The Energy and Resources Institute

SHAKTI SUSTAINABLE ENERGY FOUNDATION

# POLICY BRIEF

## SIGNIFICANCE OF THE DECISION AT KIGALI

### Implications for India


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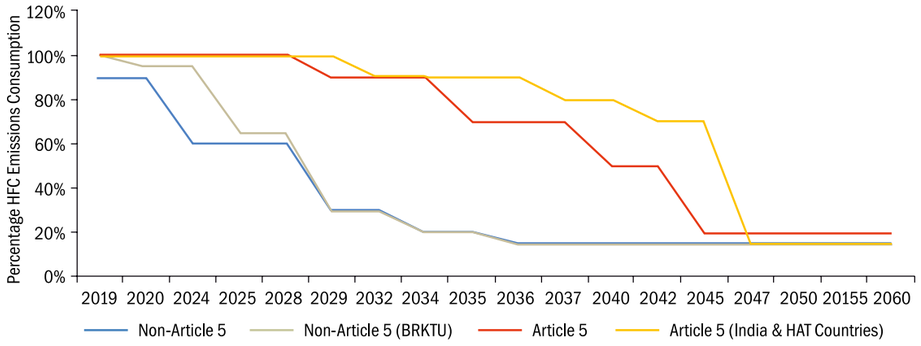
**Decision on two sets of baselines and freeze within both Article 5 and Non-Article 5 countries demonstrates highest commitment of international community towards the common but differentiated responsibility and respective capacities of countries.**

On October 15, 2016 nearly 197 countries got together to mark incremental progress in overcoming differences, drawing upon creativity, compromises, and trust towards finally reaching an agreement which is ambitious, balanced, and unique. Countries came together to adopt a deal to phase-down global climate warming hydrofluorocarbon (HFC) emissions under the Montreal Protocol, drawing a set of differentiated baselines and freeze years within both Article 5 and non-Article 5 countries. Further flexibilities are defined in Decision XXVIII/2 allowing developing countries to define sectors and select technologies to meet the agreed HFC phasedown obligations based on specific needs and national circumstances.

HFC Phase-down Schedules of Countries under Kigali Amendment




**Note:** (1) A later freeze date is provided to countries in non-Article 5 group, namely, Belarus, the Russian Federation, Kazakhstan, Tajikistan, and Uzbekistan; (2) a later freeze date is provided to countries in Article 5 grouping, namely, India, Baharain, Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, and the UAE. The dotted line indicates the plateau year for non-Article 5 countries.



POLICY BRIEF | March 2017


Table1: India's Plan of Action

| Action Point | Description | | | Comments |
|---|---|---|---|---|
| Baseline | 2024–26 | | | HFC consumption in 2047 must be less than 15% of the average consumption between 2024–26. |
| Freeze Year | 2028 | | | HFC consumption must decrease from (not later than) 2028. |
| HFC Phase-down Schedule | Step | % Reduction in Consumption | Year | HFC phase-down schedule of India |
| | 1 | 10% | 2032 | |
| | 2 | 20% | 2037 | |
| | 3 | 30% | 2042 | |
| | Plateau | 85% | 2047 | |

## India's Ambitious Stance at Kigali

- India took responsible steps to escalate its ambition from an initial proposal to phase-down HFCs from 2031 to a schedule which will begin phasing-down HFCs three years earlier. Given the Indian economy's high-growth pattern, which is yet to peak its production and demand for refrigeration/ cooling, the step came as a strong message from the Indian delegation to Kigali on its leadership in contributing to do more with limited time and available resources.
- By 2050, India would account for only 7% of the world's total emissions of HFCs which is currently distributed among the top 5 emitters in the world: USA (37.03%), China (23.32%), Western Europe (14.28%), Japan (6.41%), and India (1.6%). Keeping in mind the differences in current and future consumption of HFCs and growth in income levels, India took upon itself a much stringent reduction target of 85% from its baseline as against a target of 80% reduction in other developing country parties to the Kigali amendment.
- India announced mandatory HFC-23 incineration through domestic resources while other countries are seeking MLF funds for this. Through this policy, India has shown leadership in communicating to the world that HFC-23, which is a by-product of HCFC-22 manufacturing and a potent greenhouse gas with a GWP of 14800, must not be vented out into the environment.
- India also announced an ambitious collaborative R&D programme to develop the next-generation, sustainable refrigerant technologies as alternatives to HFCs. This R&D initiative brings together government, research institutes, industry, and civil society to develop long-term technology solutions to mitigate the impact of currently used refrigerant gases on the ozone layer and climate.

**Decision on Energy Efficiency, included in the Kigali Amendment for the first time, demonstrates recognition by countries on catalyzing benefits from energy efficiency along with sectoral transition.**

India was the first country to flag the importance of gaining energy efficiency along with HFC alternative transition where maximum emission reductions could be achieved in the process. India took the view that energy efficiency must be addressed and supported at all costs if global climate change goal is to be met.

