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Making Sustainable Cooling in India Affordable

A Study of Financing and Cooperation Models

Aarti Nain and Shikha Bhasin

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Providers of low-emission cooling services face challenges such as lack of access to capital, unaware consumers, and inadequate risk cover.

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Aarti's research is centred on design and policies for low-carbon buildings and cooling. Aarti is the co-author of HVAC Market Assessment and Transformation Approach for India. She was an advisor for the *EESL Super-efficient Air-conditioning Programme*, *Building Energy Efficiency Programme*, and update of *India's Energy Conservation Building Code*.

"Business models that deliver sustainable cooling affordably and easily are critical for controlling India's cooling energy demand."

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Shikha leads CEEW's research on sustainable cooling. A co-author of the India Cooling Action Plan (ICAP), she continues to represent CEEW as a member in the ICAP working groups on the R&D and servicing sector. She continues to work on regulatory frameworks required to meet India's Kigali Amendment commitments and the institutionalisation of an R&D platform and formalisation of the servicing sector, supporting access to sustainable cooling.

"Enhancing access to sustainable cooling requires not just technological innovations, but also innovations in financing. This research is an attempt to spur the deployment of sustainable cooling in India"

Access to sustainable cooling can be increased through business models that reduce the upfront costs without compromising cooling performance.

Image: iStock

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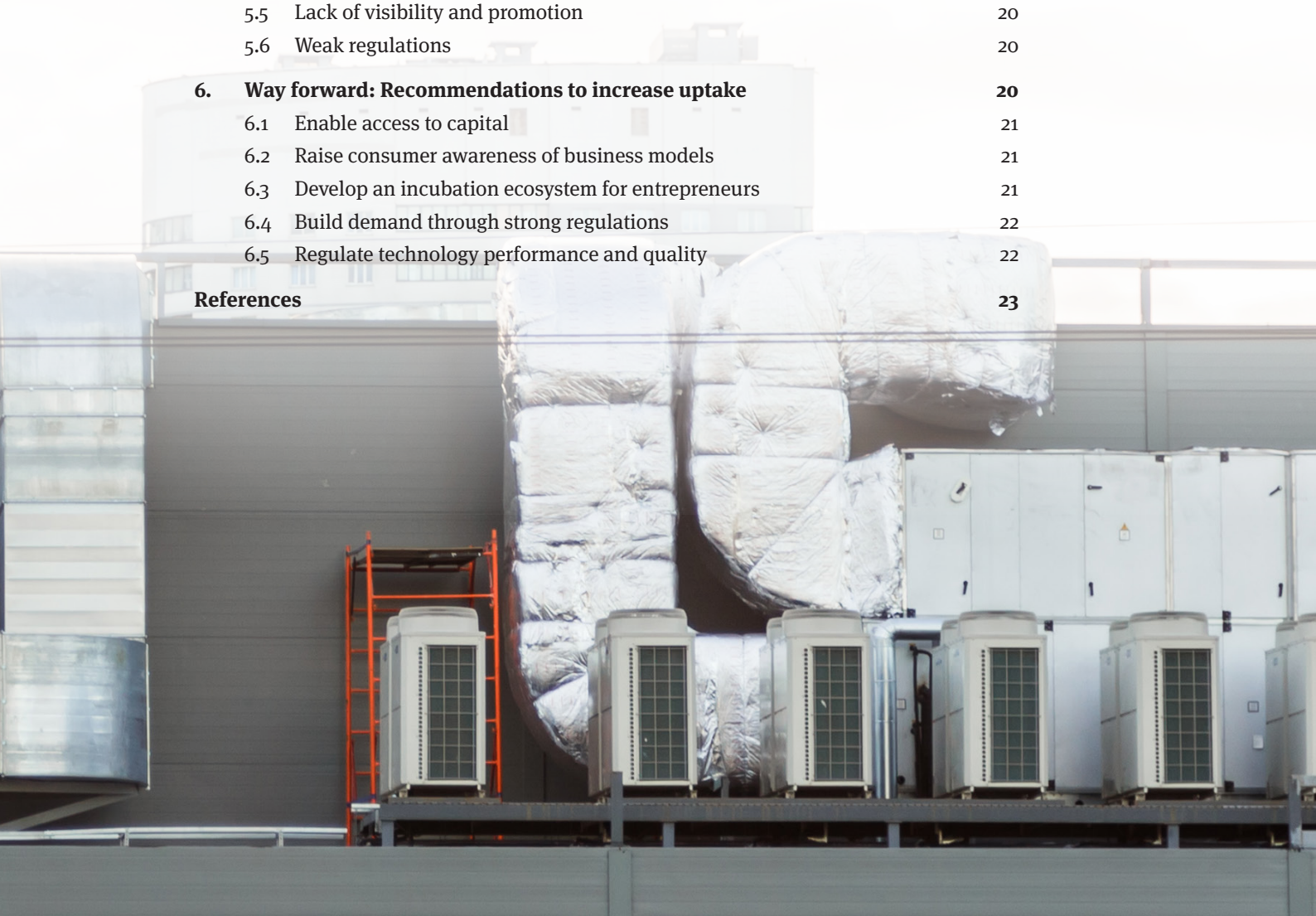


Acronyms

ADB	Asian Development Bank
ATM	automated teller machine
BEE	Bureau of Energy Efficiency
BEEP	Building Energy Efficiency Program
BLDC	brushless direct current
CaaS	Cooling-as-a-Service
CDP	Cluster Development Programme
CII	Confederation of Indian Industries
CPI	Climate Policy Initiative
CPWD	Central Public Work Department
DISCOM	distribution company
DSM	demand side management
ECBC	Energy Conservation Building Code
ECREE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EESL	Energy Efficiency Services Limited
EPC	energy performance contract
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCO	energy service company
ESEAP	EESL's Super-Efficient AC Program
FAME	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles
FFP	Farmer FIRST Programme
FICCI	Federation of Indian Chambers of Commerce & Industry
GDP	gross domestic product
GEF	Global Environment Facility
GEM	Government e Marketplace
GHG	greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GWP	global warming potential
HVAC	Heating, Ventilation and Airconditioning
ICAP	*India Cooling Action Plan*
IEA	International Energy Agency
IFC	International Finance Corporation
ILO	International Labour Organization
K-CEP	Kigali Cooling Efficiency Program
kWh	kilowatt hours
LED	light emitting diode
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoP	Ministry of Power
MSME	Micro, Small and Medium Enterprise
O&M	operations and maintenance
OBF	on-bill financing
OBR	on-bill repayment
OBW	on-bill wage
OEM	original equipment manufacturer
OWF	on-wages financing
PAT	Perform, Achieve and Trade
PRGFEE	Partial Risk Guarantee Fund for Energy Efficiency
PRSF	Partial Risk Sharing Facility
PWD	Public Works Department
RAC	room air conditioner
S&L	Standard and Labelling
U4E	United for Efficiency
UJALA	Unnat Jyoti by Affordable LED for All
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USD	United States Dollar
VCCA	Virtual Cold Chain Assistant
VCFEE	Venture Capital Fund for Energy Efficiency (VCFEE)

Almost all enterprises applying CaaS, ESCO, or OBF in India depend on social impact investors or blended finance from development banks for capital.

Image: Alamy

Executive summary

In India, equitable access to sustainable cooling is exigent for climate sustainability, economic productivity, and public health. Greenhouse gas (GHG) emissions from cooling are estimated to account for at least 7 per cent of total annual national emissions by 2037.[1] Considerable loss in labour productivity cannot be ruled out. As the planet warms up, 6 per cent of working hours may be lost to heat stress (ILO, 2019). Lack of respite from higher temperatures has already resulted in increased heat-related mortality cases and debilitating ailments such as organ failures and respiratory distress (National Disaster Management Authority 2019).

Regulations and financial support are equally important in guaranteeing access to low-emission cooling. Policies such as the *India Cooling Action Plan*, *Standard and Labelling Scheme*, and *Energy Conservation Building Code* have nudged supply and demand to some extent. Public investment through government technology deployment programmes (e.g., EESL's *Super-efficient Air-conditioning Programme*) has accelerated research and commercialisation of highly efficient products.

A key barrier that hinders mass adoption of sustainable cooling technologies despite favourable policies and public investment is that these technologies still remain unaffordable for the average buyer. While a majority of urban India is aware of energy efficiency programmes and appliances, less than 14 per cent of AC owning households have a 4- or 5- star labelled efficient AC; largely owing to budgetary constraints. (Bhasin et al 2021). Private-sector financing and the ingenuity of private actors in innovating technology and applying new models are needed to bridge this gap. This study was undertaken to examine business models that can deliver *sustainable* and *affordable* cooling profitably. Understanding the value additions of these business models and the factors that foster and inhibit their potential in India can inform pragmatic actions.

> **Affordability is a key barrier that hinders the mass adoption of sustainable cooling technologies.**

A. Enterprises face challenges in scaling up market share

Most technology suppliers have largely ignored the latent market opportunity represented by consumers interested in, but unable to afford, cooling. So far, not many companies in India are pioneering new business models to sell sustainable cooling technologies or services. An inadequate financing ecosystem for entrepreneurs, seasonal usage, cost of capital and lack of awareness among potential consumers and investors, have emerged as the biggest roadblocks. Businesses face challenges of uninformed consumers, low consumer-paying capacity, and consumer reticence to experiment with nascent technologies. Remote and geographically disbursed markets pose problems for consumer acquisition and establishing effective after-sales service networks. Scalability and growth are hindered by inadequate risk cover to protect against investment losses, risk-averse lenders, and weak investor interest.

The market-centric models reviewed in this brief – namely, cooling-as-a-service (CaaS), on-bill financing (OBF), dealer financing, leasing, energy service company (ESCO), and bulk procurement –address the affordability of sustainable cooling technologies by either reducing prices of energy efficient products or financing 100 per cent of the upfront costs. CaaS frees the end user from managing cooling systems. It inherently promotes low-emission technologies. Savings in the operational costs of cooling and refrigeration systems multiply profits for providers and affordability for end users. ESCO reduces consumer risks associated with investing in efficiency and minimises upfront costs. Dealer financing, leasing, and OBF help consumers with inadequate assets meet upfront costs. Bulk procurement makes newly commercialised or yet-to-be-commercialised technologies cost-effective.

B. Increased access to equity and consumer sensitisation will improve scalability of innovative business models

A combination of strategies are required to increase equity investment and motivate consumer familiarity with these models, the technologies they espouse and their benefits.

1 Authors' analysis based on data from cooling demand projections in India Cooling Action Plan and total emissions in NITI Aayog's India Energy Security Scenarios (IESS) 2047 tool.

Entrepreneurs that seek to increase the affordability of low-emissions cooling products must have increased access to private equity. Start-ups in the cooling sector are too small to qualify for debt financing, and, hence, they depend on equity to operate and grow. Domestic investors expect aggressive returns, and consider these business models inherently risky due to the perceived low credit worthiness of the end users served. Cost of financing is also high in India. As a result, investment flows remain limited and businesses rely almost exclusively on international social impact investors, concessional loans, and non-returnable grants from development organisations or philanthropic funds.

To scale, businesses working with models such as CaaS or OBF will require commercial debt. Commercial lending institutions must be made aware of the bankability of these businesses and their customers. Loan products, which specifically address the peculiarities of cooling markets, and well-designed risk guarantee instruments must be introduced. Currently, risk guarantees for efficiency and clean energy are primarily facilitated by development banks, but they do not address the techno-commercial risks.

Retail consumers must be made aware of value and the significance of lifetime-ownership costs over immediate-ownership costs to create demand for sustainable cooling systems. Traditional marketing messages, which target price sensitivity of retail consumers, emphasise the immediate affordability of cooling systems. Energy-use efficiency and its long-term benefits for owners and the climate are ignored; the resulting consumer perceptions must be overturned.

