REPORT

# Blueprint for Advancing Affordable and Domestically Produced Super-Efficient Ceiling Fans in India

MARCH 2026

## ACKNOWLEDGMENTS

The authors would like to thank the following stakeholders for their valuable insights and contributions, during the kick-off workshop and consultations, that informed this report: Manu Agarwal (AlphaSine Technologies Pvt. Ltd.); Bhaskar Sarma (Bajaj Electricals Ltd.); Pravatanalini Samal (Bureau of Energy Efficiency, Government of India); Promeet Ghosh, Sanjeev Agrawal, Rajat Chopra, Pravin Garje, and Uma Lanka (Crompton Greaves Consumer Electricals Ltd.); Dr. Anita Gupta (Department of Science and Technology, Government of India); Dr. Pradyot Koley (Department of Science and Technology, Government of India); Abhishek Gupta (Energy Efficiency Services Limited); Prof. B. G. Fernandes (IIT Bombay); Pradyumna Poddar (Indian Fan Manufacturers Association); Pramod Kumar Singh (Alliance for an Energy Efficient Economy), Susmit Datta (Intellecap); Sneha Sachar (Clean Cooling Collaborative); Vaibhav Mittal (Greenland Solutions); Neha Dhingra (CLASP); B. S. Praveen, Sriram Royam, and Gajanan Inamdar (Uniglobus Electricals & Electronics Pvt. Ltd.); Vaideesh Sankaran and Mehul Jain (World Bank); Shailendra Singh (Havells India Ltd.); Mayur Sundararajan (Versa Drives Pvt. Ltd.); and Yogesh Sahni (Wonder Electrical Ltd.). We would also like to sincerely thank Nishant Batra (CLASP), Akash Goenka, Sameer Kwatra and Nitish Arora (NRDC), and Graham Pugh (Propel Clean Energy Partners) for their expert comments and inputs, during the review process, which helped strengthen this report.

## Authors

Dhruv Jain, *GreenTree*
Jai Kharb, *GreenTree*
Gerry George, *NRDC India*
Saahi Uppalapati, *NRDC*
Prima Madan, *NRDC*
Syed Faraz Raza, *GreenTree*

## About GreenTree

GreenTree is a sustainability advisory and implementation firm working at the intersection of energy efficiency, climate policy, and market transformation. With experience across buildings, industry, utilities, and clean mobility, GreenTree supports governments, utilities, and private sector stakeholders in designing and scaling low-carbon solutions through research, technical assistance, and on-ground implementation.

## About NRDC

NRDC (Natural Resources Defense Council) is an international nonprofit environmental organization with more than 3 million members and online activists. Established in 1970, NRDC uses science, policy, law, and people power to confront the climate crisis, protect public health, and safeguard nature. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Bozeman, MT, Beijing and Delhi (an office of NRDC India Pvt. Ltd). Visit us at www.nrdc.org and follow us on Instagram @nrdc_org.

*NRDC Chief Communications Officer: Kristin Wilson-Palmer*
*NRDC Senior Policy Publications Editor: Leah Stecher*
*NRDC Director of Peer Review, Science Office: Laurie Geller*

*Cover image: © sema srinouljan via shutterstock*
*Design and Production: Sanjay Chaurasia*

सत्यमेव जयते
डा. अनिता गुप्ता
**Dr. Anita Gupta**

प्रमुख/वैज्ञानिक 'जी'
जलवायु, ऊर्जा व सतत् तकनीक
विज्ञान और प्रौद्योगिकी विभाग
भारत सरकार
**HEAD / SCIENTIST 'G'**
**Climate, Energy and**
**Sustainable Technology (CEST)**
**Department of Science & Technology**
**Government of India**

18th February, 2026

## FOREWORD

Cooling is becoming an increasingly important requirement across India, driven by rising temperatures, expanding urbanization, and growing expectations for comfort. Ceiling fans are the most widely used cooling appliance in the country and remain essential for providing affordable thermal comfort in homes, workplaces, and public buildings. Because of their large numbers and long operating hours, improvements in the efficiency and performance of ceiling fans can deliver meaningful benefits, including lower electricity consumption, reduced peak demand, and better service for consumers.

Advances in science and technology have opened new possibilities to improve ceiling fan efficiency. Innovations in motor design, materials, power electronics, aerodynamics, and manufacturing processes can help deliver better-performing and more energy-efficient products. At the same time, converting these advances into fans that are affordable, reliable, and manufactured domestically requires sustained research and development, adequate testing facilities, and close collaboration between research institutions and industry.

The Department of Science and Technology (DST) has been supporting research, innovation, and capacity building in areas related to energy efficiency and sustainable technologies. Strengthening domestic technological capabilities in widely used appliances such as ceiling fans supports the broader objective of promoting indigenous innovation, improving product quality, and enhancing manufacturing competitiveness.

In this context, the report Blueprint for Advancing Affordable and Domestically Produced Super-Efficient Ceiling Fans in India provides a useful reference. The analysis presented in the report is based on technical assessment and stakeholder consultations and identifies priority areas where focused research, standards development, and collaborative efforts can support the adoption of higher-efficiency ceiling fan technologies. The contributions of organizations involved in supporting this work, including NRDC and GreenTree, are acknowledged.

I hope that this publication will be of value to policymakers, research institutions, industry, and other stakeholders working to advance energy-efficient appliance technologies in India and will support informed decision-making and coordinated action in this sector.

(Anita Gupta)

**Room No.8, S&T Block-I, Old Technology Bhawan, New Mehrauli Road, New Delhi-110016**
**Tele.: 011-26523977, 26590213 Website: www.dst.gov.in / www.nstedb.com**
**E-mail : anigupta@nic.in / anitagupta2004@gmail.com**

# CONTENTS

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **ANRF** | Anusandhan National Research Foundation |
| **BAT** | Best Available Technology |
| **BEE** | Bureau of Energy Efficiency, Government of India |
| **BIS** | Bureau of Indian Standards, Government of India |
| **BLDC** | Brushless Direct Current |
| **BRPL** | BSES Rajdhani Power Limited |
| **CAGR** | Compound Annual Growth Rate |
| **CBIC** | Central Board of Indirect Taxes and Customs, Government of India |
| **CF30** | Ceiling Fans by 2030 (Blueprint Initiative) |
| **CLASP** | Collaborative Labeling and Appliance Standards Program |
| **CMM** | Cubic Meters per Minute |
| **CoEs** | Centers of Excellence |
| **CPCB** | Central Pollution Control Board, Government of India |
| **CRCA** | Cold Rolled Close Annealed (Steel) |
| **CRNO** | Cold Rolled Non-Oriented (Electrical Steel) |
| **DISCOM** | Distribution Company (Electricity) |
| **DPIIT** | Department for Promotion of Industry and Internal Trade, Government of India |
| **DST** | Department of Science and Technology, Government of India |
| **EESL** | Energy Efficiency Services Limited |
| **EPR** | Extended Producer Responsibility |
| **GST** | Goods and Services Tax |
| **IC** | Integrated Circuit |
| **ICAP** | India Cooling Action Plan |
| **IFC** | International Finance Corporation |
| **IFMA** | Indian Fan Manufacturers Association |
| **IMC** | Indian Merchants' Chamber |
| **IS 374** | Indian Standard 374 (Ceiling Fan Testing Protocol) |
| **MOSFETs** | Metal-Oxide-Semiconductor Field-Effect Transistors |

| | |
|---|---|
| **MoP** | Ministry of Power, Government of India |
| **MSMEs** | Micro, Small and Medium Enterprises |
| **NABL** | National Accreditation Board for Testing and Calibration Laboratories |
| **NdFeB** | Neodymium-Iron-Boron (Rare Earth Magnet) |
| **NMEEE** | National Mission for Enhanced Energy Efficiency |
| **PCBs** | Printed Circuit Boards |
| **PLI** | Production Linked Incentive |
| **PVC** | Polyvinyl Chloride |
| **R&D** | Research and Development |
| **RWAs** | Resident Welfare Associations |
| **S&L** | Standards and Labeling |
| **SE** | Super-Efficient |
| **SRM** | Switched Reluctance Motor |
| **SV** | Service Value |
| **SynRM** | Synchronous Reluctance Motor |
| **THD** | Total Harmonic Distortion |
| **TWh** | Terawatt-hour |
| **UJALA** | Unnat Jyoti by Affordable LEDs for All |

# EXECUTIVE SUMMARY

India's ceiling fan market stands at a pivotal moment, with a rise in demand amid intensifying heat and the twin imperatives of meeting national goals for energy efficiency and domestic manufacturing. The ceiling fan sector, which accounts for about 40% of the total residential electricity consumption, offers a unique lever to advance these priorities. Ceiling Fans by 2030 (CF30) is a strategic blueprint to transform India's ceiling fan industry by the year 2030 through the widespread adoption of domestically manufactured, super-efficient fans. The blueprint sets out a clear and actionable pathway to mainstream these super-efficient fans, delivering significant energy savings, enhanced consumer value, and sustained growth in the domestic manufacturing sector.

Developed through expert workshops and close collaboration with the ceiling fan industry, the CF30 blueprint identifies the key challenges and opportunities for scaling, i.e., increasing the production, availability, and adoption of super-efficient fans across the sector.

## Strategic Vision

CF30 is anchored in three guiding objectives: achieving energy efficiency, ensuring affordability, and strengthening local manufacturing. The blueprint lays out specific performance and market targets: entry-level fans must achieve a minimum Service Value of 6, and 5-star models must reach a Service Value of 10 (a measure of efficiency that reflects airflow delivered per unit of power consumed). These high-efficiency fans are expected to remain affordable (approximately INR 1,300 (USD 14) for entry-level models). To support the domestic industry, CF30 targets 100 percent localization for super-efficient induction fans and 80 percent for Brushless Direct Current models. The initiative also prioritizes durability and consistent performance across India's varied grid conditions and climates, with special attention to rural markets.

## Four Strategic Intervention Areas

To operationalize the CF30 vision, the blueprint outlines four interlinked areas of intervention:

1. Design and Material Innovation: Incentivizing improved motor designs, thinner stator laminations, and adoption of alternative materials such as electrical-grade steel and composites to reduce energy losses and improve performance.
2. Testing Standards: Updating IS 374 to introduce controller durability and standardizing ambient testing to ensure product reliability and consistent quality across laboratories.
3. Demand Creation: Implementing fan replacement programs within Demand-Side Management frameworks, enforcing public procurement mandates for super-efficient fans, establishing a graded Goods and Service Tax structure to incentivize super-efficient fan purchases, and launching a multilingual consumer awareness campaign to accelerate market adoption.

4. Ecosystem Development: Building a robust domestic ecosystem by establishing National Accreditation Board for Testing and Calibration Laboratories (NABL)- accredited cluster testing facilities, creating dedicated Centers of Excellence for fans, expanding Production Linked Incentive schemes for critical components, fostering integrated manufacturing clusters, and providing concessional loans to stimulate local innovation and strengthen supply chain resilience.

A structured prioritization framework guides the sequencing of interventions based on policy alignment, technical feasibility, and ease of execution. Early-stage priorities (0 to 2 years) focus on enhancing testing standards and activating consumer demand. Medium-term actions (3 to 5 years) emphasize design innovation and financing mechanisms, while long-term efforts (5+ years) aim to establish a resilient and localized manufacturing ecosystem. Together, these phases advance CF30's vision by charting a strategic path for India to lead in energy-efficient cooling through super-efficient fans, affordable comfort for every household, and a resilient domestic manufacturing ecosystem.

# 1. INTRODUCTION

Ceiling fans are everywhere in India, as they are present in nearly 90 percent of homes across the country.[1] With around 60 million units sold annually, they are the most widely used cooling appliance in the country and, consequently, one of the largest opportunities for energy savings in the residential sector.

As climate change intensifies and India's need for cooling continues to grow, driven by rising temperatures, population growth, and rapid urbanization, the energy burden from ceiling fans is expected to rise significantly. According to the India Cooling Action Plan, replacing conventional ceiling fans (that consume around 70 watts) with more efficient models (using 50 watts or less) could reduce the energy use from fans by 10 to 15 percent by 2027–28.[2] The likely savings are even greater in the case of super-efficient fans (that consume as little as 35 watts), potentially delivering up to 20 terawatt-hours (TWh) of annual energy savings by 2037–38.[3] Further, the urgency to adopt more energy-efficient fans is underscored by the rapid growth in fan ownership. The stock of ceiling fans in India is projected to increase significantly from 450 million units in 2017–18 to 950 million units by 2037–38.[4] Without targeted interventions, this growth could result in high energy consumption and carbon emissions for decades. Therefore, it is critical to accelerate the market transition toward super-efficient, affordable, and domestically manufactured ceiling fans.

To support this transformation, the blueprint focuses on achieving three core objectives by 2030: (1) driving energy efficiency through innovation in super-efficient ceiling fan technology; (2) ensuring affordability, by minimizing the cost impact of higher efficiency levels, to keep super-efficient fans accessible for widespread adoption; and (3) strengthening domestic manufacturing capabilities across diverse fan technologies to reduce reliance on imports and build a resilient local supply chain. By fostering innovation, improving affordability, and enhancing local production, the blueprint aims to accelerate the market shift toward sustainable, super-efficient ceiling fans in India.

This blueprint sets out a strategic vision to enable this transformation by 2030. It begins with an overview of the Indian ceiling fan market, examining current efficiency levels, technology trends, and pricing dynamics. It then introduces the CF30 Vision—a forward-looking agenda to mainstream super-efficient fans in India by 2030. To achieve this, the blueprint identifies four key intervention areas: design and material innovation, enhancement of testing standards, demand creation through consumer awareness, and ecosystem development, including policy support and industry collaboration. Finally, it presents a structured prioritization framework to guide stakeholders in selecting and sequencing interventions based on their policy alignment, feasibility, and ease of implementation.

The blueprint is grounded in a rigorous, multifaceted, and stakeholder-driven process. Structured consultation involving industry leaders, policymakers, researchers, and other stakeholders helped identify the key challenges and opportunities for advancing super-efficient ceiling fans in India. For a detailed overview of the methodology, please refer to Appendix A.

# 2. OVERVIEW OF THE CEILING FAN MARKET

This section offers an overview of India's ceiling fan market, highlighting current market size and growth trends, technology adoption, efficiency levels, pricing dynamics, reliability and serviceability, and the testing and compliance infrastructure.

## 2.1 Market Size and Growth Trends

India's ceiling fan market is experiencing robust growth, driven by rising temperatures and increasing demand for affordable cooling. According to the Indian Fan Manufacturers Association, the market has grown at a Compound Annual Growth Rate of 6 percent from 2018 to 2021. As of 2025, India has an estimated 584 million ceiling fans in use, and the stock is expected to grow by about 21 percent over the next five years.[5] Ceiling fans are available in various sweep sizes—including 900mm, 1050mm, 1200mm, and 1400mm—with the 1200mm sweep fans dominating the market, capturing nearly 77 percent of market share (see Figure 1).

