FREQUENTLY ASKED QUESTIONS

COOLING INDIA WITH LESS WARMING: THE BUSINESS CASE FOR PHASING DOWN HFCS

WHAT IS THE BUSINESS CASE FOR AN HYDROFLUOROCARBONS (HFCS) PHASE-DOWN?

What is the business case for phasing down high-global-warming-potential HFCs in room and vehicle air-conditioners in India?

Markets around the world are shifting away from potent heat-trapping HFCs with high global warming potential (GWP) toward more climate-friendly alternatives such as the hydrocarbon (HC), HC-290, and the hydrofluorocarbon (HFC), HFC-32. Indian companies have an opportunity to start adopting these more sustainable alternatives now with financing from the Montreal Protocol Multilateral Fund, avoid higher costs of transitioning later and gain greater access to domestic and foreign markets that are moving away from high-GWP HFCs. Because HC-290 and HFC-32 room air conditioners can achieve higher energy efficiency than units using HFC-410A, they can help improve air quality and address global climate change. Given the climate and economic benefits of shifting away from HFCs, most nations have expressed support for action under the Montreal Protocol, and many are already taking domestic actions to reduce HFCs, as detailed further below.

Why should companies, governments, and citizens work on phasing down HFCs now?

Shifting to lower-GWP alternatives from high-GWP HFCs is an opportunity to save energy through improved efficiency, reduce emissions, and stay competitive with international market trends, while potentially having the costs of transition covered by the Multilateral Fund of the Montreal Protocol.

These frequently asked questions (FAQs) are part of the continuing research project, Cooling India with Less Warming, a business case for phasing down hydrofluorocarbons (HFCs). Based on several business, government, and civil society discussions in India, this fact sheet answers some of the most often asked questions about an HFC phase-down and their alternatives for room and vehicle air conditioners. For more information, please see: http://www.nrdc.org/international/india/air-conditioner-efficiency.asp

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Power sector and energy efficiency benefits of phasing down HFCs

India faces tremendous energy demands, with air conditioner use already playing a major role in peak demand, and it is anticipated to be a significant driver of energy use in the future.[1] A recent report by the Lawrence Berkeley National Laboratories (LBNL) concludes that the efficiency of air conditioners in emerging economies like India could be significantly improved, by up to 40 percent, cost effectively.[2] Air conditioners that use lower-GWP refrigerants can provide greater energy efficiency, and can match or improve on performance at high ambient temperatures more common in India.[3]

Energy efficiency improvements accompanying a switch to alternatives can reduce the demand for energy and for more expensive power plants. A recent analysis by CEEW indicates that a switch to HFC-32/HC-290 air conditioners with energy efficiency improvements could offer a 15% energy savings over a business-as-usual scenario.[4] A study analyzing HFC transition alternatives in China estimated that HC-290 air conditioners would save more than five times as much energy as a HFC-410A air conditioner.[5] Godrej & Boyce, a leading Indian AC manufacturer, reports that even as a drop-in replacement, before further design improvements, HC-290 saves energy.[6] Another analysis conducted tests comparing the performance of HFC-410A and HFC-32 systems and concluded that, at temperatures of 35°C and above, the HFC-32 system demonstrated superior energy efficiency.[7] Energy efficiency improvements are also likely to have air quality benefits. In addition, greater energy efficiency means savings for equipment owners.

Climate change benefits of phasing down HFCs

By adopting lower-GWP alternatives, Indian companies and the Indian market can anticipate emerging changes in the international market and prevent a major share of future climate-changing emissions before they even occur. HFCs are powerful heat-trapping gases with "global warming potentials" (GWPs) hundreds or thousands of times greater than carbon dioxide. They are some of the fastest growing greenhouse gases in the world. HFCs leak from room and vehicle air conditioners during their working lives and when they are eventually retired. If we do not address HFCs now, then on a global basis they could raise the temperature a half degree centigrade by 2100, all by themselves.[8] HFCs are a low hanging fruit to tackle climate change. The CEEW analysis discussed above indicates that a switch to HFC-32 air conditioners with energy efficiency improvements, by 2050, could reduce greenhouse gas emissions from room air conditioners in India's residential sector by 31%, of which 15% would result from reduction in fossil fuels burned to generate electricity, and the remainder from reduced global warming caused by the direct emissions of the refrigerant into the atmosphere. Policies have already been adopted to reduce HFC use in Europe, Japan, Australia, and the United States, and China is also taking action. To maintain a competitive edge globally, the Indian market will need to shift to HFC alternatives. India can also avoid higher transition costs later by avoiding HFCs where technologies are already available to replace hydrochlorofluorocarbons (HCFCs) currently being phased out under the Montreal Protocol, and where HFCs have already been implemented in uses such as vehicle air conditioners.

