

# Maximising the benefits of the global phase-down of hydrofluorocarbons

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### Executive summary

The proliferation of household air conditioners and refrigerators across the world, including the rapid growth expected in developing countries, gives us an opportunity, right now, to ensure that the appliances we choose have minimum impact on the global climate and maximise sustainable development.

Last year's hard-won Kigali Amendment to the Montreal Protocol ensured a commitment to remove HFC refrigerants with high global warming potential, through a global phase-down. Maximising the climate change and related benefits of this phase-down will depend on three elements coming together:

- countries choosing refrigerants with the lowest global warming potentials
- ensuring promotion of the most energy efficient cooling technologies
- a rapid move to renewable energy to power these appliances.

The right combination of these three elements will ensure that greenhouse gas emissions over the lifetime of each appliance are minimised.

Achieving each of these elements will require a range of actions, including addressing financing and cost issues, supporting capacity building and training, developing energy infrastructure plans and updating safety and energy efficiency standards. These diverse actions will need to be coordinated strategically, often across a number of distinct but critical venues, including the Montreal Protocol, the UNFCCC, various regional groups and domestic policy-making.

As we implement both the Montreal Protocol Kigali Amendment and the Paris Agreement, making the right coordinated and complementary decisions across these issues and venues will be essential to deliver a safe world with below 1.5°C of global warming.

## Introduction

The adoption of the Kigali Amendment to the Montreal Protocol by almost 200 countries, in 2016, was a major achievement. It secured a global agreement to gradually phase down the production and consumption of hydrofluorocarbons (HFCs), and it bolstered the momentum for international action on climate change that had grown out of the Paris Agreement in 2015. Implementing the global phase-down of HFCs now presents the opportunity to avoid emissions equivalent to over 80 billion tonnes of carbon dioxide, while achieving important additional sustainable development goals.

This paper discusses what is at stake in the implementation of the HFC phase-down and related activities. It describes a suite of measures that, if taken together, will maximise the benefits of the phase-down, both in terms of the greenhouse gas emissions prevented and additional, sustainable development co-benefits.

## Context

The total emissions that will ultimately be avoided as a result of phasing-down HFCs – as well as the extent to which other sustainable development co-benefits can be secured – will depend on the choices countries make about key issues. These include: which refrigerant gases are selected for use in cooling appliances, what energy performance or energy efficiency standards are required of those appliances; and what sources of electricity are used to power those appliances.

Issues such as the sources of electricity, the choices of refrigerants and the standards for energy performance of cooling equipment, lie at the core of both climate and broader sustainable development goals. Aligning efforts to address these issues in a complementary manner across venues will not only help to maximise the benefits of the global HFC phase-down, but can also be used to promote related climate and development goals, such as improving energy security and deploying clean energy. (see Christian Aid's briefing on HFC phase-down.)<sup>1</sup>

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# Kigali Amendment – the basics

The Kigali Amendment is a global agreement to gradually phase down the production and consumption of HFCs.

## What are HFCs?

HFCs are man-made refrigerant gases, originally developed as replacements for ozone-depleting substances – namely, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) – already being phased out under the Montreal Protocol. Although HFCs have only minimal ozone-depleting impact, the Parties to the Montreal Protocol agreed to phase down their production and consumption, in addition to phasing out HCFCs, because they are highly potent climate-warming gases.

## Implementing the Kigali Amendment

The Kigali Amendment will enter into force on 1 January 2019 or 90 days after ratification by the 20<sup>th</sup> Party, whichever is later. The Amendment stipulates that developed countries will begin HFC reductions from baseline levels by 2019. Developed countries will then be followed by two groups of developing countries. These two groups will freeze production and consumption at baseline levels in 2024 and 2028, respectively. Countries will then be required to meet the scheduled reduction steps described in Table 1, below.<sup>2</sup> Under the agreement, global HFC production and use will ultimately be phased down to 80-85% below baseline levels, by the late 2040s.

## Quantifying the impact

Because the Kigali Amendment aims to limit the warming impact of HFCs, the levels of HFC production and consumption under the phase-down will be measured in carbon dioxide equivalence (CO<sub>2</sub>e), just as greenhouse gas emissions are measured under the Kyoto Protocol. Since the Global Warming Potentials (GWPs) of refrigerants are what give rise to their carbon dioxide equivalence, **the lower the GWPs of the refrigerants chosen to replace HFCs, the lower the impact on the climate system from those refrigerants** and the greater the contribution those refrigerants will make to countries meeting their reduction steps under the phase-down.