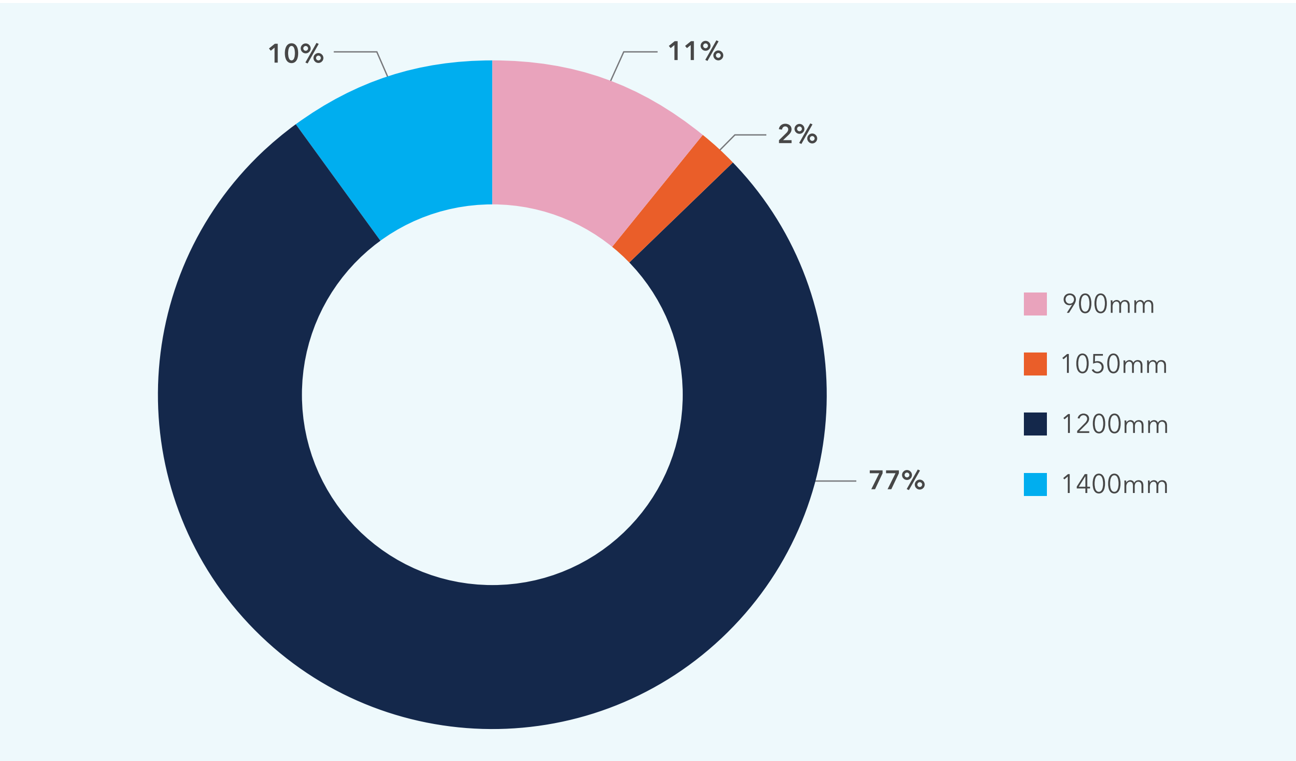


**Figure 1: Fan Market Share by Sweep Size in India**

The market, which was historically dominated by micro, small, and medium enterprises (MSMEs), has shifted significantly since ceiling fans came under the Bureau of Energy Efficiency's (BEE) mandatory Standards & Labelling (S&L) program in 2023. As of 2025, large companies control about 80 percent of the market, with MSMEs accounting for the remaining 20 percent.[i] While major brands like Havells, Orient, Usha, Bajaj Electricals, and Crompton Greaves collectively hold 82 percent of the organized fan manufacturing segment, emerging players such as Atomberg and Versa Drives are gaining ground, especially in the super-efficient fan segment (see Figure 2).[6]

i Based on stakeholder consultations with fan manufacturers and other industry experts.

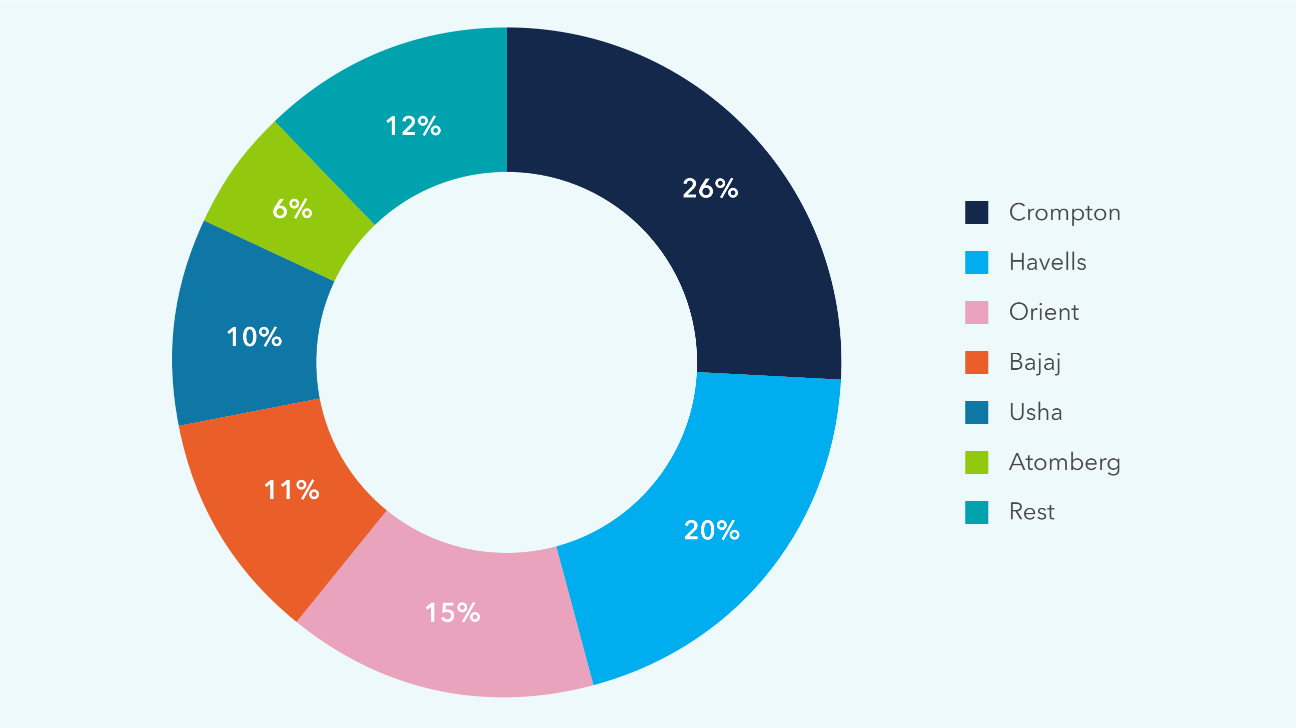


**Figure 2: Fan Market Share of Organized Players in India**

## 2.2 Efficiency Levels and Standards

Under the BEE's S&L program, ceiling fans must meet the minimum energy performance criteria, expressed through a Service Value (SV). The baseline standard requires fans to deliver at least 210 Cubic Meters per Minute (CMM) of air and consume no more than 53 watts of power.[7]

As of 2025, fans with a service value of 4 (corresponding to 53W consumption) qualify for a 1-star rating, while those achieving 6 SV or higher (typically consuming 35W or less) receive a 5-star rating (see Table 1).[8]

**Table 1: Service Value for 1200mm Ceiling Fan[ii]**

| Star Rating | Current Service Value (Since 2020) | |
|---|---|---|
| | Min SV | Max SV |
| 1-star | 4 (53W) | 4.49 (<47W) |
| 2-star | 4.5 (47W) | 4.99 (<42W) |
| 3-star | 5 (42W) | 5.49 (<38W) |
| 4-star | 5.5 (38W) | 5.99 (<35W) |
| 5-star | >=6 (<=35W) | |

Despite these standards, only 19 percent of fans, sold in 2022–23, were rated 5-star, as 77 percent of sales remained concentrated in the entry-level 1-star category. Thus, indicating a substantial room for efficiency improvements (see Figure 3).[9]

ii For a ceiling fan with a 1200mm sweep size, an air delivery of 210 CMM is considered the standard output. The power consumption and efficiency of the fan are measured using the following formula: Service Value of Ceiling Fan = Air Delivery (CMM) / Power Consumption (W).

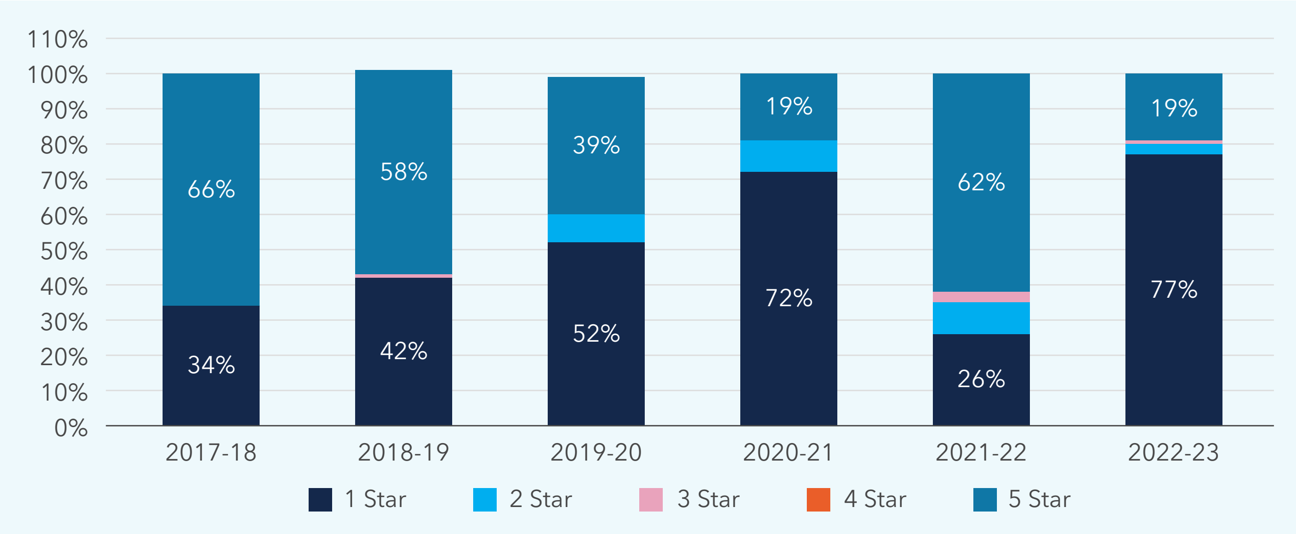


**Figure 3: Star-rating wise Break Up of Fan Production/Sales (2017-2023)**

## 2.3 Ceiling Fan Technologies

Two technologies dominate India's ceiling fan market:

- **Induction Motors:** Known for their durability and low maintenance, induction fans operate via electromagnetic induction. Traditionally linked to lower efficiency (primarily 1-star rated models), recent advancements have enabled some induction fans to achieve 5-star ratings by consuming lesser power, approximately 35W (6 SV).[iii] Industry experts anticipate further technological advancements could push power consumption down to 25W (8.4 SV), a 40 percent improvement over the best models currently available in the market.[iv]
- **Brushless Direct Current (BLDC) Motors:** These fans deliver higher efficiency by using permanent magnets and sophisticated motor controllers. Current best-in-class BLDC fans consume about 28W (7.5 SV) power, representing a 25 percent efficiency gain over top induction fans. Industry feedback suggests that BLDC technology has the potential to further improve energy efficiency by up to 40 percent over current top-performing models. This could result in fans consuming as little as 20W (10.5 SV) of power. Such an advancement would represent a 75 percent improvement in energy efficiency compared to the current minimum threshold of 6 SV for a 5-star rating under the S&L program.

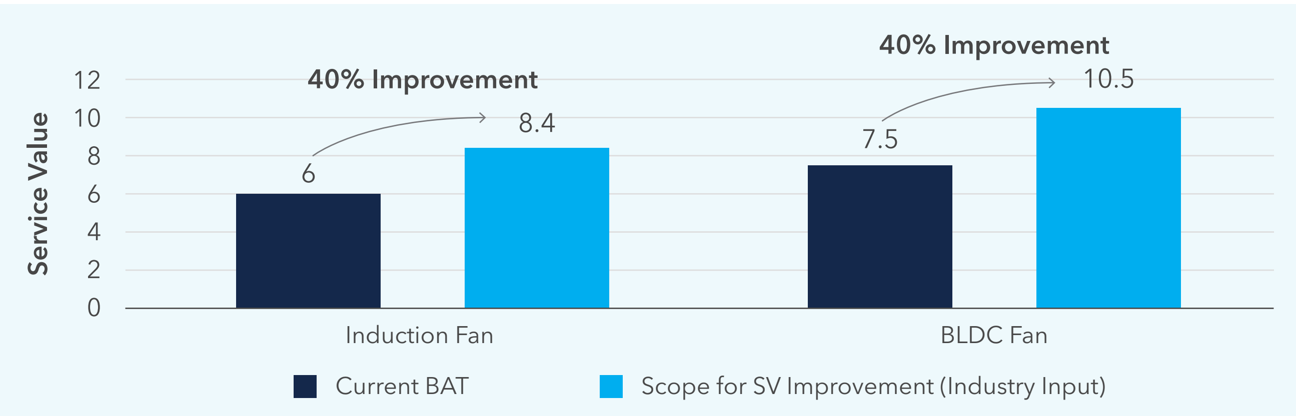


**Figure 4: Potential for Energy Efficiency Improvement in Existing Fan Technologies "**
**(as per Industry Consultations)**

iii Based on stakeholder consultations, currently, the best available technology in induction fans has a service value of 6.
iv Based on stakeholder consultations with fan manufacturers and industry experts.

## Emerging Technologies

While Induction and BLDC technologies continue to dominate the ceiling fan market, alternative motor technologies such as Switched Reluctance Motors (SRM) and Synchronous Reluctance Motors (SynRM) are being explored for their potential to offer comparable or superior efficiency with reduced import dependency and supply chain risks.

While SRMs offer the advantages of achieving 6.3 SV and cost competitiveness, challenges remain around noise and torque ripple at low speeds. SynRMs present greater promise by potentially reducing reliance on permanent magnets and electronic controllers while delivering energy efficiency comparable to BLDC fans. Prototypes have been developed at leading academic institutions, including the IITs; however, strong industry-academia partnerships will be essential to scale these technologies.

# 2.4 Pricing Trends

Price sensitivity is a key factor in consumer adoption. Retail prices vary notably by star rating and motor technology. For instance, as of November 2025, 1-star fans retail between INR 1,100 (USD 12) and 1,300 (USD 14), while 5-star fans typically cost INR 2,200 (USD 24) to 2,500 (USD 27)—a price increase of roughly 13 to 15 percent per star rating increment.[v]

- **Induction Fans:** Supported by a mature domestic supply chain and an extensive service network, induction fans are the most affordable, with manufacturing costs of INR 700 to 750 (USD 7 to 8). A detailed breakdown of the bill of materials for an induction fan is provided in Figure 5 below.

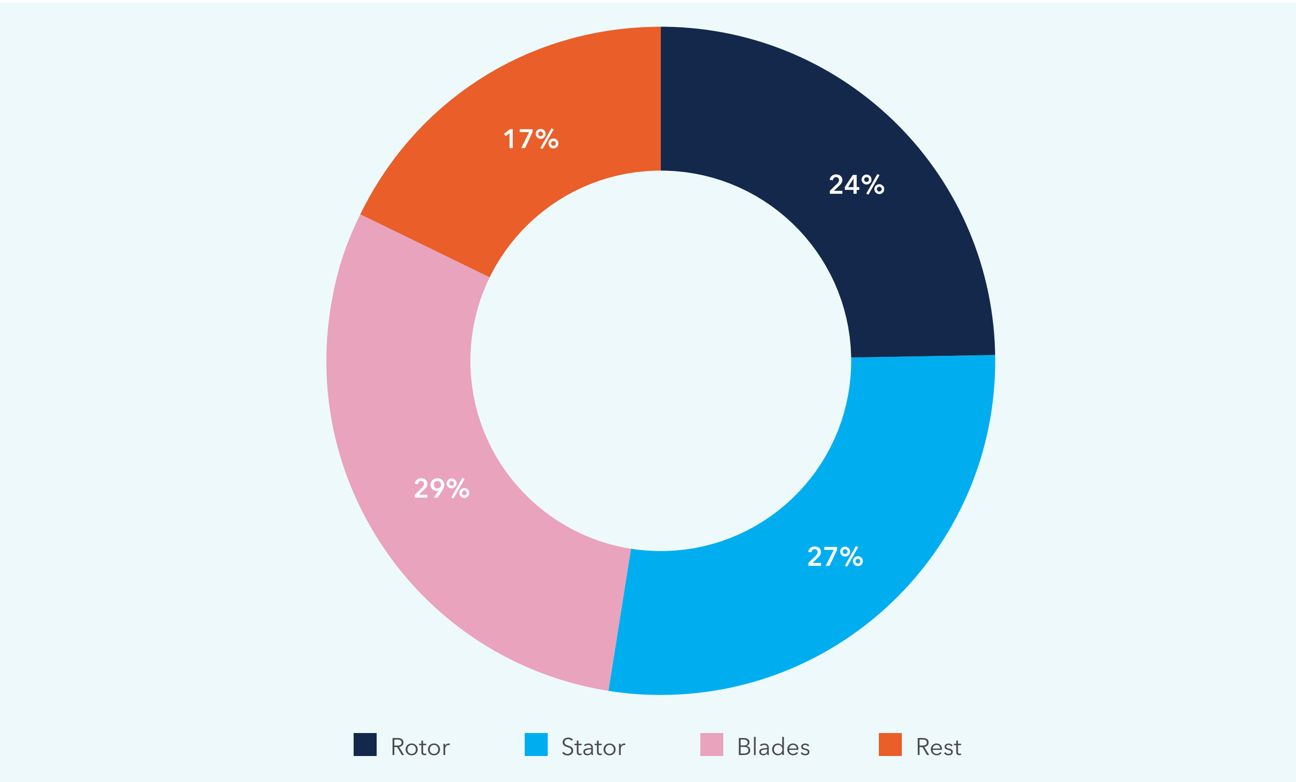


**Figure 5: Estimated Bill of Material for an Induction Fan (2025)**

v Based on stakeholder consultations with fan manufacturers and industry experts.

