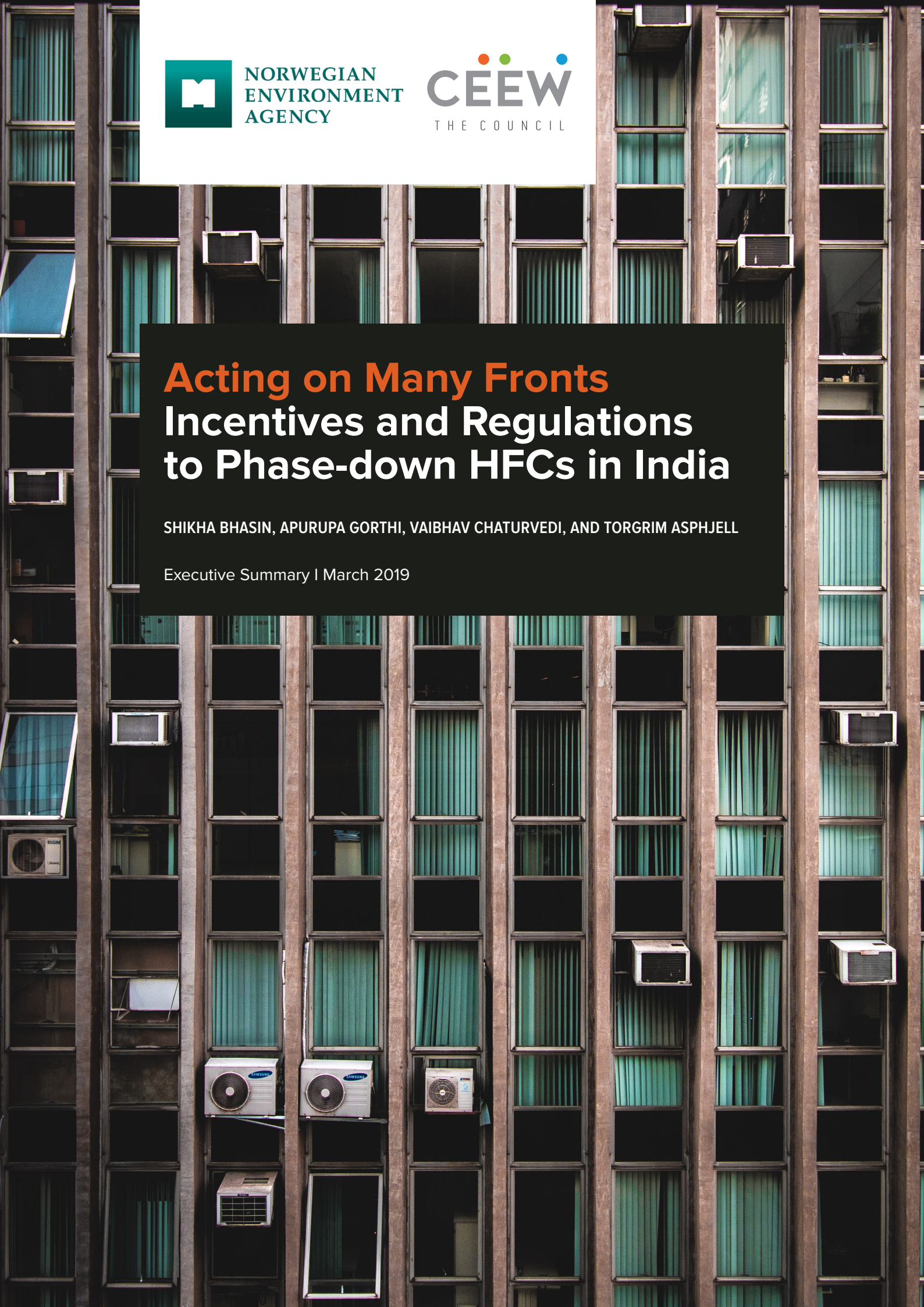

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Acting on Many Fronts
Incentives and Regulations to Phase-down HFCs in India

SHIKHA BHASIN, APURUPA GORTHI, VAIBHAV CHATURVEDI, AND TORGRIM ASPHJELL

Executive Summary I March 2019

Refrigerant-based cold chains are still largely underdeveloped in India. They have the potential to reduce post-harvest food losses and support India's goal of doubling farmer incomes.

Image: Jaun Rizvi

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ceew.in

Executive summary of the report on 'Acting on Many Fronts: Incentives and Regulations to Phase-down HFCs in India.'

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Organisations:

Council on Energy, Environment and Water

The Council on Energy, Environment and Water is one of South Asia's leading not-for-profit policy research institutions. The Council uses data, integrated analysis, and strategic outreach to explain and change the use, reuse, and misuse of resources. It prides itself on the independence of its high-quality research, develops partnerships with public and private institutions and engages with the wider public. In 2019, CEEW has once again been featured across nine categories in the '2018 Global Go To Think Tank Index Report'. It has also been consistently ranked among the world's top climate change think tanks. Follow us on Twitter @CEEWIndia for the latest updates.

Norwegian Environment Agency

The Norwegian Environment Agency (NEA) is a government agency under the Ministry of Climate and Environment, Government of Norway. The NEA employs over 700 personnel across two offices stationed in Trondheim and Oslo and at the Norwegian Nature Inspectorate's (SNO) sixty local offices. NEA's primary tasks are to reduce greenhouse gas emissions, manage Norwegian nature, and prevent pollution. The NEA is professionally independent.

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About CEEW

The Council on Energy, Environment and Water (CEEW) is one of South Asia's leading not-for-profit policy research institutions. The Council uses data, integrated analysis, and strategic outreach to explain - and change - the use, reuse, and misuse of resources. The Council addresses pressing global challenges through an integrated and internationally focused approach. It prides itself on the independence of its high-quality research, develops partnerships with public and private institutions, and engages with the wider public.

In 2019, CEEW once again featured extensively across nine categories in the '2018 Global Go To Think Tank Index Report', including being ranked as South Asia's top think tank (15th globally) with an annual operating budget of less than USD 5 million for the sixth year in a row. CEEW has also been ranked as South Asia's top energy and resource policy think tank in the latest rankings. In 2016, CEEW was ranked 2nd in India, 4th outside Europe and North America, and 20th globally out of 240 think tanks as per the ICCG Climate Think Tank's standardised rankings.

In over eight years of operations, The Council has engaged in over 210 research projects, published nearly 150 peer-reviewed books, policy reports and papers, advised governments around the world nearly 500 times, engaged with industry to encourage investments in clean technologies and improve efficiency in resource use, promoted bilateral and multilateral initiatives between governments on more than 60 occasions, helped state governments with water and irrigation reforms, and organised over 260 seminars and conferences.

The Council's major projects on energy policy include India's largest multidimensional energy access survey (ACCESS); the first independent assessment of India's solar mission; the Clean Energy Access Network (CLEAN) of hundreds of decentralised clean energy firms; India's green industrial policy; the USD 125 million India-U.S. Joint Clean Energy R&D Centers; developing the strategy for and supporting activities related to the International Solar Alliance; designing the Common Risk Mitigation Mechanism (CRMM); modelling long-term energy scenarios; energy subsidies reform; energy storage technologies; India's 2030 Renewable Energy Roadmap; energy efficiency measures for MSMEs; clean energy subsidies (for the Rio+20 Summit); clean energy innovations for rural economies; community energy; scaling up rooftop solar; and renewable energy jobs, finance and skills.

The Council's major projects on climate, environment and resource security include advising and contributing to climate negotiations (COP-24) in Katowice, especially on the formulating guidelines of the Paris Agreement rule-book; pathways for achieving INDCs and mid-century strategies for decarbonisation; assessing global climate risks; heat-health action plans for Indian cities; assessing India's adaptation gap; low-carbon rural development; environmental clearances; modelling HFC emissions; the business case for phasing down HFCs; assessing India's critical minerals; geoengineering governance; climate finance; nuclear power and low-carbon pathways; electric rail transport; monitoring air quality; the business case for energy efficiency and emissions reductions; India's first report on global governance, submitted to the National Security Adviser; foreign policy implications for resource security; India's power sector reforms; zero budget natural farming; resource nexus, and strategic industries and technologies; and the Maharashtra-Guangdong partnership on sustainability.

The Council's major projects on water governance and security include the 584-page National Water Resources Framework Study for India's 12th Five Year Plan; irrigation reform for Bihar; Swachh Bharat; supporting India's National Water Mission; collective action for water security; mapping India's traditional water bodies; modelling water-energy nexus; circular economy of water; participatory irrigation management in South Asia; domestic water conflicts; modelling decision making at the basin-level; rainwater harvesting; and multi-stakeholder initiatives for urban water management.