With the decision on energy efficiency included in the Kigali Amendment (Decision XXVIII/3 which requests the Technology and Economic Assessment Panel (TEAP) to review energy-efficiency opportunities in the refrigeration, air conditioning, and heat pump sectors), the phase-down of HFCs under the Montreal Protocol would also incentivize energy-efficiency technologies in these appliances. Given the large share of electricity demand taken up by residential and commercial refrigeration systems, the decision adopted at Kigali will help in achieving an amplified climate impact. However, modalities to work out the complementarities among the decisions needs to be further streamlined.



## LONG-TERM IMPLICATION OF THE KIGALI DECISION FOR INDIA

**With India agreeing to phase-down HFCs in 2028, the uncertainties related to the cost of transition is very high**

For India to make the transition away from HFCs, the level of uncertainty related to costs and technology is not easily understood. The burden of cost is not merely the cost of alternative refrigerants but includes a one-time cost of product redesign, servicing equipment, training of servicing personnel, and per unit equipment costs. These would further involve significant investments in assembly-line transition for the AC manufacturers in the following areas: a) heat exchanger process modifications, b) sheet metal processing modifications, c) changing area modifications, d) pressure-testing equipment, e) refrigerant-charging equipment, f) industrial-leak detectors, and g) vacuum pumps, etc. which amount to a total of Rs 30 to 35 crores for an assembly line of one lakh units (Refrigeration and Air Conditioning Manufacturers Association of India). While the above figures represent the assembly-line transition cost from HCFC-22 to low GWP HFC-based ACs, there is a large-cost uncertainty as regards the transition to HFO blend and natural refrigerant-based ACs. This is primarily due to a lack of knowledge of the thermodynamic properties as well as the safety properties of these refrigerant gases that will replace HFCs in future, which would affect the design of heat exchangers and industrial leak detectors. In addition, due to lack of knowledge of the quantity of refrigerant gas required per tonnage for HFO blends, the size of the refrigerant charging equipment is also uncertain.

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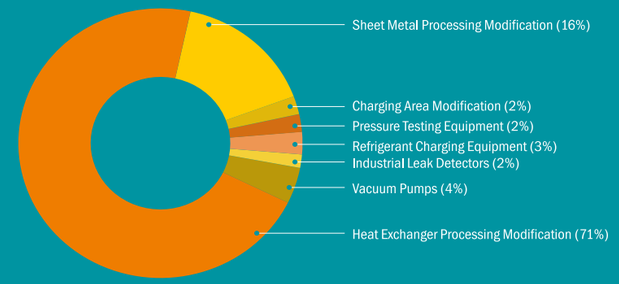


**With India agreeing to phase-down HFCs in 2028, the availability of alternate low-GWP refrigerant gases to replace HFCs becomes a key concern.**

Some of the key concerns for India in its transition to low-GWP refrigerants are: a) unavailability of technology transfer promised in the Montreal Protocol, b) compensation for a phase out not in accordance with internal economic and technical assessments, c) delay in the receipt of payments, and d) high cost of the existing low-GWP substitutes being manufactured in developed countries due to their early stage of development and IPR-related issues. Moreover, impetus towards the need to test alternatives under India's high-ambient temperature conditions is required. This would mean even larger uncertainty around the availability of technologies for India's transition.

Thus, it is essential that the technical issues regarding the assessment and evaluation of long-term low-GWP substitutes be resolved, as well as economic costs associated with multiple changeovers be developed and assessed in a rigorous manner.

However, given the current phase-down schedule of countries, it is likely that when India starts reducing the use of HFCs, developed countries will have achieved nearly 70% of HFC reduction. This would mean that there may be greater technological optimization and increased economies of scale for HFC alternatives to meet the needs of the developed countries. This may result in some certainty around alternative technologies as well as may lead to a reduction in costs for countries like India.

India's R&D programme to develop the next-generation, sustainable refrigerant technologies as alternatives to HFCs must strive to take this opportunity and develop technologies suitable to the Indian conditions.

[1] -2.%2520Indian%2520Industry%2520Perspective%2520on%2520phase%2520down%2520of%2520HFCs-N.2%2520final.pptx&rct=j&frm=1&q=&esrc=s&sa=U&ved=0ahUKEwjwq6KFwZHSAhVFMY8KHZgBD_EQFgg4MAc&usg=AFQjCNECT_7dbQzA4mxEN3Wacn7v3mWDaQ)

With India agreeing to phase-down HFCs in 2028, there is a rising opportunity to augment energy-efficiency gains.

The Kigali Amendment gives India an increasing opportunity to become the hub for manufacturing energy-efficient, environment-friendly appliances based on low-GWP refrigerant gases. The need to align its goals to 'Make in India' with green technologies in order to remain competitive in global markets is of special importance.