- **BLDC Fans:** BLDC models, primarily in the 5-star rating category, can consume as little as 28W (7.5 SV) but cost nearly twice as much to manufacture–INR 1,250 to 1,400 (USD 13 to 15)–as compared to standard induction fans.[vi] This cost premium is largely due to two import-dependent components: permanent magnets and motor controllers (see Figure 6). The heavy import dependence on magnets and electronic components adds to the cost and supply chain risks.

  Stakeholder consultations reveal that ferrite magnets, widely used across the fan industry, cost around INR 120 to 150 (USD 1 to 2) when imported. However, domestically produced ferrite magnets are nearly 50 percent more expensive, resulting in the majority of the industry (more than 95 percent) to depend on imported magnets. While there are other alternatives like rare earth magnets, such as neodymium-iron-boron (NdFeB), that offer superior performance and further enhance energy efficiency; however, these magnets cost nearly twice as much as ferrite magnets and are entirely imported.

  Motor controllers add another INR 350 to 450 (USD 4 to 5) to manufacturing costs, with 75 percent of the components (e.g., Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs), integrated circuits) sourced primarily from China and Taiwan.[10] Domestic controllers remain costlier (30 percent higher) and are often of inferior quality.[vii]

  As a result, retail prices for BLDC fans start at INR 2,200 to 2,500 (USD 24 to 27), creating affordability challenges, especially for low-income and rural consumers. A detailed breakdown of the bill of materials for a BLDC fan is provided in Figure 6 below.

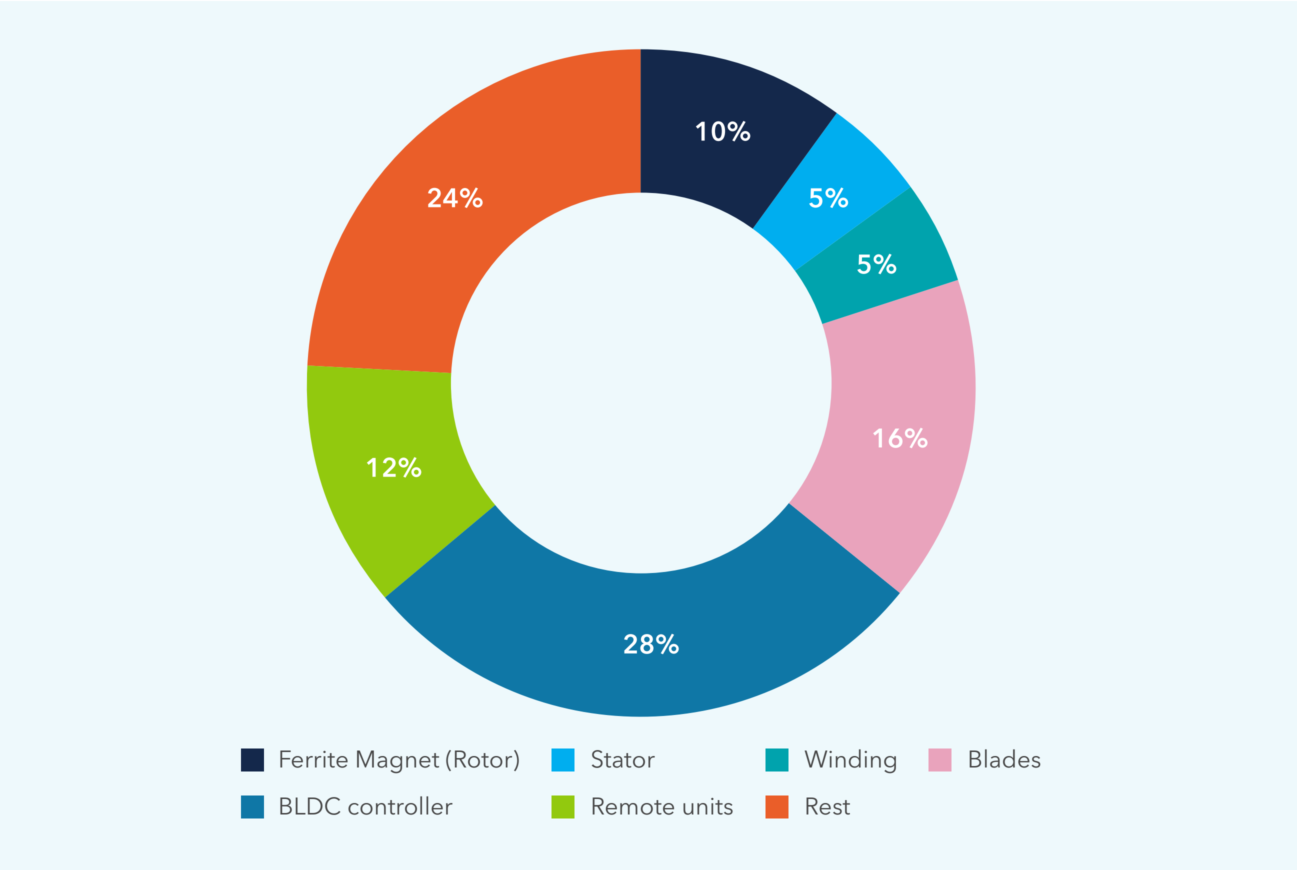


**Figure 6: Estimated Bill of Material for a BLDC Fan[viii]**

---

vi Based on stakeholder consultations with fan manufacturers and industry experts.
vii Based on stakeholder consultations with fan manufacturers and industry experts.
viii According to a report published by Prayas Energy Group, a typical ceiling fan uses around 1.1 kg of stator lamination and 0.3 kg of winding material. Based on secondary research, the cost for CRCA lamination ranges between INR 60 and 70 (USD 0.6 to 0.7) per kg, while aluminum winding material costs approximately INR 250 to 270 (USD 2 to 3) per kg.

## Price trends for super-efficient fans over the years

In recent years, the manufacturing cost of 5-star ceiling fans, predominantly BLDC models, has declined by approximately 30 percent, driven by technological advancements and economies of scale.[ix] Stakeholder inputs from relevant industry experts and researchers indicate that further cost reductions are likely as production volumes increase, especially as electronic components continue to get cheaper.

- **Controller Costs:** Controller costs have decreased by 28 percent over the last 5 years and are projected to decline by an additional 25 percent by 2030.
- **Magnet Costs:** While magnet prices have dropped by 20 percent over the last 5 years , however, further reductions are unlikely in the near future due to persistent supply constraints owing to India's continued dependence on import of raw materials for such magnets.

These cost trends are expected to gradually narrow the price gap between entry-level and super-efficient ceiling fans (see Figure 7). However, achieving widespread adoption will require concerted efforts to overcome the affordability challenges.

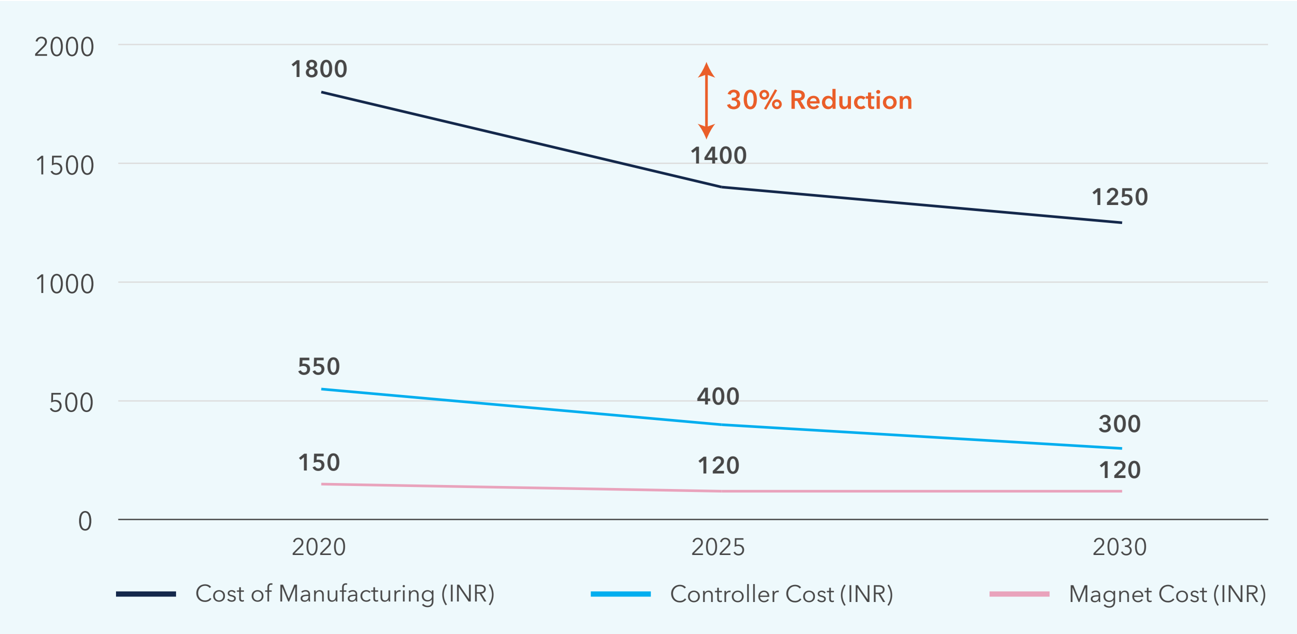


**Figure 7: Cost of Manufacturing a 5-star Fan (6 SV), 2020-2030**

## 2.5 Reliability and Serviceability

Reliability and after-sales service significantly impact consumer trust and market penetration.

- **Induction Fans:** Known for their low failure rates (<2 percent) and affordable maintenance, induction fans benefit from extensive service networks, including rural areas.[x]
- **BLDC Fans:** While they are more efficient, BLDC fans face higher failure rates in comparison to induction fans (6 to 8 percent), mainly due to controller issues exacerbated by poor power quality (voltage fluctuations and surges). During a fan's 10-year lifespan, controllers often require replacement at a significant cost (nearly 70 percent of the fan's original price). Limited service infrastructure and technician availability further restrict the adoption of BLDC fans outside urban centers.

ix Based on stakeholder consultations.
x Based on stakeholder consultations.

## 2.6 Testing Infrastructure and Compliance

Conducting thorough testing and receiving certifications remains a challenge, particularly for MSMEs:

- **Cost of Testing:** India has more than 60 accredited labs, of which 25 to 30 are open to all manufacturers. However, testing costs (INR 40,000 to 50,000 (USD 440 to 550) per model) are high, making repeated or iterative testing financially burdensome for smaller manufacturers.[xi]
- **Lab-to-Lab Variations:** Test results for the same fan model can vary significantly across laboratories located in different climatic zones. These discrepancies create compliance challenges for manufacturers under the S&L program.

Ensuring compliance with BEE's energy efficiency standards is critical to maintaining product quality and delivering national energy savings. Although IS 374, the Indian standard governing electric ceiling-type fans, specifies clear testing and performance requirements, enforcement remains weak due to limited audits, inadequate market surveillance, and poor traceability of certified products. These gaps allow substandard fans to enter the market, thereby undermining the S&L program.


xi Based on stakeholder consultations.

# 3. CF30: A VISION FOR INDIA'S CEILING FANS BY 2030

CF30 is a strategic blueprint to transform India's ceiling fan industry by 2030 through the widespread adoption of domestically manufactured, super-efficient fans. Anchored in three pillars—maximizing energy efficiency, ensuring affordability across diverse consumer segments, and strengthening the local manufacturing ecosystem—the initiative seeks to address key market barriers through targeted interventions. The goal is to unlock the sector's full energy-saving potential, lower the cost of efficient fans through scale and innovation, and establish India as a global leader in ceiling fan manufacturing.

## 3.1 Energy Efficiency: Setting Ambitious Yet Achievable Standards

Improving energy efficiency is at the heart of CF30. The BEE is expected to revise the star rating thresholds in 2026, raising minimum SV requirements by 0.5 across all categories (e.g., for 1-star fans: from 4 to 4.5 SV; 5-star: from 6 to 6.5 SV).[11]

However, consultations with relevant industry experts, researchers, etc. reveal an untapped potential for improving efficiency. Today's best-in-class BLDC fans can achieve SVs up to 10.5 (i.e., 210 Cubic Meters per Minute (CMM) at 20W), while induction fans can reach 8.4 SV (210 CMM at 25W).

- Given this potential, CF30 proposes an ambitious but feasible efficiency benchmark: a minimum SV of 6 for entry-level 1-star fans and a maximum SV of 10 for 5-star fans. For a standard 210 CMM fan, this equates to power consumption of no more than 42W for a 1-star fan and 24W for a 5-star fan. Under this framework, current 5-star fans would be reclassified as 1-star, with each star tier rising by an SV of 1. This reclassification encourages technology-neutral competition, allowing both induction and BLDC manufacturers to participate in the CF30 market. A detailed breakdown of service values per star rating is provided in Table 2.

**Table 2: Proposed Service Value for 1200mm Ceiling Fans in 2030**

| Star Rating | Current (Since 2020) | | CF30 Target | |
|---|---|---|---|---|
| | Min SV | Max SV | Min SV | Max SV |
| 1-star | 4 | 4.49 | 6 | 6.99 |
| 2-star | 4.5 | 4.99 | 7 | 7.99 |
| 3-star | 5 | 5.49 | 8 | 8.99 |
| 4-star | 5.5 | 5.99 | 9 | 9.99 |
| 5-star | >=6 (35W) | | >=10 (21W) | |

## 3.2 Affordability: Enabling Mass Adoption

In a highly price-sensitive market like India, affordability is a critical enabler of mass adoption. CF30 sets a target for entry-level models of super-efficient fans (6 SV) to be priced at around INR 1,300 (USD 14)—comparable to current 1-star induction fans. This pricing strategy aims to maintain consumer appeal across economic segments while promoting inclusivity and deepening market penetration.

## 3.3 Localization: Building a Resilient, Domestic Value Chain

CF30 aims to strengthen India's ceiling fan manufacturing ecosystem by driving localization, with a particular focus on reducing import dependence for BLDC fans.

- **Induction Fans:** Nearly 100 percent localized, with most components already manufactured domestically.
- **BLDC Fans:** Currently, 40–50 percent of the component value is imported—primarily permanent magnets (ferrite and rare-earth) and high-value electronics such as integrated circuits, MOSFETs, and semiconductors. However, a wide range of low- and mid-value components—including rectifiers, coils, and capacitors—are already locally sourced.

Energy-efficient fans also require high-grade electrical steel, such as Cold Rolled Non-Oriented (CRNO) or M15, which is largely imported. Yet, domestic production capacity and raw material availability offer strong potential for scaling local manufacturing. Likewise, while raw materials for ferrite magnets are likely to remain import-dependent, stakeholder consultations with relevant industry experts and researchers indicate that domestic processing using sintering technology is feasible.

