BEE Labeling Scheme for Inverter Air Conditioners

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Introduction

In 2012, Bureau of Energy Efficiency (BEE) made energy labeling mandatory for fixed speed room air conditioners (RACs) in India. This was an important step, as it projected India as a responsible nation contributing significantly towards reducing global warming and carbon emissions. This is very significant because RACs in residences and small commercial establishments are some big energy guzzlers.

The main aim of this article is to provide information on energy labeling of variable speed RACs (inverter air conditioners) for residences and their benefits for people and the country.

About the Author

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Background

With the rise in income and lifestyle of higher middle class, there is a surge in demand for RACs year on year especially in view of the scorching summers in India. The penetration of RACs in India, given its population, is only about 4%. This means RAC penetration is set to grow at a faster pace in the coming years, and will create huge energy demands. According to market research, the Indian RAC market would grow at 15% CAGR[1]. The growth of RAC penetration in the last 10 years is already a major reason for additional power generation demand in India.

Based on projections by a Lawrence Berkeley National Laboratory (LBNL)[2] research study, the authors have estimated the electricity demand for RACs to increase to 239 TWh/yr by 2030, which would create a peak demand of about 143 GW. To meet this increasing demand, there is a need for an additional 150 coal fired power plants of approximately 1,000 MW capacity each.

Since most of the AC stocks that will be in use in 2020 are yet to be bought, this is the right time to implement strong energy efficiency measures through standards and a labeling program to cut down the huge energy demand.

Figure 1 shows the peak saving potential from RACs in 2020 and 2030 by efficiency enhancing measures for RACs.

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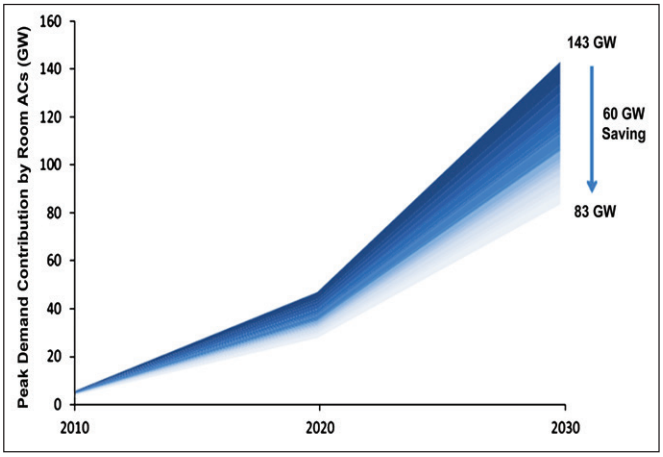

Figure 1: Peak saving potential from RACs (courtesy LBNL)

Energy Labeling of RACs in India – Current Scenario

BEE has made the labeling of fixed speed RACs mandatory from 2012. They have designated the efficiency level by the number of stars (1 star to 5 star) – more stars, more energy efficiency. These efficiency levels were revised in 2014 and one star was dropped from January 2016. That means the minimum energy performance standard (MEPS) level for fixed speed split systems stands at EER of 2.9 (W/W).

Figure 2 provides the current labeling scenario for fixed speed split systems.

BEE released the voluntary and mandatory schedules for variable capacity air conditioners on June 29, 2015 (*Table 1*).

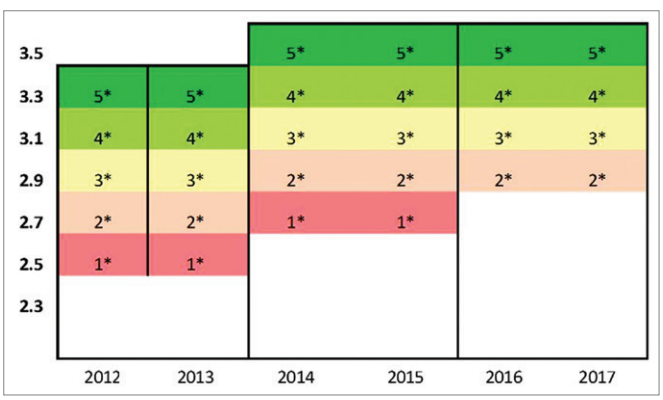

Figure 2: BEE split AC star rating schedule from 2012 through 2017

Table 1: Star rating plan for inverter ACs – voluntary and mandatory phases (source: BEE)[3]

