

PRIORITIZING
NATURAL
REFRIGERANTS IN INDIA



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HIGHLIGHTS

Current Scenario

- Stationary air-conditioning, commercial refrigeration and domestic refrigeration make up 80 percent of India's installed cooling capacity
- Currently 90 percent of India's cooling capacity and annual refrigeration and air-conditioning (RAC) is based on hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFC) refrigerants, about 10 percent is based on naturals

2015-2030 Projections

- India's total installed cooling capacity is slated to increase by 5 times by 2030
- The largest increase in annual sales in 2030 will be in the residential air-conditioning sector (6-folds), followed by commercial refrigeration and mobile air-conditioning (4 times)
- In 2030, in business as usual (BAU) scenario, 75 percent of the cooling needs will be met by HFCs and the remaining by naturals.

Potential of Natural Refrigerants

- 77 percent of India's RAC sector can be converted to naturals by using currently available technologies
- Prioritizing naturals will result in direct emissions saving of 50 million tonnes of CO₂ per year by 2030

Way Forward

- Reaching the potential mentioned above will require enabling regulations, updated safety standards and market incentives for first movers
- Bureau of Indian standards (BIS) has set-up a sub-committee to consider certain amendments to ISO 5149 - the most prominent international standard for the use of flammable standards, to make it less restrictive for the use of hydrocarbon refrigerants, especially in domestic air-conditioning.
- Natural refrigerants will significantly improve energy efficiency in the RAC sector in India. The use of natural refrigerants can therefore supplement national and international plans to improve energy efficiency and reduce GHG emissions
- India should use the flexibility offered to Article 5 countries effectively to prioritize funding for a transition to natural refrigerants in the RAC sector



BACKGROUND

The recent negotiations around the HFC phase-down amendment to the Montreal Protocol have made an assessment of alternatives to HFCs crucial. Natural alternatives to HFCs are **low GWP, non-patented and energy efficient**. A transition to these alternatives would minimize costs and maximize energy and emissions savings.

The intergovernmental panel on climate change (IPCC) classifies the RAC sector into the following sub-sectors:

- Stationary (domestic and commercial) air-conditioning
- Mobile air-conditioning (MAC)
- Commercial refrigeration
- Industrial refrigeration
- Transport refrigeration

Natural alternatives are available for almost all of the above sub-sectors, with the possible exception of mobile air-conditioning and transport refrigeration.

Description of Commonly used natural alternatives¹

Propane (R290)

R290 is currently used mainly in smaller domestic air conditioning. The refrigerant offers lower cost, low GWP and high energy efficiency compared to its fluorinated counterparts. The most commonly used fluorinated alternatives in the domestic air-conditioning sector are HFC32 (GWP=600), HFC 410a (GWP=2088) and R407a (GWP=2107), all of these have high global warming potential and are therefore not sustainable refrigerants.

The use of R290 is currently restricted due to its higher flammability profile than the fluorinated refrigerants. However, according to experts, the concerns over the flammability of R290 and other hydrocarbon based refrigerants have been exaggerated and led to overly restrictive international standards for the use of these refrigerants. Making these standards less restrictive is being discussed in all major RAC markets around the world, including European Union (EU), United States (US), China and India. Once an updated safety standard is put in place R290 can easily substitute most classes of appliances in domestic air conditioning sector.

Isobutane (R600a)

R600a is primarily used in the domestic refrigeration sector in India. Globally, more than 50% of the domestic refrigeration market comprises of R600a based domestic refrigeration systems². Like R290, R600a offers lower cost,

low GWP and higher energy efficiency than its fluorinated counterparts. The most prominent fluorinated refrigerant used in domestic air conditioning is HFC 134a (GWP=1430). HFC 134a is also used in commercial refrigeration and mobile air conditioning. It is projected that R600a will be the refrigerant of choice for the domestic refrigeration systems.

Ammonia (R717)

Ammonia is primarily used in the commercial and industrial refrigeration sectors. Ammonia also offers lower cost, low GWP and higher energy efficiency compared to its fluorinated counterparts. Although its use is restricted due to its high toxicity profile, ammonia is becoming more prevalent in commercial air conditioning chillers where R32 (GWP=600), R410 and R407a are most commonly used. In India, more than 95% of all cold storages are based on Ammonia.

Carbon Dioxide (R744)

Carbon dioxide is currently used in commercial and industrial refrigeration applications mainly in regions with lower temperatures. Carbon dioxide offers lower cost, low GWP and higher energy efficiency compared to its fluorinated counterparts. However, the energy efficiency of carbon dioxide based cooling systems is significantly reduced in high ambient temperature conditions due to their high operating pressures. Carbon dioxide based mobile air conditioning systems are being developed by global automotive giant - Daimler³. Such systems will likely require significant modifications (like a secondary loop system) to offer high energy efficiency in high ambient temperature conditions.