Based on these trends and opportunities, CF30 targets 100 percent localization for super-efficient induction fans and at least 80 percent localization across the BLDC fan value chain.

## 3.4 Reliability: Ensuring Durable, Grid-Resilient Performance

The CF30 initiative prioritizes fan reliability and consistent performance, especially in rural and underserved areas where voltage fluctuations and challenging environmental conditions are common.

Induction fans are generally robust in such settings. However, BLDC fans, despite their efficiency advantages, face reliability challenges due to inconsistent power supply and the use of low-quality components, particularly controllers.

To improve durability, the blueprint recommends transitioning to controllers with longer lifespans that are equipped with advanced safety features. Currently, market cost pressures drive the use of lower-end controllers with limited protection and a typical lifespan of approximately 5,000 hours. In contrast, a controller rated for 50,000 hours adds only INR 125 to 150 (USD 1 to 2) to the manufacturing cost but significantly improves reliability and reduces long-term costs.[xii]

As shown in Table 3, upgrading controller durability can reduce the total cost of ownership of a BLDC fan by approximately 12 percent over a 10-year period—making a strong case for its adoption under the CF30 program.

xii Based on stakeholder consultations.

**Table 3: Total Cost of Ownership of a BLDC Fan (5000-hr vs. 50000-hr Lifespan)** [xiii]

| Parameter | BLDC Fan (5,000-hour lifespan) | BLDC Fan (50,000-hour lifespan) |
|---|---|---|
| Upfront Cost | INR 2,200 (USD 24) | INR 2,325 (USD 25) |
| Operation Cost Over 10-year Horizon | INR 8,190 (USD 90) | INR 8,190 (USD 90) |
| Maintenance (1 replacement for PCB) | INR 1,540 (USD 17) | INR 0 |
| Total Cost of Ownership Over 10-year Horizon | INR 11,930 (USD 132) | INR 10,515 (USD 116) |
| **Reduction in Total Cost of Ownership** | | **12%** |

Overall, CF30 presents a hopeful yet grounded vision for the Indian ceiling fan sector, one that balances performance, price, and production strength. By setting new efficiency standards, ensuring affordability, deepening localization, and enhancing product durability, CF30 positions India to not only meet its domestic energy efficiency targets but to also emerge as a global leader in super-efficient fan technologies.

xiii Based on stakeholder consultations.

# 4. KEY INTERVENTIONS TO ACHIEVE THE CF30 VISION

Achieving the targets set under the CF30 vision requires targeted interventions that help overcome key barriers across India's ceiling fan value chain. Based on extensive stakeholder consultations, four strategic areas of intervention have been identified:

- 4.1 Design and Material Interventions
- 4.2 Enhancement of Testing Standards
- 4.3 Demand Creation and Awareness
- 4.4 Ecosystem Development

The table below provides an overview of each intervention, which are described in detail in the subsequent sections.

**Table 4: Overview of the Proposed Interventions**

| Focused Intervention Area | Proposed Intervention | Key Stakeholders |
|---|---|---|
| Design and Materials | Amend IS 374 to cap lamination thickness at 0.35 mm | Bureau of Indian Standards (BIS; nodal agency), Technical Committee of Experts, Fan Manufacturers |
| | Promote use of alternative materials in ceiling fan manufacturing | Department for Promotion of Industry and Internal Trade (DPIIT; nodal agency)<br>Department of Science and Technology (DST), BIS, Central Board of Indirect Taxes and Customs (CBIC), Fan Manufacturers, Raw Material Suppliers |
| | Enhance R&D in fan technology through an industry-academia innovation challenge | DST (nodal agency) & Fan Innovation Committee (IFC): BEE, DPIIT, Academia, Fan Manufacturers, National Accreditation Board for Testing and Calibration Laboratories (NABL), and Ministry of Power (MoP) |
| Testing and Standards | Establish standards for magnet quality and controller durability | BIS (nodal agency), BEE, Academia, NABL-accredited Labs, Fan Manufacturers |
| | Standardize ambient testing conditions | BIS (nodal agency), Certified Labs, Fan Manufacturers |
| Demand Creation and Awareness | Fan replacement program for residential consumers | MoP and DPIIT (nodal agency), BEE, DISCOMs, State Nodal Agencies |
| | Mandated fan replacement and bulk procurement by public institutions | MoP and DPIIT (nodal agency) |

| Focused Intervention Area | Proposed Intervention | Key Stakeholders |
|---|---|---|
| | Develop nationwide consumer awareness campaign | BEE (nodal agency), Indian Fan Manufacturers Association (IFMA), Marketing Firms, Civil Society, Retailers |
| | Establish graded GST structure to favor energy efficiency | DPIIT (nodal agency) Ministry of Finance, GST Council, MoP |
| Ecosystem Development | Establish affordable cluster-level NABL testing ecosystem | DPIIT (nodal agency), Quality Council of India (QCI), MSME Fan Manufacturers |
| | Establish cluster-level Centers of Excellence (CoEs) to spread knowledge on advanced technologies and serve as capacity-building hubs | DST (nodal agency), DPIIT, Academia, Fan Manufacturer Associations |
| | Production Linked Incentive scheme for incentivizing domestic manufacturing of electrical-grade steel and electronics | DPIIT (nodal agency), Ministry of Commerce, Component Suppliers |
| | Provide concessional financing for investment in energy-efficient fan manufacturing | DPIIT (nodal agency), Financial Institutions, Private Sector |
| | Develop integrated manufacturing clusters offering shared infrastructure and incentives | DPIIT (nodal agency), State Industries Departments, MSME Ministry |

## 4.1 Design and Material Interventions

Meeting the CF30 blueprint's target of a 10 SV, 5-star ceiling fan requires significant improvements in motor and blade efficiency through targeted design and material interventions. Stakeholder consultations with relevant industry experts, researchers, etc. point to meaningful gains even within existing motor technologies, particularly when supported by material enhancements and R&D investments.

### Efficiency Improvements through Design and Materials

Design enhancements—such as increasing the slot fill factor, reducing stator lamination thickness, and optimizing blade angles—can improve motor performance and airflow efficiency. Simultaneously, switching to advanced materials—including electrical-grade steel (e.g., CRNO, M15) in stators, composite materials like Polyvinyl Chloride (PVC) in blades, and pure copper in windings—can further boost the service value.

These combined interventions can increase the service value of induction motors from the current Best Available Technology (BAT) level of 6 SV to around 7.4 SV. For BLDC motors, the improvement can increase the service value from 7.5 SV to around 8.3 SV (see Figures 8 and 9).[xiv] Thus, presenting a clear path toward

xiv To examine the impact of design and material optimization on the service value of a fan, the following details were considered in the analysis: (1) Motor efficiency is 65 percent for induction fans and 85 percent for BLDC fans; (2) The motor contributes approximately 70 percent of a fan's total energy consumption; (3) Eddy current losses and hysteresis losses are each assumed to contribute equally to the overall core losses; (4) Core losses account for roughly a quarter of the total motor losses; (5) Among the remaining losses, 60 percent are variable losses, 12 percent friction and winding losses, and 3 percent stray load losses.

short-term performance gains. However, achieving the 10 SV target by 2030 will require sustained R&D into motor design, materials, and aerodynamic efficiency.

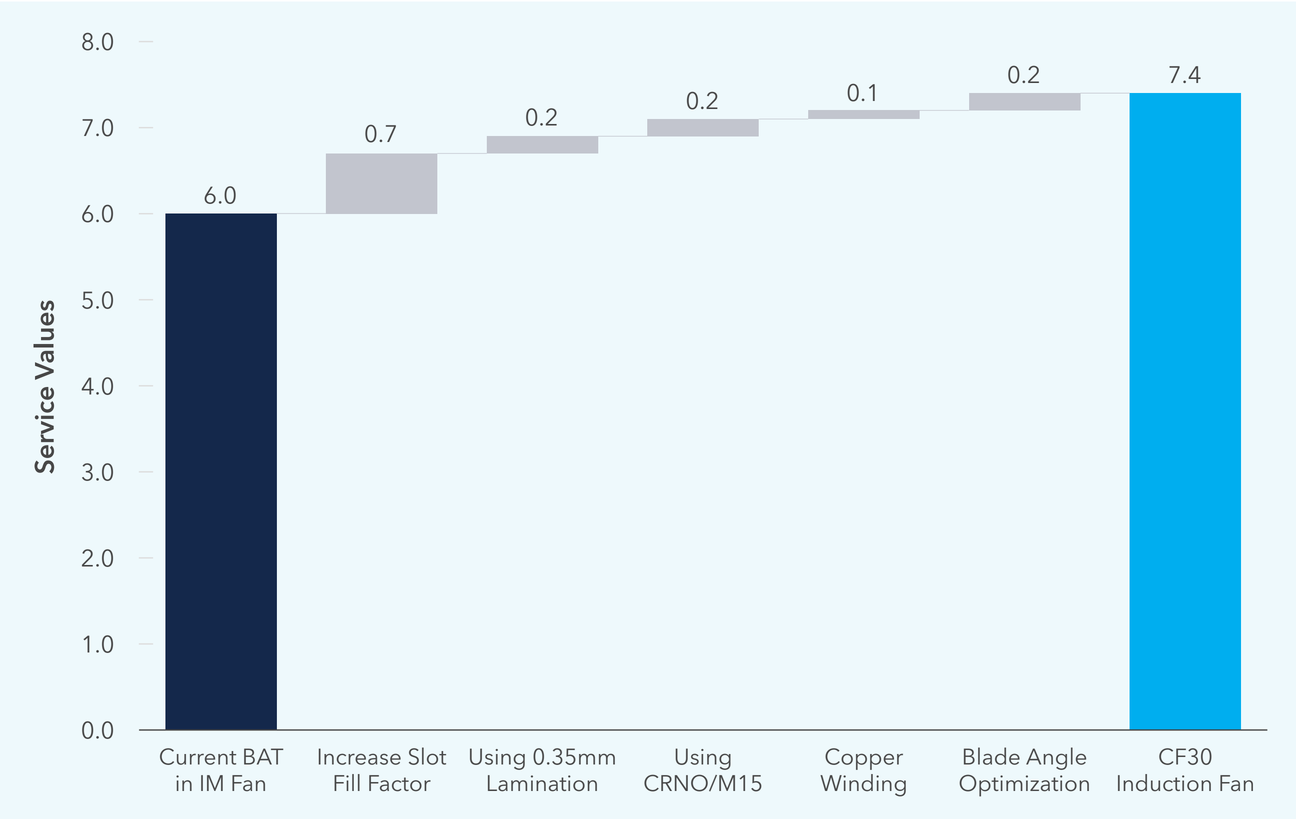


**Figure 8: Service Value Improvement, through Design & Material Optimization, in Induction Fans**

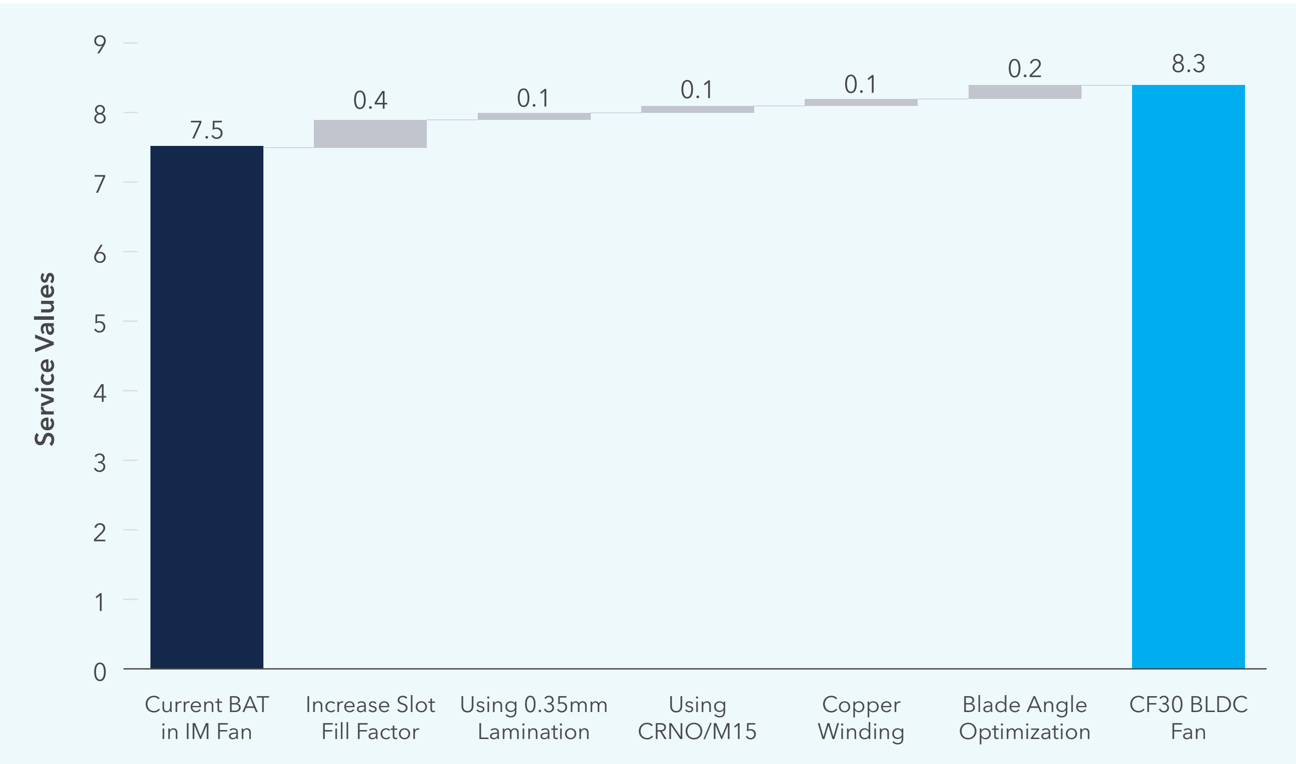


**Figure 9: Service Value Improvement, through Design & Material Optimization, in BLDC Fans**

### 4.1.1 Amend IS 374 to Cap Maximum Lamination Thickness at 0.35mm

Motor efficiency is significantly influenced by magnetic core losses—primarily eddy current and hysteresis losses. Since eddy current losses are proportional to the square of the lamination thickness ($Pe \propto t^2$), reducing this thickness substantially lowers total motor losses. While the industry norm remains at 0.50mm, shifting to 0.35mm laminations can reduce eddy current losses by approximately 51 percent.[xv]

The blueprint proposes that IS 374 should be amended to include a parameter specifying the maximum permissible lamination thickness, capped at 0.35mm. This revision will signal a clear efficiency target and encourage manufacturers to transition toward thinner laminations in stator production.

#### Operationalizing the Suggested Intervention

- **Stakeholders Involved:** BIS can serve as the nodal agency for this intervention. A technical committee of subject matter experts can evaluate the proposal and make recommendations for revising IS 374.
- **Addressing Cost Barriers:** Currently, the adoption of thinner laminations (0.35mm) is limited due to their higher cost, posing an affordability challenge. However, these thinner laminations are already in use in domestically manufactured transformers, generators, and other electrical equipment to achieve higher energy efficiency, and pose no safety concerns when applied to ceiling fan motors.
- **Market Impact:** Mandating thinner laminations in fan motors drives demand for such material. Encouraging large-scale adoption helps reduce their cost over time through economies of scale and supply chain efficiencies.