Business and economic benefits of phasing down HFCs

Much of the expected rise in HFC use will be in room and vehicle air conditioners: approximately 116 million room air conditioning units are expected to be in service in India by 2030—approaching a 30-fold increase since 2010.[9] Auto air conditioning is also booming. Shifting to cleaner chemicals in air conditioners makes business sense for the Indian market because it transitions away from outdated refrigerant technology in room and vehicle air conditioners and builds domestic and export industries based on more climate friendly alternatives. New room air conditioner models, already on the market, that use HFC alternatives are also more energy efficient and save costs and energy, adding to the case for phasing down HFCs.

At the same time, an Amendment to the Montreal Protocol to cover HFCs can include provisions for financing agreed-upon transition costs. Moreover, under the flexible structure of current proposals, reduction targets could be achieved by transitioning first in sectors and categories where workable alternatives to HFCs already exist. Since the proposals contemplate a phase-down of HFCs rather than a total phase-out, a switch away from current HFC use would not be required in sectors or subsectors where viable alternatives do not yet exist.

What are the alternatives to high-GWP HFCs and how available are they?

HFCs have multiple uses including in room and vehicle air conditioners, and in foams and other applications. Several existing and emerging alternatives for the range of HFCs uses are available. In India, Daikin has commercialized a mid-GWP compound, HFC-32, in highly energy-efficient room air conditioners. HFC-32 has a GWP of 677[10] (1/3 of the GWP of HFC-410A, the established option), and achieves the same cooling capacity as HFC-410A with about 1/3 less refrigerant charge. HFC-32 is not subject to production patents, and Daikin offers free access to its basic application patent for the design of HFC-32 room air conditioners in developing countries. They are now manufactured in India and other developing countries, for both domestic and export sales, with Daikin reporting sales of 3 million HFC-32-based units in Japan and 150,000 such units in India.[11] Daikin reports sales in 30 countries.[12] Several other prominent manufacturers such as Panasonic,Hitachi, and Mitsubishi are also producing HFC-32 air conditioners.[13] Godrej and Boyce produces energy-efficient room air conditioners using a low-GWP hydrocarbon, HC-290 (GWP < 5), reporting sales of about 100,000 HC-290-based units since 2013,[14] and Chinese manufacturers are also switching to HC-290 for air conditioners, as described further below. This refrigerant is also unpatented, readily available and inexpensive, and available for use by other companies.