Consumer demand for climate-friendly cooling must be reinforced through mandatory regulations. Regulations in favour of low-emission cooling other than the *Standard and Labelling* (S&L) programme, and *Perform, Achieve and Trade* (PAT) scheme, are voluntary. Mandatory use of sustainable cooling systems in the public sector and stricter enforcement of energy efficiency codes can help build the demand for innovative business models. Energy Conservation Building Codes for commercial and residential buildings can be turned into mandatory norms. Equipment replacement policies at manufacturer recommended lifecycles can also be introduced.

Finally, consumer behaviour, supply chain capacity, environmental or efficiency performance norms and nuances of these models itself must be studied in detail and continuously to refine their applicability and enhance their potential for overcoming barriers to supply of affordable, sustainable cooling technologies.

1. Enhancing access to sustainable cooling

In India, cooling is intricately linked to climate change, socio-economic development, health, and productivity. Tourism, healthcare and pharmaceuticals, precision manufacturing and food and beverages depend highly on cooling. Growth in these sectors will also drive cooling demand in addition to comfort cooling. The national cooling energy demand is expected to increase eight-fold from the 2018 baseline to about 1,000 tonnes of refrigeration (TR) by 2038, without interventions (MoEFCC 2019). This translates to annual greenhouse gas (GHG) emissions of 810 million tonnes CO_2e, nearly 7 per cent of the total annual national emissions estimated for 2037.[2] Cooling also adds significantly to peak power demand. In the national capital, New Delhi, about 40–60 per cent of summer peak demand is attributed to residential air conditioning (Phadke, Abhyankar and Shah 2013).

Public health and economic productivity in India will also be very sensitive to increased global temperatures. India may lose nearly 6 per cent of working hours by 2030 on account of heat stress, compared to the global average of 2.2 per cent (ILO 2019). Higher average temperatures will result in the loss of 34 million jobs in India during the same period, concentrated disproportionately among low- and low-middle-income groups. India's gross domestic product (GDP) loss could amount to USD 100 billion or more, annually (ILO 2019). Public health will also be harmed. Heat related mortality cases in India have increased manifold in recent years (National Disaster Management Authority 2019). Long term health ailments such as organ failure and respiratory distress resulting from heat stress have been documented (Intergovernmental Panel on Climate Change 2014).

Fulfilling India's huge cooling demand without exacerbating climate change requires substantial regulations and investment flows. Policies introduced to improve access to climate-friendly cooling are well designed, but they are constrained either by conflicting market priorities or weak institutional capacity for implementation. Updates to the S&L scheme to increase

2 Authors' analysis with data from cooling demand projections in the India Cooling Action Plan and total emissions in NITI Aayog's India Energy Security Scenarios (IESS) 2047 tool.

With high public debt and insignificant public spending on sustainable cooling, the private sector must be tapped.

the baseline efficiency of cooling systems have lagged. Other standards that prescribe energy and emissions norms remain voluntary.

The sector remains financially underserved as well. There are significant gaps in private- and public-sector financing for climate change mitigation in India. USD 21 billion was invested in 2019 against a requirement of USD 150–170 billion for green finance. Domestic commercial financing institutions contributed about 40 per cent of the total, but the bulk was allocated to renewable energy (CPI 2020). Public spending[3] on low-emission cooling is similarly insignificant. The majority is allocated toward improving the cold chain via agricultural infrastructure development schemes (Table 1). It is also unrealistic to expect public investment in cooling to increase drastically, given India's high public debt, which reached 52 per cent of the GDP in 2021 (MoEFCC 2019).

In this context, a potential way forward is tapping the private sector, both for finance and delivering innovation. A transition to sustainable cooling technologies, facilitated by new business models and financing, presents a major opportunity for simultaneous economic and job growth as well as emissions curtailment (UNEP and IEA 2020). The *India Cooling Action Plan*, the primary roadmap for curbing emissions from cooling, prioritises the commercialisation of more sustainable cooling technologies and underscores the role of the private sector in developing the market for sustainable technologies (MoEFCC 2019).

This brief examines market-centric models for the private sector, acting independently or in partnership with the public sector, to deliver sustainable and affordable cooling. It also reviews challenges to their scalability and solutions. Understanding the value additions of business models and the factors that foster and inhibit their potential in India can inform policy actions to unlock private-sector finance.

Table 1 Key ongoing direct and indirect public investment schemes for sustainable cooling

Implementing or financing agency	Programme details
Government or public sector	• The *Super-efficient Air Conditioning Programme* and *Building Energy Efficiency Programme* initiated by the Energy Efficiency Services Limited are large-scale technology deployment programmes for energy-efficient commercial and residential cooling • The *Farmer FIRST Programme* (FFP) by the Indian Council of Agriculture aims to improve production and productivity through technological innovations in climate-resilient agriculture and post-harvest management including cold storage (Objective of Farmer FIRST Programme 2021) • *Pradhan Mantri Kisan SAMPADA Yojana* and *Scheme of Cold Chain, Value Addition and Preservation Infrastructure* by the Ministry of Food Processing Industries provides financing to private companies, farmer organisations, and self-help groups for the development of cold chain infrastructure (Ministry of Food Processing Industries_Schemes: Cold Chain 2021) • The *Horticulture Cluster Development Programme* by the Ministry of Agriculture and Farmers Welfare supports investment in infrastructure to reduce post-harvest losses, including in cold storage (Cluster Development Programme (CDP 2021) • The Bureau of Energy Efficiency's *Partial Risk Guarantee Fund for Energy Efficiency* (PRGFEE) extends risk guarantees to financial institutions lending to ESCOs. The Venture Capital Fund for Energy Efficiency (VCFEE) provides equity, either up to INR 2 crore or greater, through a special purpose vehicle to ESCOs or customers implementing energy-efficiency projects (Ministry of Power 2021)

3 Public spending is defined as investmentsinvestment from government agencies, public institutions, multilateral agencies, and development banks.

Implementing or financing agency	Programme details
Asian Development Bank	• Concessional loan to Energy Efficiency Services Limited (EESL) for the *Super-efficient Air-conditioning Programme* to develop markets for energy-efficient and low global warming potential (GWP) room air conditioners (RACs) • ADB Ventures' USD 60 million trust fund provides seed, early, and early-growth stage equity of up to USD 3 million to start-ups (ADB Ventures 2021)
World Bank	Concessional loan and risk guarantee to Energy Efficiency Services Limited for the *Super-efficient Air-conditioning Programme* and *Building Energy Efficiency Programme*Program
International Finance Corporation	The *IFC TechEmerge Cooling Programme* provides grant funding for pilots proving the viability of cost-effective technologies and business models to meet the hospitality sector's cooling needs. It has a strong focus on IoT-enabled efficiency, passive cooling, and efficient equipment (IFC TechEmerge Sustinable Cooling in the Indian Hospitality Sector 2021)
GIZ	The *EE Cool Programme* for promoting business models and policies for district cooling systems to fulfil ICAP objectives
United Nations	• USD 98 million program for *Accelerating adoption of super-efficient technologies for sustainable thermal comfort in buildings in India* by United Nations Development Programme (UNDP), in partnership with Global Environment Facility (GEF) focuses on harmonisation of Energy Conservation Building Code and India Cooling Action Plan and development of evidence to promote investment in thermal comfort (GEF 2020). • USD 100 million project by UNIDO and GEF, *Promoting market transformation for energy efficiency in Micro, Small & Medium Enterprise* encourages deployment of 35 energy efficient technologies in partnership with EESL (PIB 2021). • Prāṇa project, a USD 12 million demonstration project on net-zero carbon, net-zero water use, zero waste and a net energy surplus cold chain packhouse based on circular economy principles that can contribute to a more resilient local power grid. It supports development of sustainable cold chain services for the agricultural and vaccine supply chain (Cool Coalition 2021).

Source: Authors' analysis and sources as cited

Note: Investments of less than USD 1 million in research and policy development are excluded. Indirect investment schemes support sustainable cooling but as a subset of another primary objective (for example, clean energy technologies promotion or agri-processing reforms).

Methodology

We used a mixed methodology for this study that combined literature review and interactions with stakeholders in the supply chain. Primary research focused on analysing existing market challenges, important cooling technologies, and possible business models.

The first step was a review of market barriers on both the supply and demand sides. Next, we mapped challenges to the adoption of advanced and climate-friendly technologies by consumers by reviewing existing studies. We also examined the shortcomings of existing business models in creating consumer demand for green cooling systems.

Our literature review included the *India Cooling Action Plan 2019* and market research reports on the domestic cooling market to shortlist critical technologies that have the greatest potential to reduce GHG emissions and to contribute positively to health and socio-economic development. Models applied successfully for these technologies were identified next. We selected business models for sustainable cooling market development from two sources: a) studies published by the International Finance Corporation, World Bank, United 4 Efficiency, and the United Nations, and b) businesses with innovative models that have succeeded in gaining a foothold in the cooling market. We have also analysed the value propositions and challenges of business models applied in India and globally. Finally, we interviewed entrepreneurs, manufacturers, and consultants to understand the challenges hindering these models and their potential. Consultations with stakeholders focused on issues influencing proponents in the immediate time frame such as:

- Market demand drivers and challenges from traditional businesses and consumers
- National policies and the global context affecting market growth
- Complexities in technology or service delivery
- Ease of access to private-sector financing and measures to improve the confidence of the investor community and lenders

2. Challenges for sustainable technologies' deployment

Within the array of low-emission cooling equipment now available in the Indian market, consumers settle for the least efficient or middle-of-the-order products. Three-star rated room air conditioners[4] remain the most sold appliances in their categories; the market share of ceiling fans with conventional induction motors and power input of 50 watts or more far exceeds that of brushless direct current (BLDC) ceiling fans that have a power input of less than 35 watts. Market share of BLDC fans is only about 3%. A similar situation persists in the case of chillers and other cooling systems. This begets the question: why the reticence to buy the most sustainable models?

2.1 Non-buyers' reticence to purchasing green cooling products

Existing research highlights that consumers' sensitivity to the price and value of technologies, as well as their low purchasing capacity, strongly influence purchase decisions. A deeper dive into these factors is undertaken in this section.

First cost barriers are high and not addressed. In conventional business models, consumers are expected to bear the capital costs or purchasing the product. Though consumer loans are common, there are no low- or zero-interest loans to ease the incremental costs of low-emission products for retail consumers. Even in the case of larger systems such as chillers, 80 per cent of replacement costs are self-financed because of the complex processes involved in borrowing project finance from lending institutions (Aarti Nain et al 2022).

> Consumers opt for less efficient technologies because of high first costs, low confidence in reliability and safety, and indifferent marketing that glosses benefits of sustainable cooling.

Sustainable cooling technologies are more expensive than conventional ones (United Nations Environment Programme 2021). Indian consumers are acknowledged to be price-sensitive, or conservative, compared to their peers in developed countries; they are value-conscious, and this behaviour affects purchases (Singhi, Mall and Puri 2016). Returns matching those of conventional systems are expected, which is not always possible.

The value of advanced, efficient, and sustainable technologies is not apparent to retail consumers. Suppliers have not endeavoured to demonstrate the monetary and health benefits of cooling. The lack of a visible, scientifically measured, and accurate measure of savings and other tangible benefits leaves consumers uncertain about the advantages of experimenting with advanced technologies (Nain, Prasad and Tathagat 2014).

Low confidence in the safety of emerging technologies and materials turns away future adopters. For example, A3 classified low global warming potential (GWP) refrigerants such as R-290, are relatively more flammable than high-GWP refrigerants such as A2L classified R-32.[5] Procurement standards of institutional buyers include stringent environmental, health, and safety guidelines that cannot be contravened for technologies with unallayed safety concerns. National testing standards and testing facilities are not established completely. As a result, manufacturers are sometimes unable to prove safety factors. Buyers will continue to hesitate unless new technologies and materials are shown to conform to established national and international safety standards.