### 4.1.2 Promote Use of Alternative Materials in Ceiling Fan Manufacturing

Material selection plays a critical role in energy losses across both the motor and blade components of ceiling fans. Stakeholder consultations identified the following high-impact alternatives:

- **Electrical-Grade Steel for Stators:** Replacing Hi-Perm or Cold Rolled Close Annealed (CRCA) steel with CRNO or M15 steel can reduce core losses from 7W/kg to 3W/kg—a 57 percent reduction.[xvi] This translates to an estimated 2.8 percent decrease in energy consumption and a 0.2-point increase in the service value.[xvii]
- **Copper Windings:** Replacing aluminum with copper in motor windings reduces friction and resistive losses due to copper's superior conductivity. Copper has a resistivity of $1.68 \times 10^{-8}\ \Omega\cdot m$ compared to aluminum's $2.82 \times 10^{-8}\ \Omega\cdot m$, resulting in approximately 40 percent lower resistive losses ($I^2R$ losses).
- **Composite Materials for Blades:** Blade geometry optimization can significantly improve aerodynamic efficiency. However, currently available materials such as aluminum and CRCA steel restrict the adoption of more efficient designs. Composite materials like PVC allow for greater design flexibility, enabling manufacturers to enhance airflow while reducing energy use. Industry inputs suggest such improvements can increase the service value of fans by at least 0.2 points.

xv Eddy current losses in motor stator laminations are proportional to the square of the lamination thickness, as given by the formula:

$$P_e = k_e \cdot f^2 \cdot B_m^2 \cdot t^2 \cdot V$$

where t is the lamination thickness. Reducing t significantly lowers these losses, improving motor efficiency.

xvi Based on stakeholder consultations with fan manufacturers and industry experts.

xvii Analysis by the authors.

- **Anti-Dust Coatings:** Blade deformation during cleaning is a key concern that affects the blade angle over time, reducing fan efficiency and air delivery. To address this issue, the application of an anti-dust coating should be made mandatory under the IS 374 standards. This would help maintain optimal blade geometry and performance over the product lifecycle.

Despite these benefits, adoption remains constrained by cost and material availability. The proposed optimizations are expected to increase fan manufacturing costs by over 12 percent (see Figure 10) and retail prices by around 18 percent (see Figure 11).

## Key Cost Drivers

1. **Lamination Material**
    - Switching to CRNO steel adds INR 75 to 80 (USD 0.8 to 0.9) to the manufacturing cost and INR 200 to 225 (USD 2 to 2.5) to the retail price.
    - This accounts for nearly 6 percent of the increased manufacturing cost and about 9 percent of the hike in retail price.
2. **Thinner Laminations**
    - While standard laminations cost INR 100 to 105 (USD 1.1 to 1.3), thinner (0.35mm) versions cost INR 120 to 150 (USD 1.3 to 1.6), pushing the input costs higher.
3. **Copper Windings**
    - Copper windings cost nearly 40 percent more than the aluminum ones due to differences in the cost of material.
4. **Composite Fan Blades**
    - Materials like Acrylonitrile Butadiene Styrene (ABS) are 10 percent more expensive than aluminum, thus increasing blade manufacturing costs.

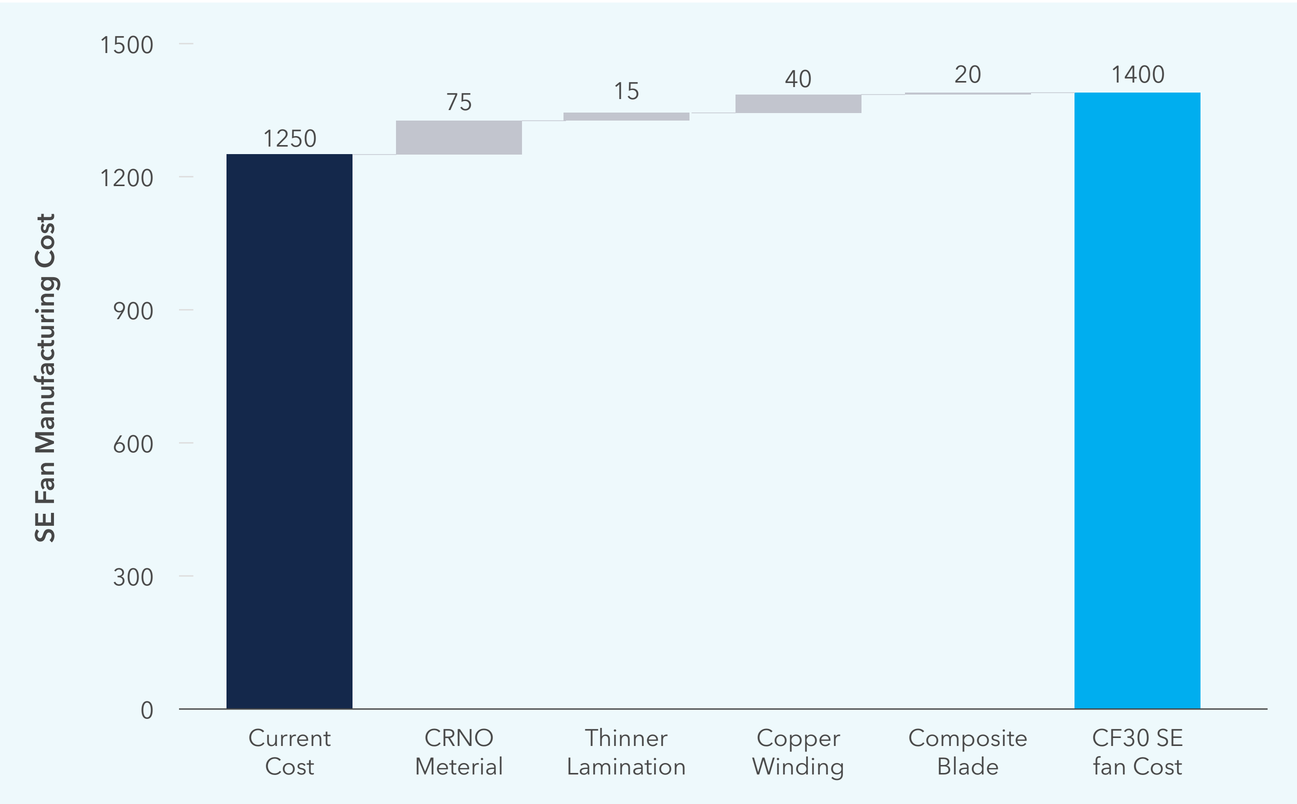


**Figure 10: Estimated CF30 Compliant Fan Manufacturing Cost (in INR)**

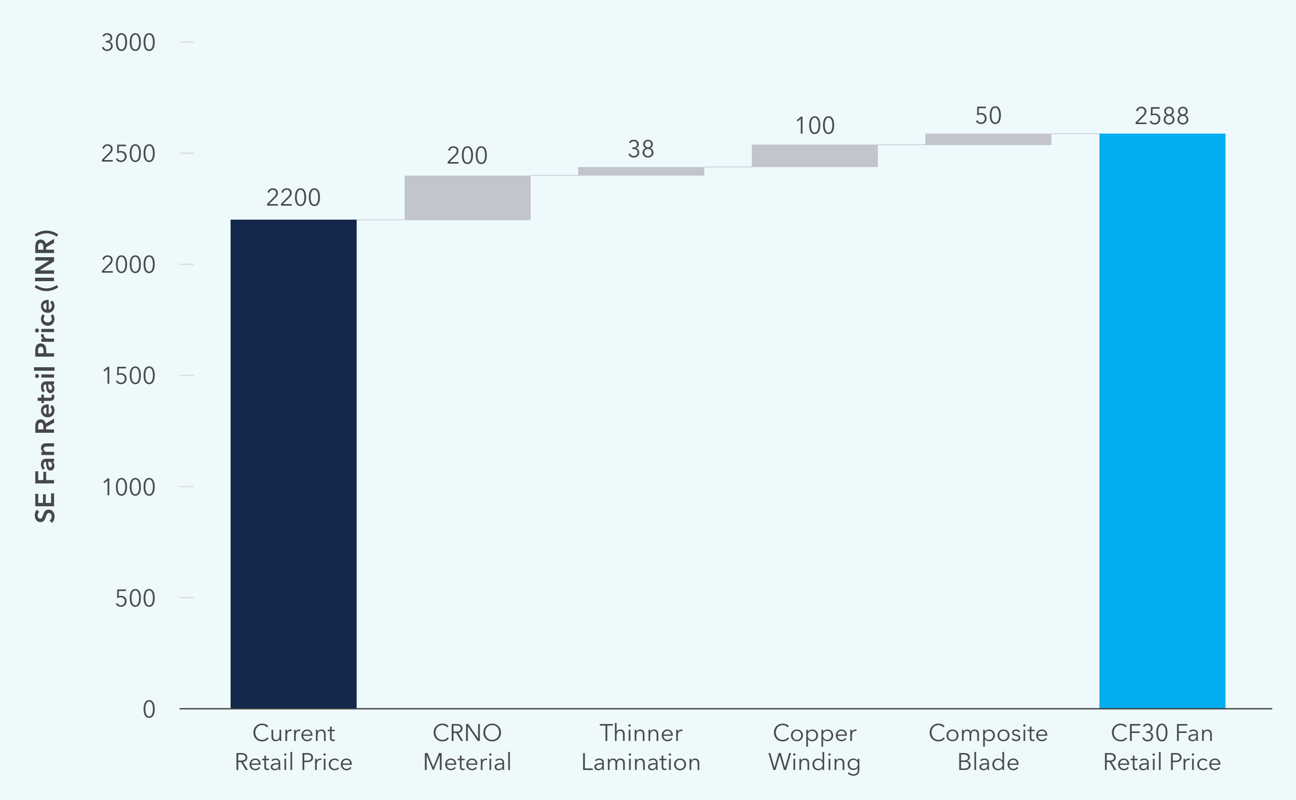


**Figure 11: Estimated CF30 Compliant Fan Retail Price (in INR)**

The table below outlines a few recommendations on how the cost constraints can be managed.

**Table 5: Operationalizing the Suggested Interventions on Alternative Materials**

| Alternative Material | Proposed Intervention |
|---|---|
| **Electrical-Grade Steel in Stators** | Reduce import duty on electrical-grade steel to 0 percent<br>• Although materials like CRNO steel significantly reduce core losses, they are largely imported and cost INR 45/kg (USD 0.5/kg) more than commonly used Hi-Perm materials, adding INR 200 to 225 (USD 2 to 2.5) to fan prices.<br>• To promote adoption, it is proposed to reduce the customs duty on electrical-grade steel from 7.5 percent to 0 percent.<br>• **Nodal Agency:** CBIC<br>• **Target Audience:** All ceiling fan manufacturers |
| **Composite Materials for Blades** | Provide low-cost, collateral-free financing for R&D and prototyping<br>• High initial R&D costs are a major barrier for MSMEs. Stakeholder inputs indicate that developing a single blade design using composite materials, like PVC, can cost INR 300,000 to 400,000 (USD 3,300 to 4,400), with total R&D costs reaching INR 2,000,000 to 2,500,000 (USD 22,000 to 27,000).<br>• To resolve this, stakeholders propose offering concessional, collateral-free financing for R&D, prototyping, and material testing.<br>• Fan blade development using composite materials can be prioritized under this intervention.<br>• **Nodal Agency:** DST<br>• **Target Audience:** MSMEs |

## 4.1.3 Enhance R&D in Fan Technology Through an Industry-Academia Innovation Challenge

CF30 is intentionally technology agnostic, i.e., success is measured by performance outcomes rather than adherence to a specific technical pathway. Developing CF30-compliant ceiling fans requires significant R&D investment to optimize existing technologies while exploring advanced alternatives. The initiative targets the development of a 21W, 5-star rated fan with a controller lifespan of at least 50,000 working hours, as well as 1-star rated CF30 fans (equivalent to current 5-star models) that are cost-competitive with today's baseline models. The initiative also emphasizes localization, aiming for 100 percent localization in developing and manufacturing induction fans and 80 percent localization in the case of BLDC fans.

Stakeholder consultations emphasized that achieving these outcomes will require targeted R&D incentives to spur innovation across the value chain. To facilitate this, and to foster strong industry-academia collaboration, a national-level innovation challenge is proposed to accelerate the development and commercialization of next-generation ceiling fan technologies.

### *Proposed Intervention: Innovation Challenge*

This proposed challenge will enable the development of energy-efficient, affordable, and locally manufactured ceiling fans by offering prototype development funding, final-stage prizes, and commercialization support. The challenge can be jointly hosted by leading academic institutions, in partnership with the Indian Fan Manufacturers Association (IFMA), and guided by a Fan Innovation Committee (FIC) that will comprise of representatives from industry, academia, the BEE, the DPIIT, and NABL-accredited labs.

### *Focus Areas for Innovation*

- Development of CF30-compliant ceiling fans
- Material innovation (e.g., alternative magnet and core materials)

### Operationalizing the Suggested Intervention

**Challenge Structure:** Participants can receive interim support for prototype development and compete for final-stage cash prizes. Joint entries from academic institutions and industry partners can be encouraged.

**Assessment Criteria:** Entries must align with all four CF30 objectives

- **Energy Efficiency:** Achieve at least 6 SV (new 1-star rating threshold) or up to 10 SV (new 5-star rating threshold) performance.
- **Durability:** Fan controllers (where applicable) must meet a minimum lifespan of 50,000 working hours.
- **Affordability:** CF30-compliant fans should be priced comparably to current 4-star models.
- **Localization:** Each prototype must demonstrate at least 80 percent localization across the fan's value chain.

**Governance:** The blueprint proposes the Department of Science and Technology to be the nodal agency. An FIC can be constituted with representatives from industry, academia, BEE, DPIIT, and NABL-accredited labs. Further, a technical agency can be appointed by the DST to support implementation under the FIC's guidance.

**Proposed Incentives for Winning Entries Include:**

- **Demand Aggregation:** Up to 10 percent of public sector ceiling fan procurement could be earmarked for challenge winners.
- **Financing:** Winners could receive access to collateral-free scale-up loans at 3 to 5 percent interest rate, facilitated by the DPIIT.
- **Market Linkages:** MoP and DPIIT could coordinate post-challenge commercialization and consumer awareness to support product rollout and retail uptake.

## 4.2 Enhancement of Testing Standards

Reliable performance is critical to scaling super-efficient ceiling fans in Indian markets. To that end, existing testing protocols must evolve to reflect the technological demands of next-generation fan designs. The two major areas that require immediate attention are: (1) the development of standards for magnets and fan controllers to ensure long-term durability, and (2) the definition of uniform ambient testing conditions across laboratories to guarantee consistent performance evaluations.

### 4.2.1 Establishing Standards for Magnet Quality and Controller Durability

Ensuring the long-term performance of CF30-compliant fans and building consumer trust in these fans require strengthening the product reliability at the component level—particularly in magnets and fan controllers.

#### I. Need for Defining Magnet Standards

Fan motor performance, particularly in BLDC technologies, is dependent on the quality of magnets used. Variability in magnetic strength, coercivity, and thermal resistance can lead to degraded motor performance, overheating, or early failure. However, the current IS 374 standard lacks any specifications regarding magnet type or performance thresholds. As a result, low-quality magnets with poor coercivity or high thermal sensitivity may be used, compromising both efficiency and product lifespan.

Relevant industry experts and researchers have recommended that the BIS should develop and codify specifications for magnet strength, temperature resistance (e.g., demagnetization thresholds), and long-term operational durability. Establishing such norms will not only increase product reliability but also accelerate market confidence in super-efficient fans.

#### II. Ensuring Controller Durability and Reliability

Fan controllers are vital to regulating speed, managing energy use, and maintaining stable performance across voltage fluctuations. Stakeholders emphasized the need to codify controller durability standards under IS 374, targeting a minimum operational life of 50,000 hours. Controllers with this level of robustness currently cost about INR 125 to 150 (USD 1 to 2) more than the standard models, thus creating a barrier against widespread adoption in the absence of a regulatory mandate.

However, enforcing such standards could yield long-term consumer and industry benefits. Modeling suggests that these upgrades could reduce total cost of ownership by up to 12 percent while improving consumer satisfaction and driving up the demand for super-efficient fans.

## Operationalizing the Suggested Intervention

- BIS, in collaboration with stakeholders, can draft and adopt standards for magnet strength, temperature resistance, and controller durability, and incorporate them into IS 374.
- A detailed performance-based specification for fan controllers is proposed below, using temperature rise as a proxy for long-term reliability (Table 6).
- **Nodal Agency:** BIS
- **Collaborating Stakeholders:** Fan manufacturers, academic researchers, NABL-accredited labs, BEE.