About NEA

The Norwegian Environment Agency (NEA) is a government agency under the Ministry of Climate and Environment, Government of Norway. The Norwegian Ministry of Climate and Environment has the main responsibility for ensuring integrated governmental climate and environmental policies. The NEA is dedicated to working for a clean and diverse environment. Through a merger between the Norwegian Directorate for Nature Management and the Norwegian Climate and Pollution Agency, the NEA was created in July, 2013.

The NEA employs over 700 personnel across two offices stationed in Trondheim and Oslo and at the Norwegian Nature Inspectorate's (SNO) sixty local offices. The SNO preserves national environmental values and prevents environmental crime by means of inspections, monitoring, information, guidance, and operative management in important natural and cultural heritage areas.

NEA's primary tasks are to reduce greenhouse gas emissions, manage Norwegian nature, and prevent pollution. They implement and give advice on the development of climate and environmental policy. The NEA is professionally independent. This means that they act independently in the individual cases that they decide and when they communicate knowledge and information or give advice.

NEA's principal functions include collating and communicating environmental information, exercising regulatory authority, supervising and guiding regional and local government level, giving professional and technical advice, and participating in international environmental activities. The NEA exercises authority pursuant to the Pollution Control Act, Product Control Act and Nature Diversity Act under the Ministry of Climate and Environment.

Acknowledgments

The authors of this report would like to thank the Norwegian Ministry of Foreign Affairs and the Royal Norwegian Embassy in New Delhi for their financial support for this project. We are particularly grateful to Erlend Draget and Vivek Kumar from the Embassy for their continued support.

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Shikha Bhasin is a researcher on climate change mitigation policies who has a keen interest in innovation systems for low-carbon technologies. She is currently leading The Council's research on regulatory incentives and approaches required for phasing down HFCs and enabling cooling in India. She has previously worked on the institutionalisation of an R&D platform to support the phase-down of HFCs in India, and has served as a member of the National Cooling Action Plan's R&D Working Group.

"Over a hundred stakeholder meetings to understand technologies, challenges, and policies that will enable India's contributions to potentially avoid 0.5 degrees of warming - this was an exhilarating research opportunity! India is home to so many development aspirations, and if we can crack our cooling and HFC challenge, we can contribute to jobs, industrial growth, productivity, health, and sustainability."

APURUPA GORTHI
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Apurupa Gorthi is a Research Analyst at CEEW on the Technology, Finance, and Trade team. Her research interests broadly concern climate change mitigation policies and the food-water-energy nexus. Prior to joining the Council, Apurupa served as a research intern and project lead for the Food and Water Security team in the Think Tanks and Civil Societies Program at the University of Pennsylvania.

"Interacting with industry stakeholders on a daily basis for this project taught me about the ground realities of this industry and the many opportunities for growth here. This study is especially important as it addresses India's international commitments through the voices of the industry stakeholders. What is encouraging is that they care about the environment just as much as I do."

VAIBHAV CHATURVEDI
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Vaibhav Chaturvedi is a Research Fellow at CEEW, and leads The Council's research on Low-carbon Pathways. His research focuses on Indian and global energy and climate change mitigation policy issues within the integrated assessment modelling framework of the Global Change Assessment Model (GCAM). Vaibhav has been part of Government of India committees for advising on issues related to energy and climate policy. He actively publishes in, and reviews articles for, leading international energy and climate policy journals.

"The Kigali deal has been done, and India has demonstrated its leadership in structuring the deal. Active domestic engagements and progress is required now to ensure that India aligns the objectives of the Kigali deal with its developmental goals as well as with the multiple objectives of its national cooling action plan. Without thinking strategically about regulations and incentive policies, India might miss achieving this strategic alignment."

TORGRIM ASPHJELL
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Torgrim Asphjell is a Senior Adviser at the Department of Climate in the Norwegian Environment Agency. His key fields of work include fluorinated greenhouse gases, climate gas inventories, and development assistance. With over 10 years of work experience on fluorinated greenhouse gases, Torgrim has been instrumental in the implementation of the regulations for these gases in Norway. He has worked at the Norwegian Public Administration on climate change, air pollution and other environmental issues since 1992. While he is currently working with the NEA and the Pollution Control Authority in Norway, in the past, Torgrim has worked for the Ministry of Environment in Norway and also the Norwegian Agency for Development Cooperation. He has a Master of Science in Mechanical Engineering from the Technical University of Norway (NTH).

"India is set to be one of the biggest AC and cooling markets in the world and it is crucial to make this transition as sustainable as possible. Norway is pleased to give inputs to the very professional team at CEEW and we hope that the Norwegian experience can contribute to finding the right path for HFC phase-down in India."

Author contributions

Shikha Bhasin
Led the design and execution of this research project. She led the development of the methodological framework, data collection, analysis of the results and the project's outreach strategy. She was responsible for initiating and maintaining working relationships with the interviewees and experts in India and internationally, as well as for coordinating all outreach activities relating to this research.

Apurupa Gorthi
Provided research assistance and support for the entire research project through desk-based studies, database management, data collection, data analysis, stakeholder meetings, and research writing.

Vaibhav Chaturvedi
Conceptualised the project and was one of the original contributors to the proposal for this research project. He was responsible for high-level engagement with project funders, and overall project management. He oversaw the execution of the entire project, providing management and strategic guidance at every stage.

Torgrim Asphjell
Was an original contributor to the proposal for this research projecton behalf of NEA. He supported the development of the research strategy for this project, providing guidance and feedback. Torgrim also organised the study trip to learn and gather information on Norway's and the European Union's strategies for enabling an HFC phase-down.

Abbreviations

AC	air conditioning
AHRI	Air Conditioning, Heating and Refrigeration Institute
AHU	air handling unit
B2B	business-to-business
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
CAC	commercial air conditioning
CARB	California Air Resources Board
CFC	chlorofluorocarbons
CGT	Classical Grounded Theory
CO_2e	carbon dioxide equivalents
CR	commercial refrigeration
CSO	civil society organisations
EMAS	Eco-Management and Audit Scheme
EOL	end-of-life
EU	European Union
F-gas	fluorinated gas
FTE	full-time employment
GDP	gross domestic product
GHG	greenhouse gases
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
Gt CO_2e /year	Gigatons of CO_2 equivalent per year
GWP	global warming potential
HC	hydrocarbons
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
HVAC	heating, ventilation, and air conditioning
HVAC&R	heating, ventilation, air conditioning, and refrigeration
IEA	International Energy Agency
IIT	Indian Institute of Technology
INR	Indian Rupee
IPCC	Intergovernmental Panel on Climate Change
ISHRAE	Indian Society for Heating, Refrigerating and Air Conditioning Engineers
IPUA	India Polyurethane Association
MAC	mobile air conditioning
MEA	Ministry of External Affairs
MLF	multilateral fund
MoEFCC	Ministry of Environment, Forest and Climate Change
MoU	memorandum of understanding
MRV	Measurement, Review, and Verification
MSME	micro, small, and medium enterprises
NCAP	National Cooling Action Plan
NEA	Norwegian Environment Agency
NGO	non-governmental organisation
ODS	ozone-depleting substances
OEM	original equipment manufacturers
OPSGGM	ozone protection and synthetic greenhouse gas management
R&D	research and development
RAC	residential air conditioning
RAMA	Refrigeration and Air Conditioning Manufacturers Association
RASSS	Refrigeration and Air Conditioning Service Sector Society
R&R	recovery and recycling
SINTEF	Norwegian Foundation for Scientific and Industrial Research
SLCP	short-lived climate pollutants
SNAP	Significant Alternatives Policy Program
SRG	ReturGass Foundation (Norwegian HFC/CFC waste collection company)
TEAP	Technology and Energy Assessment Panel
TPES	total primary energy supply
TR	tonnes of refrigeration
TWh	terawatt hours
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
USD	United States Dollar
VKE	Norwegian HVAC & refrigeration association

The executive summary of the report 'Acting on Many Fronts: Incentives and Regulations to Phase-down HFCs in India', is part of the CEEW - NEA research initiative on phasing down 'HFCs in India through Incentives and Regulatory Approaches' (HIIRA).

This research is an outcome of a CEEW-NEA partnership, funded by the Government of Norway, to understand forthcoming challenges and policy preferences to meet India's Kigali Amendment commitments to phase down HFCs.

Image: iStock

Contents

The complete report is available on ceew.in.

HFCs, commonly used as refrigerants, have a very high global warming potential. The Kigali Amendment to the Montreal Protocol established a global timeline to phase-down emissions resulting from their use.

