work within the *Montreal Protocol* to an HFC amendment in 2016, by first resolving challenges by generating solutions in the contact group on the feasibility and ways of managing HFCs'.<sup>23</sup> In order to achieve this outcome, Parties agreed on an intensive schedule of meetings in 2016 (updated in figure 2, page 4).

**Fig. 2: HFC-related meetings 2016**

4-8 April	37 <sup>th</sup> OEWG	Geneva, Switzerland
15-16 July	37 <sup>th</sup> OEWG (resumed)	Vienna, Austria
18-21 July	38 <sup>th</sup> OEWG	Vienna, Austria
22-23 July	3 <sup>rd</sup> Extraordinary MOP	Vienna, Austria
10-14 October	27 <sup>th</sup> MOP	Kigali, Rwanda

Source: UNEP Ozone Secretariat <http://ozone.unep.org/en/meetings>

In April 2016, Parties met in Geneva for the 37<sup>th</sup> Open-Ended Working Group (OEWG). Building on the momentum and positive atmosphere of the *Paris Agreement* in December 2015, Parties were able to make meaningful progress on core challenges. They reached provisional agreement on specific exemptions for 34 countries with high ambient temperatures.<sup>24</sup> There was also tentative agreement on text originally based on a conference room paper submitted by the Africa Group, to ensure the MLF covers incremental costs for converting to climate-friendly alternatives and supports training of service technicians.<sup>25</sup>

Beyond this, Parties initiated discussions around a number of the remaining challenges, including the special situation of developing countries; intellectual property rights; the relationship with the ongoing hydrochlorofluorocarbons (HCFCs) phase out and non-party trade provisions. With much work still to accomplish, Parties agreed to suspend the 37<sup>th</sup> OEWG and reconvene with two additional days at the start of the OEWG 38 and extraordinary MOP taking place in Vienna in July. The Secretariat was asked to produce a consolidated text based on the four pending HFC amendments for consideration at OEWG 38 in Vienna.<sup>26</sup>

**How does this fit with the Paris Agreement goals and its mitigation potential for 2050 and 2100, and achieving the Sustainable Development Goals (SDGs)?**

Ambitious action to phase down HFCs would be consistent with the climate-change agenda set by the international community in recent years. Addressing HFCs can help to achieve the goals

established in the *Paris Agreement* and several of the SDGs associated with the UN's 2030 Agenda for Sustainable Development.

The *Paris Agreement*, struck at the Conference of the Parties to the UNFCCC in December 2015, is a pivotal step for climate policy. In a remarkable diplomatic achievement, the world endorsed ambitious targets for emissions reduction while also recognising the urgency of the problem and the need for speedy action. UNFCCC Parties resolved to 'ensure the highest possible mitigation efforts in the pre-2020 period' and to keep the increase in global temperatures to well below 2°C, while pursuing efforts to keep temperature increases below 1.5°C.<sup>27</sup> Many governments have HFC phase down as part of their intended nationally determined contributions (INDCs) under the *Paris Agreement*.

Now that Parties have agreed to ambitious targets and the 'highest possible' pre-2020 mitigation efforts, the real question is how quickly they can act to begin meaningful emissions mitigation. Addressing HFC emissions is one of the biggest opportunities for fast action. With the limited number of applications for HFCs, a number of alternatives already identified, and a mechanism to provide support for developing country transitions, the *Montreal Protocol* provides a ready-made structure for speedy action. In addition, due to the lifespan of HFCs, the benefits of mitigation will be speedy as well – experienced in a matter of years rather than decades or centuries.

An HFC phase down is also critically important to achieving several of the SDGs. Most obviously, goal 13 – 'take urgent action to combat climate change and its impacts' – cannot be achieved without

addressing this major source of global warming. An HFC phase down also has important implications for goal 7 – 'ensure access to affordable, reliable and sustainable modern energy for all' – as transitioning to alternative chemicals will provide an opportunity to modernise equipment and increase efficiency with supporting finance from the MLF.

There are also implications for goal 12 – 'ensure sustainable consumption and production patterns' – as HFC mitigation under the *Montreal Protocol* relates directly to target 12.4, which calls for achieving environmentally sound management of chemicals in accordance with international frameworks. A number of SDGs stand to benefit from the reduced warming associated with a phase down. In particular, a phase down will boost progress on goal 3 – 'good health and wellbeing';

goal 14 – 'life below water'; and goal 15 – 'life on land' – by limiting the warming to which humans, oceans and the terrestrial environment will be exposed.