Table 1: Hydrofluorocarbons and Replacements in Room Air Conditioners and Their Availability in India					
REFRIGERANT	**GWP (SEE N. 9)**	**ENERGY EFFICIENCY**	**ASHRAE & ISO FLAMMABILITY**	**MARKET STATUS**	**REGULATORY STATUS**
Current High-GWP Refrigerant Used in Room Air Conditioner					
HCFC-22	High (1760)	High	Class 1: Not flammable	Scheduled for phase-out under the Montreal Protocol, with a reduction scheduled over time in India.	No longer allowed in new appliances sold in the E.U., the U.S., or other developed countries
Replacements for HCFC-22 in Room Air Conditioner					
HFC-410a	High (2088)	Low	Class 1: Not flammable	Has been licensed to a number of global chemical producers and its patents are expiring.	
HFC-32	Medium (677)	High	Class 2L: Mildly flammable	There will be multiple suppliers of HFC-32, since the chemical is already manufactured as a component of HFC-410a; patents for manufacturing HFC-32 have long expired, guaranteeing competitive pricing; Daikin is producing HFC-32 air conditioners, including in India. Daikin has announced that it will allow companies in developing countries to use basic HFC-32 air-conditioning patents at no charge through "non-assertion contracts."	
HC-290 (Propane)	Low (<5)	High	Class 3: Highly flammable, but is approved by respected national and international safety authorities for refrigeration and air-conditioning applications with relatively small charges and explosion-proof electrical connections and components such as switches.	Godrej in India produces room air conditioners using HC-290; Gree in China and more than half of the manufacturers in China have chosen HC-290. Two air-conditioner production lines and a compressor production line have already been converted. China adopted IEC 60335-2-40, which will enter into effect in July 2013, allowing air conditioners to be charged with up to 350 grams of HC-290.	Companies have yet to apply to the United States Environmental Protection Agency (EPA) for the Significant New Alternatives Policy (SNAP) approval
HFO/HFC blends (DR7, L41, L20)	Medium (~350 to ~700)	Neutral to Positive	Class 1: (not flammable) or Class 2L: (mildly flammable)	DuPont, Honeywell, Arkema, and other companies announced plans to commercialize low-GWP blends suitable for room air conditioners; they are not yet available in commercial room air-conditioner products.	

For vehicle air conditioners, HFC-152a (GWP = 138 compared to the business as usual alternative, HFC-134a, GWP = 1300) is an alternative that is out of patent and produced by many companies. HFO-1234yf (GWP = <1) is another alternative produced by Asahi Glass Chemicals, DuPont and Honeywell, under separate chemical process patents and marketed by DuPont and Honeywell under an application patent. Other companies are working toward producing alternative chemicals and equipment designs. Supply of HFO-1234yf is now sufficient to meet world demand with the opening of production-scale factories and plans for expansion.

The door is open for innovative industries to secure market share with a variety of HFC-alternative products. Costs will trend downward as scale and experience improve, and with the announced entry to the market of new producers. Several global leading AC component suppliers such as, Guangdong Meizhi Compressor (GMCC), Copeland, Dalian Sanyo (Panasonic), Danfoss, Sanhua, and Saginomiya are also developing or have already announced compressors and components for use with HFC-32.[15] Given the expansion of HFC-32-oriented production, the cost of appliances using this refrigerant are expected to decline in the future, making them more viable compared to existing alternatives. Transitions could proceed by switching to low-GWP refrigerants in sectors or subsectors where viable alternatives already exist at the time of transition.

Are hydrocarbon air conditioners feasible for the room air conditioner segment? Does the use of a flammable refrigerant pose a fire hazard?

Designed with relatively small charge sizes, flammable hydrocarbons room air conditioners have been found effective and safe, as evidenced by Godrej and Boyce's energy efficient air conditioning units already on the Indian market. Chinese manufacturers are also moving production lines to HC-290 air conditioners, as described below. As with automobiles that use flammable materials like petrol, system designs can be used to reduce potential fire hazards for room air conditioners by reducing leaks as well as, for smaller units, ensuring that leaks pose no flammability threats. It is not safe to retrofit vehicle air conditioners to use hydrocarbons due to high leak rates, casual service, and the many sources of ignition in the engine compartment and in service facilities.

Table 2: Technical Options to Replace HFC-134a in Automobile Air Conditioning				
REFRIGERANT	**GWP**	**MARKET STATUS**	**ALLOWED IN U.S. OR EUROPE**	**ASHRAE & ISO FLAMMABILITY**
Current High-GWP Refrigerant Used in Automobile Air Conditioners				
HFC-134a	1300[a]	Replaced CFC-12 in new Japanese, North American, and European cars in 1994 and worldwide by 2010	Currently allowed under EPA SNAP, but under review to be removed; does not meet the E.U.'s F-Gas directive	Class 1: Not Flammable
Replacements for HFC-134a in Automobile Air Conditioners				
HFO-1234yf	<1[b]	Choice of automobile manufacturers in North America, Japan, and Europe; world-scale production plant now operating in China; first cars entering the market	Allowed under EPA SNAP; meets the E.U.'s MAC F-Gas directive	Class 2L: Mildly flammable
HFC-152a	138[c]	Prototyped, but not commercialized; no intellectual property barriers to manufacture or use	Allowed under EPA SNAP; meets the E.U.'s MAC F-Gas directive	Class 2L: Mildly flammable
Hydrocarbons	<5[d]	Not considered safe by any major vehicle manufacturer; no intellectual property barriers to manufacture or use	Not allowed under EPA SNAP; meets the E.U.'s MAC F-Gas directive	Class 3: Highly flammable
Carbon Dioxide (CO_2)	1[e]	Prototyped, but not commercialized	Allowed under EPA SNAP; meets the E.U.'s MAC F-Gas directive	Class 1: Not flammable