Marketing strategies do not differentiate sustainable products clearly. The difference in efficiency and the resulting benefits to consumers is not the most prominent marketing message. Differences in the environmental impact of refrigerants is not conveyed clearly through marketing. As a result, premium models of any cooling technology are expected to have functionalities such as internet-enabled 'smart' controls, greater cooling, higher airflow, and air filters rather than environmental performance. Highly sustainable cooling

4 BEE's Standard and Labeling Scheme awards ratingsrating on a 1 to 5 scale, with 5 being the highest.
5 A3 and A2L are refrigerant safety group classificationsclassification as per ASHRAE's Standard 34.

technologies can only compete with market-average models if they are marketed with the 'bells and whistles' synonymous with premium products.

Investment in sustainability is not a priority. Indian consumers are often not aware of the importance of climate change and affirmative actions that can control it (BASE 2019). Competing expenditures that boost end-users earnings or lifestyle supersede investing in climate-friendly assets. A preference for low-risk, short-term opportunities is ingrained in investors' minds.

2.2 Inadequacies in traditional business models

The traditional distributor–retailer model dominates the Indian market for plug-in cooling and refrigeration systems (room air conditioners, ceiling fans, evaporative coolers, refrigerators). Rules regulating efficiency and environmental performance standards place the onus of compliance on the manufacturer. The power to influence final purchase decisions, however, rests with the retailer who deals with the consumer (Bhasin et al 2021). Retailers are aware of the price sensitiveness in Indian consumers; hence, they recommend average models — generally, a middle-of-the-stack model, awarded a 3-star rating under India's *Star Labelling Programme* — to increase sales.

> **Retailers are not inclined to recommend the most efficient models due to the price sensitivity of Indian consumers.**

3. Critical cooling applications and technologies

The *India Cooling Action Plan* identifies space cooling, cold chain, and refrigeration as the largest contributors to cooling energy demand. Building or space cooling will represent the bulk of national cooling energy consumption in the coming decades and out-pace all other end uses by a large margin. Space cooling will be 59 per cent of the total tally by 2038, while refrigeration (29 per cent), transport air-conditioning (10 per cent), and cold chain (2 per cent) will contribute to the total cooling energy consumption in smaller proportions (MoEFCC 2019).

Cold chain, despite its small footprint, has a pivotal role to play in enhancing the socio-economic development of marginalised rural and urban populations, health conditions, and food security. Rural and urban micro-enterprises and small-holder farmers can improve their economic situation by accessing cost-effective refrigeration and cooling. Forty per cent of agricultural produce is wasted post-harvest because of limited cold chains. Not only is it an economic loss to farmers, but it also causes additional environmental harm, as the decomposition of waste adds to GHG emissions (MP Ensystems 2019).

Technologies critical to India's cooling needs are as diverse as the end uses. Room air conditioners (RACs), fans, and evaporative coolers, all with a connected load

Table 2 Key cooling and refrigeration end uses and possible business models

Technologies and models	Space cooling: residential and small commercial	Space cooling: medium to large commercial	Cold chain and commercial refrigeration
Key technologies	- Window air conditioners - Split air conditioners - Evaporative coolers - Ceiling and table fans - Variable refrigerant - Flow systems	- Ceiling fans - Variable refrigerant flow systems - Ducted multi-split systems - Chillers	- Vapour compression based brine chillers - Electrical domestic and commercial refrigerators[6] - Evaporative cooling - Icemaking - Decentralised solar refrigeration
Business models	- On-bill repayment - On-wages or remittance financing - Energy performance contracting through ESCOs - Servitisation - Dealer financing - Leasing	- On-bill repayment - Energy performance contracting through ESCOs - Servitisation - Dealer financing - Leasing	- Energy performance contracting through ESCOs - Servitisation - Dealer financing - Leasing

Source: Authors' analysis, MoEFCC (2019), BASE (2019), Evans (2018)

6 Includes water coolers, vending machines, drinkingdrink fountains, display units, and freezers.

of less than 7 kW, will dominate other technologies in residential and small commercial space cooling in the next two decades (MoEFCC 2019) (TechSci Research 2019). Variable refrigerant flow (VRF) systems, ducted, light commercial ACs (cassette units) and chillers deliver most of the medium to large commercial space cooling. Vapour compression-based Brine chillers and commercial refrigeration systems are popular technology choices in cold chains (MP Ensystems 2019). Decentralised renewable energy–based cooling and refrigeration are gaining traction in geographies where power supply is erratic and are expected to emerge as critical for commercial cooling and cold chains (Margdarshan Advisory and CLEAN Network 2020). Off-grid solar appliances for cooling and refrigeration are also critical as they fill the gap in providing comfort cooling, livelihood and health services in areas with weak supply grid infrastructure (Intellcap and GOGLA 2021).

4. Business models for sustainable cooling

The diversity of cooling needs in India necessitates a multiplicity of ideas. One size will not fit all because of differences in the paying capacities and priorities of different consumer categories, different technology types, their ownerships costs, and the end use of cooling itself. Five highly market-driven models that have yielded positive results for financing sustainable cooling in Africa, the Caribbean, other developing countries, and India, are reviewed in this section. Two of these,

The diversity of cooling trends in India necessitates a multiplicity of ideas.

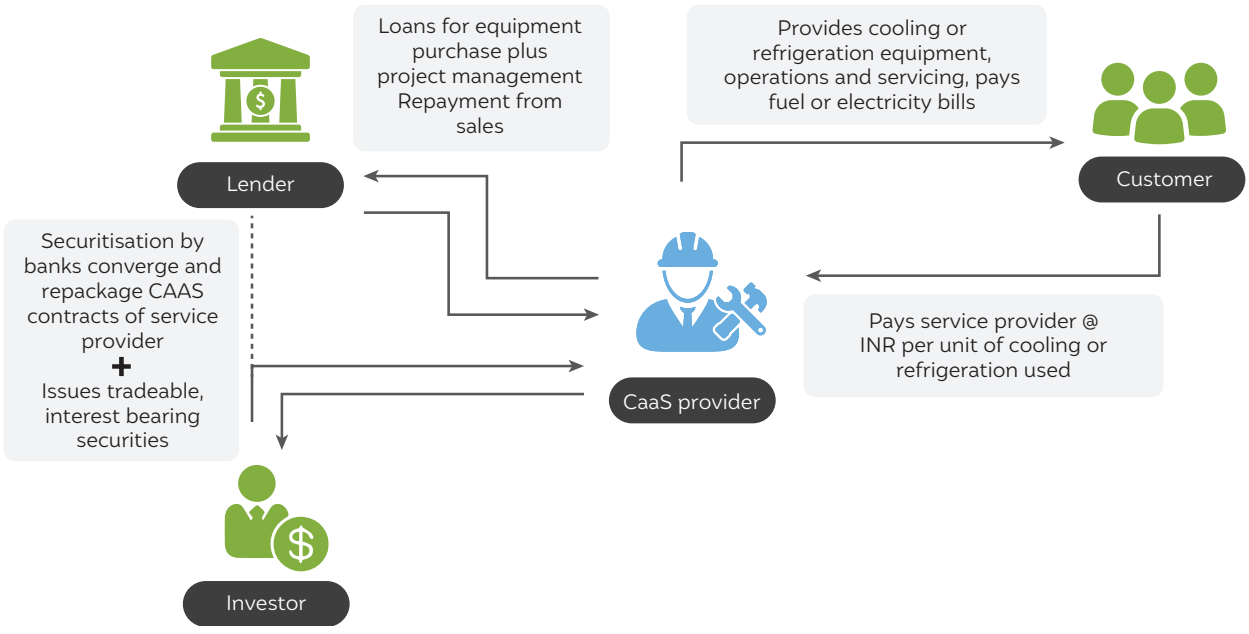
energy performance contracting (EPC) with energy service companies (ESCOs) and bulk procurement are already applied by public- and private-sector energy-efficiency developers in India.

4.1 Servitisation or cooling-as-a-service

Servitisation is essentially a subscription model that sells the outcome of products as a service rather than the product itself. Customers pay for the cooling delivered by the cooling system without purchasing the system. Ownership of the asset that enables the service, as well as its operation and upkeep, rests with the manufacturer or service provider for the entire duration of the contract. Companies working with the cooling-as-a-service (CaaS) model have realised profit margins of at least 20 per cent (Efficiency for Access Coalition 2021).

Its origin can be traced to the 1960s, when Rolls-Royce introduced its *Power By the Hour* plan for airlines on its Viper engine. Airlines were interested in securing the hassle-free performance of their fleet so that they could concentrate on the core business of delivering passenger comfort. Rolls-Royce, as a leading engine supplier, converted this into a business opportunity and offered servitisation agreements, wherein the performance of

Figure 1 Cooling-as-a-Service model with securitisation to finance CaaS providers



Source: Authors' analysis

> **The CaaS model inherently encourages efficiency as it increases profit margins of the service provider and reduces costs for consumers.**

engines by flying hours was sold instead of engines. Today, giants across different industries, from electric car manufacturer Tesla to media heavyweight Netflix, operate primarily on this model.

CaaS is built around contracts between the cooling provider and the consumer, where the provider owns the cooling system, assumes all risks and liabilities, and bears all running costs and utility costs. Customers pay per unit of cooling (TR or refrigeration tonnage) used in each billing cycle. The provider is incentivised to operate with efficient and recyclable equipment to reduce costs and increase profits. The provider finances equipment using private equity. Recapitalisation is possible either through sale-leaseback or securitisation of cash flows once business volume increases (BASE CaaS Initiative 2021).

In the sale-leaseback system, the lending institution purchases the cooling equipment and leases it to the CaaS provider for a fixed term, i.e. the duration of CaaS contract between provider and customer. This frees up capital for the provider for financing operations and maintenance. The CaaS contract between the provider and the customer becomes a guarantee instrument (Abramskiehn and Richmond 2019). Service provider is insured by a third-party against risks of payment default by the customer through the contract period. In securitisation, the lender converges contracts of the provider, hosts this with a special purpose vehicle to issue tradeable, interest- bearing securities to public or private investors.

Value addition

1. **CaaS inherently espouses efficient and economical products**. The service provider stands to increase profits by reducing the energy consumption of cooling devices and their upfront cost. Users are incentivised to pursue efficiency as monthly payments or bills reflect usage and the opportunity for conserving energy.
2. **CaaS encourages environmentally safe disposal and recycling.** Businesses gain from recycling machines to lower operational costs and can transfer reusable components to other systems. This is very useful as, despite the *e-Waste Management Rules 2016*, manufacturers find loopholes to escape from their responsibilities, and the methods followed by recyclers are not always adequate.
3. **The model can help reduce expenditure on maintaining and repairing** cooling or refrigeration products in rural markets with restricted access to servicing infrastructure.
4. **CaaS is a purely market-based model, which can be deployed mostly independent of any regulatory support** once the owners understand benefits and investors grasp the returns on investment.
5. **Lenders and investors can turn fixed assets into a continuous revenue stream** as the business grows through securitisation.

Challenges

1. **Payback for the investor can be slow** as substantial upfront investment is required to procure and service cooling systems. This strains the finances of businesses and compared to rate of returns in other sectors, slows payback for investors. CaaS requires extensive service networks developed in-house or with third parties. It can consume substantial resources, more so in remote areas.
2. **The risk of default on payment is high among low- income consumers.** Risk guarantee instruments for energy-efficiency projects and end users with a low-paying capacity are complex and scarce.
3. **Cultural resistance to the concept of servitisation can affect demand negatively.** Consumers in India are accustomed to asset ownership and switching to alternate models can be difficult.