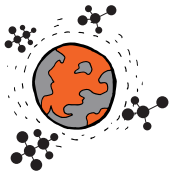
Image:Satish Kumar

Executive Summary

Limiting global warming upto a two-degree celsius temperature increase requires significant ambition and action. At the current rate, even if all global pledges made under the Paris Agreement are met, the world is set to warm by at least 2.7°C by the end of the century.[i] In this warming world, remaining safe, healthy, and productive has become even more challenging. Our rapidly urbanising population continues to find refuge in artificially cooled oases. This cooling, largely based on hydrofluorocarbons (HFCs), is an Achilles heel.

HFCs are far more potent than carbon dioxide as greenhouse gases. A transition away from these high-global warming potential (GWP) fluorinated gases holds the key to 0.5°C of global warming.[ii] In October 2016, 197 countries committed to the Montreal Protocol's Kigali Amendment, agreeing to lower consumption and production of HFCs with high global warming potential (GWP), in recognition of the role of HFCs in contributing to global warming.[iii]

The Government of India agreed to a timeline of curtailing national HFC emissions by 85 per cent by 2047, as part of the Kigali Amendment. India negotiated for an extended phase-down period, allowing it a window of opportunity to learn from global best practices, and to recalibrate domestic strategies and plans to successfully meet its international commitments while ensuring that gains on other domestic frontlines, such as industrial productivity, jobs and skilling, manufacturing capacity, technology improvements and R&D, energy efficiency, and others, are optimised.



In October 2016, 197 countries committed to the Montreal Protocol's Kigali Amendment, agreeing to lower consumption and production of HFCs with high global warming potential (GWP), in recognition of the role of HFCs in contributing to global warming

[i] Climate Action Tracker (2017) "Improvement in Warming Outlook as India and China Move Ahead, but Paris Agreement Gap Still Looms Large," Climate Action Tracker, November, available at https://climateactiontracker.org/publications/improvement-warming-outlook-india-and-china-move-ahead-paris-agreement-gap-still-looms-large/. accessed 12 January 2019.

[ii] Velders, Guus, David Fahey, John Daniel, Stephen Andersen, and Mack McFarland. (2017) "Climate Impacts of Montreal Protocol and Kigali Amendment," paper presented at the IO3C 30th anniversary MP Symposium, Paris, 28 March, available at http://www.montreal30.io3c.org/sites/montreal30.io3c.org/files/pictures/20%20matin/Velders_30MP_Symposium_Paris_Sept2017.pdf; accessed 12 January 2019.

[iii] India committed to reducing 85 per cent of its average production/consumption of HFCs compared to its baseline years (2024–2026). See Chapter 1 for more details.

The sectors that will lie at the heart of this refrigerant transition - residential air conditioning (RAC), mobile air conditioning (MAC), commercial air conditioning (CAC), and commercial refrigeration (CR) - are poised for significant growth that will add to India's GDP and job creation potential.[iv,v] Moreover, these sectors will also be central to India's development imperatives, including providing thermal comfort against heat stress to ensure well-being and productivity, minimising food losses through cold chain development, and enhancing energy savings as a result of efficient appliances and equipment.

In response to this international environmental and national development imperative, in 2018, the Government of India released a consultative draft of its National Cooling Action Plan (NCAP), the first country to do so.[vi] It also created and signed a memorandum of understanding (MoU) to enhance servicing technicians' training,[vii] as well as initiated efforts to update standards for some refrigerants that can be used as alternatives to HFCs.[viii,ix,x] The government has also recently announced a 'Global Cooling Prize' to encourage innovation for climate-friendly cooling.[xi] A snapshot of international and domestic policy drivers that are increasing the momentum towards climate-friendly cooling in India have been captured in the following page.

Continuing its efforts to research pathways to phase-down HFCs and transition to alternative refrigerants, CEEW signed an agreement with the Government of Norway in November 2017 to study incentives and regulatory approaches to enable the HFC phase-down in India.[xii] This research project, funded by the Government of Norway, has been undertaken in collaboration with the Norwegian Environment Agency (NEA). It intends to inform policymakers on the expected challenges and the role of regulations and policies in phasing down HFCs in sectors where these refrigerants are already in use, and where they could come into use in the near future.

Continuing its efforts to research pathways to phase-down HFCs and transition to alternative refrigerants, CEEW signed an agreement with the Government of Norway in November 2017 to study incentives and regulatory approaches to enable the HFC phase-down in India

It is widely accepted that the air conditioning and refrigeration sectors, as a whole, need to be overhauled to successfully transition away from HFCs. This will encompass changes and challenges for all parts of the supply chain, including: refrigerant and component manufacturers and suppliers; commercial users of these refrigerants and equipment; original equipment manufacturers (OEMs); research and testing labs; technology providers; standards authorities; educational and training institutions; operating, maintenance, and sales personnel.

[iv] Bhasin, Shikha, Lekha Sridhar, and Vaibhav Chaturvedi (2017) "Developing an Ecosystem to Phaseout HFCs in India: Establishing a Research and Development Platform," CEEW, September, available at https://www.ceew.in/publications/developing-ecosystem-phase-out-hfcs-india; accessed 12 January 2019.

[v] Chaturvedi, Vaibhav, Mohit Sharma, Shourjomoy Chattopadhyay, and Pallav Purohit (2015) "India's Long Term Hydrofluorcarbon Emissions," CEEW-IIASA Report, May, New Delhi.

[vi] Press Information Bureau (2018) "World Ozone Day 2018," Press Release, MoEFCC, Government of India, 17 September, available at http://pib.nic.in/newsite/PrintRelease.aspx?relid=183506; accessed 12 January 2019.

[vii] UNI (2018) "MSDE Inks MoU with Environment Ministry for Upskilling in AC Sector," United News of India, 2 August, available at http://www.uniindia.com/msde-inks-mou-with-environment-ministry-for-upskilling-in-ac-sector/business-economy/news/1307899.html; accessed 12 January 2019.

[viii] According to industry experts, BIS has created a panel to consider amendments to refrigerant standards for wider use of HC 290, a low-GWP, flammable refrigerant.

[ix] CSE (2016) "Safety Issues and Standards for HC-290 in Room Air Conditioners," Shakti Foundation, available at http://shaktifoundation.in/wp-content/uploads/2017/06/CSE-2016-Safety-issues-and-standards-for-HC-209-in-RAC.pdf; accessed 12 January 2019.

[x] According to industry experts, BIS has created a panel to consider amendments to refrigerant standards for wider use of HC 290, a low-GWP, flammable refrigerant.

[xi] For more information, please see https://globalcoolingprize.org/

[xii] Royal Norwegian Embassy. 2017. "Cool Alternatives." The Royal Norwegian Embassy in New Delhi, News and Events, December 4, 2017. available at https://www.norway.no/en/india/norway-india/news-and-events/new-delhi/news/cool-alternatives/; accessed 12 January 2019.

Increasing Momentum for Climate-friendly Cooling in India

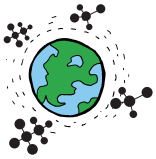
DETAILS INSIDE

1985

Vienna Convention. Established mechanisms for international cooperation **to address the Earth's ozone hole** caused by Ozone Depleting Substances (ODS).

1987

Montreal Protocol. Milestone global agreement to **tackle substances that deplete the ozone layer.**



1990

London Amendment. Montreal Protocol changed to mandate **complete phase out of CFCs and other ODSs** by 2000 in developed countries and by 2010 in developing countries.

2002

Indian CFC manufacturers pledge to **phase out CFC production by 2010.**

2003

India ratifies Copenhagen Amendment (1992), Montreal Amendment (1997) and Beijing Amendment (1999).

CFC phase out initiated.

2004

National CFC Consumption Phase out Plan for **service technicians** launched.

2005

India achieves 50% reduction in CFC production and consumption.

2006

India's Country Programme to phase out ODSs updated.

Bureau of Energy Efficiency (BEE) launches the first voluntary star labelling programme for home appliances.

2007

Montreal Protocol. Accelerated phase out of HCFCs adopted for all countries.

BEE launches the Energy Conservation Building Code (ECBC).

2016

Kigali Amendment.
Hydrofluorocarbons (HFCs) to be phased down globally.

R&D programme to develop alternatives to HFC refrigerants proposed by the Government of India.

Foam sector enterprises in India receive government support to transition from HCFCs to low GWP HFC cyclopentane.

BEE introduced an India-specific energy efficiency measure (Indian Seasonal Energy Efficiency Ratio (ISEER)).

2017

India's HPMP Phase II launched.

Energy Conservation Building Code updated to reduce building energy consumption.

2018

Draft National Cooling Action Plan released for public comments.