In the lead-up to the Kigali meeting, an $ 80-million 'Kigali Cooling Efficiency Fund' was launched for developing countries to provide an opportunity to improve energy efficiency of appliances while shifting to HFC alternatives. While the fund is welcome, the actual cost of transition is expected to be much higher in developing countries. The agreed decision (XXVIII/3) requires the Montreal Protocol's Multilateral Fund to cover incremental costs related to production, consumption, servicing, and patents. However, unless the guidance document on calculating costs is prepared, it remains unclear as to how much of the total costs will get covered.

## COOLING INDIA EFFICIENTLY

In India, the building sector accounts for approximately 35% of the total energy consumption and is growing at a rate of eight% annually within which lighting and HVAC comprise 80% of the total energy demand. As energy consumption from residential buildings is predicted to rise by more than eight times by 2050, in a typical business scenario, it is of vital importance for India to develop energy-efficiency strategies focused on the residential sector to limit the current trend of unsustainable, escalating energy demand. By using energy-efficient technologies in buildings, energy consumption could be reduced by up to 60%. According to the Indian Brand Equity Forum (IBEF), the Indian AC sector, from 4 million units in 2016, is expected to grow by 25%, that is, to 5 million units in 2017. The penetration of room ACs in Indian households is just 4%, implying that there is considerable potential for growth. Moreover, given the increasing necessity of reliable and uninterrupted power supply, economical electricity tariffs for urban households and commercial establishments have seen a significant increase in the last few years. This is likely to drive consumer choice towards energy-efficient models: 5 star and inverter ACs.





## Emerging Opportunities

1) There are several low-hanging fruits in the area of energy-efficiency technologies that can be captured by Indian AC manufacturers.
2) These measures primarily focus on optimizing the cooling capacity, thereby improving the Energy Efficiency Ratio (EER) of the equipment.
3) Choice of compressor technology can affect EER up to 2%, with lesser noise and low cost of maintenance, thereby reducing the life cycle cost of the equipment
4) The quality of refrigerant gas plays a significant role in determining the cooling capacity.
5) Some low-GWP refrigerant gases have been shown to achieve 11% higher energy efficiency than the minimum requirements for a five-star rating.
6) Flammability and toxicity concerns of a refrigerant need to be kept in strong check.
7) Improvements in the operation and maintenance protocols followed by AC manufacturers can significantly reduce the leakage rates by 5–7 % per annum, thereby reducing emissions and aligning it with the best global practices.
8) The resulting energy-efficiency gains and emissions mitigation will also play a significant role towards achieving India's INDC with respect to the target of 33–5% reduction in emissions intensity.

Table 2: Trade-off matrix for refrigerant gases used in room ACs

| Refrigerant Gas used | Refrigerant Gas Usage (kg/TR) | GWP | ODP | Toxicity | Flammability | Energy Efficiency gains* | Total AC Cost of transition |
|---|---|---|---|---|---|---|---|
| HCFC-22 | High (1.0) | High (1810) | High (0.05) | Low | Low | - | Low |
| R-410a | Medium (0.8) | High (2088) | Nil | Low | Low | Low | Low |
| R-32 | Medium (0.8) | Medium (675) | Nil | Low | Medium | Medium | Medium |
| R-290 (propane) | Low (0.65) | Low (3) | Nil | Low | High | High (11%) | High |
| HFO Blend | Can't say | Low-medium (<500) | Nil | Can't say | Can't say | Can't say | High (expected) |

*Energy-efficiency gains are measured in terms of Coefficient of Performance of compressors (COP). Qualitative ranges are given based on stakeholder inputs from AC manufacturers and referenced with respect to HCFC-22 ACs.

## INNOVATIVE APPROACHES TO MEET THE GOALS

1) Given the extent of energy-efficiency gains that can be leveraged through smart interventions, it is prudent to identify business models that will bring down the costs of high-efficient ACs for Indian consumers. The bulk aggregation scheme, as applied in the case penetration of energy-efficient lighting through LEDs, provides a promising example.

2) More research is required in the area of opportunities and challenges in the industry's transition to meet India's commitment towards Kigali including choice of refrigerants and technologies. Amidst the differential baselines and freeze of HFCs by both developed and developing countries, research on the international stimulus which may affect the pace of transition of the Indian industry domestically needs further investigation.

3) With the inclusion of the decision on energy efficiency within the Kigali decision, there is a pressing need to look at both the funds—the Kigali Cooling Efficiency Fund and the Multilateral Fund—through the same lens. Designing the complementarities and challenges in seeking energy efficiency within the Montreal Protocol and its linkages to the effective achievement of the Nationally Determined Contributions along with delivering a variety of co-benefits for sustainable development, including demands for energy security and other public health benefits, is essential. In the light of this, economic feasibility of enhancing energy efficiency across different countries needs further scrutiny.

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