Case study 1.1 Cooling-as-a-service (CaaS)

CaaS in India

CoolCrop, Ecozen Solutions, and Oorja Development Solutions are all relatively new businesses centred on offering decentralised, renewable-powered refrigeration for perishable products as a service to small farmers in remote areas. KAER, a Singapore-based company, and Smart Joules are improving cooling efficiency in the commercial and industrial sectors through servitisation. In 2021, Climate Finance Lab, in partnership with BASE, developed a digital decision-making tool, Virtual Cold Chain Assistant (VCCA), to help small farmers access best practices, regularly updated market intelligence about cold storage facilities, and a cost–benefit analysis calculator to estimate returns on subscribing to CaaS providers. Next BASE, EMPA, Oorja Development Solutions and CoolCrop will undertake two pilot cold storage facilities in Himachal Pradesh and Bihar using the VCCA tool (Sidhu 2021).

Koolboks, Nigeria

Koolboks, a for-profit company, provides solar-powered cooling and refrigerating solutions through a CaaS model to commercial customers and the healthcare sector in remote corners of the country. Refrigerators provided to the healthcare sector are controlled remotely for optimal operation. Koolboks has made it affordable for small enterprises to store and sell perishable goods. The solar-powered appliances provide reliable cooling despite power outages. This has improved livelihood opportunities for the company's commercial customers, primarily self-help groups or other community associations. The risk of payment default and damage to leased equipment are reduced as associations ensure enforcement of servicing contracts, and members are careful not to spoil their reputation within their community. Koolboks partners with local service providers to deliver services and ensure maintenance of its CaaS equipment. CaaS has allowed Koolboks to acquire business beyond its basic customer base of domestic end users (Efficiency for Access Coalition 2021).

CaaS is ideal for the commercial sector where owners are interested in securing access to effective and economical cooling without the hassle of actively managing cooling systems. Outsourcing cooling to CaaS providers provides an opportunity to focus on core areas. Industrial and commercial building cooling and refrigeration in India have a high potential for CaaS deployment (Abramskiehn and Richmond 2019). So far, the model has gained some traction in decentralised cold storage and space cooling for commercial purposes. Its success will depend on the availability of risk-mitigating guarantees and fast access to capital. Most CaaS companies operating on this model are not original equipment manufacturers. Hence, the scalability of their customer base depends on the availability of a strong network of technology manufacturers, committed financiers who are aware of the risks and value of CaaS, and local distributors (Efficiency for Access Coalition 2021).

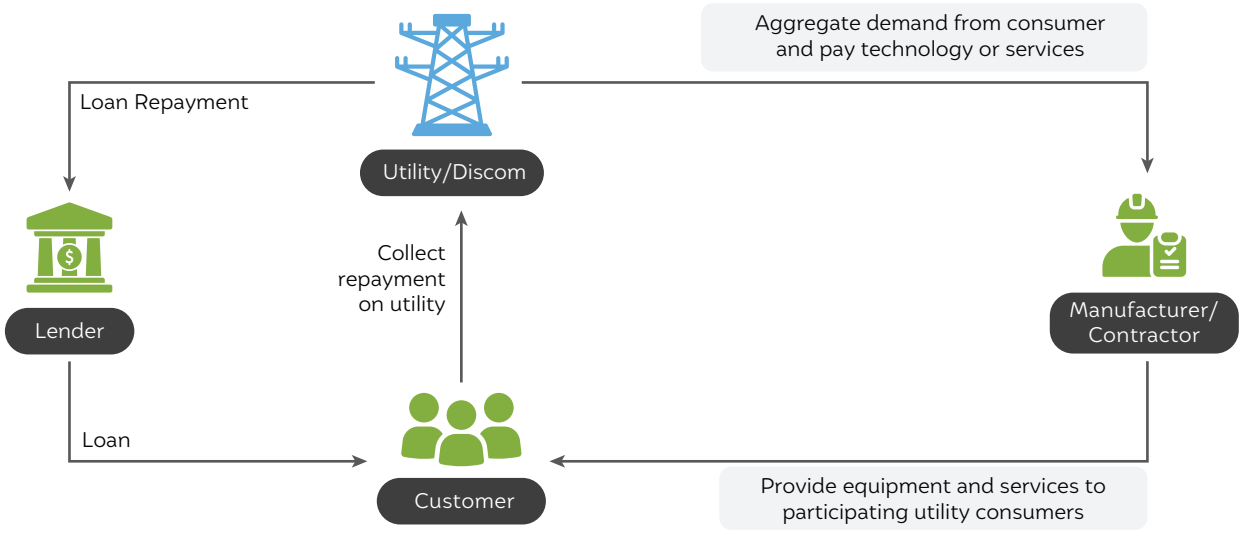
> **Industrial and commercial building cooling and refrigeration in India have high potential for CaaS deployment.**

4.2 On-bill financing

In this model, the upfront costs of purchasing equipment are provided by a third party such as a bank, power distribution company (DISCOM), or a public or private agency. The lender collects repayments as part of utility bills, wages, or remittances. The buyer retains ownership of the assets and is responsible for its upkeep through its lifecycle. On-bill financing (OBF) is traditionally rolled out by discoms, either solo or in partnership with banks, and mostly under energy efficiency or carbon neutrality obligations mandated by governments. The US and Europe have experienced success with the discom-led OBF model. OBF depends on strong partnerships between lenders, discoms, technology and service contractors, and local civic organisations. In India too, utilities may be best positioned to apply this model. On-bill repayment and on-wages financing are iterations of the model.

OBF can be the optimal solution for low-income end users. This category of end users aspire to ownership of high-performance cooling systems, but they lack liquid assets to make the purchase (Bhasin et al 2020). Smaller cooling products (<7 kW) with lower servicing and ownerships costs are ideal for targeting through OBF.

Figure 2 On-bill financing with discoms



Source: Authors' analysis

Case study 1.2 On-bill financing and on-wages financing

ECOFRIDGES on-bill financing initiative in Senegal

The government of Senegal, in partnership with United for Efficiency (U4E), African Development Bank, Renewable Energy and Energy Efficiency (ECREEE), and BASE, is offering short- to medium-term loans on energy-efficient refrigerators and cooling products, to be repaid through utility bills. The model obliviates the need for customer credit-risk assessments, collateral, and upfront costs. Eligibility for the scheme is instead determined by the consumer's utility bill payment track record and income. Manufacturers participating in the scheme offer product take-back and recycling options to enable environmentally safe disposal of inefficient cooling or refrigeration products. Key partners are the Government of Senegal, the United Nations Environment Programme (UNEP), Clean Cooling Collaborative, local financial institutions, and technology manufacturers or suppliers (BASE Projects: ECOFRIDGES Senegal 2020).

ECOWAS on-wages financing in Ghana (BASE 2020)

Lending institutions, technology providers, and private companies have established concessional credit facilities and standardised finance agreements for energy-efficient refrigerators. Small- and medium-term unsecured loans are offered at zero per cent interest to qualified salaried customers. Employers become the guarantors. Repayment is guaranteed either by employers, who also participate as an aggregator or deduct from wages in case of default. Rebates from manufacturers on the cost of refrigerators are predetermined, and these rebates are used to cover the lender's costs. Repayments can be a) aggregated by the employer and paid in bulk to the financier, b) directly deducted from the salary account, or c) made through a customer's checking account. In this scheme, technology providers are responsible for customer engagement and acquisition. Customers can also apply for additional rebates if they participate in the take-back scheme, wherein they give away existing appliances to the technology vendor for environmentally safe e-waste disposal. Key partners are the Government of Ghana, UNEP, Clean Cooling Collaborative, local financial institutions, and technology manufacturers or suppliers.

Value addition

1. **Customers who are not eligible for traditional loans can avail financing through OBF.** This allows low-income communities with low to zero liquid assets to transition to sustainable technologies for enhanced comfort, health, and economic productivity.
2. **The cost of loans can be low.** OBF and on-bill wages (OBW) managers aggregate demand from large consumer bases so that they can negotiate a discount on interest rates from lenders and bring down the cost of the loan.
3. **Environmentally safe recycling is encouraged.** In OBF, technology providers can offset costs by recycling older products collected in exchange offers.
4. **Increased capacity.** OBF proponents, such as intermediaries between lenders, technology suppliers, and borrowers, circumvent the lack of knowledge or capacity of each stakeholder and ease the flow of finance into this sector.

Challenges

1. **Weak demand-side management (DSM) regulations dampen discoms' incentive to attempt OBF.** Regulations currently do not specify any DSM targets in terms of energy savings.
2. **OBF entails high transaction and recovery costs, as well as high loan default risks.** OBF is unsecured, and few avenues of recourse are available in case of payment defaults. Reliable and experienced demand aggregators must be integrated for the smooth functioning of the model (Meal, et al. 1996).
3. **Non- or underperforming cooling technologies can threaten programme viability.** OBF relies on external technology providers or vendors and exercising quality control in products supplied by third party is challenging. Consumers may default on payments if the products supplied in OBF models are faulty.
4. **Public utilities in India are financially distressed.** Public-sector discoms in India bear a debt burden of USD 56 billion, equivalent to nearly 2–3 per cent of India's GDP. They are likely to experience difficulties in accessing low-cost capital to disburse loans for OBF (ICRA 2021).

Energy Efficiency Services Limited provided OBF for its *UJALA* (LED lighting) and *Agricultural Demand Side Management* (AgDSM) programmes. *UJALA* was one of the most successful efficient lighting financing programmes globally. More recently, the European Union's International Partnerships Agency (INPTA) has identified to give concessional loans and grants for OBF programmes to encourage efficient residential cooling. These will be the first megawatt-scale initiative for low-emission cooling run on the OBF model in the country.

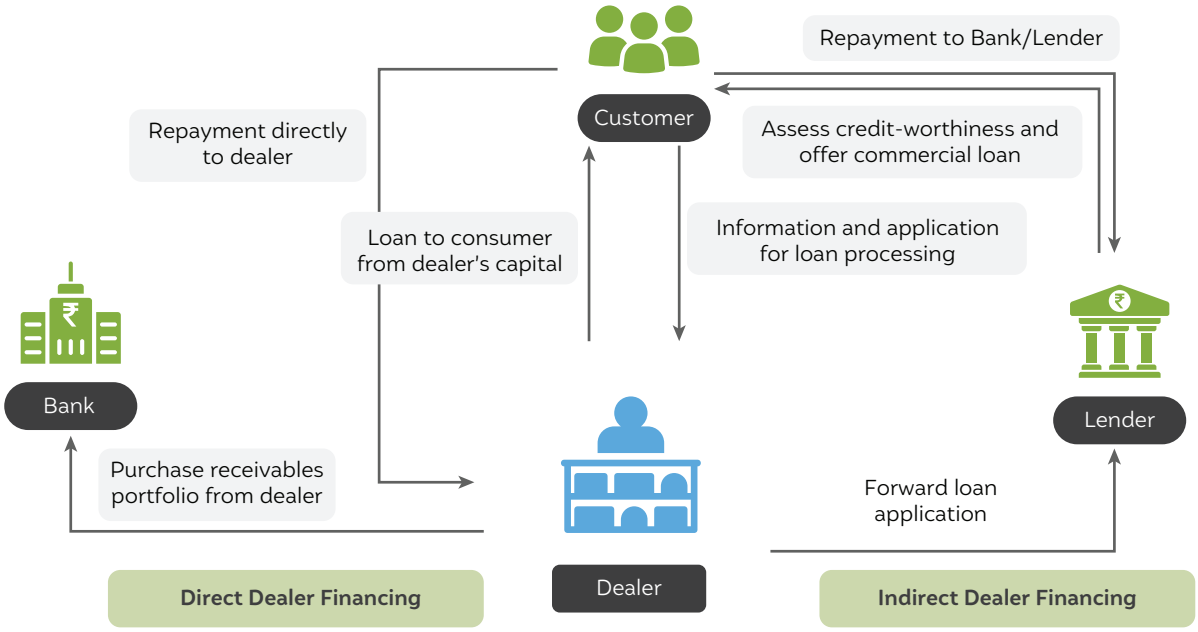
Opportunities for OBF are vast if state electricity regulatory commissions strengthen existing demand side management (DSM) regulations and make DSMs mandatory for discoms, while also building confidence in banks to lend for the same. DSM programmes in India can save about 180 billion units (kWh) of electricity annually and catalyse USD 20 billion investment as per World Bank estimates (Sarkar, et al. 2016).