[a] 100-year GWP from IPCC Fifth Assessment Report. [b] 100-year GWP from IPCC Fifth Assessment Report. [c] 100-year GWP from IPCC Fifth Assessment Report. [d] EPA (see note 9). [e] 100-year GWP from IPCC Fifth Assessment Report.

Does HFO-1234yf pose an unacceptable flammability threat in vehicle air conditioners?

Daimler has claimed that HFO-1234yf is too flammable for their automobiles. However, SAE International, the global professional society of automobile engineers, and several other fire safety organizations have investigated the potential flammability of HFO-1234yf extensively. Members of the SAE cooperative research project that carried out the analysis included members of most major car manufacturers from various regions of the world. SAE's analysis found that the refrigerant poses an "extremely low-level risk," a million times lower than the risk of vehicle fires due to all causes. SAE found that flammability claims being made by Daimler were based on highly unrealistic crash test conditions, conditions that would be extraordinarily unlikely to occur in real life.[16] Many of the other components in automobiles are far more flammable—petrol and liquid petroleum gas (LPG), for instance. Yet, passengers and service workers are kept safe by effective systems designs—the same is true for HFO-1234yf in auto air conditioners.

HOW WOULD A PHASE-DOWN OF HFCS WORK?

HFCs are not ozone-depleting chemicals, so why should they be considered under the Montreal Protocol?

The 1987 Montreal Protocol is the treaty that saved the ozone layer by phasing out chlorofluorocarbons (CFCs), HCFCs, and other ozone-depleting chemicals.

HFCs fall within the jurisdiction of the Montreal Protocol and its parent agreement (the 1985 Vienna Convention) because the ambit of those treaties includes assuring the safety of replacement chemicals.[17] HFCs were invented as replacements for CFCs and HCFCs, and their rapid growth is directly attributable to the phase-out of those chemicals under the Montreal Protocol. Though HFCs do not deplete ozone, they are powerful greenhouse gases.

The Montreal Protocol and the climate treaties could complement one another, without any conflict. The Montreal Protocol could control the production and consumption of manufactured chemicals, whereas the Kyoto Protocol could control and account for emissions.

Why a phase-down of HFCs and not a complete phase-out?

A phase-down provides time and flexibility for government and industry to manage the transition to alternative chemicals and technologies with the lowest carbon footprint (measured best by Life-Cycle Climate Performance). The phase-down also allows continued use in previously manufactured equipment that may not be suitable for retrofit to new refrigerants. A phasedown gets the world started—developed countries first, then developing countries—replacing HFCs where alternatives are already available, or are coming to market soon and allowing time to develop alternatives for uses where alternatives are not now available. At the same time, because it is not a total phase-out, a phase-down gives the assurance that HFCs can continue to be used indefinitely if there are some applications that prove essential and cannot be replaced. For example, the phase-down in medicine will take longer than in party streamers, dust blowers, foam and most refrigeration and air conditioning applications.

What are the proposed amendments to the Montreal Protocol?