RESEARCH OBJECTIVE

Study was conducted by CSE with the support of cBalance Solutions, to ascertain **the current state of refrigerant use in the RAC sector in India and the role natural refrigerants can play**. The study had three components, i.e. the current scenario of refrigerants use in India, the projected refrigerants use by 2030 and the potential of Natural refrigerants to replace fluorinated refrigerants during the HFC phase-down. These were estimated with the help of comprehensive reviews of available information, detailed market surveys and extensive expert interviews.

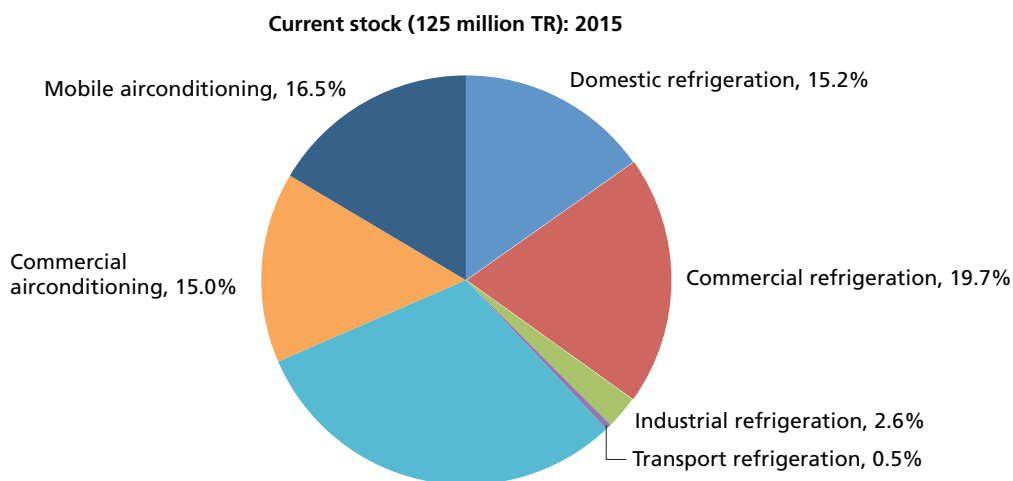
**RAC capacity is represented in tons of refrigeration (TR), which is a commonly used unit to represent cooling capacity*

Current Scenario

RAC Stock in 2015

The current stock of RAC equipment in India is estimated to be 125 million TR. Stationary air conditioning (45 percent), mobile air-conditioning (16.5 percent) and domestic refrigeration (15.5 percent) account for almost 80 percent of India’s installed cooling capacity, as illustrated in graph 1 below.

GRAPH 1: INSTALLED COOLING CAPACITY IN INDIA IN 2015

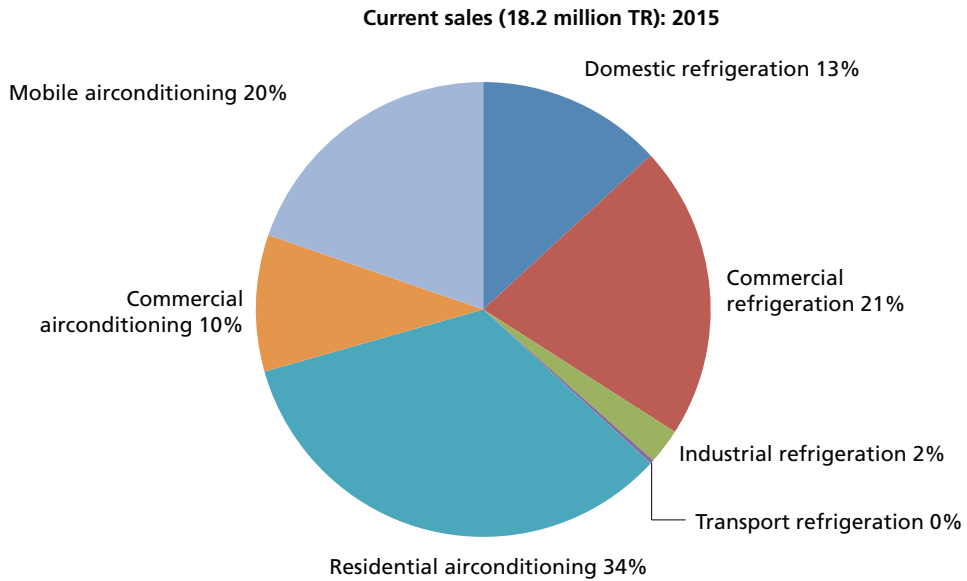


Source: cBalance Solutions

Sales in 2015

The current annual sales of RAC equipment in India are estimated to be 18.2 million TR. Sales in 2015 exhibit a similar pattern to the existing stock, with stationary air conditioning (44 percent), mobile air-conditioning (20 percent) and domestic refrigeration (13 percent) accounting for almost 80 percent of India’s added annual cooling capacity in 2015, as illustrated in graph 2.