> **OBF allows low-income households with zero to low liquid assets to adopt sustainable cooling technologies.**

4.3 Dealer or retailer financing

In this model, technology suppliers finance loans to consumers to purchase cooling equipment either through their own capital or partner with third-party financial institutions. In indirect dealer financing, retailers arrange the required supporting documentation for their clients and help third-party lenders conduct credit-risk assessments. This increases the affordability of efficient cooling products for customers.

Figure 3 Dealer or retailers acquire loans at lower buy rates from commercial banks and lend to customers



Source: Authors' analysis

Value addition

1. **Dealer financing brings down the cost of loans for consumers.** The dealer or distributor can negotiate with multiple lenders simultaneously and facilitate higher discounts on interest rates.
2. **The model ensures easier access to credit for financially illiterate consumers.** Dealers manage the complicated documentation required for credit-risk assessment for buyers who may be unequipped to navigate the paperwork.
3. **Increases sales and develops new markets for suppliers.** It converts potential buyers, limited by financial difficulties, into confirmed customers. It also adds a revenue stream for the distributor from the interest earned through loans.

Challenges

1. **Dealers and retailers cannot always afford the capital cost of financing consumer loans.** This model requires high initial capital infusion, either directly or indirectly. Established dealers and retailers with multiple, large revenue streams may have the risk elasticity to expend their capital, but smaller enterprises and retailers do not have this cushion. Strong support from financial institutions is indispensable (BASE 2019).
2. **There is no incentive for manufacturers, distributors, and retailers to sell efficient models over inefficient ones.** Efficiency policies and product-labelling schemes only regulate the manufacture of cooling technologies; encouraging market uptake of the same is not within their ambit.
3. **Customer defaults increase risks for loan providers.**

Dealer-financing for efficient cooling technologies has a high potential for new markets in India.

Outlook for India

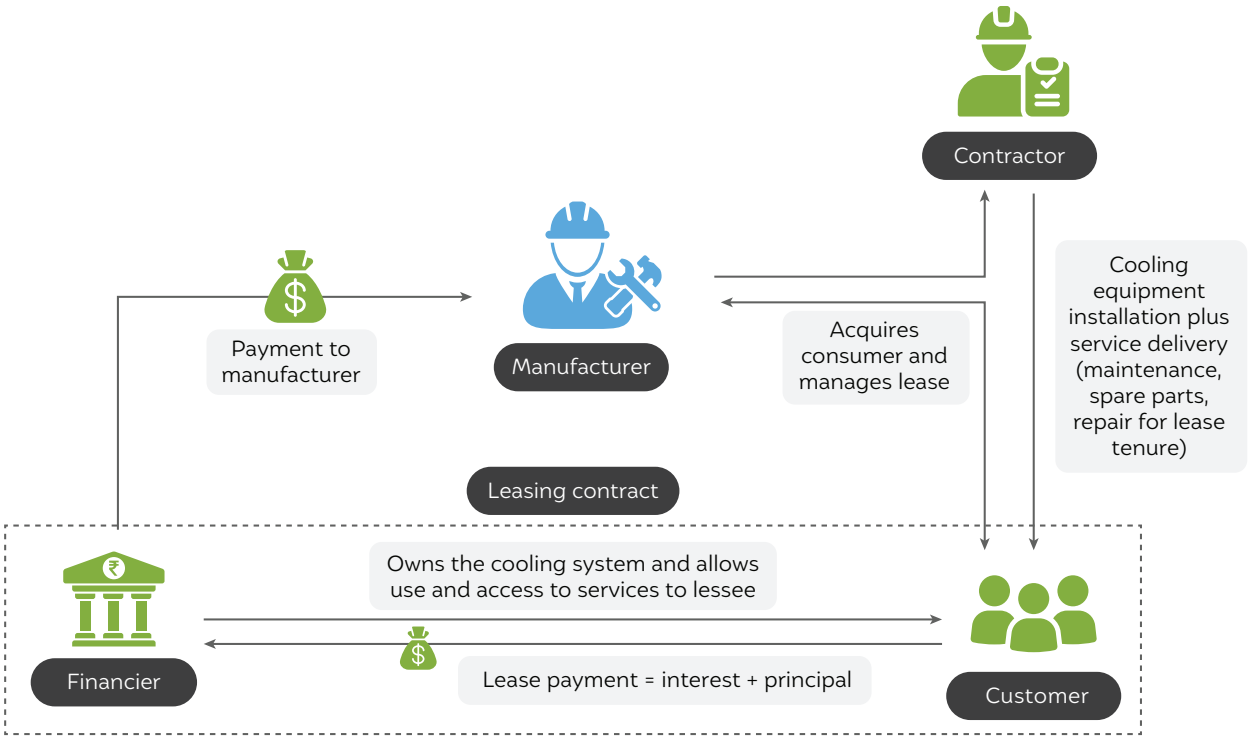
Dealer financing could be a game-changer for residential and small commercial end users. Indian consumers are accustomed to the concept. Large retailers already partner with banks and non-banking finance institutions to facilitate consumer loans at point-of-sales for home appliances. Active loans for consumer durables in India stand at USD 0.5 billion; a 3 per cent annual growth is expected in the coming years (CRIF 2021). Dealer financing is also actively offered for decentralised renewable energy-based appliances and equipment that improve livelihood opportunities for buyers in low-income segments. There is mature infrastructure that can handle lending for sustainable cooling but has not been leveraged for efficiency yet. Mainstream manufacturers of efficient cooling technologies have also not considered this model despite its potential for creating new markets.

4.4 Leasing

Leasing is an asset-based form of financing. It is a time-bound agreement between two parties wherein a financier, or lessor, allows the end user, or lessee, use of financed assets for a specified time frame in return for fixed monthly payments (IFC 2009). In the case of cooling, leasing is often managed through a partnership between financing agencies, technology manufacturers, and service vendors or contractors. The manufacturer or contractor's consumer network is leveraged with the capital of the financier. Servicing and equipment repair costs are also covered in the lease.

The roles, rewards, and risks of the cooling technology or service provider, customer, and financier can differ in leasing models. Ownership remains with the lessor throughout the contract. In financial leasing or lease-to-own models, ownership of the leased equipment passes to the lessee after the residual amount is paid to the financier. In an operational lease, the financier owns the assets and bears the associated risks, whereas in a financial lease, the end user bears operational costs and risks (IFC 2009).

Figure 4 Financier funds upfront and upkeep costs and manages risks (depending on the type of leasing)



Source: Authors' analysis

Value addition

1. **Technology upgradation opportunity.** This model offers the lessee the opportunity to upgrade equipment and operate with the most advanced technologies in the market.
2. **Tax benefits.** The taxable income of the lessee can be reduced in the operational leasing model as the consumer's capital expenditure are converted into operational expenses (Loughran 2021).'
3. **Improves the company's valuation.** This model makes additional off-balance-sheet financing possible for commercial consumers as lease payments are not reflected on balance sheets. This improves the company's valuation (Loughran 2021).
4. **Supports other business models aimed at deployment.** Leasing can be combined with other models such as ESCO, bulk procurement, and servitisation.

Challenges

1. **Customers unaccustomed to the leasing concept can sign on to a losing proposition if they are unaware of the fine print of the lease contract.** The terms and conditions of the contract, if not designed properly, can exacerbate lifetime or leasing costs for consumers and eventually alienate them from this model. Situations like accidental damage to equipment and lack of redressal about potentially poor-quality servicing can affect the leasing experience and success of the model.
2. **Low customer awareness.** The non-familiarity of Indian retail or residential consumers with this model can slow adoption for sustainable cooling. Repayment default is a generic risk.
3. **Regular oversight is key.** The financier has to be licensed to provide leases as a business activity, and profitability also depends on tax regimes that are favourable to leasing activities.

Case study 1.3 Ultimate home comfort: leasing model by York® (Johnson Controls)

Residential customers are offered highly efficient cooling and heating systems from York's OpenBlue product line on a 10-year lease with zero upfront costs (YORK Ultimate Home Comfort 2021). The programme offers the following services at no additional cost:

- Warranty and parts warranty
- Service repairs
- Annual maintenance
- Upkeep services such as blower and coil cleaning and condensate line flushing

Financing is provided by a third party, Fundient Capital LLC. York is not responsible for any liabilities associated with the installed systems. York's costs are recovered through fixed monthly payments received from lessees. Customers can lease air conditioners, gas furnaces, and electric heat pumps under this model. Because of the highly sustainable nature of the OpenBlue equipment leased in this programme, 53 per cent annual savings from reduced energy costs are possible according to York (Gargaro 2021). The OpenBlue line has artificial intelligence–enabled remote diagnostics, predictive maintenance, and risk assessment.

York piloted the leasing programme initially for three years in United States. Of the customers presented with this model, 50 per cent opted for it. Now, Ultimate Home Comfort is a full-fledged initiative with 500 of York contractors as partners. Participating contractors have reported an increase in both sales and profit margins. Four exit options are available to customers at lease expiry:

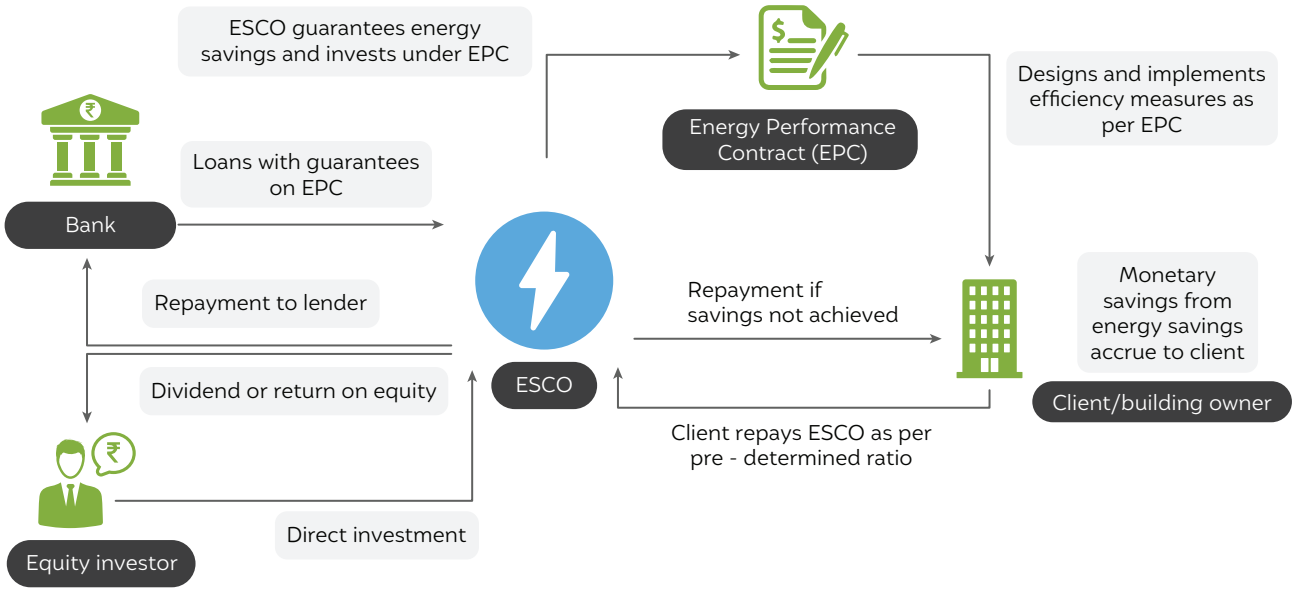
- Enter a new 10-year lease with 100 per cent new equipment
- Extend the lease by two years with existing equipment and maintenance without parts and labour
- Lease-to-own, i.e., pay a predetermined balance to the financier and gain ownership
- Not renew the lease and hand over the equipment to the financier

India has a mature leasing market for real estate, renewable energy, electronic equipment, and the vehicle industry. Leasing is primarily concentrated among small and medium enterprises. The business model is being tested by large manufacturers, non-banking finance institutions, and start-ups in the developing electric vehicles market (Phillip 2021). However, none of the established original equipment manufacturers (OEMs) or financing companies in India have applied this model to cooling.