Table 1: Phase-down schedule for HFCs applicable to Article 5 and non-Article 5 parties.<sup>3</sup>

	A5 parties (developing countries) Group 1	A5 parties (developing countries) Group 2	Non-A5 parties (developed countries)
<b>Baseline formula</b>	Average HFC consumption for 2020-2022 + 65% of hydrochlorofluorocarbon (HCFC) baseline	Average HFC consumption for 2024-2026 + 65% of HCFC baseline	Average HFC consumption for 2011-2013 + 15% of HCFC baseline*
<b>Freeze</b>	2024	2028	–
<b>1st step</b>	2029 – 10%	2032 – 10%	2019 – 10%
<b>2nd step</b>	2035 – 30%	2037 – 20%	2024 – 40%
<b>3rd step</b>	2040 – 50%	2042 – 30%	2029 – 70%
<b>4th step</b>	–	–	2034 – 80%
<b>Plateau</b>	2045 – 80%	2047 – 85%	2036 – 85%

\*For Belarus, Russian Federation, Kazakhstan, Tajikistan, Uzbekistan, 25% HCFC component of baseline and different initial two steps (1) 5% reduction in 2020 and (2) 35% reduction in 2025

#### Notes

1. Group 1: Article 5 parties not part of Group 2
2. Group 2: Bahrain, India, the Islamic Republic of Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia and the United Arab Emirates
3. Technology review in 2022 and every five years
4. Technology review four to five years before 2028 to consider the compliance deferral of two years from the freeze of 2028 of Article 5 Group 2 to address growth in relevant sectors above certain threshold

## The importance of refrigerant choice

As stated, HFC production and consumption levels under the phase-down will be measured in terms of CO<sub>2</sub>e. Therefore, in addition to reducing overall impacts on the climate, the lower the GWP of the refrigerants chosen as alternatives to HFCs, the easier it will be for countries to meet the steps of the HFC phase-down.

However, there are also other issues countries will have to consider when making refrigerant choices. These issues include a refrigerant's cooling capacity (how effective it is at achieving the needed cooling), energy efficiency, flammability, cost and availability in a specific market. In addition, countries will need to consider the different kinds of equipment systems that use these refrigerants, including the costs and energy efficiencies of those systems (see below).

It is possible to overcome many of these barriers – such as cost, market availability and safety concerns – in order to promote the least damaging choices. However, it will take a concerted effort, involving the refrigerant industry both nationally and internationally, to set this sector on the right path.

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Table 2: Considering low-GWP alternatives to HFCs in refrigerant choices.

Application		Current refrigerant GWP	Alternative	GWP
Refrigeration (domestic)	HFC-134a	1,430	HC-600 (isobutene)	~3
	HFC-152a	124	HC-290 (propane)	3
			HFO-1234yf	<1
Refrigeration (commercial & industrial)	HFC-22	1,810	HC-600 (isobutene)	~3
	HFC-407C	1,774	R-744(CO <sub>2</sub> )	1
	HFC-134a	1,430	R-717 (ammonia)	0
	HFC404a	3,922	HFCs and HFC blends	<1-1,600
Air conditioners (room)	HFC=410a	2,088	HC-290 (propane)	3
	HCFC-22	1,810	HFC-32	675
	HFC-407C	1,774	HFC/HFC blends emerging	~350
			HFC12334yf	<1
Air conditioners (commercial)	HFC-134a	1,430	HFC12334zd	<1
	HCFC-22	1,810	HFC12334ze	<1
	HCFC-123	77	HFC/HFC blends emerging	400-500
			HFC-1234yf	<1
Mobile air conditioners	HFC134a	1,430	HFC-1234yf	<1
			HFC-152a	124
			R-744 (CO <sub>2</sub> )	1
Foams	HFC-277ea	3,220	HCs	<5
	HCFC-142b	2,310	CO <sub>2</sub> /water	1
	HFC-245fa	1,030	HFC-124ze	<1
	HCFC-22	1,810	Methyl formate	<25
	HFC-134a	1,430	HFC-1366mzz-Z	2