An MoU signed with Ministry of Skill Development and Entrepreneurship for **Recognition of Prior Learning scheme for service technicians.**

Global Cooling Prize launched to encourage climate-friendly cooling innovation.

Doubling of Farmers' Income by 2022 becomes a national agenda, encourages cold chain expansion.

Ministry of Power issues advisory to air conditioner manufacturing companies to limit minimum temperature of the units to 24°C for promoting energy efficiency.

2020-22

Baseline years for Article 5 (Group 1) Parties under the Kigali Amendment.

HCFC phase out complete in developed countries (2020).

Bharat Stage VI norms for vehicle to come into effect (2020).

2024-26

Baseline years for India (Group 2) under Kigali Amendment.

India to achieve 67.5% reduction in HCFC consumption and production (2025).

International treaties | Domestic policy drivers | Indirect domestic policy drivers

1991

Multilateral Fund (MLF). Established to **financially assist** Article 5 countries for ODS phase out.

India joins the Vienna Convention for the **Protection of the Ozone Layer.**

1992

Copenhagen Amendment. **Hydrochlorofluorocarbons (HCFC) included as ODS** to be phased out in 2030.

India signs the Montreal Protocol and ratifies the London Amendment.

India-Swiss-German collaboration (ECOFRIG) launched to **transfer ODS-free technologies** to refrigeration equipment manufacturers in India.

1993

India's Country Programme to phase out ODSs developed.

1997

Montreal Amendment. **Established HCFC phase out** in developing countries.

Kyoto Protocol. Adopted under the United Nations Framework Convention on Climate Change, to **control greenhouse gas emissions.**

1998

Indo-Swiss Human and Institutional Development in Ecological Refrigeration (HIDECOR) commences, aimed at encouraging **good servicing practices** for CFCs.

1999

Beijing Amendment. **Increased controls** on production and trade of HCFCs.

CFC freeze established for production and consumption under the Montreal Protocol.

2000

Ozone depleting substances (regulation and control) Rules 2000, enforced to **regulate production, consumption, export, import and trade.**

2008

ODS global consumption reduced by 98%.

India launches its Hydrochlorofluorocarbons Phaseout Management Plan (HPMP).

Ministry of Food Processing Industries initiates the **Scheme of Cold Chain, Value Addition and Preservation Infrastructure.**

2009-10

Universal Ratification. Montreal Protocol ratified by 196 countries (2009).

CFCs and Halons global production ends (2010).

India's baseline years for HCFC phase out.

BEE mandates star labelling for room air conditioners and frost-free refrigerators (2010).

2011-13

Baseline years for non-Article 5 Parties under the Kigali Amendment.

CFCs completely phased out (2012).

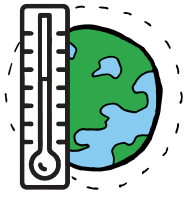
HCFC consumption and production frozen, as per the Montreal Protocol (2013).

2014

Make in India initiative launched to promote manufacturing.

2015

Paris Agreement. Limiting global warming to 'well under 2°C' target accepted.



2028

Freeze HFC production and consumption in India.

Increasing Momentum for Climate-friendly Cooling in India

Source: CEEW compilation, 2019

Image: iStock

Accomplishing this transition, as a result, will depend on the collaboration and cooperation of many actors. It will require calibrated and coordinated efforts all along the supply chain. Multiple governing agencies will also need to be actively involved, including ministries responsible for industry and commerce, human resource development, agriculture, health, buildings, automobiles, heavy industry, power, consumers, as well as the Ozone Cell of the Ministry of Environment, Forest and Climate Change.

Each of these actors has their own rationale, and their own barriers preventing them from moving forward. This research study is based on an effort to understand their challenges, and prioritise actions to address the rationales of different stakeholder groups.

For this study, the authors focused on stakeholder groups within industry, the main protagonist in the execution of India's Kigali commitments. The research methodology included desk research, study trips to countries with policies to phase-down HFCs, and a series of interviews with private-sector stakeholders across the RAC, MAC, CAC, and CR supply chains, supplemented by consultations with experts from academia and government.

The information gathered from these studies and discussions has been used to understand policy preferences, the challenges in undertaking an HFC phase-down, and the larger elements of the entire ecosystem that must be made ready for India's successful transition away from HFCs. Moreover, this study addresses India's transition imperatives in achieving HFC phase-down commitments internationally, while enhancing its industrial and economic value to meet its growing aspirations for adequate cooling and a better quality of life.

In an effort to bridge the research gap impeding India's policy discourse on phasing down HFCs, this report presents specific responses to the following research questions.

1. What policies and regulations do other countries use to phase-down emissions from HFC consumption and production?

2. Who are the different stakeholders in India (for example, HFC producers, equipment manufacturers, commercial building managers, service sector and waste collection personnel, etc.)?

3. What are the challenges for stakeholders, and what actions will they need to undertake, in order to move towards low-GWP refrigerant alternatives, and to reduce the operational and end-of-life emissions of high-GWP HFCs?

4. What policy incentives and regulatory approaches can propel the actions of different stakeholders towards an accelerated transition away from high-GWP HFCs?

Research findings arising from an attempt to answer these questions have been highlighted below. To this end, this report is an attempt at introducing policy choices that can support India's transition away from HFC gases. Key findings, on challenges and policy prescriptions, have been tabulated in the following spreadsheet ahead.

A. Learning from global regulations

Although the Kigali Amendment to the Montreal Protocol was formalised only in 2016, many countries have already established regulations, policies, and incentive structures to phase-down the use of high-GWP refrigerant gases. The authors undertook an extensive literature review to map out global regulations and policies affecting HFC consumption and resultant emissions. They supplemented this with a study trip to understand the regulatory framework of Norway and the European Union (EU), including policies and mandates spanning the supply chain, servicing standards and trainings, refrigerant technology references, leakage and operational management of equipment, as well as end-of-life disposal. Key lessons for India from global policies are listed below.

Lessons from global regulations and previous transitions:

- A successful transition will depend on policy coherence across a range of government agencies and multiple stakeholders.
- Industry is the key protagonist in undertaking the transition away from HFCs.

The critical role of industry and markets

- Firms remain the most significant stakeholders in implementing commitments made internationally to phase-down HFCs, and regulations should attempt to incentivise such actions.[xiii,xiv]
- Voluntary industry actions dissipate the need for imposing strong regulatory measures on industry.[xv, xvi, xvii]
- The purpose of regulations in this sector is to direct market behaviour, as evidenced in several studies.[xviii]

[xiii] Bergeson, Lynn L. (2017) "The Montreal Protocol Is Amended and Strengthened," Environmental Quality Management 26(3): 137–41.

[xiv] DeSombre, Elizabeth R. (2000) "The Experience of the Montreal Protocol: Particularly Remarkable, and Remarkably Particular," UCLA Journal of Environmental Law and Policy 19(1): 49–81.

[xv] Consumer Goods Forum (2018) "Refrigeration," available at https://www.theconsumergoodsforum.com/initiatives/environmental-sustainability/key-projects/refrigeration/; accessed 12 January 2019.

[xvi] Samuelson, Shiela (2010) "Voluntary Reporting of Carbon Emissions: How and Where?" Triple Pundit, available at https://www.triplepundit.com/2010/05/voluntary-reporting-carbon-emissions/; accessed 12 January 2019

[xvii] Schwarz, Winfried, Barbara Gschrey, Andre Leisewitz, Herold Anke, Sabine Gores, Irene Papst, Jurgen Usinger, et al. (2011) "Preparatory Study for a Review of Regulation," (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, European Environment Agency, available at https://www.eea.europa.eu/data-and-maps/indicators/emissions-and-consumption-of-fluorinated-2/preparatory-study-for-a-review; accessed 12 January 2019.

[xviii] Molina, Mario, Durwood Zaelkeb, K. Madhava Sarmac, Stephen O. Andersend, Veerabhadran Ramanathane, Donald Kaniaruf (2009) "Reducing Abrupt Climate Change Risk Using the Montreal Protocol and Other Regulatory Actions to Complement Cuts in CO2 Emissions," Proceedings of the Natural Academy of Science 106(49): 20616-20621.