4.5 Energy service company

Sustainable cooling can also be financed through energy service company (ESCO) and energy performance contracts (EPCs) that guarantee energy and monetary savings. The ESCO identifies optimal cooling and other technologies for the client and integrates these through its equity or third-party finance under an EPC. Clients incur zero upfront cost. They repay the costs incurred by ESCO in fixed instalments over an agreed tenure, provided the project delivers energy savings and other performance commitments as promised in the contract. ESCOs exit the project on recovery of investment and profits.

Figure 5 Energy performance contracting with energy service company (shared savings model)



Source: Authors' analysis

Value addition

1. **Reduces customers' need for technical expertise** (BASE 2019). The customer is also able to offload risk partly or completely with an ESCO.
2. **No upfront customer expenditure.** Customers can redirect resources to priority functions as an upfront investment is not required in the case of the shared savings ESCO model.
3. **Multiple applications.** It is a highly flexible financing model that applies to multiple cooling technologies and end uses.

Challenges

1. **Risk guarantees for energy efficiency are uncommon and complex.** Borrowing for energy-efficiency projects, even against EPCs, is difficult for both owners and ESCOs.
2. **Missing baseline data.** Inaccuracies and uncertainties in developing project baselines can increase project costs or reduce savings. Both undermine the ESCO and customer confidence.
3. **High transaction costs.** The costs render this model unsuitable for smaller cooling or refrigeration systems unless they are combined with other efficiency measures.
4. **End users are not convinced unless savings are clearly visible.** If this is not managed, the risk of repayment default can be high.

> **ESCO is a highly flexible financing model that applies to multiple cooling technologies and applications.**

Technical and financial risks are either borne solely by the ESCO (shared savings model) or are divided between the ESCO and energy user respectively (guaranteed savings model).

In India, the Bureau of Energy Efficiency (BEE) manages risk guarantees (PRGEEF) and venture capital funds (VCFEE) for ESCOs. Energy Efficiency Services Limited operates as a Super ESCO to implement different national programmes for efficiency in transport, buildings, agriculture, and industries. The BEE's *Perform, Achieve, and Trade* (PAT) scheme also drives demand.

There are over a hundred ESCOs in India; only about 20 provide the full scope of services (design, execution, monitoring, and finance) (Kumar, et al. 2017). Most ESCOs operate within a guaranteed savings model, i.e., they restrict themselves to design, execution, and management operations. Securing project financing from lenders is complex: ESCOs avoid it and leave financing to energy users. Until commercial financing is unlocked, mandatory regulations demanding energy efficiency introduced, and simplified risk guarantee instruments addressing both commercial and technical risks integrated within the lending system, the ESCO model will struggle to take off.

4.6 Bulk procurement

Procurement in large volumes leverages economies of scale and demand aggregation from buyers to enable cost-effective commercialisation of sustainable technologies. Procurers or aggregators bring together buyers with unique or similar requirements, convert these into concrete product specifications, and negotiate with manufacturers through multiple bidding rounds to arrive at the lowest cost. Costs are also lower because dealers and retailers between the end user and manufacturer are eliminated. After-sales services can also be customised and extended to participating consumers. Of all the models discussed here, bulk procurement does not cover consumer financing gaps directly. Instead, it relies on reducing technology manufacturing and marketing costs.

> **By aggregating demand, bulk procurement leverages economies of scale to reduce prices of emerging technologies.**

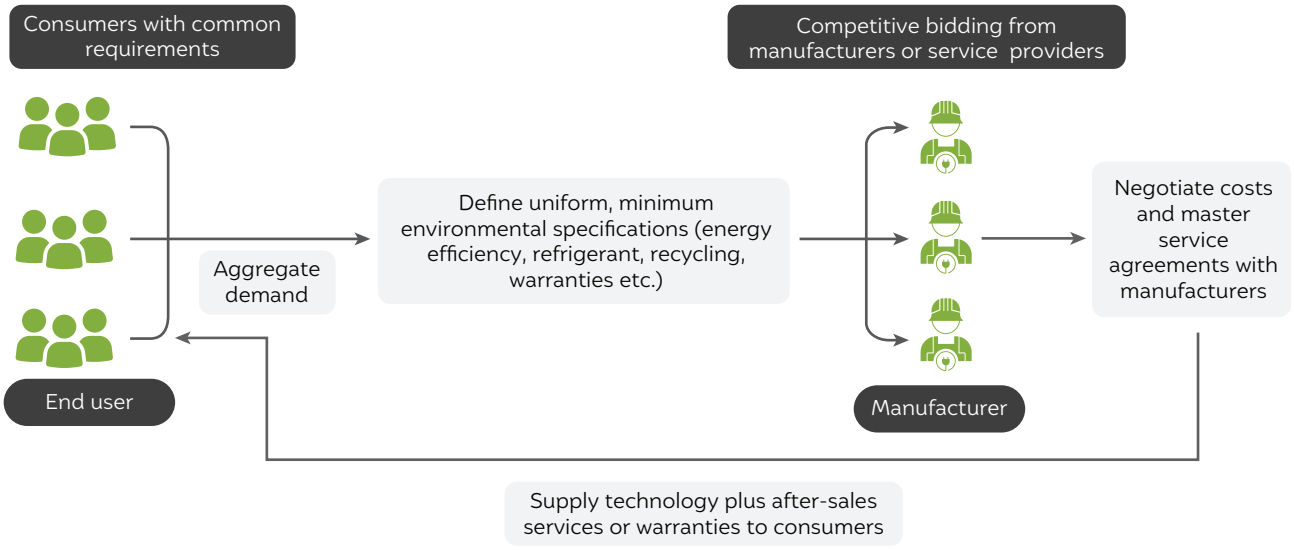
Value addition

1. **Economises the cost of climate-friendly technologies.** EESL's *Super-efficient Air-conditioning Programme (ESEAP)* reduced prices of 5-star inverter split air conditioners by about 22 per cent in two successive rounds of bulk purchase.
2. **Encourages innovations.** Local manufacturing capacity for high-performance technologies is enhanced by inducing faster product innovation.
3. **Secures demand.** Manufacturers are incentivised for innovation as bulk procurement guarantees consolidation of existing markets and development of new markets (Alison, et al. 1998).

Challenges

1. **Volumes game.** Procurement volumes must be large enough to reduce manufacturing costs and allow price savings to be forwarded to end users. It must be supplemented by strong buy-in from consumers.
2. **Hard to sustain.** Bulk procurers must calibrate consumer expectations plus purchasing power with manufacturer capacity and willingness to deliver. It must also be repeated to have a sustainable impact (Alison, et al. 1998).
3. **The timing of bulk procurement for cooling systems has an important role to play.** The Indian market activity fluctuates with the season. Annual retail sales start peaking in February and fade out by June. Bulk procurement must coincide with this cycle to realise the aggregate demand, else consumers will resort to buying from other channels.
4. **Not ideal for multiple complex systems.** Complex cooling technologies with multiple performance parameters for efficiency and product reliability are difficult to combine with bulk procurement, as a common minimum set of specifications and after-sales servicing that satisfies a large user group is unlikely.

Figure 6 Bulk procurement leverages economies of scale and demand aggregation to bring cost-effective technologies to markets



Source: Authors' analysis

The government, public-sector institutional buyers, the banking sector, and retail chains capable of aggregating demand for a very clearly defined set of efficiency specifications are best positioned to adopt this model. As per the Reserve Bank of India, there are about 2,00,000 (ATMs) in the country. Banks can cost-effectively transition to sustainable cooling of branches and ATMs through large-scale technology procurement. DISCOMS, too, can undertake bulk procurements as part of DSM programmes for residential and commercial cooling.

Case study 1.5 Bulk procurement for sustainable cooling in India

Bulk procurement in India is mostly practiced in the public sector. Energy Efficiency Services Limited (EESL) designs its national efficient technology deployment and commercialisation programmes around bulk procurement and ESCO models. These are *Building Energy Efficiency Programme* (BEEP) and *Super-efficient Air-conditioning Programme* (ESEAP). Performance specifications better than, or matching, best-in-the market products are defined, bids are directly solicited from OEMs fulfilling the eligibility criteria, and orders are awarded to the proposal with the lowest cost but best technical performance. Selected manufacturers along with service partners are then contracted to deliver the products and services to EESL customers.

In 2019, green air conditioners were selected as a priority product category for a green public procurement policy developed by the Ministry of Finance (MoF) with support from the UNEP (UNEP and USAID 2019). Standard specifications for green air conditioners were developed by the MoF and UNEP, and products meeting this criterion are now listed for purchase on the Government e-Marketplace (GeM), an e-procurement platform. Fifty-two thousand government agencies procure through GeM and their combined buying power can send a strong message to the market (Green Room ACs on GeM 2021).

Table 3 Overview of business models for developing markets for sustainable cooling

Headings	Cooling-as-a-service (pay-per-use)	ESCO (pay-as-you-save)	Bulk procurement
Equipment ownership	Service or technology provider	Transferred to end user at the end of the service contract	End user
O&M responsibility	Service or technology provider	Service or technology provider	End user
Initial investment for business or provider	High	High	High
Target sector	• Space cooling through central systems in commercial and multi-storied residential buildings • Industrial operations • Cold chain (including decentralised cold storage) • Commercial refrigeration	• Applicable for all types of end uses	• Government and public sector institutions, food and beverage sector • Private sector organisations with a large physical infrastructure (e.g., banks, educational institutions)
Target technologies	• Large central cooling and refrigeration systems with extensive and expensive O&M • Small commercial and decentralised cold chain	• All types and sizes of cooling systems	• Small, portable systems (room air conditioners, portable evaporative coolers, ceiling fans, decentralised solar-based cooling and refrigeration units) where standardisation of specifications is possible
Efficiency performance guarantee	Not guaranteed contractually	Guaranteed by contract	No guarantee
Proponents/ actors	Private companies	Private and public sector ESCOs	Large public or private institutional buyers and private companies
Value addition/ benefits	• Allows the end user to concentrate on core, revenue-generating functions while availing optimal outcomes in cooling and refrigeration • Inherently integrates high efficiency and environmentally safe disposal or recycling, as it saves costs for the service provider	• Integration of energy-efficient and low-carbon technologies at zero upfront cost to the end user • Flexible financing model applicable to multiple end uses and cooling technologies	• Makes the cost of climate-friendly technologies more economical • Enhances the local manufacturing capacity for high-performance technologies by inducing faster product innovation • Incentivises manufacturers to innovate as it facilitates consolidation and development of new markets
Key challenges	• Long payback periods for investors • Requires extensive and expensive service networks for customers in remote areas • Technology quality issues are common as most sustainable technologies offered are not regulated by S&L schemes and BIS • Risk mitigation guarantees and countermeasures are limited and weaken investor interest	• High risk of default on repayment • End users are not convinced unless savings are demonstrated • Access to project finance from lending institutions is restrictive • Risk mitigation guarantees and countermeasures are inadequate and limited in nature	• The cost of technologies is likely to reduce if the aggregate demand attains critical mass • Consumer expectations plus purchasing power must be calibrated with manufacturer capacity and willingness to deliver • Complex cooling technologies do not work optimally with bulk procurement • The procurement cycle must align with the peak cooling season
Access to capital	Dependent on international investors and blended finance (grants + concessional loans)	Restricted despite risk guarantees (only for public or municipal projects) provided by international development banks	Availability depends on the creditworthiness of the procurer and international banks willing to invest in the public sector with sovereign guarantee