**Table 6: Recommended Standards for Fan Controllers (as suggested by stakeholders)[xviii]**

| S.No. | Parameter | Specification |
|---|---|---|
| 1 | Type of Controller | Low voltage |
| 2 | Input Voltage Range | Must withstand up to 340V constantly without damage |
| 3 | Constant Output Range | 100 to 300V AC, 50Hz, single phase–fan output should remain unaffected within this range, with continuous operation even at 100V input |
| 4 | Under Voltage Behavior | Below 70V–fan switches off (max cut-off at 95V); automatic restart once voltage normalizes |
| 5 | Over Voltage Behavior | Cut-off at 310V (max), auto-restart at 302V |
| 6 | Surge Protection | 4kV DM as per IEC 61000-4-5 Clause 8.3 |
| 7 | Voltage Dip/Interruption Protection | As per EN 61000-4-11 |
| 8 | Voltage Burst Protection | As per EN 61000-4-4 |
| 9 | Total Harmonic Distortion (THD) | THD ≤10% at max rated speed and nominal voltage; ≤50% across varying speed or voltage conditions |
| 10 | Input Power | To align with fan power requirements |
| 11 | Controller Efficiency | >88% at rated voltage and power |
| 12 | Power Factor | >0.95 at rated input voltage and full load |
| 13 | Inrush Current | <20A |
| 14 | Tuning | Pre-tuned controller; no adjustment required during installation |
| 15 | Output Voltage Ripple | <10% under nominal operating conditions |
| 16 | Reliability Assessment | At 50°C ambient with rated load, test at min, rated, and max input voltage until thermal equilibrium. Component temperatures must not exceed:<br>• Transformer winding: <110 to 115°C<br>• Transformer core: <100 to 105°C<br>• Output electrolytic capacitor: <80 to 85°C<br>• $V_{cc}/V_{dd}$ capacitors: <75 to 85°C<br>• MOSFET: <95 to 100°C<br>• Output diode: <80 to 85°C<br>• IC: <80 to 85°C<br>• Line filter: <85 to 90°C<br>• Fuse: <55 to 60°C<br>• Bridge rectifier: <70 to 80°C<br>*(Test method reference: UL 8750)*[12] |

xviii Based on stakeholder consultations.

| S.No. | Parameter | Specification |
|---|---|---|
| 17 | Service Life Assessment | 50,000 hours under continuous operation at peak performance, 50°C ambient, and lowest input voltage. Assessed using temperature and capacitor lifetime data from manufacturers. |
| 18 | Warranty | Minimum 5 years |

### 4.2.2 Standardizing Ambient Testing Conditions

One of the critical challenges, when it comes to testing ceiling fans, is the lack of uniform ambient testing conditions across laboratories, which leads to significant variations in reported performance. For instance, a fan may qualify as super-efficient in one lab but fail to meet the same criteria in another, due to differing environmental parameters such as temperature, humidity, and air pressure. This inconsistency undermines the reliability of test results, complicates enforcement of energy efficiency standards, and may erode consumer trust. To avoid this, the intervention proposes standardizing ambient testing conditions for ceiling fans across all certified labs. Standardizing ambient conditions will improve the accuracy and comparability of test results, enhance the credibility of star ratings, and bolster consumer confidence in super-efficient fan technologies.

#### Operationalizing the Suggested Intervention

- The BIS can act as the nodal agency for this intervention.
- BIS can revise IS 374 to include mandatory, standardized ambient testing conditions–such as controlled temperature, humidity, and airflow levels–for all accredited ceiling fan testing laboratories.
- These conditions can be enforced uniformly across NABL-accredited facilities.

## 4.3 Demand Creation and Awareness

The widespread adoption of super-efficient ceiling fans is hindered by two primary challenges: their relatively high upfront cost, which limits demand and economies of scale, and low consumer awareness. This section outlines targeted interventions to overcome both.

#### *Driving Economies of Scale*

Super-efficient fans have gained momentum in recent years, with a 19 percent share of the annual sales in the fan market. This growth has helped reduce production costs: the manufacturing cost of BLDC fans has fallen by nearly 17 percent, controller prices by 27 percent, and magnet prices by 20 percent, largely due to increased production volumes. However, to achieve CF30’s affordability targets, demand must not only be sustained but also expanded.

Consultations with relevant industry experts, researchers, and fan manufacturers suggest that strengthening India’s domestic electronics manufacturing ecosystem, paired with continued market growth, can drive a 20 percent reduction in controller card costs (see Figure 12 for numbers). This will make super-efficient fans more affordable and accelerate market adoption. Currently, however, super-efficient ceiling fans typically carry a price premium of approximately 50 percent compared to models with a 1-star rating.

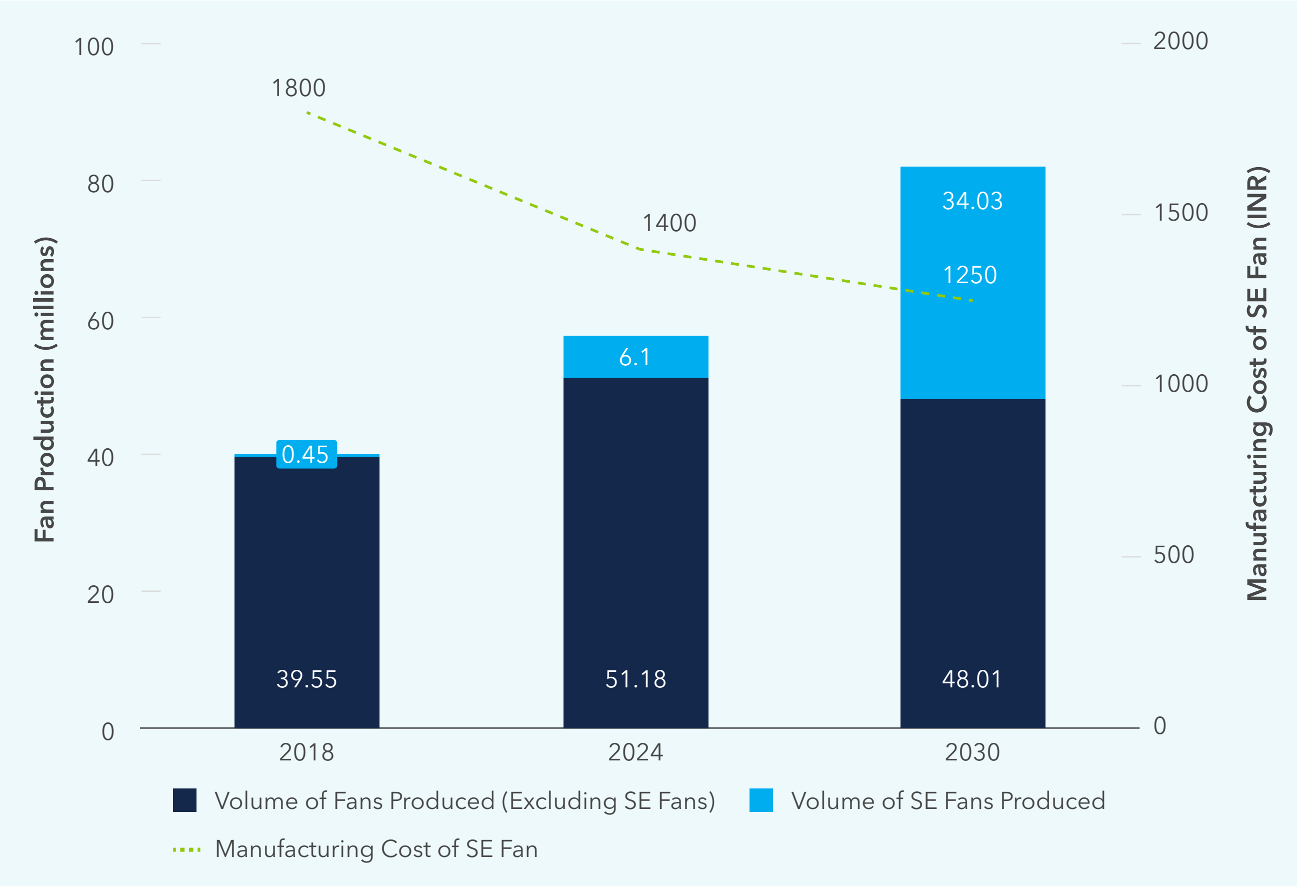


**Figure 12: Estimated Demand vs. Manufacturing Cost Trends**

### *Overcoming Awareness Barriers*

A major barrier to super-efficient fan adoption is the limited awareness among consumers regarding the star rating programs and the benefits of energy-efficient fans. Many consumers focus on upfront purchase cost without understanding the full lifecycle benefits, i.e., lower electricity bills, better performance, and environmental impact. This gap hinders the widespread acceptance of energy-efficient technologies, especially among cost-sensitive communities.

## 4.3.1 Fan Replacement Program for Residential Consumers

Despite long-term cost and energy savings, the adoption of super-efficient fans among residential users remains low, primarily due to high upfront costs—especially for low-income households. As of 2025, approximately 60 percent (about 354 million) of India's total fan stock (585 million) is more than a decade old. This figure is projected to reach around 414 million by 2029–30 (see Figure 13), thus representing a significant opportunity for targeted replacement.[xix]

xix Based on stakeholder consultations.
A ceiling fan that has been used and connected to the grid for 10 years or more is considered eligible for replacement, in accordance with the E-Waste Rules under the Extended Producer Responsibility (EPR). Based on stakeholder inputs, the estimation of the fan replacement market assumes that only 10 percent of annual ceiling fan production caters to the replacement segment.

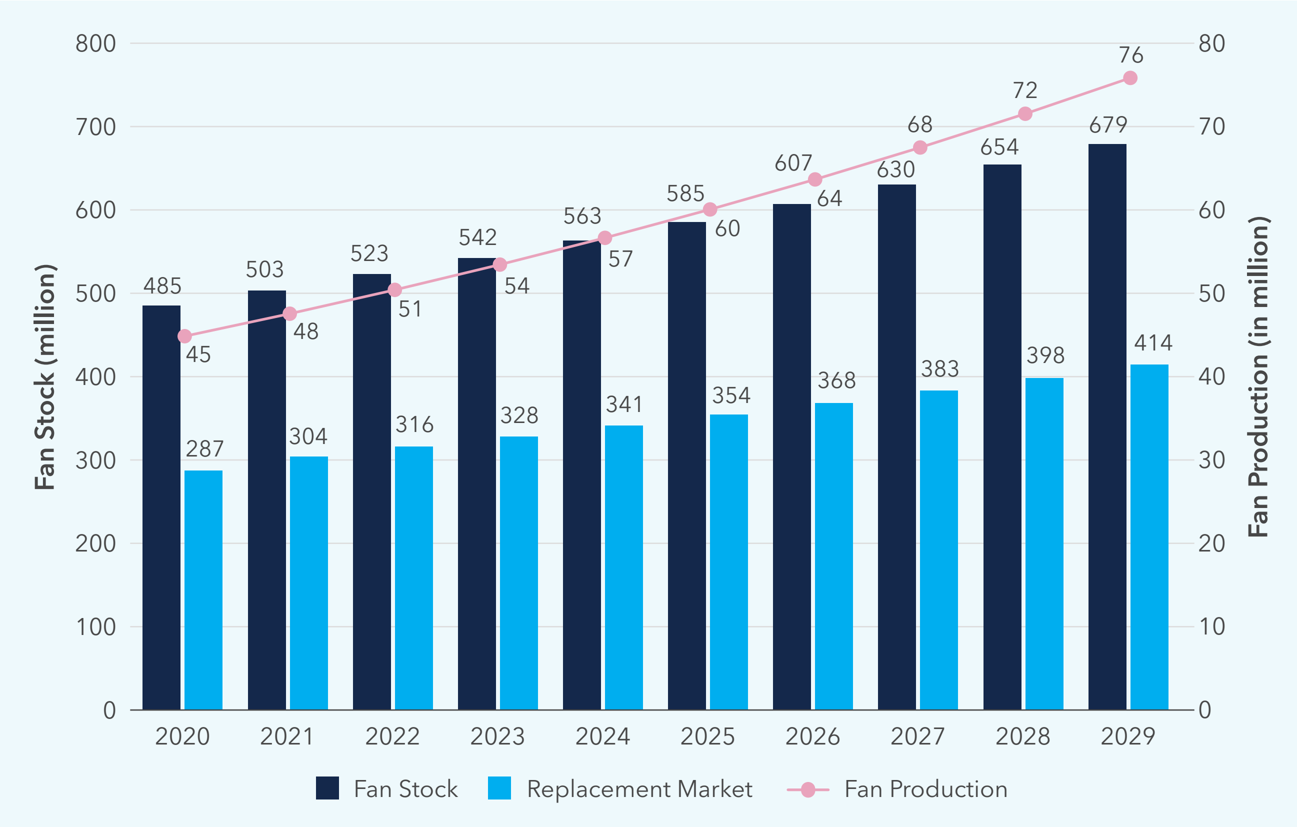


**Figure 13: Fan Replacement Market in India**

One of the promising proposed interventions is the implementation of a structured fan replacement program within the Demand-Side Management (DSM) framework. This program would offer financial incentives such as rebates to bridge the price gap between the lower-efficiency 1-star fans and the higher-efficiency 5-star models. By reducing the payback period and lowering financial risk for consumers, this approach has the potential to accelerate the turnover of inefficient fan stock, thereby increasing the market share of super-efficient fans. In turn, this can help distribution companies (DISCOMs) reduce their short-term power procurement costs.

## Operationalizing the Suggested Intervention

- The replacement program can be led by state DISCOMs as part of their mandated DSM activities, coordinated closely with the BEE and the DPIIT, and supported by a designated technical agency.
- A rebate mechanism can be established to cover the price differential between 1-star and 5-star rated ceiling fans. Rebates can be disbursed either directly at the point of sale or through adjustments on consumers' electricity bills.
- Incentive levels can be determined based on prevailing market prices and can be regularly reviewed and adjusted to reflect changing conditions.
- To complement financial incentives, targeted consumer awareness campaigns can be launched. These campaigns can leverage partnerships with local retailers, manufacturers, and service providers to educate households on the benefits of super-efficient fans–including energy savings, improved performance, and environmental impact.
- Compliance can be ensured through rigorous verification processes, including validation of BEE star labels, review of purchase receipts, and photographic evidence of replaced fans.

- **Management of Replaced Fans:** All old fans, collected under the replacement program, must be handled through an authorized disposal and recycling pathway. Collected fans must be sent to Central Pollution Control Board (CPCB)-registered dismantlers and recyclers, where metals such as copper, steel, and aluminum must be recovered. Electronic components–including BLDC controllers, Printed Circuit Boards (PCB), and capacitors–must be treated as e-waste and processed in compliance with the e-waste management rules. In line with the Extended Producer Responsibility (EPR) norms, recovered electronic parts must be channeled to authorized recyclers who issue EPR recycling certificates, enabling fan manufacturers and importers to meet their statutory EPR obligations. Non-recyclable residues must be disposed of strictly as per CPCB guidelines, ensuring that no material enters informal or unsafe waste streams.
- A robust monitoring and evaluation framework must be established to track program implementation, measure outcomes, and inform continuous improvement.

Example: BSES Rajdhani Power Limited (BRPL) operates a fan replacement scheme that enables domestic consumers in Delhi to upgrade up to three outdated ceiling fans to 5-star rated, super-efficient models. The program offers discounts of up to 89 percent, reducing prices from around INR 4,400 to INR 8,900 (USD 48 to 98) to approx. INR 883 to 1,650 (USD 9 to 18) across empaneled brands including Atomberg, Halonix, Kuhl, and Adhunik. By bundling free installation and dismantling services, the scheme helps minimize the adoption barriers. Consumers can achieve annual electricity savings of INR 1,118 (USD 12), with payback periods ranging from 9 to 18 months. This initiative, which is accessible via online registration or authorized retail channels, exemplifies a replicable DISCOM-led, OEM-partnered model for driving high-efficiency appliance adoption and delivering measurable household energy savings.