- Some of the key qualifiers for the success of the Montreal Protocol include: (1) having a broad international agreement mandating global markets to move in a particular direction, thereby opening up a large market for companies offering non-CFC refrigerant-based products; (2) domestic regulations imposed on ozone-depleting substances (ODSs), to incentivise the use of alternative refrigerants; and (3) ensuring the representation of companies and industry in policy and technical discussions, encouraging them to find alternative technological solutions.[xix, xx, xxi]

HFC phase-down is a multi-institutional regulatory challenge

- A successful transition requires tackling the HFC phase-down through a regulatory framework that is based on systematic stakeholder engagement.[xxii]
- Different regulations have been employed for phasing down HFCs across the world, addressing HFC refrigerant use in terms of the supply side, demand side, service sector, and/or end-of-life disposal. [xxiii, xxiv]
- For a smooth transition to alternative refrigerants, it is imperative to establish regulations for safety and technology standards, national phase-down targets, operational emissions, and end-of-life disposal policies.[xxv]

A successful HFC phase-down in India will need in-depth and broad-based stakeholder interactions between the government, scientific community, and industry

- The success of the Montreal Protocol is largely attributed to regulations working in tandem with the private sector.[xxvi] Drawing on this, a successful HFC phase-down in India will need in-depth and broad-based stakeholder interactions between the government, scientific community, and industry.

B. Key stakeholders for India's HFC phase-down

As highlighted above, the HFC phase-down in India will require the participation of various stakeholders, both within and outside the government.

Based on literature, existing networks, consultations with experts, and the snowballing method, an estimation was made of the broad base of institutions, sectors, and supply chains impacted by, or influencing, India's Kigali Amendment commitments. Specific to this study, we identified key stakeholder groups in India, as detailed in the table on the following page.

[xix] Oye, K. A, and Maxwell, J H. (1995) "Self-Interest And Environmental Management", in Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains 191,198 (Robert O. Keohane & Elinor Ostrom, eds., 1995)

[xx] Greene, Owen (1998) The System For Implementation Review In The Ozone Regime, In the Implementation and Effectiveness of International Environmental Theory and Practice 89, 97-8 (David G. Victor et. al., eds. 1998)

[xxi] Hoerner, J. A, (2000) "Taxing Pollution, In Ozone Protection in the United States, 39-54.

[xxii] UNEP. 2016. "OzonAction Factsheet: The Kigali Amendment to the Montreal Protocol: HFC Phase-Down." UNEP. http://wedocs.unep.org/bitstream/handle/20.500.11822/26589/HFC_Phase-down_EN.pdf?sequence=1&isAllowed=y; accessed 12 January 2019.

[xxiii] see for example Zaelke, Durwood, Nathan Borgford-Parnell, and Stephen O Andersen (2018) "Primer on HFCs," Institute for Governance and Sustainable Development, available at http://www.igsd.org/wp-content/uploads/2018/01/HFC-Primer-v11Jan18.pdf; accessed 12 January 2019.

[xxiv] Brack, Duncan (2017) "National Legislation on Hydrofluorocarbons," Institute for Governance & Sustainable Development, available at http://igsd.org/documents/NationalLegislationonHydrofluorocarbons_9.11.15.pdf; accessed 12 January 2019.

[xxv] Based on learnings from study trip and literature review. Refer to Annex I and Annex II of the main report for details.

[xxvi] DeSombre, Elizabeth R. (2000) "The Experience of the Montreal Protocol: Particularly Remarkable, and Remarkably Particular," UCLA Journal of Environmental Law and Policy 19(1): 49–81.

Stakeholders to enable India's HFC phase-down

Stakeholder group	Key stakeholder
Government	» Ministry of Environment, Forest and Climate Change » Ministry of Power » Ministry of Consumer Affairs, Food and Public Distribution » Ministry of Commerce and Industry » Ministry of Skill Development and Entrepreneurship » Department of Science and Technology » Ministry of Finance » Ministry of External Affairs
International Stakeholders	» Governing bodies of the Montreal Protocol, the Paris Agreement, and other international treaties » Development agencies » Subsidiary bodies of the Montreal Protocol » Multilateral funds and banks » Other countries' governments
Research and Educational Institutions	» Think tanks and research organisations » Universities and research labs » Technical and other expert consultants
Industry	» Associations » Manufacturers and suppliers of refrigerant gases » Manufacturers and suppliers of components » Consultants and service providers » Primary users of refrigerants » Commercial users of end products

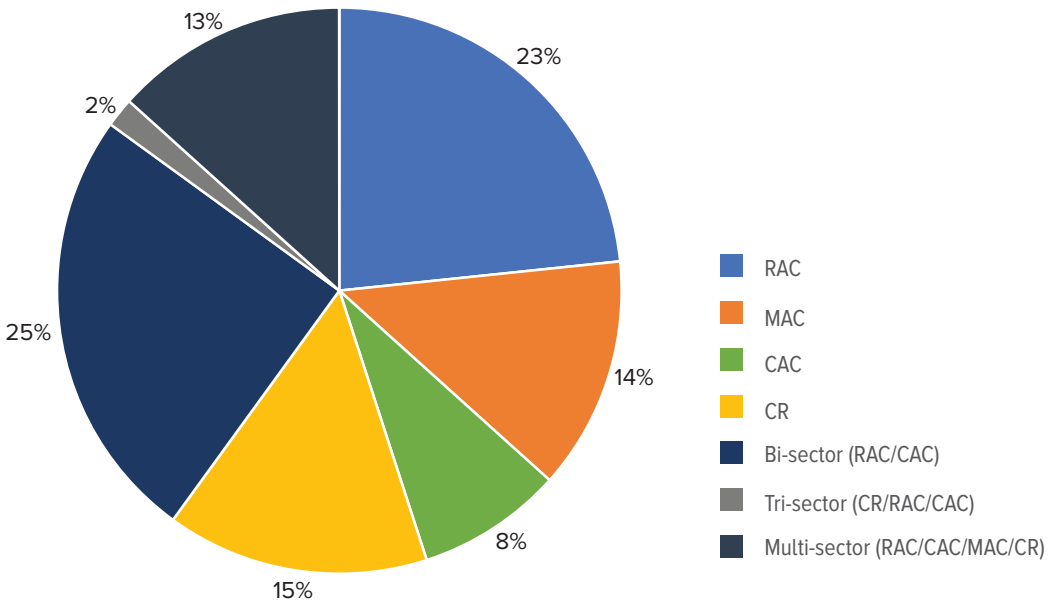
Source: CEEW compilation, 2019

C. Industry challenges and policy responses to propelling the phase-down of HFCs

Using the above mapping, industry stakeholders were identified across supply chain roles, and 60 mid- to senior-level respondents were interviewed for this study. These interviews were based on semi-structured questionnaires aimed at developing an understanding of industry's policy needs and regulatory preferences with regard to taking forward the challenge of transitioning away from HFCs in India.

The interviewees belonged to the RAC (23 per cent), MAC (14 per cent), CAC (8 per cent), and CR (15 per cent) sectors. Close to 40 per cent of the stakeholders were involved in two or more of these major sectors. In terms of supply chain roles, primary refrigerant consumers constituted the largest percentage of stakeholders, followed by component manufacturers/ suppliers, consultants and service providers, refrigerant manufacturers and suppliers, and commercial users of products. The authors also interviewed four industry associations representatives from the RAC, CAC, and CR sectors. The study also covers stakeholders from small, medium, and large enterprises, which are classified according to their annual turnover, representing 20 per cent, 27 per cent, and 46 per cent of the stakeholderbase, respectively. Associations were not classified in terms of enterprise size.

Sectoral mix of industry stakeholders interviewed



Source: CEEW compilation, 2019

Barriers to transition: policy uncertainty

In order to empirically understand and record the challenges and opportunities anticipated by stakeholders in enabling or undertaking HFC reductions, and the ways in which regulations or policy incentives could respond to them, we used qualitative data from interviews to construct a 'grounded theory'. Based on this qualitative analysis, we found that the largest drawback that unanimously came through in all interviews was the policy uncertainty, preventing companies from making adequate changes in preparation for phasing down HFCs in India.

The key reasons why this lack of policy certainty emerges so consistently as an impediment can be understood from the perspective of both supply chain readiness, as well as the investments that HFC phase-down would require.

Supply chain readiness

Alternative refrigerants' applicability

Stakeholders spoke of the need to know definitively which alternatives to high-GWP HFCs would be viable and available, before investing accordingly. While several natural and synthetic refrigerants have been identified and are being deployed globally as alternatives to HFCs, their application is contingent on several factors, including standards, charge limits, levels of energy consumption, safety aspects, as well as performance. For smaller players,[xxvii] these factors constrain future strategy and planning, especially given the lack of policy certainty around the phase-down in general, and the alternatives' standards and applicability in India. The lack of government-initiated pilot programmes to measure and test alternatives also contribute to this information gap.

[xxvii] Bergeson, Lynn L. (2017) "The Montreal Protocol Is Amended and Strengthened," Environmental Quality Management 26(3): 137–41.

