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Energy efficient Ceiling Fans

Country

India

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1 Subtypes and markets

Ceiling fans contribute significantly to residential electricity consumption, especially in developing countries with warm climates. As per report the stock for fans in Indian households adds up to 246 million in the year 2008. While the number of units used per household is close to one for most appliances, it is about 1.8 per household for fans. The sales of fan in the same year are calculated to be 30 million (Boegle, Singh, & Sant). Previous research shows that ceiling fans accounted for about 6% of residential primary energy use in India in 2000, and this figure is expected to grow to 9% in 2020 (Sathaye, Phadke, Shah, & Letschert, October 2012).

Ceiling fans contribute significantly to residential electricity consumption, especially in developing countries with warm climates. Even though ceiling fans are one of the most common groups of electrical appliances after electric lights in Indian households, they are rarely mentioned in discussions of energy efficiency. This has resulted in the loss of an opportunity to realize significant savings in energy. Initially the fan industry in India was dominated by imports. With the ban on imports after independence, domestic production picked up. Jay Engineering (JE) set up the first manufacturing unit in 1947 in Kolkata. Other manufacturers around Kolkata and in the other metropolitan cities followed it. Due to labour problems the JE plant in Kolkata was shut down, thus JE's Hyderabad unit became the main manufacturing hub for the company. Starting in mid-eighties, other brands emerged and JE's sales started to decline resulting in excess capacity with the component manufacturers. As these component manufacturers scouted around for new customers, the ceiling fans technology became accessible and open, in Hyderabad. Over time, the component manufacturers became organised and started to function together, there also emerged a number of units in the unorganised sector, which instead of manufacturing the whole ceiling fans, manufactured one or two components such as cast iron castings, aluminium die castings, blades, stators, rotors etc., or provided single services such as machining. Several assembly units also surfaced resulting in making assembly work a cottage industry. In this way a cluster of units for manufacturing fans developed in Hyderabad. Similarly many clusters came up in and around Delhi, Kolkata, Bangalore, Pune, Varanasi, and in parts of Punjab and Haryana.

More recently, the increased competition in the fan industry has forced manufacturers to look for additional ways to cut costs. Today Indian fan market is divided into three segments:

- Eight leading brands- together have a share of about 60%.
- About a hundred lesser-known brands in the unorganised sector having a market share of about 25%.
- A large number of very small manufacturers having the remaining market share of 15%.

Given the predominance of the unorganized sector in the market, sales data for fans are scarce and available estimates differ widely. The Indian Fans Manufacturers Association estimated the size of the fan market in 2007 at 30 million fans with an annual growth rate of 10% (Chunekar, et al., June, 2011).

The ceiling fans come in different sizes. The "sweep" of the fan is the diameter of the circle traced by the tips of the fan blades. Generally, ceiling fans come in various size such as 600 mm, 750 mm, 900 mm, 1,050 mm, 1,200 mm, 1,400 mm and 1,500 mm. However, 1,200 mm is the most prevalent fan size with about 90% share of the ceiling fan market (Singh, Barve, & Sant, 2010). Ceiling fans mainly consists of following parts:

- An electric motor
- Blades
- Metal Arms, which hold the blades and connect them to the motor.
- Fly wheel, a metal or tough rubber that is attached to the motor shaft, and to which the metal arms may be attached
- Rotor, alternative to metal arms, secures blades and bolts directly to the motor, thus eliminating most balancing problems

According to Bijli Bachao website the ideal sizing of a fan for various room sizes is given below in *table 1* (Bijli Bachao Team, 2016):

Table 1: Sizing of fan for various room sizes

Fan Size (in mm)	Room Size (in sq metres)
900	<7
1,050	07-10
1,200	10-12
1,400	12-14
>1,400	Greater than 14 sq meters or Use 2 or more fans

As per report, share of total consumption of fans, out the various appliances is shown in the figure 1 below (Boegle, Singh, & Sant).