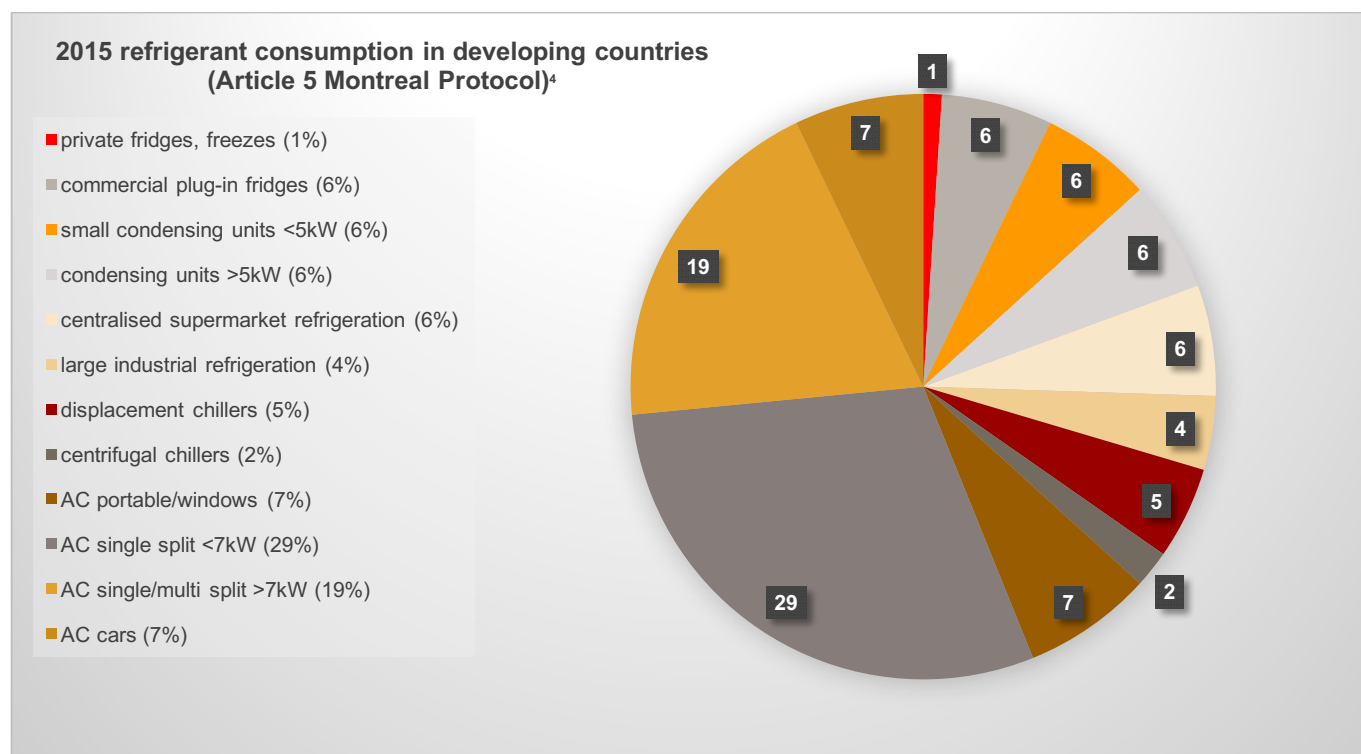
As Table 2 indicates, the GWPs of refrigerants that might be used in place of high-GWP HFCs vary considerably. For example, in small room air conditioners, many developing countries presently use HCFC-22, which has a GWP of 1,810. During their ongoing HCFC phase-outs, were it not for the recently agreed HFC phase-down these countries might have switched from HCFC-22 to HFC-410a, which has a GWP of 2,088. Now that there is also an HFC phase-down, the high GWP of HFC-410a makes it a much less attractive option. Developing countries are now likely to choose other, lower-GWP alternatives for small room air conditioners. These include propane (HC-290), with a GWP of 3, or medium-GWP HFCs or blends, such as HFC-32, with a GWP of 675.

In making such choices, countries will have to keep in mind how their refrigerant choices affect the climate and, specifically in terms of the HFC phase-down, what contribution their refrigerant choices, within a particular sector, will make to achieving their agreed phase-down steps, which apply across all sectors of HFC production and use. For example, if for the room air conditioning sector a country moves from HCFC-22 (GWP of 1,810) to HFC-32 (GWP of 675), this will have reduced the climate impact of the refrigerant by about two thirds. However, if a country moves from HCFC-22 to a refrigerant with an even lower GWP, such as propane (GWP of 3), the climate impact of the refrigerant will be almost eliminated. Choosing propane would therefore lead to a much lower climate impact from the



refrigerant and make a larger contribution to achieving the country's phase-down steps – especially if room air conditioning comprised a large portion of the country's refrigerant use.

The importance of such a choice is made clearer when considering the chart below, which shows **that small room (single split and portable/window) air conditioning made up more than one third (36%) of total developing country HFC consumption in 2015.**



### Considering safety and capacity concerns

A variety of refrigerants, with a wide range of GWPs, might all function to meet at least the minimum requirements of the HFC phase-down. But to maximise the climate benefits, and to make achievement of the agreed phase-down steps easier, parties should be encouraged and supported to choose the lowest GWP refrigerant and helped to overcome concerns they have about making the transition. Parties should be supported in meeting any concerns (eg, safety concerns, technical capacity), which, if effectively addressed, could allow them to choose lower-GWP refrigerants.

For example, propane has both a very low GWP and is highly energy efficient, but there are concerns over its safety as it's a highly flammable gas. Overcoming this obstacle to its use – by, say, tackling outdated safety standards or a lack of training for technicians – could be considered an effective means of helping countries achieve the emissions reductions that would result from its use. In this sense, an investment in training and capacity – that enables the use of refrigerants and equipment with lower climate impact – can also be an investment in mitigation.

**'Parties should be encouraged and supported to choose the lowest GWP refrigerant and helped to overcome concerns they have about making the transition'**

### Considering costs

An assessment of costs must take into account not just the cost of the refrigerant gases but also that of the systems that use the refrigerants and of any training required to use them safely and effectively.

In choosing refrigerants, countries will have to consider which costs are covered by the Multilateral Fund for the Implementation of the Montreal Protocol (MLF), which is the financial body that provides funding to developing countries to meet their compliance obligations. How and to what extent this funding is provided is dictated by the MLF guidelines. It is essential that the Executive Committee of the Multilateral Fund recognises the most effective ways that its support can maximise benefits of the HFC phase-down for the lowest possible cost, and that the Parties give it the mandate to offer that support.