Alternative refrigerants' affordability and availability

Sourcing affordable and adequately available alternative refrigerants is a huge anticipated challenge for industry. In India's previous refrigerant transition, the prices of refrigerants rose dramatically, and in smaller cities and towns there was a recorded shortage as well as price hike. This, in turn, led to the creation of an unorganised black market that sold the refrigerants, many of them uncertified blends, at an even higher price. The policy framework for any phase-down must include checks and balances, such that refrigerants are readily available in the market, and illegal market capture through imports and shortage-induced price manipulations are kept in check. Policy measures to consider while creating a regulatory framework to phase-down HFCs in India may include measures to monitor refrigerant availability by reporting national production; transparent and diligent testing of imports; minimising leakage during operations and at the end-of-life of the refrigerant; as well as indicating a 'maximum retail price' of various refrigerants.

Alternative refrigerants' standards and benchmarks

The lack of government-authenticated performance and safety benchmarks for alternatives discourages their uptake and investments towards R&D to optimise these refrigerants' applications in India

Several industry stakeholders have been working closely with the Bureau of Indian Standards (BIS) on reforming and updating standards for various low-GWP refrigerants; however, progress has been slow on multiple fronts in this regard. The lack of government-authenticated performance and safety benchmarks for alternatives discourages their uptake, and lowers investments towards R&D to optimise these refrigerants' applications in India. A fast-track window to develop or update different refrigerants' standards may be a way to indicate intent towards a low-GWP transition. More significantly, it may facilitate a fairer competition between various refrigerants in the market, rather than inadvertently picking winners based on a few established standards. India would also benefit by undertaking a life-cycle assessment of all alternatives coming into the market, given that several alternatives in use globally are being found to have negative environmental impacts.

Component availability and readiness

Some degree of change is required in components and system design for integrating any alternative refrigerant, even in the case of retrofitting replacement gases. In order to invest in such changes in systems and components, a clear timeline of how a phase-down will affect each sector (and thereby each company) is required, so that component manufacturers and suppliers can ready themselves. If this is not planned adequately as an opportunity for Indian industries to upgrade their supply chains, factories and companies will be forced to rely on imports and international suppliers, rather than encouraging innovation and investments among Indian component suppliers.

Service sector readiness

If the quality and safety of servicing practices are to remain intact, a minimum threshold for trainings has to be established

If the quality and safety of servicing practices are to remain intact, a minimum threshold for trainings has to be established by way of updated curricula, and more significantly, certifications for service technicians. Many countries prohibit non-licensed or non-certified service technicians from installing, servicing, or repairing air conditioners, or handling refrigerants. With such certifications, social welfare and

security can also be enabled through targeted insurance and repeated trainings. Investments and a blueprint for undertaking such a formalisation of the service sector will be necessary to create an ecosystem in which several refrigerant gases can exist in the Indian market. Moreover, training and the fomalisation of the service sector need to be accompanied by a policy instrument that mandates leak tests (in large and mobile applications especially) and establishes standardised professional servicing practices. Good policy-directed practices that have already been brought out in India, such as the banning of disposable cylinders, also need to be implemented effectively.

End-of-life disposal

In India, there is no mandate to recover, reclaim, or destroy refrigerant gases effectively. Even where facilities exist for the disposal of gases, the recovery and transportation costs act as a huge disincentive, so there is often a need for incentives or regulations to ensure recovery. This part of the value chain in India remains severely constrained and inadequately understood. Convenient and functional infrastructure, accompanied by policy mandates, is crucial to ensure safe and effective end-of-life management of gases. For India to meet its HFC phase-down targets, end-of-life disposal of refrigerants is important, as is reducing emissions during the operational life cycle. Given the lack of infrastructure, policy, and business action in India on this front, there is a need to identify and understand different business cases for effective policy implementation to minimize operational and end-of-life emissions.

Investment decisions

Investments will be directed towards safety on factory floors, infrastructure modulations, technology training, the cost of new manufacturing facilities, updating systems to adapt to the new refrigerant, and other verticals, in addition to the new cost of manufacturing or procuring the refrigerant itself

Any policy to phase-down HFCs will affect significant parts of the value chain; the transition will require investments in, and upgrading of, industrial supply chains in the heating, ventilation, and air conditioning (HVAC) sectors. For any change that the manufacturing or adoption of an alternative refrigerant will require, a company will need to pay for associated costs. Investments will be directed towards safety on factory floors, infrastructure modulations, technology training, the cost of new manufacturing facilities, updating systems to adapt to the new refrigerant, and other verticals, in addition to the new cost of manufacturing or procuring the refrigerant itself. As highlighted above, even gases that can be substituted for HFCs through retrofitting will still require some degree of component change. There is a need for clear policy directives to guide the timing of such an investment, especially given the cost-competitive market that India already is. Moreover, a strategic policy framework can propel investments towards R&D and increased manufacturing in these sectors, and provide a fillip to key policy initiatives of the Government of India, such as Make in India and Doubling of Farmers' Income.

Policy coordination and effective implementation

Given that refrigerant change will not occur in isolation, stakeholders across government agencies must cooperate to ease the transition, rather than imposing multiple mandates on industry. This will require policy cohesiveness between the Ozone Cell and other government agencies. A coordinated effort to meet India's HFC phase-down commitments can also benefit strategic industrial growth in cold chain development, enhanced energy efficient appliances, etc. Similarly, development and implementation of building norms, accompanied by the roll out

of alternatives to HFCs for cooling needs, must be considered. Furthermore, misuse or non-compliance with guidelines and norms set by the government, sale of spurious or substandard components and gases, and the use of equipment that is in direct violation of regulations must be checked. Ineffectiveness in policy implementation is a huge challenge for India, and is not limited to this sector.[xxviii]

Consumer awareness

For the supply side to deliver effectively, demand must also be created and assured for this transition. To aide policy in this direction, it is important to identify the role of information and awareness on consumer behaviour. Suggestions from industry with regard to policy interventions on this front include labelling systems for products which indicate environmental performance or 'goodness'. This awareness must also be reflected in larger training interventions for retail suppliers and sales teams.

Given the challenges faced by industry in phasing down HFCs, their expressed policy preferences, and their proven potential for leadership in this endeavour, there is a clear need for a robust regulatory framework supporting industry in the transition away from HFCs. The next section of this study, therefore, highlights the stakeholders' perceived preferences for specific HFC phase-down regulations and policies and their expected impact, as applicable in the Indian context.

D. Regulatory options for phasing down HFCs in India

Five policy options employed to lower HFC consumption in different parts of the world were handpicked in consultation with senior India experts from civil society, industry, and the Government of India's Ozone Cell. These were then assessed based on stakeholders' responses to them during the interviews. Interviewees were requested to rank these policies, as well as to indicate their preferences and the anticipated impact across two Likert scales, ranging from least to most desirable, and least to most impactful, respectively.

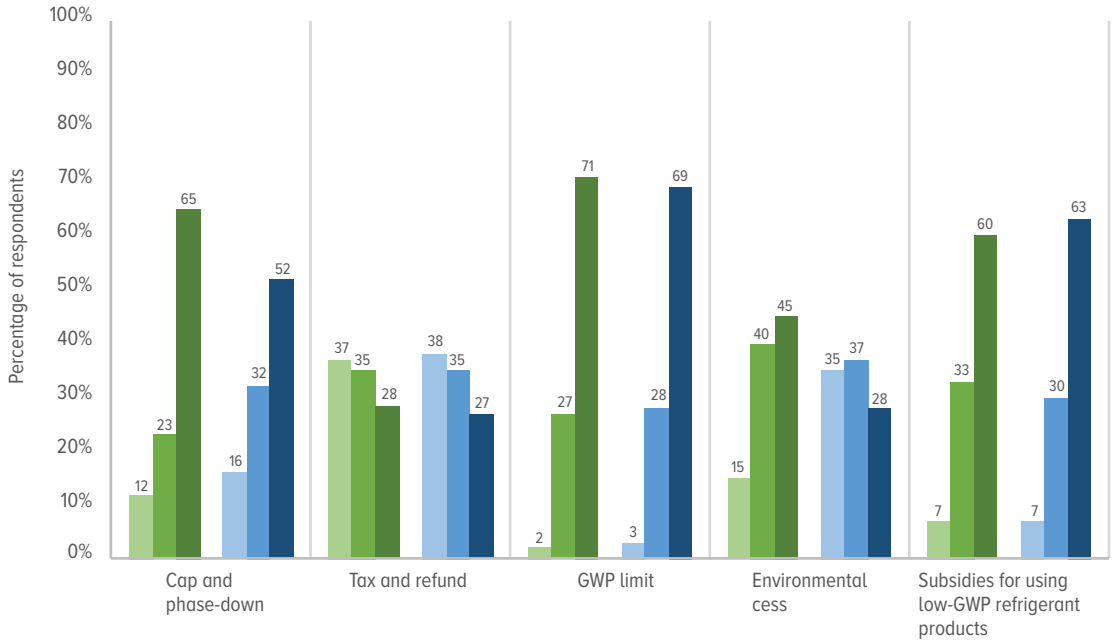
Responses on policy choices were evaluated at a macro-scale, following which data was reassessed to examine any trends emerging in policy choices based on sector (RAC, CAC, MAC, and CR) and enterprise size (small, medium, and large).