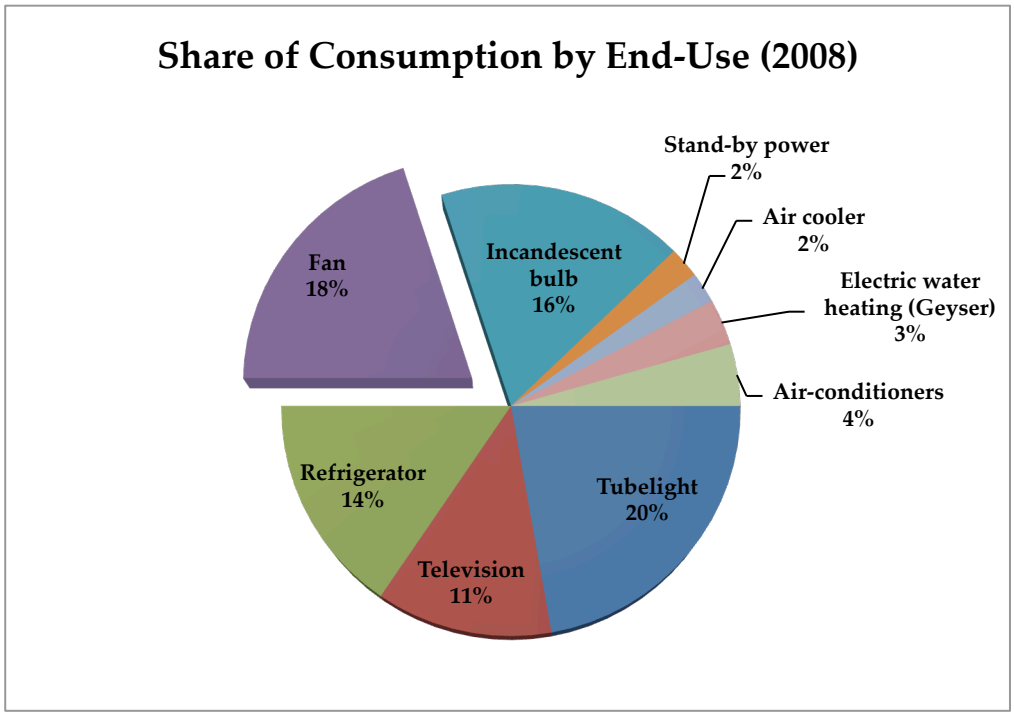

Figure 1: Focus Areas and Their Share of Total Consumption In 2008

2 Efficiency range and user savings

Historically, ceiling fans have utilized AC induction motors because these motors are durable, easy to construct, and relatively inexpensive to manufacture (Shah, Sathaye, Phadke, & Letschert, 26 April 2013). However, these AC induction fan motors are relatively inefficient because of the slip associated with single-phase induction motors. A significant influence on the fan efficiency can be achieved by improving fan blade design as well.

Level	**Typical appliance in the stock (over all appliances in use)**	**Typical Inefficient appliance. If MEPS is implemented: Appliance just complying to minimum requirement (MEPS)**	**Typical appliance purchased (BAU – Business As Usual)**	**Best Available Technology (BAT)**	**Expected future BAT (Best not yet Available Technology)**
Typical Capacity / Size	1,200 mm Ceiling Fan (Sweep)				
Type	Brushed AC Motor	Brushed AC Motor	Brushed DC Motor	Brushed DC Motor	Brushless DC Motor (BLDC)
Lifetime (years)	10	10	10	10	10
Qualitative classification of the provided service (e.g.: washing perfor-	☐ Poor ☐ Low ☒ Average ☐ Good	☐ Poor ☐ Low ☒ Average ☐ Good	☐ Poor ☐ Low ☒ Average ☐ Good	☐ Poor ☐ Low ☐ Average ☒ Good	☐ Poor ☐ Low ☐ Average ☐ Good

mance /etc.)	☐ Excellent ☐ No information	☐ Excellent ☐ No information	☐ Excellent ☐ No information	☐ Excellent ☐ No information	☒ Excellent ☐ No information
Yearly energy consumption *(Electricty kWh)*	113.6	113	104	81.6	56
Yearly energy cost (national currency INR) (taking unit rate as Rs.10/kWh or 0.15 US Dollar)	1,136	1,136	1,040	816	560
Purchase cost in INR	1,500	2,000	1,500	2,500	3,500
Labelling class (for the aforementioned labels)	No star	No Star	1 star	5 star	5 star

3 Performance and information requirements

In the Standard & Labelling (S&L) programme, the Bureau of Energy Efficiency (BEE) has identified the product group ceiling fans as one of the appliance groups applicable for the voluntary scheme. The schedule specifies the requirements for participating in the energy efficiency Standards & Labelling (S&L) for ceiling fans covering 1,200mm sweep only.

Ceiling fans is one the appliance groups covered in the Standard & Labelling (S&L) programme. Fans with a sweep of 1,200mm are covered under voluntary rating scheme. The referred Indian Standard is 'IS 374:1979 Specification for ceiling type fans and regulators with all amendments'. The star-rating plan for ceiling fans is as follows:

Table 2: Star Rating Index Calculation for Ceiling Fans

Star Rating	Service Value for Ceiling Fans*
1 Star	≥3.2 to < 3.4
2 Star	≥3.4 to < 3.6
3 Star	≥3.6 to < 3.8
4 Star	≥3.8 to < 4.0
5 Star	≥4.0

BEE has proposed a base service value of 3.2 at present and would upgrade it to higher value once the BIS value is finalised. The BIS has proposed from the year 2010 the service value of 3.5. All ceiling fans covered under this standard shall comply with minimum Air Delivery of 210 cu m/min.

Efficiency of the ceiling fan is the ratio of air delivered by fan in cubic metres per minute & electrical power inputs in watts, when fan is operated at rated voltage[1]. This is known as the service value of the fan. Service value is the air delivery per unit of power consumed and expressed as cubic meter per minute per watt (CMM/Watt) or cubic feet per minute per watt (CFM/Watt).

[1] Rated voltage is the voltage written on the rating plate of the fan (It is normally equal to the supply voltage available in the house).

4 Test procedures and standards

The Indian standard IS-374 defines minimum efficacy (service value) levels for five different ceiling fan size categories, which are based on the fan sizes of 900mm, 1,050mm, 1,200mm, 1,400mm, 1,500mm.

For ceiling fans the referred Indian standard is IS 374: 1979 (Specification for Ceiling Type fans and regulators) with all amendments. Parameters to be tested are:

- Air Delivery
- Fan Speed & power input

Air Delivery Test: The fan shall be tested in a test chamber measuring 4.5 X 4.5 X 3.0m. Before starting of the test a 'run-in' period of two hours is required for achieving of steady conditions. The measurements shall be carried out with the fan running at full speed at the test voltage. The testing instrument to measure air movement should be a rotating vane anemometer having an internal diameter of not more than 100mm.

Fan Speed & Power Input: The fan is connected to the supply at the test voltage and at the highest speed setting of the regulator. The power factor under the above conditions shall not be less than 0.90. The input under the above conditions is measured and it shall not exceed the marked input by more than 10 percent. The rated speed is also measured and it shall not differ from the declared value by ± 10 percent.

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The bigee.net platform informs users about energy efficiency options and savings potentials, net benefits and how policy can support achieving those savings. Targeted information is paired with recommendations and examples of good practice.

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