**In summary, the lower the GWP of a refrigerant, the lower its impact on the climate and the greater its contribution to achieving the steps of the phase-down. Therefore, the principal incentive of the Kigali Amendment is for countries to lower the GWPs of the refrigerants they use. However, refrigerant GWP is one among a number of important issues – including cost, safety, availability, cooling capacity and energy efficiency – that countries may consider when making their refrigerant choices.**

**'It is essential that the Executive Committee of the Multilateral Fund recognises the most effective ways that its support can maximise benefits of the HFC phase-down for the lowest possible cost, and that the Parties give it the mandate to offer that support'**

### The importance of the energy efficiency of cooling appliances

The principal direct impact of the Kigali Amendment will be the selection of cooling equipment refrigerants that have reduced GWPs. (As noted, GWPs gives rise to the carbon dioxide equivalence (CO<sub>2</sub>e) by which HFC production and consumption levels are measured.) However, over the lifetime of cooling equipment such as air conditioners and refrigerators, the bulk of the climate impact comes not from the highly warming refrigerant gases leaking into the atmosphere, but from the carbon dioxide emitted in generating the electricity to power that equipment. Thus, **increasing the energy efficiency of cooling equipment, ie, reducing its energy demand, can also greatly reduce carbon dioxide emissions and so the overall climate impacts of cooling.** In addition, reducing energy demand in this way can reduce the peak load carried by the electric grid, thereby improving energy security: reducing black outs and other occasions when access to electric power is reduced.

### The potential of improved energy efficiency

In a recent study, the Lawrence Berkeley National Laboratory (LBNL) in the United States estimated that 'moving to efficient room air conditioning (~30% more efficient than current technology), in parallel with low-GWP refrigerants in room air conditioning, could avoid up to ~25 billion tonnes of CO<sub>2</sub> in 2030, ~33 billion in 2040, and ~40 billion in 2050, ie, cumulative savings of up to 98 billion tonnes of CO<sub>2</sub> by 2050'. The authors highlight that more than 60% of

Achieving the Paris Agreement commitment to pursue efforts to keep global temperature rise below 1.5°C of warming will require a rapid global shift to a zero-carbon energy system by 2050. Over the next three decades, energy efficiency of appliances will play a critical role in delivering this transition as fossil fuels are phased out. Minimising CO<sub>2</sub> from energy use of appliances will also reduce the overall greenhouse gas emissions in this period, helping to keep the 1.5°C warming goal viable.

the 98 Gt CO<sub>2</sub>e emissions they say could be avoided would be due to improvements in the energy efficiency of room air conditioners.

In some hot countries, including India, Saudi Arabia and others that use predominantly fossil-fuel based electricity and have numerous cooling days, the emissions avoided from improvements to the energy efficiency of air conditioners would be even greater than the emissions avoided from lowering the GWP of the refrigerants these appliances use.

### The benefits of energy efficiency improvements

Overall, the more cooling a country requires and the more it relies on dirty fossil fuels for electric power, the greater the benefits there will be from energy efficiency improvements. These benefits include preventing both carbon dioxide emissions and emissions of other traditional air pollutants from electricity generation, including nitrogen oxides, sulphur dioxide and particulate matter. They also include improved public health and energy security, improved access to energy, lower overall costs for consumers of electricity, and reduced public and private expenditures on energy infrastructure, due to fewer power plants being required. **Indeed, the LBNL study estimates that improvements to the energy efficiency of air conditioners alone could avoid the need to build up to 2,500 or more 500 MW power plants worldwide by 2050.**

As we will see in a later section, a swift move to renewable energy in these countries will reduce the global warming impact even further.

### Maximising refrigerant and equipment efficiencies

It's important to note that both the refrigerants themselves and the equipment in which they are used have their own separate energy efficiencies. And it should be emphasised that maximising the energy efficiency of the equipment (which can often be improved by 30-40% or more) will, over the lifetime of the equipment, have significant additional climate benefit when coupled with maximising the energy efficiency of the refrigerants (which tend to vary only by 5-10% or so). Therefore, countries should be encouraged both to choose the most energy efficient refrigerants and to maximise the energy efficiency of the equipment that uses these refrigerants. This will in turn maximise both the climate and other sustainable development benefits from the HFC phase-down – such as improvements in public health and energy security.

### Hopes for the 29<sup>th</sup> Meeting of the Parties (MOP 29)

There are a number of important actions that countries can take to secure the major benefits from improved energy efficiency of cooling appliances. First, **all countries should aim to deliver, at the 29<sup>th</sup> Meeting of the Parties to the Montreal Protocol (MOP 29), in Montreal this year, a robust decision on energy efficiency** (hereinafter '2017 EE Decision') that builds substantially on the Kigali Decision on Energy Efficiency of 2016. The 2017 EE Decision should accomplish at least three things:

- First, it should include clear guidance to the Executive Committee of the Multilateral Fund to report on potential incentives the MLF could offer countries to improve the energy

**'Countries should be encouraged both to choose the most energy efficient refrigerants and to maximise the energy efficiency of the equipment that uses these refrigerants'**

efficiency of their appliances, and provide estimates of the cost per tonne avoided as a result of efficiency measures.