At the macro-level, a subsidy-based policy instrument emerged as the top policy choice, followed closely by the GWP limit policy instrument. This was based on a policy receiving the highest number of 'most impactful' and 'most desirable' ratings from stakeholders. The subsidy-based policy would be directed at users of refrigerants, so as to encourage demand creation for low-GWP alternatives to high-GWP HFCs; and the GWP limit policy suggested mandating medium-term targets on the maximum GWP value applicable on refrigerants in specific applications, based on current commercial viability.

On aggregating Likert scale values into negative ('not' and 'least') and positive ('mildly' and 'most') responses for policy preference and impact, we observed a slightly different trend. The GWP limit policy instrument emerged as the top choice in terms of preference and impact, followed by the subsidies-based policy instrument. Further, the GWP limit was ranked fifth (the lowest preference) by 18 per cent of the stakeholders, while 25 per cent of the stakeholders ranked the subsidies-based policy instrument, fifth. The third-highest ranked policy choice was cap and phase-down.

[xxviii] This is beyond the scope of the study at hand; hence, no policy recommendations are being indicated here.

Comparison between preference* and impact* of the policy options based on Likert scale evaluation



*Impact assessed as negative (number of respondents that marked a policy as least and not impactful), neutral (number of respondents that marked a policy as neutral), and positive (number of respondents marked a policy as mildly and most impactful). The same was done to assess preference (through 'desirability' markers, ranging from least to most desirable).

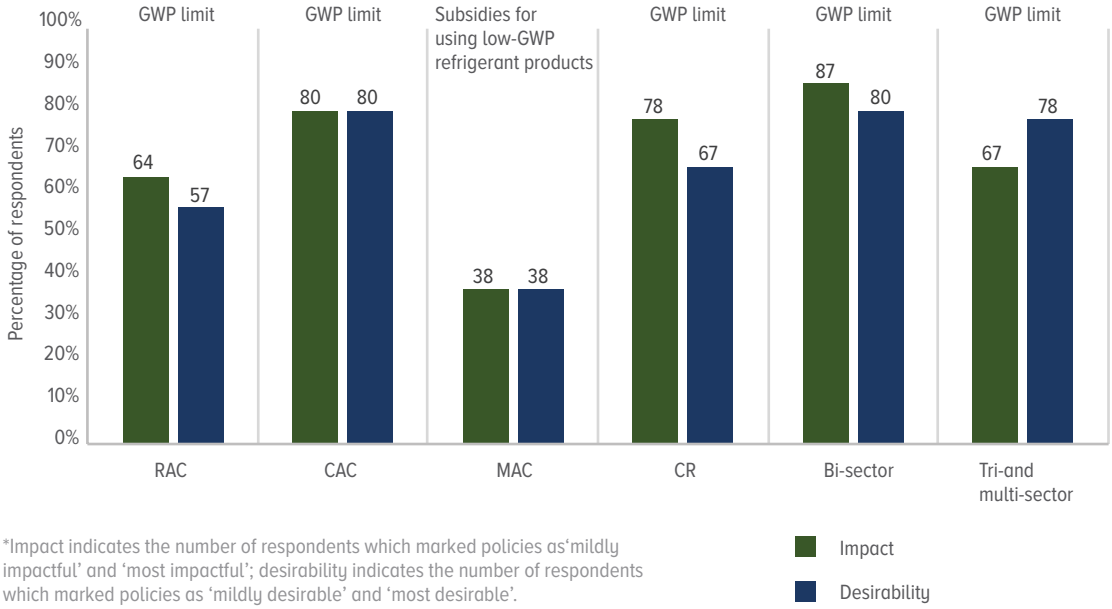
Source: CEEW compilation, 2019

Trends in policy choices based on sector and enterprise size

The top three policy choices at the macro-level, based on a sector-based classification (RAC, CAC, MAC, and CR) and on enterprise size (small, medium, and large) were: the GWP limit, subsidising low-GWP-based products, and the cap and phase-down approach.

In terms of positive impact and desirability, GWP limit was the top policy choice for all sectors, except MAC. 38 per cent of MAC sector stakeholders indicated subsidies for using low-GWP refrigerant products as their top policy choice, still, 25 per cent of MAC sector stakeholders also chose GWP limit.

Sectoral trends: Top policy choices based on impact* and preference*

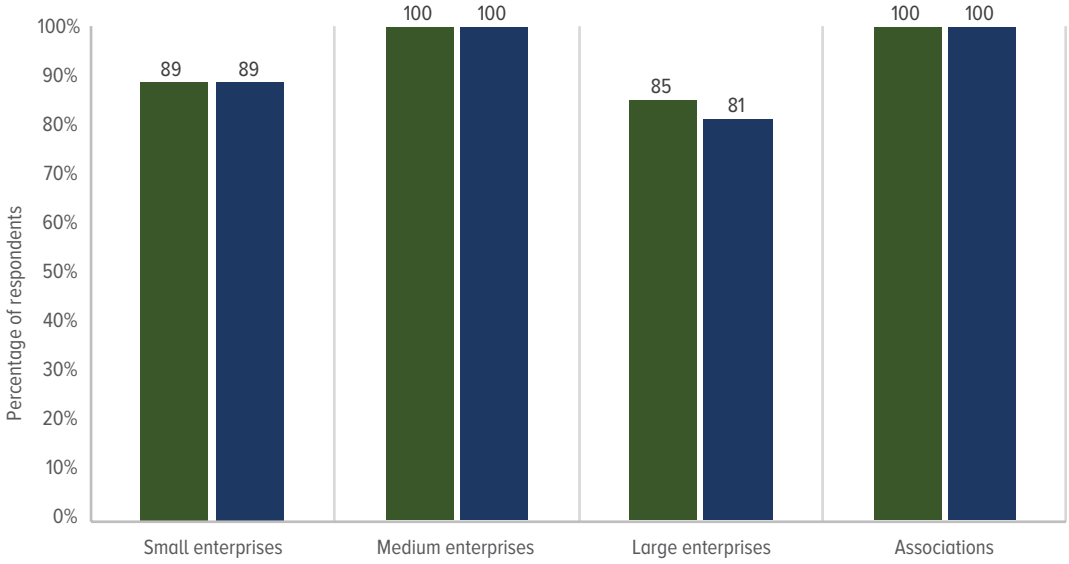


*Impact indicates the number of respondents which marked policies as'mildly impactful' and 'most impactful'; desirability indicates the number of respondents which marked policies as 'mildly desirable' and 'most desirable'.

Source: CEEW compilation, 2019

Medium-sized enterprises and associations unanimously selected GWP limit as the top policy choice in terms of preference and impact. Among large enterprises as well, the GWP limit emerged as the top policy choice in terms of impact and desirability. In terms of positive preference and impact, about 89% of small enterprises placed the GWP limit at the top.

GWP limit was the top policy choice across enterprises of different sizes based on impact* and preference*



*Impact indicates the number of respondents which marked policies as'mildly impactful' and 'most impactful'; desirability indicates the number of respondents which marked policies as 'mildly desirable' and 'most desirable'.

Source: CEEW compilation, 2019

Thus, based on the 60 stakeholder interviews, we find that the most popular and feasible policies according to industry were: (i) placing of GWP limits, (ii) subsidising low-GWP-based products, and (iii) the cap and phase-down approach. Among these, the GWP limit - based policy instrument emerged as the most popular, with a few deviations observed under specific conditions. At the macro-level, the aggregate positive responses for preference and impact were noticeably higher for the GWP limit option than for the subsidies-based policy instrument. Given that this policy choice was also validated as a key outcome of a closed-door industry roundtable that the research team hosted to share initial research results, the authors are able to conclude that a policy placing a medium-term GWP limit on refrigerant-based applications, based on current commercial viability, is the most preferred industry option for establishing India's HFC phase-down strategy.

E. Conclusion

India has a lot at stake in how industry in the RAC, MAC, CAC and CR sectors moves forward, from a domestic development perspective as well as from a global good, or environmental preservation, perspective. Despite the data that asserts the criticality of a timely and adequate transition to low-GWP refrigerants, research has yet to put forward the various policy elements that a regulatory framework in India must incorporate to achieve this end. This report is an attempt at bridging this research gap.