GRAPH 2: RAC SECTOR SALES IN 2015

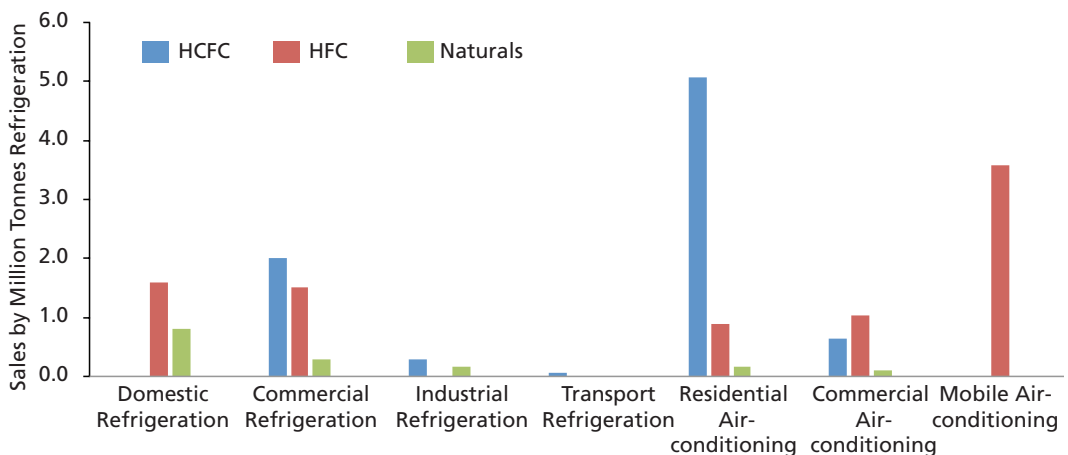


Source: cBalance Solutions

Refrigerant-wise classification of sales in 2015

HCFCs and HFCs account for 90 percent of the total sales in the RAC sector in India, with about 10 percent accounted for by natural refrigerants. In 2015, 44.26 per cent of RAC sales was based on HCFCs and 47.29 per cent was based on HFCs. The use of HCFCs has gone down in most sectors in the recent past. Most of HCFC is used in residential air conditioning (60 percent) and commercial refrigeration (25 percent). The reduction in HCFC use has been accompanied by an increase in the use of HFCs. The highest HFC use is in the MAC sector (40 percent), followed by domestic (19 percent) and commercial (18 percent) refrigeration, as illustrated in graph 3 below.

GRAPH 3: SECTOR-WISE REFRIGERANT MIX IN 2015



Source: Centre for Science and Environment



Centre for Science and Environment

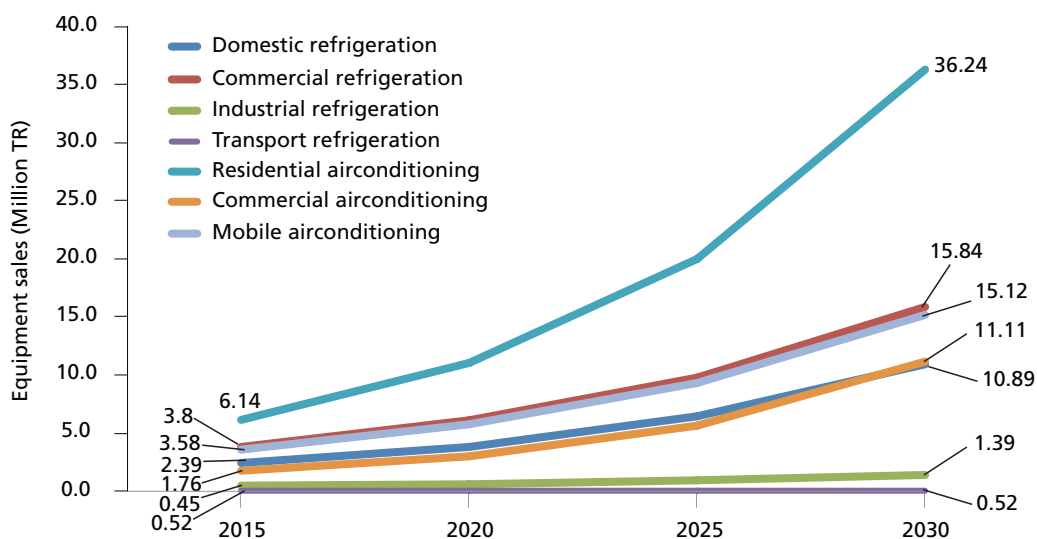
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Future Scenario