- Second, the Executive Committee of the Multilateral Fund will be finalising its guidelines for funding the HFC phase-down by the end of 2018. These guidelines will outline, among other things, how and to what extent to promote energy efficiency during the HFC phase-down. The 2017 EE Decision should therefore be designed to inform the development of these guidelines and, where those guidelines fall short on energy efficiency issues, highlight opportunities to access other climate funds.
- Third, it should launch a Work Programme or a series of workshops or other means through which Parties can enhance their understanding of the appliance efficiency issue, so that they can maximise the benefits of their upcoming actions to implement both the HCFC phase-out and the HFC phase-down. The workshops could include engagement not only with experts from within the Montreal Protocol bodies but also other international energy efficiency, climate finance or related experts. This kind of engagement will help the relevant bodies, including financial institutions, see how the related efforts they are undertaking can come together in the most complementary ways.

Countries should also begin to coordinate any policies and programmes promoting energy efficiency in cooling appliances that they may already have in place, with the actions they are planning under the HCFC phase-out and HFC phase-down. Many countries use a variety of policies and programmes, from labelling and minimum energy performance standards (MEPS) to government procurement and consumer incentive and rebate programmes. Officials in charge of these should be in regular communication with ozone officers and those working on implementing the HFC phase-down under the Montreal Protocol.

## The relationship of the HFC phase-down to the HCFC phase-out

Under the earlier, ongoing HCFC phase-out agreed in the Montreal Protocol, developing countries were obliged to reduce HCFC production and use to 35% below the baseline level by 2020, to 67.5% below baseline in 2025 and to 97.5% below baseline in 2030. Hence, many of these countries will soon be making choices in sectors such as air conditioning that will bear upon both the HCFC phase-out and the HFC phase-down.

For example, in transitioning out of HCFC-22 in room air conditioners, countries might previously have switched to HFC-410a, as many developed countries did for their own HCFC phase-outs. However, as there is now also an HFC phase-down, the high GWP of HFC-410a, (GWP 2,088), makes it a less attractive option than the alternatives mentioned earlier: HFC-32 (GWP 675) and propane (GWP 3). **Indeed, part of the value of the HFC phase-down, as emphasised by its proponents during the Kigali Amendment**

### A quick look back: progress since 2016

In our briefing paper on HFCs for the Montreal Protocol negotiations last year, Christian Aid concluded by proposing a way forward in three parts. We stated that 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.

With the adoption of the Kigali Amendment in 2016, Part A was largely achieved, pending ratification and entry into force of the amendment.

Now the Parties must ensure that Parts B and C are also achieved. They can do this by supporting the actions called for in the recommendations section of this document, especially:

- ensuring robust funding from the Multilateral Fund for phase-down activities, including capacity building and training
- making low-GWP refrigerant choices
- implementing strong energy efficiency standards for cooling appliances
- supporting the increased use of renewable energy power sources.

The Kigali Amendment was a major step, but if we are to maximise its benefits through the middle of this century, the additional work we called for last year remains to be done –

negotiations, is that it provides an incentive for countries to leapfrog over HFCs during their ongoing HCFC phase-outs.

### **Moving straight to low GWP alternatives**

Clearly it does not make sense to support countries in choosing high-GWP HFCs as their alternatives to HCFCs, since under the HFC phase-down they will need to replace those high-GWP HFCs with lower-GWP alternatives. Guidance and support from the Multilateral Fund should reflect this critical consideration. **The MLF should not fund countries in choosing high-GWP refrigerants such as HFC-410a during their HCFC phase-outs.**

Avoiding the choice of HFC-410a as a refrigerant will also help to reduce the low energy efficiency appliances that often use HFC-410a. In addition, **developing countries in particular, should be wary of other countries dumping residual HFC-410a systems on them, especially when producers remove their offerings from developed country markets, as is expected with the removal of HFC-410a systems from European markets after 2018.**

## **Appliance energy efficiency and renewable energy deployment**

In addition to refrigerant choice and appliance energy efficiency, the electricity sources used to power cooling system appliances can dramatically affect their climate impact. The use of highly polluting fossil fuel electricity sources, such as coal, oil and gas, will increase that impact, especially when used in hot regions with numerous cooling days. A shift to the use of sustainable, clean-energy sources, such as renewable energy, can greatly reduce emissions from cooling systems and could avoid the most emissions in precisely those high-demand, regions currently using fossil fuels.

### **Energy efficiency standards as facilitators of renewable energy use**

The deployment of sustainable renewable energy is an excellent means of reducing the climate impacts of cooling systems and other systems that rely on electric power. In addition, strong energy efficiency standards for cooling and other appliances should be considered a valuable means of facilitating renewable energy deployment. As the LBNL study shows, the use of energy efficient appliances can avoid the need for up to 2500 500 MW power plants worldwide. This means countries would need less investment, including foreign investment, to put their required clean energy infrastructure in place.

Likewise, reduced energy demand, through the use of energy efficient cooling and other appliances, will allow existing energy infrastructure to meet a greater portion of the overall energy demand of the area served.

Thus, the use of clean energy will reduce the impact of electrical appliances on the climate; the use of energy efficient electrical appliances will drive down the costs of deploying clean energy; and the reduced cost of deploying clean energy will increase the access

**‘Clean energy will reduce the impact of electrical appliances on the climate; energy efficient electrical appliances will drive down the costs of clean energy; and the reduced cost of deploying clean energy will increase access to energy provided by the existing energy infrastructure’**

to energy provided by the existing energy infrastructure. The newly emerging regional renewable energy initiatives (such as the African Renewable Energy Initiative and the LDCs Renewable Energy and Energy Efficiency Initiative) should be sure to recognise this key principle and use it to accelerate the achievement of their renewable energy deployment goals.