The two main proposed amendments are the North American and Micronesian Proposals. Under the proposals (UNEP/OzL.Pro.WG.1/33/3, UNEP/OzL.Pro.WG.1/31/4), a phase-down would begin with countries freezing production and consumption of HFCs at a baseline level. The freeze would take effect first for developed and later for developing countries. Countries would gradually reduce production and consumption from the baseline, with incremental target decreases occurring over the next two decades, with developed countries acting before developing ones. As with previous Montreal Protocol phase-downs of ozone-depleting substances which used a basket approach based on ozone depletion potentials, HFC phase-down targets could be achieved by switching in sectors and categories where viable alternatives to HFCs already exist. A switch away from current HFC use would not be required in sectors or subsectors where viable alternatives do not exist at the time of transition.

How can the Montreal Protocol support industry transition to lower-GWP refrigerants?

The Montreal Protocol is built on the principles of common but differentiated responsibilities (CBDR). Developed countries are always obligated to act first. Developing countries follow after a grace period, and with the benefit of financial assistance provided through the Montreal Protocol's Multilateral Fund (MLF). Over the Montreal Protocol's 25-year history, the MLF has successfully raised and delivered more than U.S. $3 billion at a current level of about U.S. $500 million/year in assistance to developing countries, facilitating their phase-out of CFCs, HCFCs, and many other ozone-depleting greenhouse gases. Using the proven financing mechanism of Montreal Protocol to phase down HFCs offers a distinct advantage over climate treaties, under which a functioning financing mechanism has yet to be created.

The MLF is one of the reasons why the Montreal Protocol is the world's most effective environmental treaty. The Montreal Protocol, through the MLF, has a track record of delivering specific funding to go with new control commitments. It is a proven way to support developing country transitions to environmentally superior technology. Current HFC phasedown proposals include the commitment to additional funding for the MLF to be used to replace HFCs.

Is transitioning to lower-GWP alternative refrigerants economically viable? What are the anticipated costs of transitioning to lower-GWP alternatives?

Lower-GWP refrigerant alternatives are economically viable. Leading companies including Daikin, Mitsubishi, Fujitsu General, Hitachi, Panasonic, and Sharp are selling HFC-32 room air conditioners, with global sales in 30 countries now exceeding 3 million. The Indian market has some of the leading players in the transition to lower-GWP refrigerants in air conditioners, with Daikin establishing its first developing country HFC-32 factory in India (capacity 1 million units) and reporting sales of 150,000 such units. Similarly, Godrej and Boyce are leading the way on HC-290 air conditioners in India, reporting sales of 100,000 units since 2013. Chinese manufacturers are also switching to HC-290, as outlined below.

At their annual meeting in October 2013, the Parties to the Montreal Protocol tasked the Technology and Economic Assessment Panel (TEAP) with further research on alternative technologies and financing needs relating to an HFC phase-down. The recently released TEAP report contains overall estimates of costs for Article 5 (developed) countries for two scenarios, with costs ranging between US $ 459-972 million for the first scenario and ranging between US $ 1080-3240 million for the second.[18] TEAP describes the first scenario, as a "relatively achievable scenario based on current technology

options and potential trends."[19] It describes the second scenario as "a more progressive 'what if' assessment . . . believed to be at the limit of what could be achievable in the period to 2030."[20] TEAP also concludes that both HFC-32 and HC-290-based small self-contained air conditioners and mini-split air conditioners are economically viable, with little to no additional costs anticipated.[21] Such air conditioners dominate the market in India.[22] Furthermore, an Amendment to the Montreal Protocol controlling HFCs can include provisions for financing of agreed incremental costs, which could accomplish the transition at little or no cost to the companies. Current proposals for HFC phasedown include commitments for additional funding for the MLF to be used to transition to lower-GWP alternatives. Finally, under the proposals, sectors where viable alternatives do not exist need not switch away from current uses, and sectors with currently available alternatives can be used to meet GWP reduction goals.

What progress has been made to date towards an HFC phase-down under the Montreal Protocol?

India and the US released a joint statement agreeing to hold bilateral talks on HFCs, while recognizing the role for both the Montreal Protocol and the UN Framework Convention on Climate Change (UNFCCC) to address different aspects of HFC emission reductions.[23] It states:

> The leaders recalled previous bilateral and multilateral statements on the phase-down of HFCs. They recognized the need to use the institutions and expertise of the Montreal Protocol to reduce consumption and production of HFCs, while continuing to report and account for the quantities reduced under the UN Framework Convention on Climate Change. They pledged to urgently arrange a meeting of their bilateral task force on HFCs prior to the next meeting of the Montreal Protocol to discuss issues such as safety, cost and commercial access to new or alternative technologies to replace HFCs. The two sides would thereafter cooperate on next steps to tackle the challenge posed by HFCs to global warming.