By combining financial incentives with sustained demand creation efforts and accountability mechanisms, this intervention can drive the adoption of super-efficient ceiling fans at scale.

## 4.3.2 Mandated Fan Replacement and Bulk Procurement by Public Institutions

Mandating the replacement of existing fans with super-efficient ceiling fan models across public institutions, combined with bulk procurement, is a powerful strategy to aggregate demand at scale. This aggregated demand can drive economies of scale in manufacturing, leading to reduced production costs and, ultimately, lower prices for consumers. By requiring all government establishments to procure and install only super-efficient ceiling fans, this initiative can act as a catalyst for market transformation, accelerating the transition toward more energy-efficient appliances nationwide.

### Operationalizing the Suggested Intervention

- Ministry of Power (MoP) and DPIIT can jointly serve as nodal agencies.
- MoP can issue an Office Memorandum mandating all central and state government agencies, PSUs, and autonomous bodies to replace their existing fan stock entirely with super-efficient ceiling fans.
- BEE can integrate SE-specific procurement clauses into model tender documents for government procurement.
- Government e-Marketplace can enforce compliance by restricting product listings exclusively to super-efficient ceiling fans.
- Department of Expenditure, Ministry of Finance, can amend the General Financial Rules to institutionalize the procurement mandate across all public institutions.

Example: In March 2025, the Delhi state government mandated that all government departments purchase only BEE 5-star or higher energy-efficient BLDC ceiling fans. This mandate targets 100 percent compliance for new installations and replacements in all government buildings, government-aided institutions, boards, corporations, and autonomous bodies. Defective induction motor fans in existing buildings must be replaced solely with energy-efficient 5-star BLDC fans.

## 4.3.3 Establish Graded GST Structure to Favor Energy Efficiency

Under the CF30 blueprint, a 1-star rated fan starts at an SV of 6, increasing incrementally by 1 SV per star rating, up to 10 SV for a 5-star fan. This improvement in efficiency inherently raises production costs. For example, a CF30-compliant 5-star fan (10 SV) is projected to cost approximately INR 2,588 (USD 28), compared to the current average 5-star fan price of INR 2,200 (USD 24), reflecting a price premium of 18 percent.

Similarly, current 5-star fans will become the new baseline 1-star models, which will be typically priced at around INR 2,200 (USD 24), with market prices increasing by about 15 percent per SV increment.

To bridge the price gap and enhance affordability, stakeholders propose a graded Goods and Services Tax (GST) structure. Under this system, lower-efficiency fans would attract higher GST rates, while higher-efficiency models, such as 5-star fans, would benefit from reduced rates. This approach aims to lower consumer costs without revenue loss for the government, as increased sales volumes of energy-efficient fans could offset potential revenue shortfalls.

### *Operationalizing the Suggested Intervention*

- Introduce a tiered GST structure with lower rates for higher-efficiency fans, i.e., maintaining an 18 percent GST for 1-star fans, while reducing it to 12 percent for 5-star fans.
- Currently, all ceiling fans are taxed at 18 percent GST. Reducing this to 12 percent for 5-star fans will lower the price of a CF30-compliant model by approximately 5 percent, from INR 2,588 (USD 28) to INR 2,456 (USD 27). This adjustment will position the fan within the standard pricing category, below INR 2,499 (USD 27), making it accessible to around 65 percent of consumers—about 45 percent of the standard market and 20 percent of the premium segment.
- A further reduction to 5 percent GST will cut the price by about 11 percent, bringing the cost of a 5-star fan down to roughly INR 2,303 (USD 25). This will significantly narrow the price differential between the 1-star and 5-star models.
- The Ministry of Finance can serve as the nodal authority overseeing this intervention.

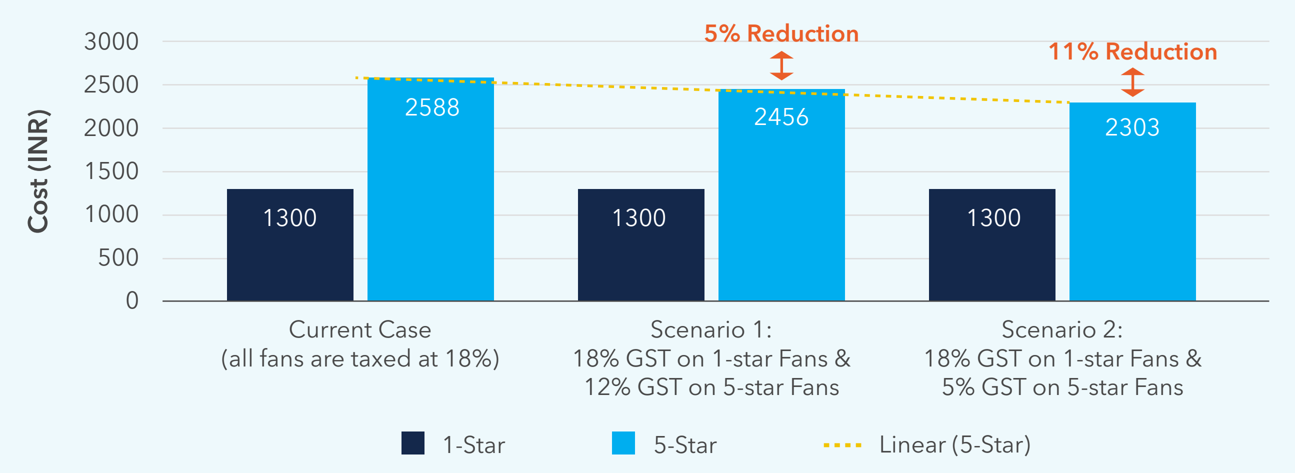


**Figure 14: Cost Reduction Using Graded GST Structure**

### 4.3.4 Develop Nationwide Consumer Awareness Campaign

Consumer awareness about energy-efficient fans remains critically low. According to the CEEW's 2020 India Residential Energy Survey, only 25 percent of electrified households are aware of the BEE Star Label—with urban awareness at 37.8 percent and rural awareness at 19.1 percent. This knowledge gap significantly limits the market demand for 5-star rated ceiling fans. A comprehensive, multilingual, and sustained nationwide consumer awareness program must be launched to bridge this gap. Modeled after large-scale awareness and behavior change campaigns such as the Swachh Bharat Mission, it must target diverse socio-economic and geographic segments, with a particular focus on rural and semi-urban areas where awareness levels are currently the lowest.

The initiative is envisioned as a multi-stakeholder effort involving fan manufacturers, retailers, distributors, BEE, and local institutions such as Gram Panchayats and Resident Welfare Associations (RWAs) to ensure effective last-mile engagement. Strategic partnerships with industry bodies like IFMA and regional trade associations can help align messaging with market dynamics and consumer preferences.

#### Operationalizing the Suggested Intervention

- BEE can serve as the nodal agency for developing and implementing the campaign.
- Adopt a multi-channel communication strategy, modeled after successful programs like the Swachh Bharat Mission.
- Create and share region-specific audiovisual content via TV, radio, and print to promote the benefits of super-efficient fans.
- Launch digital campaigns (social media, influencers, online ads) to engage younger demographics.
- Enhance point-of-sale engagement with in-store displays, shelf talkers, and QR-based product comparisons.
- Conduct mobile van campaigns and community workshops in vernacular languages to engage consumers in rural and semi-urban areas.
- Train retail staff, using standardized modules, to promote informed, energy-efficient purchasing guidance.
- Anchor messaging around 'total cost of ownership'—emphasizing lifecycle savings, performance, and environmental impact.

Through widespread behavioral change, this intervention aims to spark demand and build a self-sustaining market for energy-efficient appliances.

## 4.4 Ecosystem Development

### 4.4.1 Establish Affordable Cluster-Level NABL Testing Ecosystem

The limited availability of testing infrastructure in India restricts growth and innovation within the ceiling fan industry. Currently, there are only 60 NABL-accredited laboratories across the country that conduct ceiling fan evaluations, thus creating bottlenecks in product certification and delaying market entry.

Another major challenge is the high cost of testing—typically INR 40,000 to 50,000 (USD 443 to 554) per fan model—which disproportionately impacts MSMEs, limiting their ability to innovate and compete effectively. Additionally, the certification process takes approximately 2 to 2.5 months, increasing operational expenses and postponing product launches. Expanding testing infrastructure and lowering costs is essential to fostering inclusivity and accelerating the adoption of energy-efficient technologies.

## Operationalizing the Suggested Intervention

- DPIIT can lead the initiative, in collaboration with the QCI and existing NABL-accredited laboratories, with support from a designated technical agency responsible for planning, implementation, and monitoring.
- The initiative aims to double the number of fan-testing laboratories by establishing cluster-level NABL-accredited facilities, focusing on underserved regions and areas near MSME manufacturing clusters.
- Laboratories must be strategically established based on the following criteria:
  - Proximity to major fan manufacturing clusters
  - Current absence of adequate NABL-accredited testing infrastructure
  - Demonstrated market demand for testing services
  - Accessibility and operational feasibility
- Facilities are to be developed in partnership with local manufacturer associations or relevant entities to ensure local ownership and operational relevance.
- Capital subsidies can be provided to support establishment costs.
- All new laboratories must obtain NABL accreditation within specified timelines, undergo regular proficiency testing per NABL 163 Policy, and coordinate with BEE to align with national energy efficiency certification standards.
- Stakeholders have emphasized the need for stronger compliance mechanisms, including enhanced market surveillance, QR-coded digital labels for traceability, and stricter enforcement. Providing technical support to small manufacturers can further improve adherence and help ensure consistent product quality across the sector.[xx]

## 4.4.2 Establish Cluster-Level Centers of Excellence (CoEs) to Share Knowledge on Advanced Technologies and Serve as Capacity-Building Hubs

The Indian ceiling fan industry faces challenges in adopting advanced technologies, primarily due to limited knowledge transfer and a shortage of skilled manpower, particularly for servicing energy-efficient fans. Advanced technologies such as hairpin winding—available within academic institutions like IITs—have not been widely adopted within the industry due to the lack of structured knowledge-sharing mechanisms.

Hairpin winding technology can help increase the slot fill factor (the ratio of copper winding area to available slot area in the motor stator) from approximately 0.3 to between 0.6 and 0.7, effectively doubling the copper cross-sectional area and halving the resistive losses (Pcu). This directly improves energy efficiency, aligning with CF30 goals. However, these technologies are not adopted at scale. Therefore, to overcome this challenge, the intervention aims to establish cluster-level CoEs through industry-academia collaboration, either as extensions of existing labs or within dedicated R&D centers. These centers can showcase advanced technologies, including but not limited to hairpin winding, SynRM, among others.

## Operationalizing the Suggested Intervention

- Provide MSMEs affordable access to R&D infrastructure for rapid prototyping (e.g., Computational Fluid Dynamics analysis for blade design) to reduce development costs.
- Serve as capacity-building hubs, training technicians on advanced manufacturing and servicing techniques, with special focus on rural serviceability challenges.
- Source funding through the ANRF or similar government R&D initiatives like the Mission for Advancement in High-Impact Areas.

xx Based on stakeholder consultations with MSME manufacturers.

## 4.4.3 Extend PLI Scheme for Incentivizing Domestic Manufacturing of Electrical-Grade Steel and Electronics

India's ceiling fan industry faces multiple supply chain vulnerabilities due to high import dependence on components essential for super-efficient fans, such as electrical-grade steel and electronics. Electrical-grade steel is primarily imported, with costs approximately 20 percent higher than alternatives like Hi-perm or CRCA steel. Furthermore, around 75 to 80 percent of the PCB components used in fans are imported, increasing geopolitical risks.[xxi] Developing a domestic manufacturing ecosystem is essential for resilient, cost-effective supply chains and sustainable CF30 market adoption.

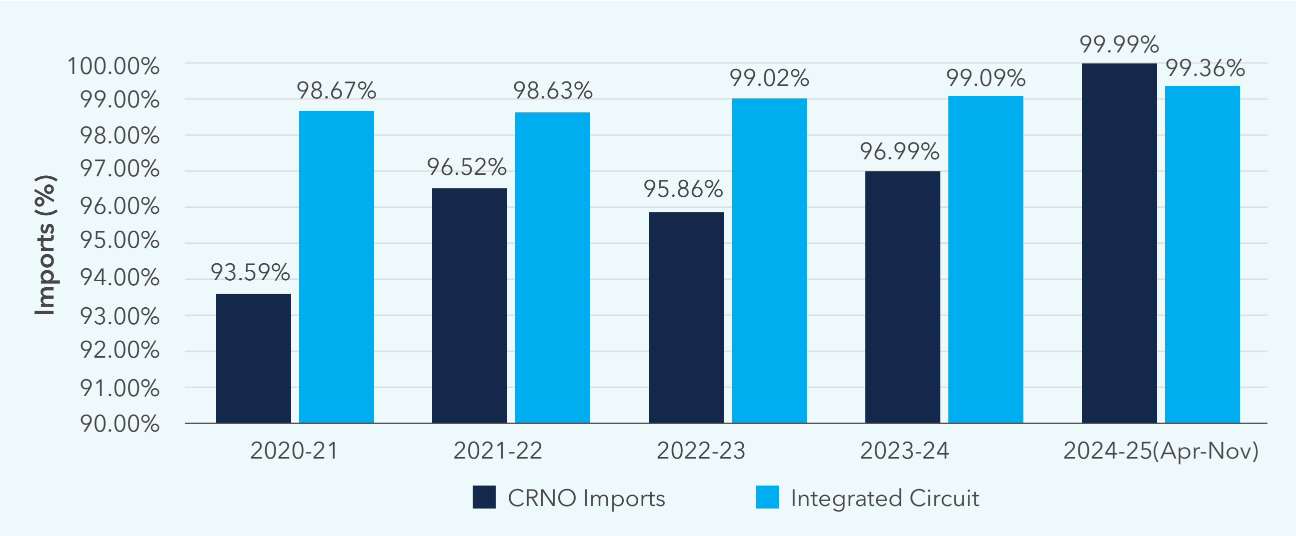


**Figure 15: Share of Imports in Total Trade[xxii]**

### Operationalizing the Suggested Intervention

- Introduce a targeted Production Linked Incentive (PLI) scheme to foster domestic manufacturing of essential inputs, including CRNO steel and electronic components (integrated circuits, MOSFETs, semiconductors).
- Address low demand and cost-competitiveness barriers through financial incentives that enable economies of scale, reduce unit costs, and improve commercial viability.
- Encourage investment in capacity expansion, product quality improvements, and progress toward self-reliance in super-efficient fan component production.
- DPIIT can act as the nodal agency overseeing the scheme.

## 4.4.4 Provide Concessional Loans for Investment in Energy-Efficient Fan Manufacturing

The Indian fan industry's heavy reliance on imported magnets–approximately 90 to 95 percent of ferrite magnets used in fans are imported–poses a significant barrier to domestic localization efforts. While raw materials for ferrite and rare-earth magnets may still require importation, stakeholders suggest local processing through sintering technology is feasible. Promoting domestic magnet manufacturing is crucial to localizing a significant portion of the magnet value chain and advancing the CF30 vision.

---

xxi Based on stakeholder consultations.
xxii Import Export Data: Directorate General of Foreign Trade, Ministry of Commerce and Industry, Government of India

## Operationalizing the Suggested Intervention

- Provide concessional loans to support establishment of magnet manufacturing facilities.
- Offering financing at lower interest rates will incentivize investments, expand capacity, and reduce import dependence.

# 4.4.5 Develop Integrated Fan Manufacturing Clusters Offering Shared Infrastructure and Incentives

Currently, the ceiling fan industry in India is fragmented, with dispersed manufacturing units leading to higher logistics costs and limited economies of scale. This fragmentation hampers cost-effective production of energy-efficient fans. Integrated manufacturing clusters can consolidate operations, streamline supply chains, and promote cost efficiencies through shared infrastructure and specialized ecosystems. These integrated clusters can also facilitate access to resources like cluster-level testing laboratories, supporting the transition to CF30-compliant fan production.