Overall, refrigerant and appliance energy efficiency decisions are directly related to countries' broader climate and low-carbon development plans, such as energy infrastructure development. The more carbon-intensive a country's energy supply (eg, heavy reliance on coal for electricity) the more beneficial the higher energy efficiency standards for cooling appliances will be.

**In some countries, the potential climate benefits from improving the energy efficiency of appliances are even greater than those from the switch to lower GWP refrigerants.** In addition, reducing energy demand with energy efficient appliances can also help countries avoid the need to finance and build large numbers of power plants, thereby saving money that can be directed at ensuring newly installed power is clean power.

## Actions within the UNFCCC

Actions to phase-down HFCs under the Montreal Protocol, and complementary actions to improve the energy efficiency of cooling appliances, should be coordinated with relevant actions under the United Nations Framework Convention on Climate Change (UNFCCC). (This framework is the principal climate treaty under which emissions of both HFCs and carbon dioxide are targeted.) For example, because a global phase-down of the production and consumption of HFCs will reduce HFC emissions, **countries should plan to include these avoided emissions within their Nationally Determined Contributions (NDCs) under the Paris Agreement.** Doing so will enhance the aggregate mitigation reflected in NDCs and may encourage further global mitigation ambition.

Similarly, **within the UNFCCC, countries and stakeholders should raise awareness about the opportunity to improve the energy efficiency of appliances in conjunction with the global HFC phase-down.** Indeed, for many countries the carbon dioxide reductions resulting from improved appliance energy efficiency fall under the remit of their climate change policy makers and UNFCCC delegations. Therefore, coordination between countries' Montreal Protocol officials and others addressing energy efficiency, including both domestic regulators and climate negotiators, is crucial if the climate benefits of the HFC phase-down are to be maximised. In addition, any expected reductions in carbon dioxide emissions from associated improvements in appliance energy efficiency should also be reflected in countries' NDCs. Overall, the HFC phase-down presents an important opportunity to describe, to coordinate, and to undertake additional mitigation activity under the UNFCCC.

## Continuing leadership by developing countries

The HFC phase-down effort has frequently showcased climate leadership by developing countries. In 2009, a group of small Island developing states, led by the Federated States of Micronesia, first proposed phasing down HFCs under the Montreal Protocol. Later joined by Morocco and the Philippines, these states continued the push for an HFC amendment for almost a decade.

In 2015, the island states amended their proposal to include a special provision on the energy efficiency of appliances. This was the same year the African countries launched the African Renewable Energy Initiative, which aims to deliver up to 10 GW of renewable energy by 2020 and up to 300 GW by 2030.

During the Kigali Amendment negotiations in 2016, developing countries including island states, African states and the countries of the Gulf Cooperation Council, all pushed for the Technical and Economic Assessment Panel of the Montreal Protocol to consider enhancing energy efficiency in its cost estimates for the Multilateral Fund. Also in 2016, Morocco and Rwanda proposed and secured the adoption of the Kigali Decision on Energy Efficiency. In 2017 African Ministers issued a statement calling for rapid ratification of the Kigali Amendment. As of August 2017, four countries have ratified the Kigali Amendment, two island states (the Federated States of Micronesia and the Republic of the Marshall Islands), and Mali and Rwanda.<sup>6</sup>

Developing country leadership will likely continue, as awareness grows about the opportunity of coupling energy efficient appliances with renewable energy deployment in a manner that enhances access to energy and energy security and at the same time avoids emissions of carbon dioxide and other hazardous air pollutants.

## UNFCCC's Climate Technology Centre and Network (CTCN)

Countries may also want to consider using the **UNFCCC's Climate Technology Centre and Network (CTCN) to facilitate their efforts to enhance the energy efficiency of appliances and equipment.**

As the operational arm of the UNFCCC Technology Mechanism, the CTCN provides technology solutions, capacity building and advice on policy, legal and regulatory frameworks, tailored to the needs of individual countries. The CTCN has already identified enhancing the energy efficiency of appliances as an ideal climate mitigation and energy security strategy. It is presently working with a number of developing countries, providing technical assistance for developing effective policies and measures. For example, a group of 10 African countries is presently working with the CTCN to develop a Regional Efficient Appliance and Equipment Strategy in Southern Africa.<sup>7</sup>

Other countries or groups of countries might likewise engage with CTCN to explore options for regional appliance efficiency strategies that coordinate with their plans to phase down HFCs under the Kigali Montreal Protocol Amendment. Encouraging more countries to develop such policies and measures, and facilitating the communication of best practices and lessons learned, will be critical. So too, will be ensuring the ongoing collaboration between experts and officials from the UNFCCC, Montreal Protocol and other bodies.