The US-India bilateral task force can discuss and address issues such as safety, cost, and commercial access to new or alternative technologies to replace HFCs, as well as cooperate on next steps to move forward on the issue. Carrying forward the momentum from the joint statement, the first meeting of the bilateral task force took place in New Delhi in October. The 2013 China-US statement is similar to the India-US statement, but expressly calls for establishing a contact group—the formal vehicle for negotiations under the Montreal Protocol—on all aspects of HFC management, including phase-down proposals. The US-China Climate Change Working Group is exchanging technical and policy information on HFC reductions in parallel with continuing discussions about an amendment to the Montreal Protocol to address HFCs.[24] India could also follow that model.

There has been significant diplomatic progress towards phasing down HFCs under the Montreal Protocol. Earlier, the world's largest economies agreed at the G-20 summit in 2013 to use the institutions and expertise of the Montreal Protocol to phase down HFC production and consumption, while continuing to account for HFC emissions under the climate treaties.

The G20 countries agreed to:

> "support complementary initiatives, through multilateral approaches that include using the expertise and the institutions of the Montreal Protocol to phase down the production and consumption of hydrofluorocarbons (HFCs), based on the examination of economically viable and technically feasible alternatives. We will continue to include HFCs within the scope of UNFCCC and its Kyoto Protocol for accounting and reporting of emissions."[25]

The G-20 agreement built on earlier multilateral agreements at Rio+20, the Arctic Council, and the Climate and Clean Air Coalition (of which India is not a member), as well as the Bali and Bangkok declarations signed in 2011 and 2012 by the majority of the world's nations, both developed and developing, at meetings of the Montreal Protocol.

In short, support for phasing down HFCs under the Montreal Protocol, and for using its institutions including the MLF, continues to grow.

What are the benefits of a "contact group" under the Montreal Protocol?

Forming a "contact group" under the Montreal Protocol means, in essence, to form a discussion group. It allows the parties to discuss technical, policy, funding and other issues. It gives the parties a forum to raise and address concerns, including ensuring adequate funding for transition costs. The contract groups would also allow developing economies to structure agreement toward securing financial support for a leapfrog transition to technologies that the world is moving towards and help address growing energy needs by moving towards more efficient air conditioners. The contact group is the fastest way to determine through a consensus process what provisions are necessary to make an amendment work in the interest of all parties. At the end of the negotiations, India, like other nations, would only agree to an Amendment if it found the terms agreeable.

Formation of a contact group at the 2014 meeting would allow time to the parties to discuss issues prior to the 2015 climate talks and meeting of the parties.

What are other countries doing to phase down HFCs?

There is a variety of activity in different jurisdictions to phase down HFCs as described further below. India was one of a small handful of countries, including Kuwait, Saudi Arabia, and Cuba to oppose an amendment to the Montreal Protocol to address HFCs at talks in July 2014.[26] More than 100 parties to the Montreal Protocol now support phasing out HFCs.[27]

The U.S. Environmental Protection Agency notes that 24 countries plus the European Union (EU) have existing or proposed HFC policies.[28] Below are some details on developments in the EU and in Japan, as well as a note on China's actions.

European Union
Building on its 2006 regulations, which aimed to stabilize EU F-gas emissions at 2010 levels, the EU finalized a new and stronger regulation that goes into effect January 1, 2015. It seeks to reduce F-gas emissions by two-thirds over 2014 levels. The regulation includes a "phasedown and quota system for the supply of HFCs beginning in 2015, along with bans on certain HFC-containing equipment, and a requirement to destroy or recycle HFC-23 (a production byproduct). Existing regulation on labeling, refrigerant management and reporting requirements, and training programs have also been expanded to cover HFCs."[29]

Japan
In April 2013, Japan enacted a new law to reduce HFC emissions through "measures that cover the total life cycle of fluorocarbons from manufacture through disposal, as well as equipment using these gases."[30] The law includes requirements that air conditioner and refrigeration unit manufacturers and importers transition to non-fluorinated gases or low-GWP fluorocarbons by prescribed deadlines.