This report presents policy prescriptions based on the responses gathered from key stakeholders in Indian industry. The study empirically establishes that policy certainty is key to achieving India's international commitments to phasing down HFCs. This factor is most relevant for industry to initiate this transition, as it is crucial to enabling supply chain readiness and justifying the necessary investments.

Among the policies discussed with stakeholders to enable a refrigerant transition in India, the most preferred policy involved putting a medium-term limit on the GWP value of HFC refrigerant gases for each application, based on current commercial viability. A supplementary incentive for the end-user to promote low-GWP products would be an ideal policy package directed at discouraging high-GWP HFCs. Furthermore, checks and balances to implement these policies are critical to their success in India.

In addition to the above, ancillary policies to facilitate other refrigerant-management strategies should form an important part of India's phase-down strategy. These management practices could address servicing standards and the certification of service sector professionals as a way to limit operational leakages, as well as regulate the end-of-life recovery and disposal of refrigerants. There is an industry inclination towards the impending HFC transition, but the 'ecosystem' of the supply chain, policy directives towards end-of-life disposal, as well as service sector training and certifications, must be readied adequately for it to have an impact. This would also include institutionalising measurement, review, and verification (MRV) systems and agencies, in order to control stockpiling and the emergence of a second-tier black market, regulate the availability and pricing of refrigerants to avoid market manipulation, and bring out clear standards and safety mandates for all refrigerants to be able to compete in the Indian market.

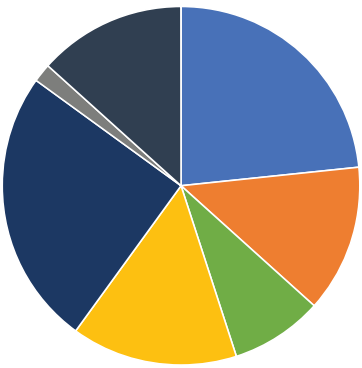
Finally, access to information regarding the refrigerant transition has to be systematically organised and widely diffused. This is important for consumers (to change purchasing behaviour and demand), for industry (to prepare itself for the impending refrigerant transition), and for service sector technicians (to ensure safety and maintenance).

Challenges and policy recommendations: Enabling India's transition to low-GWP refrigerants

Industry-group classification of survey respondents

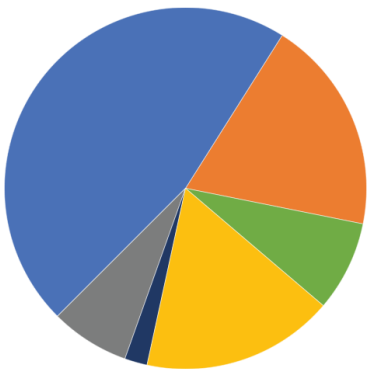
By sector

23%	RAC
14%	MAC
8%	CAC
15%	CR
25%	Bi-sector (RAC/CAC)
2%	Tri-sector (CR/RAC/CAC)
13%	Multi-sector (RAC/CAC/MAC/CR)



By supply chain role

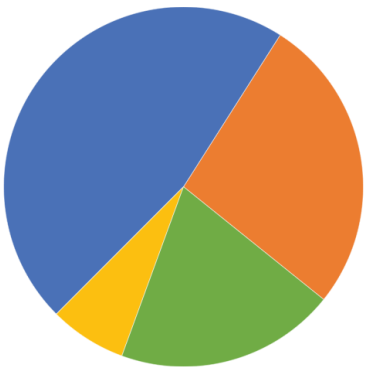
47%	Primary refrigerant consumers
19%	Component manufacturers/suppliers
8%	Refrigerant manufacturers/suppliers
17%	Consultants and service providers
2%	Commercial users of product
7%	Associations



Source: CEEW compilation, 2019

By size of enterprise

46% Large
27% Medium
20% Small
7% Associations



Policy recommendations
next page

Industry group	Challenge to transition
All	Investment justification and supply chain readiness
Small enterprises (across supply chain roles)	Alternative refrigerants' applicability
Refrigerant suppliers; primary users of refrigerants; commercial users of refrigerants	Alternative refrigerants' availability and affordability
All	Alternative refrigerants' standards and benchmarks
Component manufacturers and suppliers; commercial users of refrigerants; primary users of refrigerants; industry associations	Component availability and readiness
All	Service sector readiness
Primary and commercial users of refrigerants; service sector associations; other industry associations	End-of-life disposal
Medium enterprises (particularly: component manufacturers and suppliers; and primary users of refrigerants)	Investment in R&D
Refrigerant manufacturers; primary and commercial users of refrigerants	Investment in manufacturing
Large and medium enterprises (across supply chain)	Policy coordination
Primary users of refrigerants; service sector associations; refrigerant manufacturers and suppliers	Consumer awareness

Source: CEEW compilation, 2019

Policy recommendation	Key policy stakeholders
Medium-to long-term policy certainty to signal upcoming market reform to industry and regulators. **Imposing medium-term limits** on the permissible GWP value as per India's phase-down timeline, based on current commercial viability for refrigerants specific to every application.	Ozone Cell, MoEFCC
Publish government authenticated list of refrigerant alternatives and their application benchmarks specifically for India. **Increase pilot programme** to test and adjudge alternative refrigerants' applicability and usability in India. **Increase public procurement** of equipment using alternative refrigerants, especially those with energy efficiency gains.	Ozone Cell, MoEFCC; Department of Science and Technology; Ministry of Commerce and Industry; Ministry of Power
Indicate a medium-to long-term policy for refrigerant manufacturers and suppliers to ensure availability. **Create checks and balances** in the refrigerant market to ensure availability and affordability: • Institutionalise production and consumption reporting. • Establish a maximum pricing cap on refrigerants. • Effectively check stockpiling and illegal imports through stricter reporting and custom controls. • Ensure the quality of refrigerants through increased testing facilities.	Ministry of Finance; Ozone Cell, MoEFCC; Ministry of Commerce and Industry
Develop a fast-track window to update and develop standards for alternatives to high-GWP refrigerants. **Create government authorised benchmarks** for referencing these technologies usage.	Ministry of Consumer Affairs, Food & Public Distribution; Ozone Cell, MoEFCC; Department of Science and Technology
Indicate a medium-to long-term policy for component manufacturers and suppliers to ensure availability of components. **Public procurement programmes** can support development of know-how within component manufacturers and suppliers on reforms in value chain for low-GWP end-products.	Ozone Cell, MoEFCC; Ministry of Commerce and Industry
Large-scale trainings and certification schemes for service sector technicians. **Mandate good-servicing practices** to be employed across sectors. **Update curricula for trainings, and trainings of trainers,** to include low-GWP alternative refrigerants. **Create a labelling system** to help easily recognise the type of refrigerant in an equipment/ product.	Ozone Cell, MoEFCC; Electronics Sector Skill Council of India, Ministry of Skill Development and Entrepreneurship; Ministry of Commerce and Industry; Ministry of Human Resource Development
Establish infrastructure and a mandate to enable safe disposal of refrigerants.	Ministry of Power; Ozone Cell, MoEFCC
Institutionalise the collaborative R&D programme announced by Government in September 2016 to encourage innovations to support this transition. **Medium- to long-term policy certainty** on HFC phase-down plan for India.	Ozone Cell, MoEFCC; Department of Science and Technology; Prime Minister's Office
Recognise cooling sectors as strategic within industry-focussed programmes such as Make in India. **Assess the potential of import tariffs** on refrigerants and components that are being/have potential to be manufactured in India. **Establish mandates for certified quality and standards** on components to discourage their imports.	Ministry of Commerce and Industry; Ministry of Finance; Ozone Cell, MoEFCC; Ministry of Consumer Affairs, Food & Public Distribution
Minimise competing policy mandates on the sectors in a systematic manner. This would include issuing technological guidelines or mandates to ensure: • Energy efficiency enhancements are aligned with the impending refrigerant transition. • Building norms reflect the need for climate-friendly cooling or space comfort. • Cold chain development takes into account the impending refrigerant transition.	Ministry of Power; Ministry of Consumer Affairs, Food and Public Distribution; Ministry of Commerce and Industry; Ministry of Housing and Urban Affairs; Ministry of Food Processing Industry; Ozone Cell, MoEFCC
Demand-creating consumer awareness programmes for low-GWP products. **Labelling programme to suggest environment-friendliness** of appliances in addition to energy efficiency.	Ministry of Consumer Affairs, Food and Public Distribution; Ozone Cell, MoEFCC

The HVAC industry is poised for significant growth in India. Policy must nudge it to move forward in environmentally conscious ways.

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