## Marrakech Partnership for Global Climate Action

Yet another way the UNFCCC can contribute to enhancing the energy efficiency of appliances, and therefore to improving global mitigation ambition, is through the Marrakech Partnership for Global Climate Action. The Marrakech Partnership has emerged from the Global Climate Action Agenda to take on the mantle of coordinating international climate initiatives. The Marrakech Partnership now also houses the Technical Examination Process that, through its Technical Expert Meetings, aims to identify promising near-term (pre-2020) ways of raising ambition. The High-Level Climate Champions, representing the present and upcoming COP presidencies, work with the UNFCCC Secretariat to plan activities under the Marrakech Partnership. Their role is to rally stakeholders and countries to cooperate to unlock additional action. They play a key role in promoting and raising the profile of new mitigation initiatives and opportunities.

To date, Technical Expert Meetings have focused both on non-CO<sub>2</sub> pollutants, including HFCs, and on energy efficiency in buildings. But these workshops and the resulting summaries for policymakers have so far failed to capture and convey clearly the significant contribution that energy efficiency in appliances can make towards emissions prevention and reduction. There is therefore an important opportunity to raise such awareness within the Marrakech Partnership, and specifically within the Technical Examination Process. This is also the opportunity to get support, from the many stakeholders, for action on these goals that will complement the actions being planned to phase-down HFCs worldwide. The High-Level Climate Champions should be encouraged to play a central role in this effort.

At a minimum, **the opportunity to enhance the energy efficiency of appliances concomitant with the HFC phase-down should be highlighted in the *Yearbook of Climate Action*, which is being developed under the Marrakesh Partnership.** In addition, stakeholders may want to consider developing an international initiative focused specifically on energy efficiency in appliances. Such an initiative could promote norms for manufacturing, for standards and labelling, and for export and import of appliances.

Such an initiative might also lead a call for **the Green Climate Fund to develop appropriate, tailored financial mechanisms to support the enhancing of appliance energy efficiency. Such mechanisms could complement any financing that may be provided for enhancing efficiency through the Multilateral Fund of the Montreal Protocol.**

An initiative on appliance energy efficiency might also develop useful metrics to demonstrate progress and the opportunity to determine which policies are most effective – ie, provide metrics designed not just to count the CO<sub>2</sub>e tonnes avoided but to articulate the most effective policy environments for improving appliance efficiency.

### **UNFCCC Facilitative Dialogue and Global Stocktake**

All such work, from the Technical Examination Meetings to the Yearbook to a new initiative on energy efficiency in appliances, should aim to elevate the issue of appliance energy efficiency to wide recognition as a key means of enhancing mitigation ambition during the UNFCCC's Facilitative Dialogue in 2018. For example, **an effort could be made at the Facilitative Dialogue to ensure that all countries adopt effective appliance efficiency standards by the time of the UNFCCC's Global Stocktake in 2023.** This would complement the HFC phase-down, given that 2024 is the freeze year for Group 1 Developing Countries.



## Summary and recommendations

The historic Paris Agreement is now in place and the Kigali Amendment to the Montreal Protocol has been agreed. But what follows from these can vary widely: the refrigerants countries choose for various applications could have Global Warming Potentials (GWPs) ranging from below 5 to more than 600; and the appliances that use these refrigerants may have varying levels of energy efficiency – depending on the energy consumption of the appliances and on the sources of electricity that power them – leading to a range of carbon dioxide emissions levels.

The climate benefits from the global phase-down of HFCs will depend upon choices of refrigerant, in the setting of energy efficiency standards, and in the sources of energy that are deployed to power electricity grids. The mapping and coordinating of this decision-making across all relevant venues and actors is crucial for the implementation stage.

The plan presented in this proposal outlines the first stage for driving the most effective and ambitious ways of implementing the global HFC phase-down and for achieving the most critical complementary actions. **These actions will take place across venues such as the Montreal Protocol and the UNFCCC, so it is essential that the relevant policy makers, regulators, negotiators, and other officials begin to coordinate these enormously beneficial actions now.**

To do so, we make the following recommendations:

### Within the Montreal Protocol:

- Parties should act rapidly to ratify the Kigali Amendment so that it can enter into force on 1 January 2019.
- Parties should be encouraged and supported to choose the lowest GWP refrigerant options that meet their other concerns, such as cost, safety, cooling capacity and availability.
- Parties should be eligible to receive financial support for meeting any concerns, which, if cost effectively addressed, could then allow them to choose lower GWP refrigerants. Support to address such concerns should be considered a legitimate form of funding for emissions mitigation.
- Parties should be encouraged to choose the most energy efficient refrigerants and, especially, to maximise the energy efficiency of the appliances they use.
- The Executive Committee of the Multilateral Fund must recognise the various ways that its support can maximise benefits of the HFC phase-down for the lowest possible cost, including:
  - ensuring robust funding for phase-down activities, including for capacity building and training
  - not funding the use of high-GWP HFCs during the ongoing HCFC phase-outs
  - providing incentives for the use of highly energy efficient cooling appliances during the HFC phase-down.