China
In June 2014, China announced a target of reducing HFC emissions by 0.28 billion tons of CO2e by 2015, building on two US-China agreements on HFCs in 2013.[31] When China previously agreed to eliminate its production and surplus production capacity for HCFCs in April 2013, the Multilateral Fund for the Implementation of the Montreal Protocol agreed to support China's efforts with an amount up to US $385 million.[32] Current contributions to the Multilateral Fund total over US $3.21 billion as of May 12, 2014,[33] and China is eligible for funding from this pool.

China elected not just to move away from HCFCs, but also to move to more climate-friendly alternatives. With assistance from the Montreal Protocol's Multilateral Fund as part of China's HCFC phase-out management plan (HPMP), Chinese appliance manufacturers such as Midea and Meizhi have converted production lines to safely manufacture R290 (propane) based room air conditioners, which use a refrigerant that does not deplete the ozone layer and is not a powerful contributor to global warming.[34] The Ministry of Environmental Protection is also preparing a subsidy program that will use Multilateral Fund funding for the HPMP to support Chinese companies manufacturing R290 room ACs for the domestic market and for export. The subsidy provides about 300 RMB per unit for split air conditioners and about 125 RMB per unit for window air conditioners. Fourteen manufacturers with 22 production lines have applied for funding to support the manufacture of these more climate-friendly air conditioners.[35]

United States
Automobile manufacturers in the United States are rapidly phasing out HFC-134a in vehicle air conditioning in order to continue sales in the European Union and in response to incentives from the US EPA that offer credit toward mandatory fuel efficiency standards for low-GWP refrigerants.[36] EPA is also in the process of removing HFC-134a from the list of allowable refrigerants and removing other high-GWP refrigerants from a half-dozen other products, including domestic refrigerators and freezers, stand-alone refrigerated display cases and vending machines, and other appliances.[37] On 16 September 2014 more than a dozen companies pledged rapid phaseout of obsolete HFC products and phase-in of replacement technology.[38]

Worldwide
Small island nations and other countries most vulnerable to climate change are considering a wide range of strategies to avoid HFC purchases that destroy the future of their communities. Although small countries cannot move markets with their small volume of commerce, they can be a voice for change.

Endnotes

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9 Phadke, *et al*., at 16-17, tbl. 4.

10 The latest official GWP are estimated by the Intergovernmental Panel on Climate Change (IPCC) Assessment Report Number 5 Chapter 8 Table 8.A.4. Values of refrigerant blend are calculated by the authors on a basis of weighted GWP. GWP numbers here are 'AR5 GWP100-yr,' i.e. they reflect Assessment Report Number 5 (AR5), unless otherwise noted, http://www.ipcc.ch/report/ar5/wg1/. If not found in Assessment Report Number 5, the GWPs are from U.S. EPA's fact sheet, Transitioning to Low-GWP Alternatives in Unitary Air Conditioning, http://www.epa.gov/ozone/downloads/EPA_HFC_UAC.pdf (last accessed Nov. 3, 2014).

11 Interview with Daikin experts in New Delhi: Kanwal Jeet Jawa, Gaurav Mehtani, and Kuldeepak Virmani at Daikin Airconditioning India Pvt. Ltd.; see Daikin UK, White Paper: Introducing R32 (noting sales exceeding 2 million), http://www.daikin.co.uk/contacts-and-downloads/whitepapers/index.jsp; see Shravan Bhat, Forbes India, "How cool! Daikin eyes Indian market using Japanese technology," Jul. 28, 2014 (quoting Mr. Jawa as stating that of 400,000 ACs sold since launch of R32 inverter ACs, about 25% were R32 ACs), http://forbesindia.com/printcontent/38305 (last accessed Oct. 28, 2014).

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