## Operationalizing the Suggested Intervention

- Offer extended tax holidays of up to 25 years for manufacturers located within integrated fan manufacturing clusters.
- Such incentives will attract investment, encourage operational aggregation, and foster collaboration among industry stakeholders.

# 5. IMPLEMENTATION PRIORITIZATION FRAMEWORK

The interventions proposed in the CF30 blueprint target systemic barriers across the ceiling fan industry, including high R&D costs, limited consumer awareness, inadequate testing infrastructure, supply chain vulnerabilities, and technological constraints.

To effectively navigate through these challenges, each intervention has been systematically evaluated through a structured prioritization framework based on three core criteria:

- **Policy Alignment:** This criterion assesses how effectively the proposed interventions align with India's national priorities, specifically the National Mission for Enhanced Energy Efficiency (NMEEE)–which aims to double energy efficiency by 2030, and the Make in India initiative–which promotes domestic manufacturing. The policy alignment ensures that interventions support energy savings and sustainability objectives while fostering local production and supply chain resilience. This integration enhances the blueprint's credibility, scalability, and stakeholder buy-in.
- **Technical Feasibility:** This criterion ensures that the interventions are grounded in robust engineering and business principles and are adaptable to India's manufacturing capabilities. Evaluation includes peer-reviewed technical assessments to verify scientific rigor and input from industry experts to confirm real-world applicability. This approach prioritizes proven, scalable solutions, thus minimizing implementation risks and supporting the CF30 objectives.
- **Ease of Implementation:** This criterion evaluates whether the interventions can be realistically executed within available timelines and resource constraints. It considers stakeholder readiness, component and material availability, and practical implementation schedules, ensuring that interventions are both innovative and actionable at scale.

By applying this structured framework, CF30 prioritizes interventions that deliver early wins while establishing a solid foundation for long-term industry transformation. A comprehensive evaluation of all proposed interventions is summarized in Table 7.

**Table 7: Structured Assessment of Interventions Against the Prioritization Framework**

*Color indicators reflect the level of Policy Alignment, Technical Feasibility, and Ease of Implementation ( = High, = Medium, = Low)*[xxiii]

| Area of Intervention | Intervention | Policy Alignment | Technical Correctness | Implementation Feasibility |
|---|---|---|---|---|
| Design & Material Interventions | Amend IS 374 to cap maximum lamination thickness at 0.35mm | Incorporating lamination thickness in fan standards promotes use of thinner laminations, improving motor efficiency and aligning with NMEEE energy-saving targets. | Thinner stator laminations reduce core losses in motors, as supported by literature and stakeholder feedback. | Potential resistance from manufacturers concerned about restrictions on design innovation when revising IS 374. |

xxiii Assessments of policy alignment, technical correctness, and implementation feasibility were made by the authors based on insights from stakeholder consultation sessions.

| Area of Intervention | Intervention | Policy Alignment | Technical Correctness | Implementation Feasibility |
|---|---|---|---|---|
| | Promote use of alternative materials in ceiling fan manufacturing | Use of alternative materials like electrical-grade steel and composites supports NMEEE goals, but may increase imports, potentially impacting Make in India efforts. | Alternative materials improve fan energy efficiency, validated by industry experts and research. | Fiscal incentives may face opposition due to concerns regarding potential government revenue loss. |
| | Enhance R&D in fan technology through an industry-academia innovation challenge | Promotes Make in India and NMEEE objectives by encouraging development of energy-efficient, domestically manufactured super-efficient fans. | Fosters industry-academia collaboration, essential for CF30-compliant fan innovation. | Proven success in analogous sectors (e.g., Global Cooling Prize for ACs) suggests high feasibility. |
| Enhancement of Testing Standards | Establish standards for magnet quality and controller durability | Enhances product durability, a key aspect of Make in India's drive for reliable and globally competitive manufacturing. | Addressing durability gaps can reduce super-efficient fan failures and boost consumer confidence. | BIS can revise IS 374 to include minimum durability requirements, subject to stakeholder engagement. |
| | Standardize ambient testing conditions | Standardizing ambient testing conditions under IS 374 supports Make in India by improving test consistency and compliance ease. | Reduces variability in lab test results as reported by manufacturers, thus enhancing reliability. | BIS can incorporate ambient testing conditions into IS 374; however, adequate funding for NABL lab upgrades remains unaddressed |
| Demand Creation & Awareness | Fan replacement program for residential consumers | Aligns with NMEEE's goal to double energy efficiency by incentivizing replacement of inefficient fans. | DSM frameworks enable DISCOMs to offer rebates and recover costs through reduced power purchases. | DISCOMs use DSM programs to manage peak load, and replacing fans with super-efficient models can support these efforts, though such initiatives have seen limited scale historically. |
| | Mandate fan replacement and bulk procurement by public institutions | Fully supports NMEEE by leveraging public procurement to stimulate demand and reduce retail prices through scale. | Aggregates demand via government directives, enabling market transformation towards super-efficient fans. | Requires coordination across government agencies and compliance enforcement mechanisms. |

| Area of Intervention | Intervention | Policy Alignment | Technical Correctness | Implementation Feasibility |
|---|---|---|---|---|
| | Establish a graded GST structure to favor energy efficiency | Reduces costs of super-efficient fans to boost adoption, aligning with NMEEE's energy efficiency goals. | A graded GST regime narrows the price gap between low- and high-efficiency fans, encouraging demand for SE models | May face resistance from the finance ministry over potential revenue impacts. |
| | Develop a nationwide consumer awareness campaign | Critical to increasing demand for super-efficient fans and achieving NMEEE's energy efficiency targets. | Non-financial demand driver that can be scaled through multi-stakeholder collaboration. | Feasible with partnerships between BEE, industry bodies, and local institutions for broad reach. |
| Ecosystem Development | Establish affordable cluster-level NABL testing ecosystem | Strengthens domestic manufacturing quality and compliance, thus supporting Make in India's manufacturing ecosystem. | Improves MSME access to testing, fostering adherence to efficiency and quality standards. | Requires substantial financial and institutional support; detailed implementation plan needed. |
| | Establish CoEs to share knowledge on advanced technologies and serve as capacity-building hubs | Enhances industry's technological capabilities and supports Make in India innovation objectives. | Facilitates sharing of best practices, benefiting smaller manufacturers. | Can be integrated into existing NABL infrastructure with appropriate resourcing. |
| | Create PLI scheme for incentivizing domestic manufacturing of electrical-grade steel and electronics | Encourages local manufacturing aligned with Make in India initiatives, reducing import dependency. | Can help reduce risks in establishing local production, boost investor confidence, and promote domestic manufacturing. | Can be incorporated into existing PLI schemes for white goods (particularly ACs and LED lights), requiring government approval. |
| | Develop integrated fan manufacturing clusters offering shared infrastructure and incentives | Supports localized manufacturing growth contingent on sustained market demand. | Can catalyze cluster development with targeted fiscal incentives. | May encounter government resistance due to fiscal implications. |
| | Provide concessional loans for energy-efficient fan manufacturing | Aligns with NMEEE and Make in India by enabling technology upgrades and local component production. | Facilitates in-house manufacturing of components like magnets, reducing reliance on imports. | Interest subvention schemes may face opposition due to concerns about fiscal impact. |

## 5.1 Timeline

### Short-Term (0 to 2 Years): Early Wins Through Standardization and Demand Stimulation

- Immediate opportunities exist to enhance testing standards and stimulate demand.
- Updating IS 374 to include ambient testing conditions and controller durability standards will improve product reliability and boost consumer confidence.
- Implementing a structured fan replacement program, mandating public procurement of super-efficient fans, and introducing a graded GST structure will significantly reduce upfront costs, thus accelerating market adoption.

### Medium-Term (3 to 5 Years): Scaling Design Optimizations and Strengthening Domestic Manufacturing

- Design and material innovations require coordinated policy action and targeted investments to deliver measurable improvements.
- Reducing import duties on electrical-grade steel and providing low-cost financing for material research will lower barriers and encourage innovation.
- Introducing targeted PLI schemes for electrical steel and electronics will accelerate domestic manufacturing and reduce import dependence.

### Long-Term (>5 Years): Structural Reforms for Resilient Manufacturing Ecosystems

- Ecosystem development efforts–such as establishing a CoE, integrated manufacturing clusters, and local magnet production—will support sustained investments and multi-agency collaboration.
- Establishing cluster-level NABL-accredited testing facilities and shared R&D infrastructure will enhance productivity, shorten time-to-market, and support SME participation in the super-efficient fan ecosystem.

# 6. CONCLUSION

The CF30 Blueprint represents an ambitious and comprehensive national strategy to boost the adoption of super-efficient ceiling fans across India by 2030. This initiative, which has been developed with extensive stakeholder inputs and grounded in rigorous technical analysis, aims to deliver affordable, high-performance 5-star rated fans while significantly reducing energy consumption. Consequently, the CF30-compliant fans have the potential to uplift the domestic fan manufacturing ecosystem.

By highlighting critical systemic barriers—including high R&D costs, limited consumer awareness, inconsistent testing infrastructure, supply chain vulnerabilities, and technological challenges—the blueprint outlines four core intervention areas:

- Design and Material Innovations
- Enhanced Testing Standards
- Demand Creation and Consumer Awareness
- Ecosystem Development

Together, these interventions align with India's national priorities under the NMEEE and the Make in India initiative, thereby ensuring credibility, scalability, and sustainable impact.

Realizing the CF30 vision will require coordinated policy action, strategic investments, and multi-stakeholder collaboration across government agencies, industry, and research institutions. The prioritization framework and roadmap provided in this report offer clear guidance for phased implementation, emphasizing early wins alongside longer-term structural reforms to build a resilient and competitive super-efficient fan industry.

Ultimately, the successful execution of this blueprint promises substantial energy savings, reduced greenhouse gas emissions, improved consumer value, and a thriving domestic manufacturing sector—contributing meaningfully to India's energy security and climate goals.

# APPENDIX

## Appendix A: Development Process of the Blueprint

The development of this blueprint is grounded in a rigorous, multi-faceted, and stakeholder-driven approach. A structured consultation process was conducted to identify key challenges and opportunities in advancing the initiative's objectives within the ceiling fan industry. The main steps in this process are outlined below:

**Literature Review:** An extensive review of relevant literature was performed, including U4E's model regulation guidelines for energy-efficient ceiling fans[12], the India Cooling Action Plan, Bureau of Energy Efficiency impact assessment reports,[13] Unnat Jyoti by Affordable LEDs for All (UJALA) program case studies[14], and related research. This review provided foundational insights into:

- Technological advancements in motor design, materials, and control systems
- Energy efficiency benchmarks and emerging trends in fans
- Case studies and lessons learned from similar initiatives in other sectors

**Stakeholder Workshop:** A kick-off workshop was held at Government of India's Department of Science and Technology (DST), convening key stakeholders such as fan manufacturers, component suppliers, government representatives, and academia (see Appendix Figure 1).[15] The workshop aimed to identify the primary challenges and refine the problem statement to align with the initiative's goals. Five thematic areas emerged as the central points of discussion and guided subsequent consultations:

- Enhancing energy efficiency in ceiling fans
- Ensuring affordability and increasing market adoption within the CF30 framework
- Building a resilient and localized supply chain
- Establishing testing and standards for reliability and quality assurance

This collaborative forum ensured that diverse perspectives were integrated into the initiative's framework.


**Kick-off Workshop on Advancing Affordable and Domestically Produced Super-Efficient Ceiling Fans in India at the Department of Science and Technology**

Source: NRDC India & GreenTree

**One-on-One Stakeholder Consultations:** To delve deeper into the identified themes, one-on-one consultations were held with 11 organizations including industry leaders, manufacturers, and academic experts (see Appendix Table 1 and Figure 2). These discussions provided nuanced insights into challenges, potential solutions, and strategies for achieving the initiative's objectives. Findings from these consultations were later presented at the AHEAD (Alleviating Heat Stress by Enhancing production of Affordable cooling Devices) workshop, jointly organized by the World Bank and DST in May 2025.

**One-on-One Stakeholder Consultations**

| S.No. | Stakeholder Organization | Stakeholder Type |
|---|---|---|
| 1 | Greenland Solutions | MSME Fan Manufacturer |
| 2 | Versa Drives Pvt. Ltd. | |
| 3 | Hyderabad MSME | |
| 4 | AlphaSine Technologies Private Ltd. | |
| 5 | Wonder Electricals Ltd. | Large Fan Manufacturer |
| 6 | Bajaj Electricals Ltd. | |
| 7 | Crompton Greaves Consumer Electricals Limited | |
| 8 | Havells India Limited | |
| 9 | Indian Fan Manufacturers Association | Association |
| 10 | Uniglobus Electricals & Electronics Pvt. Ltd. | Component Manufacturer |
| 11 | IIT Bombay | Academia |


**One-on-One Consultation with Crompton Greaves Consumer Electricals Limited**

Source: NRDC India & GreenTree

# REFERENCES

Most of the insights and recommendations in this report have been informed by stakeholder workshops, expert interviews, and internal consultations conducted as part of the CF30 blueprint development process. As such, not all content is directly drawn from publicly available sources, and references included here primarily support supplementary context or sectoral data.


1 Shalu Agrawal, Abhishek Jain et al., Awareness and Adoption of *Energy Efficiency in Indian Homes,* Council on Energy, Environment and Water (CEEW), October 2020, https://www.ceew.in/publications/awareness-and-adoption-energy-efficiency-indian-homes.

2 Ministry of Environment, Forest and Climate Change, Ozone Cell, *India Cooling Action Plan*, Government of India, March 2019, https://ozonecell.nic.in/wp-content/uploads/2019/03/INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf.

3 Ibid

4 bid.

5 Ibid.

6 Aditya Chunekar and Abhiram Sahasrabudhe, "Up in the Air: Star Ratings for Ceiling Fans," Power Perspectives, *Prayas (Energy Group)*, April 20, 2023, https://energy.prayaspune.org/power-perspectives/up-in-the-air.

7 Bureau of Energy Efficiency, Ministry of Power, Government of India, *Star Labeling Notification – Ceiling Fans*, August 14, 2024, https://www.beestarlabel.com/Content/Files/CFN_Notification.pdf.

8 Bureau of Energy Efficiency, Ministry of Power, Government of India, *Ceiling Fan Notification,* May 19, 2022, https://beeindia.gov.in/sites/default/files/CFN_Notification.pdf.

9 Bureau of Energy Efficiency Ministry of Power, Government of India, *Impact of Energy Efficiency Measures, For The Year2022–23*, December 2023, https://beeindia.gov.in/sites/default/files/publications/files/Impact%20Assessment%202022-23_%20FINAL%20Report.pdf.

10 Directorate General of Foreign Trade, Ministry of Commerce and Industry, Government of India, *Trade Statistics Portal*, https://www.dgft.gov.in/CP/?opt=trade-statistics.

11 UL Standards & Engagement, "UL Standard 507 for Electric Fans," n.d., https://www.shopulstandards.com/ProductDetail.aspx?productId=UL507_10_S_20171109.

12 United for Efficiency (U4E), United Nations Environment Programme (UNEP), Model *Regulation Guidelines for Energy-Efficient Ceiling Fans – Supporting Information Annex,* October 2023, https://united4efficiency.org/wp-content/uploads/2023/10/U4E-CF-MRG-Annex_20231102.pdf.

13 Bureau of Energy Efficiency, Ministry of Power, Government of India, *Impact of Energy Efficiency Measures, For The Year 2022–23,* December 2023, https://beeindia.gov.in/sites/default/files/publications/files/Impact%20Assessment%202022-23_%20FINAL%20Report.pdf.

14 "India's UJALA Story," *Energy Efficiency Services Limited (EESL),* 2017, https://eeslindia.org/img/uajala/pdf/UJALA_Case_Studies_1.pdf.

15 Prima Madan, "Experts Discuss Advancing Affordable, Energy-Efficient, and Locally Produced Ceiling Fans in India," *Natural Resources Defense Council (NRDC)*, October 18, 2024, https://www.nrdc.org/bio/prima-madan/experts-discuss-advancing-affordable-energy-efficient-and-locally-produced-ceiling.