- Parties should build upon the 2016 Kigali Decision on Energy Efficiency by securing a robust 2017 Energy Efficiency Decision that would:
  - give clear guidance to the Executive Committee of the Multilateral Fund (MLF) to report on potential incentives the MLF could offer countries to improve the energy efficiency of their appliances, and provide estimates of the cost per tonne CO<sub>2</sub>e avoided from efficiency measures.
  - be designed to inform the development, by 2018, of the MLF's HFC phase-down funding guidelines and, where those guidelines fall short on energy efficiency issues, outline strategies to access other funds
  - launch a work programme or series of workshops or other means through which Parties can enhance their understanding of the appliance efficiency issue, so as to maximise benefits of their upcoming actions to implement both the HCFC phase-out and the HFC phase-down. The workshops could include engagement not only with experts from within the Montreal Protocol bodies but also other international energy efficiency, or related, experts.

### Within the UNFCCC and elsewhere:

- Parties should include within their NDCs the HFCs emissions they expect to be avoided as a result of their actions to phase-down HFC production and consumption under the Montreal Protocol.
- Parties should report on the status of implementing such HFC measures within the new transparency framework.
- Parties and stakeholders should raise awareness throughout the UNFCCC, and especially within the Marrakesh Partnership and the Technical Examination Process, of the mitigation potential from improved energy efficiency in cooling appliances – and of the opportunity to secure such efficiency improvements concomitant with the HFC phase-down. These opportunities should be highlighted in the *Yearbook of Climate Action* being developed under the Marrakesh Partnership.
- Parties and stakeholders should encourage the High-Level Climate Champions to highlight the appliance efficiency opportunity at the annual High-Level Event and within the Facilitative Dialogue and Global Stocktake.
- Parties and stakeholders should further recognise the potential of highly energy efficient appliances to increase access to energy and energy security, as well as to lower the cost of clean energy infrastructure by decreasing the number of power plants needed.
- The newly emerging regional renewable energy initiatives (such as the Africa Renewable Energy Initiative and the LDCs Renewable Energy and Energy Efficiency Initiative) should be sure to recognise this key principle and use it to accelerate the achievement of their renewable energy deployment goals.
- Parties should coordinate any energy efficiency programmes they may already have in cooling appliances and equipment with

the actions they are planning under the HCFC phase-out and HFC phase-down.

- Officials in charge of policies and programmes promoting energy efficiency in cooling appliances and equipment should be in regular communication with ozone officers and those working on implementing the HFC phase-down under the Montreal Protocol.
- As markets for air conditioning and refrigeration start to change, due to the HCFC phase-out and HFC phase-down, Parties should not allow the dumping of older, inefficient appliances into their countries.
- Parties and regional groups should consider using the CTCN to develop plans for their countries and regions to implement energy efficiency standards, labelling and other incentive programmes.
- Stakeholders should consider developing an international initiative focused specifically on the multiple co-benefits of energy efficient appliances.

## Endnotes

- <sup>1</sup> *Christian Aid briefing on hydrofluorocarbon (HFC) emissions*, July 2016, [www.christianaid.org.uk/Images/hfc-emissions-briefing-paper-july-2016.pdf](http://www.christianaid.org.uk/Images/hfc-emissions-briefing-paper-july-2016.pdf)
- <sup>2</sup> Note that the Parties agreed to a High Ambient Temperature Exemption, under which countries that qualify and choose to use it may delay their freeze date and control obligations, by four years, in certain sectors
- <sup>3</sup> 'Frequently asked questions relating to the Kigali Amendment to the Montreal Protocol,' UNEP, 17 February 2017, [http://ozone.unep.org/sites/ozone/files/pdfs/FAQs\\_Kigali\\_Amendment.pdf](http://ozone.unep.org/sites/ozone/files/pdfs/FAQs_Kigali_Amendment.pdf)
- <sup>4</sup> 'Climate-friendly alternatives to HFCs and HCFCs', European Commission, [https://ec.europa.eu/clima/policies/f-gas/alternatives\\_en](https://ec.europa.eu/clima/policies/f-gas/alternatives_en)
- <sup>5</sup> 'Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning', Shah, N. et al., Ernest Orlando Lawrence Berkeley National Laboratory, October 2015, <https://ies.lbl.gov/sites/default/files/lbnl-1003671.pdf>
- <sup>6</sup> An updated list of countries that have ratified the Kigali Amendment and other Montreal Protocol agreements can be found at: [http://ozone.unep.org/sites/ozone/modules/unep/ozone\\_treaties/inc/datasheet.php](http://ozone.unep.org/sites/ozone/modules/unep/ozone_treaties/inc/datasheet.php)
- <sup>7</sup> 'Development of a Regional Efficient Appliance and Equipment Strategy in Southern Africa', Climate Technology Centre & Network, [www.ctc-n.org/technical-assistance/projects/development-regional-efficient-appliance-and-equipment-strategy](http://www.ctc-n.org/technical-assistance/projects/development-regional-efficient-appliance-and-equipment-strategy)

*Ratification of the Kigali Amendment, a briefing note from the Ozone Secretariat*, February 2017, can be found at [http://conf.montreal-protocol.org/meeting/oewg/oewg-39/presession/briefingnotes/ratification\\_kigali.pdf](http://conf.montreal-protocol.org/meeting/oewg/oewg-39/presession/briefingnotes/ratification_kigali.pdf)