Source: Author's analysis

Dealer financing	On-bill financing (on-wage/ remittance-based financing)	Leasing
Transferred to the end user after payment recovery	End user	With financier during lease tenure, can be transferred to the user in lease-to-own contracts
End user	End user	Technology provider or contractor
High	High	Low
• Applicable for all types of end uses but higher efficacy for smaller systems where maximum sales are made through retailers or dealers	• Decentralised cooling and refrigeration • Residential and small businesses with less than 10 kW demand per cooling unit	• Applicable for all types of end uses
• All types and sizes of cooling systems; smaller systems will be a more lucrative market	• Small, portable systems wherein end users have limited liquidity or borrowing bandwidth with private financiers	• All types and sizes of cooling systems
No guarantee	No guarantee	No guarantee
Dealers, retailers, distributors, manufacturers	Private and public sector banks, MFIs, NBFCs, and discoms	Manufacturers, contractors, banks, leasing companies, and non-banking finance companies
• Brings down the cost of loans for consumers • Eases access to credit for financially illiterate consumers • Increases sales and develops new markets for suppliers	• Allows low-income communities to transition to sustainable technologies for enhanced comfort, health and economic productivity • Users have flexibility in brand and product selection	• Lessee can change equipment and operate with the most advanced technologies in the market • Taxable income of the lessee can be reduced in the operational leasing model • Additional off-balance-sheet financing is possible as lease payments are not on balance sheets
• Dealers and retailers cannot always afford the capital costs of financing loans • No incentives or regulations for manufacturers, distributors, and retailers to encourage sales of efficient models over inefficient ones • Customer defaults increase risks for loan providers	• High risk of default on the loan • Transactional and recovery costs are high unless reliable and experienced demand aggregators are integrated • Financial institutions face difficulties in accessing low-cost capital to disburse zero-interest loans	• Incorrectly designed terms and conditions can exacerbate costs for consumers and alienate them from leasing • Residential consumers' and Indian retail's lack of familiarity with the model can slow adoption • Tax regime should be favourable for leasing activities
Dealer financing is available from public and private sector banks	Challenging for businesses and public sector entities like discoms	Depends on the project size and creditworthiness of the end user or borrower

5. Challenges in scaling up these models

CaaS, OBF, ESCO, dealer financing, leasing and bulk procurement models increase affordability of low-emission cooling. Each can fulfil the diverse funding needs of the majority of key consumer segments and technologies in India. Yet, mainstream manufacturers in the heating, ventilation and air conditioning (HVAC) industry have mostly shied from them. A relatively small number of new enterprises have ventured into this domain. Among the various models, CaaS is stimulating the most interest among entrepreneurs, investors, and policymakers. This momentum can be traced to the *Kigali Cooling Efficiency Programme* (KCEP), now known as the *Clean Cooling Collaborative*, which is leveraging a USD 50 million multi-lateral fund to promote CaaS as an alternate mechanism for financing efficient cooling (CCC Home 2021).

Pioneers driving the delivery of efficient cooling are propelled primarily by their entrepreneurial spirit and desire to provide access to the benefits of cooling to the underserved. They face challenges such as lack of access to capital, unaware consumers, and inadequate risk cover detailed below.

5.1 Access to capital

Entrepreneurs working with these business models find raising capital problematic. Most companies offering CaaS and ESCO services depend on blended finance (grants plus concessional loans) from development banks and foreign social impact investors to build capital. The costs of raising capital for purchasing, operating, and servicing equipment are high while the returns are slow.

Longer returns periods deter domestic investors, and formal lending institutions deem the sector and its end users as risky. Individual cooling projects are relatively smaller in size. The average size of energy-efficiency projects in India is between INR 2–5 crore (BEE 2021), and cooling is mostly a small subset of this. From the point of view of banks, the transaction costs of underwriting a loan to a smaller enterprise is comparatively higher and, thus, less profitable (Taylor, et al. 2008). Further, businesses working exclusively with new cooling technologies and small enterprises are deemed riskier. As mainly start-ups work in this sector, serving low-income end users, they appear an unfavourable investment for lending agencies. Recent regulations advise lending institutions to practise caution and increase the stringency of risk-assessment criteria to reduce the share of non-performing assets in their portfolio. This has exacerbated problems of borrowing for businesses.

> **Indian companies offering CaaS and dealer finance recover their investment in 7–8 years.**

> **"Domestic investment in climate-friendly, rural cold chain services is low. Sensitising investors about the growth potential of business models that bring affordable, sustainable cooling to rural consumers is needed to correct this trend."**
>
> **Amit Saraogi**
> CEO and Co-founder, Oorja Development Solutions

International experience suggests that these models can have a slower turnaround time because of high equipment costs. Indian companies offering CaaS and dealer finance for sustainable cooling products recover their investment in 7–8 years. Their end users consist primarily of small farmers, micro-enterprises, and low-income consumers whose weak paying capacity results in extended breakeven points. Indian investors accustomed to more aggressive returns promised in other sectors are, thus, disinclined to test the cooling industry.

Managing blended finance is not an easy task either. Attention of the development sector, private and public financing agencies providing climate finance is diverted more towards renewable energy. Funds and credit lines dedicated to renewable energy outnumber those focussed on efficiency.

Enterprises promoting innovative cooling technologies are often run by social entrepreneurs, who are not skilled in marketing themselves to investors and lenders. These businesses have been unable to prove the long-term market potential of their models and services so far. This also serves to dilute their bankability and harms their capital-raising efforts.

5.2 Inadequate de-risking for businesses

Businesses do not have adequate risk cover and collateral to satisfy the risk-assessment criteria of lenders. World Bank has, to some extent, catalysed investment toward energy efficiency through its *Partial Risk Sharing Facility* (PSRF). Banks are partnering with the World Bank to disburse loans through this platform. The need for collateral is waived off because of the guarantees from the PRSF. However, it is the sole actor de-risking investments in efficiency and sustainable cooling. The rest of the ecosystem is still exclusively focused on clean or green energy.

The nature of the risks in ESCO and CaaS is also not understood correctly. Risk guarantees are being offered only for technical risks. Commercial risks, arising from customers defaulting on repayments despite technical performance, are ignored. It leaves businesses struggling for working capital.

5.3 Costly and unreliable emerging technologies unregulated by quality assurance standards

A significant share of service providers' capital expenditure goes towards procuring highly priced equipment. Renewable energy-based technologies especially come with high margins. As the field is not mature, there are only a few original manufacturers of decentralised renewable-based technologies who have a virtual monopoly of the market and demand high prices. Lack of performance standards is another barrier to the scaling up of sustainable cooling technologies; it reduces consumer trust (ESCAP and United Nations 2021). Sustainable cooling businesses in India also underlined the problem of higher repair costs in the case of renewable cooling technologies. Repair costs are high because of unavailability of spare parts and low competency of service technicians.

> **"Risk guarantee instruments to cover commercial risks comprehensively will strengthen credit-worthiness of projects and ability of enterprises to drive investments in sustainable cooling."**
>
> Arjun P Gupta, CEO, SmartJoules

Business offering decentralised renewable-based cooling and refrigeration assemble individual components sourced from different manufacturers on site. National performance and testing standards have not been developed either for components or the assembled products. Testing lab infrastructure is also insufficient to accommodate recommended tests. Due to the risk of technical failures, the lifecycle costs of products increase for service providers, and these are inadvertently transferred to the end user. The servicing infrastructure offered by manufacturers is limited to a few urban centres. Manufacturers expand after sales service support It can be a deterrent for servicing-centred models such as CaaS and ESCO. Companies offering CaaS now must invest additional capital in developing an internal servicing infrastructure that caters to the maintenance needs in off-the-map, semi-urban, and rural areas.

5.4 Difficult business acquisition

Business and demand acquisition are challenging because of the weak purchasing capacity of consumers, and a widely dispersed client base. End users are also unable to understand the benefits of services and cooling systems because of low literacy. Conventional marketing methods are also not as productive. Consequently, the cost of consumer outreach and acquisition turns out to be high for businesses. All these problems are accentuated in the rural cold chain sector. Most produce varies by seasons and so the full capacity of cooling systems is not utilisable. This also effects repayment. Businesses engage with established demand aggregators, such as farmer producer organisation (FPO), and end up having to share profits with them. These costs are passed along to end users, which ultimately increases the cost of service delivery.

Risk guarantees in ESCO and CaaS are offered for technical risks, not commercial risks.

Weak institutional capacity to enforce environmental regulations also hamper market demand.

5.5 Lack of visibility and promotion

Discussions about the application and scaling up of these models are relegated to a small community of non-governmental and research organisations. End users, investors, and the government are largely unaware of the value addition. Knowledge dissemination by development organisations fills the vacuum to some extent. The generalised nature of awareness building, however, misses key decision-makers along the value chain.

5.6 Weak regulations

Voluntary, incohesive and inconsistent national and sub-national regulations also hamper market demand. National programmes to deploy green technologies have only targeted institutional end users and ignored the much bigger latent demand from retail end users. Recent studies also underline the meagre progress made in implementing the *India Cooling Action Plan*, *EcoNiwas Samhita*, the *Energy Conservation Building Code* (ECBC), key policies articulating demand and performance standards for low-emission cooling (Shakti Sustainable Energy Foundation 2021). This is in stark contrast to mature and constantly evolving policies for the renewable and clean vehicles sectors. The latter are updated frequently to reflect technological progress. State and central governments have set stringent and quantifiable targets for a transition to renewable energy and electric vehicles.

6. Recommendations to increase uptake

Catalysing investor confidence, fostering consumer confidence, and creating strong demand through consistent policies can alter the currently challenging situation. The growth trajectory of renewable energy and low-emission transport in India offers a possible roadmap for sustainable cooling. Ambitious mandatory targets and direct incentives to end users are continued to this day. The low-emission electric transport sector is following` the same strategy: obligatory targets for the public sector and private sector, coupled with incentives for vehicle owners, automobile manufacturers, and charging station developers. The *Faster Adoption and Manufacturing of Hybrid and Electric* (FAME) scheme supports direct incentives for consumers and large-scale public procurement of electric two- and three-wheelers. Lower GST for high efficiency products considering that the GST for cooling is in high tax bracket can act as a catalyst. Private-sector investment can be supported through strategies that are explained in this section.

6.1 Enable access to capital

The first push for financing and accompanying support instruments must come from international development institutions and the central government. Within the energy-efficiency sector, sustainable cooling has enjoyed pre-eminence in the Indian portfolio of multilateral development and international development finance institutions. The majority, however, has been channelled to the public sector with sovereign guarantees from the Government of India. This must be redirected towards the private sector. International Finance Corporation's *TechEmerge Sustainable Cooling* programme and ADB Ventures are good examples of development agencies investing in start-ups, and early-stage companies bringing innovative technologies and business models to Indian markets.

6.2 Raise consumer awareness of business models

CaaS and OBF are relatively unknown alternative business models to cost-effectively accessing high-performance cooling. This can be remedied by demonstrating the value proposition of these models in highly visible government and public-sector projects. Central Public Work Department (CPWD) and state Public Work Departments (PWDs) can become early adopters of these models to demonstrate their benefits and raise awareness. Possible projects can be prominent and new public buildings, airports, government warehousing facilities, and civic infrastructure projects. Reinforcing the government's support for sustainable cooling as a critical pathway to controlling climate change will also catalyse the interest of investors.