**How to address the problem**

There are a number of available alternatives to HFCs that have low global-warming potential (GWP) including both factory-made gases and 'natural refrigerants' such as ammonia, propane, isobutene, and CO<sub>2</sub>. The *Montreal Protocol's* Technology and Economic Assessment Panel defines low GWP as refrigerants with a 100-year GWP of 300 or lower. This is well below the GWP of one of the most commonly used HFC refrigerants today – HFC-134a – which has a GWP of 1,300.<sup>28</sup>

**Fig 3: Indicative list of low-GWP alternatives to HFCs<sup>29</sup>**

Application	Current refrigerant	GWP	Alternative	GWP
Refrigeration (domestic)	HFC-134a	1,300	HC-600 (isobutene)	~3
	HFC-152a	138	HC-290 (propane)	<5
			HFO-1234yf	<1
Refrigeration (commercial & industrial)	HFC-22	1,760	HC-600 (isobutene)	~3
	HFC-407C	1,774	R-744(CO2)	1
	HFC-134a	1,300	R-717 (ammonia)	0
	HFC-404a	3,943	HFCs and HFC blends	<1-1,600
Air conditioners (room)	HFC-410a	1923	HC-290 (propane)	<5
	HCFC-22	1,760	HFC-32	677
	HFC-407C	1,774	HFC/HFC blends emerging	~350
			HFC-1234yf	<1
Air conditioners (commercial)	HFC-134a	1,300	HFC1233zd	<1
	HCFC-22	1,760	HFC-1234ze	<1
	HCFC-123	79	HFC/HFC blends emerging	400-500
			HFC-1234yf	<1
Mobile air conditioners	HFC-134a	1,300	HFC-1234yf	<1
			HFC-152a	138
			R-744 (CO2)	1
Foams	HFC-277ea	3,200	HCs	<5
	HCFC-142b	1,9800	Co2/water	1
	HFC-245fa	1,030	HFC-124ze	<1
	HCFC-22	1,810	methyl formate	<25
	HFC-134a	1,300	HFC-1366mzz-Z	2

The *Montreal Protocol* has historically achieved significant reductions by phasing out production and consumption of ozone-depleting gases at a low cost. In the 19 years between 1991 and 2010, the *Montreal Protocol* achieved an estimated 188-200 Gt CO<sub>2</sub>e in emissions reductions due to the phase down of CFCs and other fluorinated gases. The cost to the MLF was US\$2.4bn, with a net cost of less than US\$0.01 per tonne of CO<sub>2</sub> reduced.<sup>30</sup>

According to recent analysis by the *Montreal Protocol's* Technology and Economic Assessment Panel (TEAP), an HFC phase down for the refrigeration and air-conditioning sectors would cost the MLF one-and-a-half to two times more than current funding for the ongoing HCFC phase out, assuming the HFC phase down started in 2020. TEAP anticipates that delaying the start date of the phase down from 2020 to 2025 would increase the total cost to the MLF by approximately 40% and increase costs for servicing by 250%.<sup>31</sup> The reduced cost of a faster phase down is associated with avoiding build-up of unnecessary HFC banks, which could cost as much as US\$35 or more per CO<sub>2</sub>e tonne to collect and destroy, as opposed to less than US\$1 per tonne to avoid their production and consumption entirely.

By accelerating the transition from HFCs, and leapfrogging straight from HCFCs to low-GWP alternatives where possible, countries could reduce their impacts from global warming, while saving energy, staying competitive, and benefiting from MLF support towards equipment upgrades.

### The proposed way forward

A total of 95 Parties have put forward proposals for HFC amendments under the *Montreal Protocol*. The final agreement is not anticipated to be adoption of any single proposal, but rather a negotiated outcome drawing on aspects of the various proposals. There are many similarities among the proposals and some significant differences. For a full comparison of proposals see the chart from the Natural Resources Defence Council (NRDC).<sup>32</sup>

All the proposals have separate reduction schedules for developed and developing countries; developing countries will be allowed to continue emitting 100% of baseline emissions for some period into

the future. In addition, all the proposals foresee the MLF providing funding for developing country transitions. The differences in requirements for the various countries lie in the speed and magnitude of developed country emissions reductions, as well as the grace period for developing countries.

All four proposals have significant overlap in their expectations for developed country Parties, though there are notable differences in terms of the speed at which the phase down should begin; however, the proposals end up in very similar places by the mid 2030s, with the Island States Proposal ending in a deeper reduction than the other three.

The biggest difference in the proposals is found in the proposed grace period for developing countries, with India proposing a 15-year delay, while the other Parties' proposals range between delays of 0-3 years. The final reduction level for developing country Parties is the same under the Indian proposal, but comes 4-10 years later than in the other proposals.

Developing countries have much to gain from an ambitious phase down of HFCs. Ambitious reductions are an important way of protecting vulnerable countries and populations from the potential for dramatic global warming. Swift action in reducing HFCs might enable us to avoid tipping points on certain warming feedback loops, by reducing the rate of warming in the Arctic.

To realise maximum benefits of phasing down HFCs, Parties must:

- a. agree to amend the *Montreal Protocol* in October in Kigali, Rwanda, to include an ambitious global phase down of HFCs with the earliest possible start dates for Non-Article 5 and Article 5 Parties, and ensuring that Non-Article 5 Parties lead the way
- b. provide adequate means of implementation, including additional funding and technology transfer, to enable Article 5 Parties to comply with an ambitious phase down
- c. promote strategies that maximise the ability of Article 5 Parties to leapfrog to the lowest-possible GWP alternatives. while significantly increasing energy efficiency.

### Endnotes

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