Sales projections till 2030

India’s total installed cooling capacity is slated to rise about 5 times to 610 million TR by 2030. As illustrated in the graph 4, the most significant increase in annual sales is projected for the domestic air-conditioning sector, amounting to almost a six-fold increase over the next 15 years. This will be driven by the increasing standards of living in India along with the increase in temperatures caused by climate change. Mobile air conditioning and commercial air conditioning sectors are slated to a four fold increase by 2030. Additionally, as per National Centre for Cold Chain Development, policies are being designed to increase of cold storages, Refrigerated Vehicles and pack houses in multiple folds in India. Requirement for cold chains is double the existing, refrigerated trucks is six times the existing and around 70000 new Pack houses are required.

GRAPH 4: SALES PROJECTION: 2015-2030

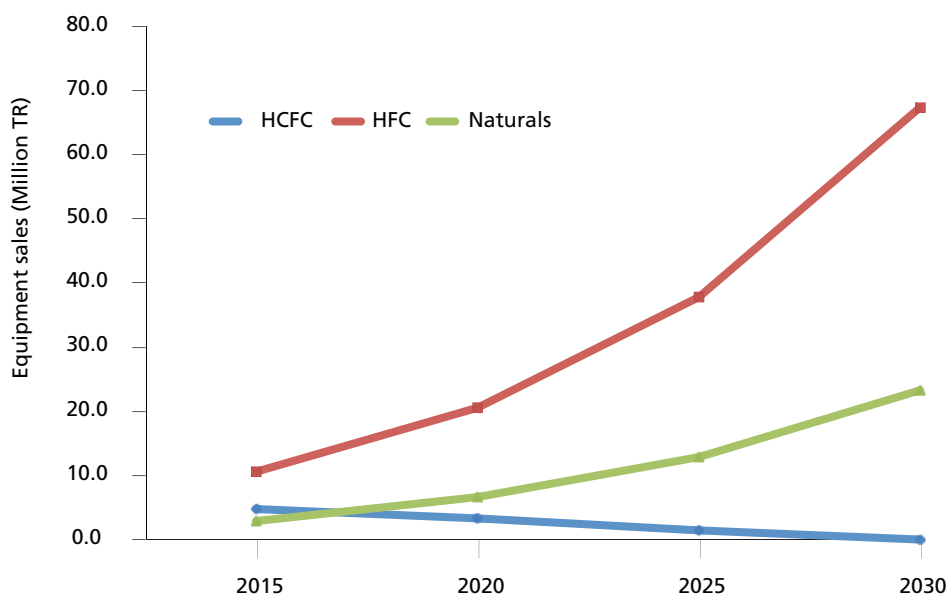


Source: cBalance Solutions

Refrigerant mix between 2015 and 2030

Sales of equipment using HFCs will rise about seven times and account for 75 per cent of total sales in terms of cooling capacity in a BAU scenario. The sales of RAC equipment using natural refrigerants (mainly including R290, R600a and ammonia) on the other hand is slated to rise more than 10 times and account for 25 percent of the total sales. This increase in natural refrigeration will be most prominently driven by the already mandated phase-out of HCFCs, as illustrated in graph 5.

GRAPH 5: REFRIGERANT MIX PROJECTION: 2015-2030



Source: cBalance Solutions

Potential of Naturals in India

The analysis shows that other than the MAC and transport refrigeration sectors, all other sectors can be converted to natural refrigerants with the help of currently available technologies. About 77 percent of the RAC sector can be converted to naturals by using currently available technologies, as illustrated in table 1 below.