Interventions educating consumers about the benefits of efficient cooling for both productive and consumption purposes can help supersede retail and institutional buyers' resistance. Labelling and promoting high efficiency and low GWP based products as Green products will increase visibility.

Case study 1.6 **Incentives from discoms for heating-as-a-service in Europe**

Incentives schemes, to promote cooling or heating-as-a-service, are gaining traction in Europe. Denmark, Netherlands, and Belgium are awarding additional incentives, over and above those provided on installing energy-efficient heating or cooling, to owners for using the heating-as-a-service model. The Danish Energy Agency offers rebates to both service providers offering renewable energy-based heating (about 15 per cent of total project cost) and to owners for leasing equipment under pay-per-use models. Utilities are also partnering with service and technology companies to offer customers heating as a service (Bellini 2021).

6.3 Develop an incubation ecosystem for entrepreneurs

Almost all the enterprises applying CaaS, ESCO, or OBF in India depend on social impact investors or blended finance from development banks for capital. Sensitising the investor community about the returns on investment in CaaS and OBF is of primary importance. This confidence-building efforts need to be helmed by the government. Investor summits and B2B networking events hosted by government agencies and industry associations such as the Confederation for Indian Industries (CII) and Federation of Indian Chambers of Commerce & Industry (FICCI) can boost awareness about the potential profits that can be gained through cooling sector innovation. A mature market for cost-effective technologies will help improve the livelihood security of small farmers and enterprises. The interest of Indian social impact investors can be stirred by demonstrating the societal benefits of investing in sustainable cooling.

6.4 Build demand through strong regulations

Incorporating ECBC and *Eco Niwas Samhita* (residential building energy code) into mandatory local and state laws and separate technology programmes for municipal and public assets will drive demand. Stringent DSM targets and regulations for discoms to conserve energy will also induce demand for efficient cooling.

6.5 Regulate technology performance and quality

Standardising the performance requirements of emerging cooling technologies will help service providers deliver high-quality, reliable cooling services. Technologies utilising renewable energy and thermal battery storage are currently governed by international standards. The Bureau of Energy Efficiency, Ministry of New and Renewable Energy, Bureau of Indian Standard, and other environmental performance-setting bodies need to step up the development of product standards and testing protocols valid for the local context and simultaneously push for infrastructure to enable regular testing Capacity building is essential.

The models discussed are being enthusiastically applied in other countries to increase penetration of sustainable cooling. With moderate support from government and private sector, the story for India can be similar if not better. This study is a first attempt to put the advantages, drawbacks and challenges of the models under the lens. It must be followed by consistent attempts to understand consumer needs, market capacity to supply sustainable cooling and role of government regulations.

Standardising the performance requirements of emerging cooling technologies will help service providers deliver high-quality, reliable cooling services.

References

Aarti Nain et al. 2022. *Chiller Energy Efficiency Program: Market Research and Feasibility Study*. United States Agency for International Development (USAID)

Abramskiehn, Dario,synchronize the development of technologies and Morgan Richmond. 2019. *Cooling As a Service: Lab Instrument Analysis*. Delhi: Global Innovation Lab for Climate Finance.

ADB Ventures. Accessed on December 10, 2021. https://ventures.adb.org/

Alison, Cate ten, Jeff Harris, John Shugars, and Hans Westling. 1998. "Technology Procurement as a Market Transformation Tool." Washington DC: American Council for Energy-Efficient Economy.

BASE. 2019. *Manual of Financing Mechanisms and Business Models for Energy Efficiency*. Paris, Washington DC, and Basel: United Nations Environment, United for Efficiency, Global Environment Facility, Basel Agency for Sustainable Energy.

BASE. 2020. *Knowledge Brief Series: Green On-Wage Financing*. Basel: Basel Agency for Sustainable Energy.

BASE. n.d. "Cooling as a Service Initiative." Basel Agency for Sustainable Energy. Accessed December 9, 2021. https://energy-base.org/projects/cooling-as-a-service-initiative/.

BEE. 2021. "Venture Capital Fund for Energy Efficiency (VCFEE)." Bureau of Energy Efficiency. https://beeindia.gov.in/sites/default/files/VCFEE.PDF.

Bellini, E. 2021. "New Incentive Round for Electric Heat Pumps in Denmark." *PV Magazine*, 15 September. https://www.pv-magazine.com/2021/09/15/new-incentive-round-for-electric-heat-pumps-in-denmark/.

Bhasin, Shikha, Apurupa Gorthi, and Vaibhav Chaturvedi. 2020. Do Residential AC Buyers Prioritise Energy Efficiency? Indian Consumer Perception and Purchases. New Delhi: Council on Energy, Environment and Water

CCC Home. n.d. Accessed in November, 2021. https://www.cleancoolingcollaborative.org/

Cluster Development Programme (CDP). n.d. "National Horticulture Board." Accessed on December 10, 2021. http://nhb.gov.in/AboutCDP.aspx?enc=3ZOO8K5CzcdC/Yq6HcdIxNRZ9Jd/gg/vMB84vUqhmUw=

CPI. 2020. *Landscape of Green Finance in India*. Delhi: Climate Policy Initiative and Shakti Sustainable Energy Foundation.

CRIF. 2021. *How India Lends: Credit Landscape in FY 2021*. Mumbai: CRIF High Mark Credit Information Services.

Efficiency for Access Coalition. 2021. *Business Model Innovations Addressing Affordability: Case Studies*. Nairobi: Access for Energy.

ESCAP and United Nations. 2021. *Mapping Existing Solutions and Best Practices on Sustainable Cooling: Scoping Review*. Bangkok: Economic and Social Commission for Asia and the Pacific.

Evans, J. 2018. *Cold Chain Technology Brief: Commercial, Professional and Domestic Refrigeration*. Paris: United Nations Environment and OzonAction.

Gargaro, K. July 2021. "HVAC Contractors Should Consider Leasing HVAC Equipment to Homeowners." *the NEWS*. Accessed on December 6, 2021. https://www.achrnews.com/blogs/17-opinions/post/145145-hvac-contractors-should-consider-leasing-hvac-equipment-to-homeowners#comments201.

GeM. n.d. "Green Room ACs." Accessed in December, 2021. https://gem.gov.in/green-ac

Henderson, P. 2013. *Issue Brief: On-Bill Financing Overview and Key Considerations for Program Design*. New York: Natural Resources Defense Council.

ICRA. 2021. *Indian Power Sector – Electricity Distribution: Distribution Sector Reforms Imminent with Rising DISCOM Debt and Dues to GENCOS*. New Delhi: ICRA.

IFC. 2009. *Leasing in Development: Guidelines for Emerging Economies*. New York: International Finance Corporation.

ILO. 2019. *Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work*. Geneva: International Labour Organization.

Intellecap, G. a. (2021). *Decentralised Solar Refrigeration: Opportunities in the Livelihood Appliances Market in India*.

Kumar, Satish, Narendra Kumar, Koshy Cherail, Sudha Shetty, Neha Yadav, Akash Goenka. 2017. *Transforming the Energy Services Sector in India: Towards a Billion Dollar ESCO Market*. New Delhi: Alliance for an Energy-Efficient Economy and Shakti Sustainable Energy Foundation.

Loughran, M. 2016. "Advantages of Leasing." *dummies*, 26 March. https://www.dummies.com/article/business-careers-money/business/accounting/general-accounting/the-advantages-of-leasing-175195

Margdarshan Advisory and CLEAN. (2020). *Sensitizing Financial Institutions Towards Lending to Decentralised Renewable Energy Enterprises and End Users*. New Delhi: CLEAN.

Ministry of Food Processing Industries. *n.d. Ministry of Food Processing Industries Schemes: Cold Chain*. Accessed on December 11, 2021. https://mofpi.nic.in/Schemes/cold-chain.

Ministry of Power. Accessed on December 10, 2021. https://powermin.gov.in/en/content/energy-efficiency

MoEFCC. 2019. *India Cooling Action Plan*. Delhi: Ministry of Environment, Forest and Climate Change.

Monsen, Megan, and A. Selting. 1996. "Financing Options for Demand-Side Management Programs: Risk-Reward Tradeoffs for Ratepayers." *ACEEE Proceedings on Energy Efficiency and the Utility of the Future*. Volume 7: pp 95–103. Washington DC: American Council for Energy-Efficient Economy.

MP Ensystems, S. U. (2019). *Promoting Clean and Energy Efficient Cold Chain in India*. Delhi: Shakti Sustainable Energy Foundation.

Nain, A., A. Prasad, and T. Tathagat. 2014. *HVAC Market Assessment and Transformation Approach for India*. Delhi: United States Agency for International Development PACE-D Technical Assistance Program.

Farmer FIRST Programme (Indian Council of Agricultural Resource). n. d. "Objective of Farmer FIRST Programme." Accessed on December 10, 2021. https://ffp.icar.gov.in/about_ffp.aspx.

Phadke, Amol, Nikit Abhyankar, and Nihar Shah. 2014. *Avoiding 100 New Power Plants by Increasing Efficiency of Room Air Conditioners in India: Opportunities and Challenges*. Berkeley: Ernest Orlando Lawrence Berkeley National Laboratory.

Phillip, L. 2021. "Leasing options build highway to EV adoption." *Economic Times*, 15 September. https://economictimes.indiatimes.com/tech/tech-bytes/leasing-options-build-highway-to-ev-adoption/articleshow/86218149.cms

Sarkar, Ashok, Neha Mukhi, Padu S. Padmanaban, Amit Kumar, Kulbhushan Kumar, Manoj Bansal, Shuboday Ganta. 2016. *Utility Scale DSM Opportunities and Business Models in India*. Washington DC: World Bank.

Shakti Sustainable Energy Foundation. 2021. *Implementing the India Cooling Action Plan: Status Check and Way Forward*. Delhi: Shakti Sustainable Energy Foundation.

Sidhu, D. 2021. *Cooling as a Service: Lab Instrument Analysis – India Replication*. Delhi: Global Innovation Lab for Climate Finance.

Singhi, Abheek, Amitabh Mall, and Namit Puri. 2016. *Retail Transformation: Changing Your Performance Trajectory*. Mumbai: Boston Consulting Group.

Taylor, Robert P., Chandrasekar Govindarajalu, Jeremy Levin,Anke Meyer, and William Ward. 2008. *Financing Energy Efficiency: Lessons from Brazil, China, India, and Beyond*. Washington DC: World Bank.

TechEmerge. n.d. *IFC TechEmerge Sustainable Cooling in the Indian Hospitality Sector*. Accessed on December 10, 2021. https://www.techemerge.org/country/sustainable-cooling-indian-hospitality-sector

TechSci Research. 2019. *Indian HVAC Market by Type, by End-Use Sector, Competition Forecast and Opportunities, 2022*. New York: TechSci Research.

UNEP and IEA. 2020. *Cooling Emissions and Policy Synthesis Report: Benefits of Cooling Efficiency and the Kigali Amendment*. Nairobi and Paris: United Nations Environment Programme and International Energy Agency.

UNEP and USAID. 2019. *Sustainable Public Procurement in India: Selection of Priority Products and Preliminary Market Assessment*. Delhi: United Nations Environment Programme.

United Nations Environment Programme. 2021. *Report of the Technology and Economic Assessment Panel-Volume 4: Continued Provision of Information on Energy Efficient and Low Global Warming Potential Technologies*. Nairobi: United Nations Environment Programme.

YORK Ultimate Home Comfort. Accessed on December 12, 2021. https://www.york.com/residential-equipment/ultimate-home-comfort

Educating consumers about the benefits of efficient cooling for both productive and consumption purposes can help supersede retail and institutional buyers' resistance.

Image: Alamy

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