TABLE 1: POTENTIAL OF NATURAL REFRIGERANTS IN INDIA

Sector	Natural alternatives	Percentage potential
Domestic Refrigeration	R600a	100%
Commercial Refrigeration	CO ₂ , R600a, Ammonia	100%
Industrial Refrigeration	Ammonia, R290	100%
Transport Refrigeration	None available	0%
Residential Airconditioning	R290	95%
Commercial Airconditioning	Ammonia	50%
Mobile Airconditioning	None available	0%
Total Potential	77% of India's RAC sector can be converted to naturals by using currently available technologies	

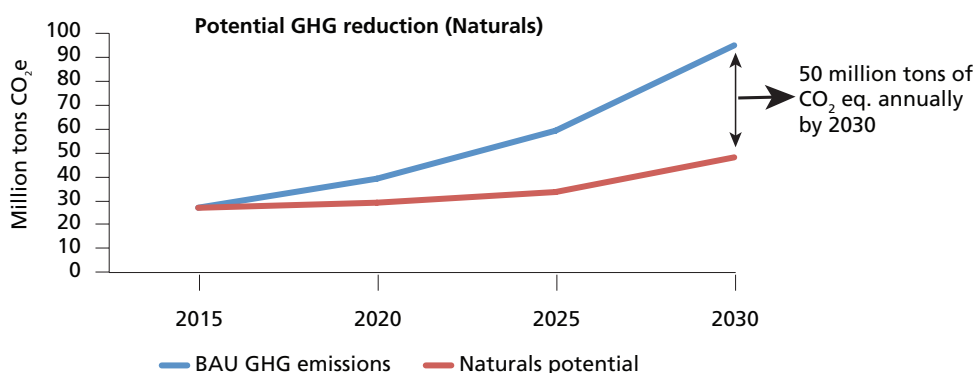
Source: cBalance Solutions



Potential direct GHG abatement with the help of a conversion to naturals

Prioritizing naturals will result in direct emissions saving of 50 million tonnes of CO₂e per year by 2030 in India. This accounts for more than 50 percent of the current emissions from HCFC and HFC use. The use of natural refrigerants with currently available technologies can make a significant reduction in emissions of high-GWP HFCs in India, as illustrated in graph 6 below.

GRAPH 6: POTENTIAL GHG REDUCTION THROUGH A CONVERSION TO NATURALS (2015-2030)



Source: cBalance Solutions

WAY FORWARD

The above analysis demonstrates that India and other Article 5 countries have an opportunity to phase-down a large portion on their HFC demand with the use of low-GWP, non patented, natural refrigerants. Reaching this potential however will require enabling regulations, updated safety standards and market incentives for first movers. The following actions can help India prioritize natural refrigerants in the HFC phase-down:

Amending ISO 5149

Among the most promising natural refrigerants especially in the domestic air-conditioning space (which accounts for 30% of cooling needs) is R-290 or propane. The use of this refrigerant has been curtailed due to exaggerated safety concerns, that are based on antiquated tests performed decades ago. This has led to restrictive safety standards, which are a major barrier to the large scale implementation of R-290 based technologies.

To make the existing standards more accommodative for the use of R-290 in domestic air conditioning, BIS has set-up a sub-committee to consider certain amendments to ISO 5149 - the most commonly applied standard for the use of flammable refrigerants in the air-conditioning sector. The sub-committee will look at the feasibility of changes to ISO 5149 that will allow for the wider use of R-290 with added safety considerations in the AC sector.

Supplementing India's energy efficiency enhancement initiatives

Enhancing energy efficiency is going to be crucial for ensuring India's energy security. The government of India has instituted a number of initiatives that promote the development and use of energy efficient equipment and technologies. These initiatives include – Perform, Achieve and Trade (PAT) scheme and the Bureau of Energy Efficiency's star rating program that is revised periodically to mandate improvements in energy efficiency. This is in addition to the standards endorsed by the government of India for energy efficiency of commercial and residential buildings.

The use of natural refrigerants offers significant energy efficiency advantages in almost all RAC sector applications. The use of these refrigerants will allow us to set more ambitious energy efficiency targets for ensuring energy security and reducing GHG emissions. A study by CSE estimates that a doubling of energy efficiency in the domestic air-conditioning sector alone will lead to reduction of 100 million tons of CO₂ equivalent annually in India by 2030.

Using flexibility to prioritize natural refrigerants

As part of the current negotiations for an HFC phase-down amendment to the Montreal Protocol, parties have agreed to flexibility in implementation of the agreed phase-down schedule. Under this mechanism Article 5 countries can “prioritize HFCs (to be phased down first), define sectors, select technologies/alternatives, elaborate and implement their strategies to meet agreed HFC obligations”⁴. This is a departure from the current mechanism wherein the Executive Committee of the MLF considers the cost effectiveness of transition in various sectors and technologies to decide how funding and therefore the phase-down in various sectors is prioritized.

Parties can use this flexibility to prioritize the use of natural refrigerants through funding from MLF for conversion of existing HFC and HCFC based RAC systems to natural refrigerants like hydrocarbons, ammonia and carbon dioxide. Utilizing this mechanism will be crucial for Article 5 countries to avoid an expensive transition with the use of patented fluorinated refrigerants.

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