(a) Star Rating Plan – Voluntary Phase (Valid from 29/06/2015 to 31/12/2017		
Star Rating	**Minimum ISEER**	**Maximum ISEER**
1 Star	3.10	3.29
2 Star	3.30	3.49
3 Star	3.50	3.99
4 Star	4.00	1.49
5 Star	4.50	
(b) Star Rating Plan – Mandatory Phase (Valid from 01/01/2018 to 31/12/2019		
Star Rating	**Minimum ISEER**	**Maximum ISEER**
1 Star	3.10	3.29
2 Star	3.30	3.49
3 Star	3.50	3.99
4 Star	4.00	1.49
5 Star	4.50	

Moving Towards Energy Labeling of Variable Capacity Air Conditioners

Since 2012, BEE has revised the 5 star rating of fixed speed split system from EER 3.3 to 3.5 and further extended this till the end of 2017. Technology maturity and efficiency levels in fixed speed compressors have reached a flat curve, and any further increase in efficiency levels in fixed speed systems will increase the cost substantially, with minor increase in efficiency.

Figure 3 shows a typical simulation comparison between fixed speed and inverter ACs when additional cost is involved in increasing their efficiencies. This clearly shows variable speed can save more energy with minimal incremental cost. Of course, the capital cost of variable speed systems is higher than fixed speed. But with higher energy savings and falling inverter prices the ROI will be much higher than earlier, and this will provide major opportunities in reducing the energy demand when the urban and rural segments are getting ready for a growth surge in RACs.

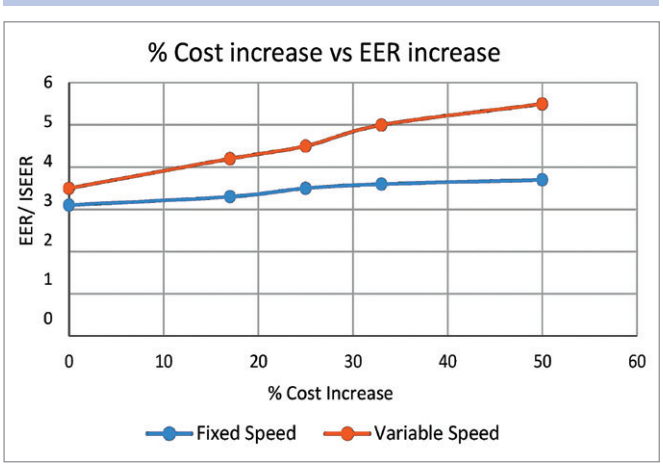

Figure 3: Trane UP-2 energy comparison simulation results for 1 ton model[4]

Standards and Norms for Energy Labeling of Variable Speed RACs

The main advantage of variable speed is that it can work on part load conditions unlike fixed speed systems. As the ambient comes down and space load reduces, the input power of the compressor will gradually reduce and adjust according to the required space load, which provides better energy savings.

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Table 2: Reference outdoor temperature bin distribution – National Weather Data

Temperature in °C	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	Total
Average Annual Hours	527	590	639	660	603	543	451	377	309	240	196	165	130	101	79	59	44	31	20	10	**5774**
Fraction	9.1	10.2	11.1	11.4	10.4	9.4	7.8	6.5	5.4	4.2	3.4	2.9	2.3	1.7	1.4	1.0	0.8	0.5	0.3	0.2	**100**
Bin Hours	146	163	177	183	167	150	125	104	86	67	54	46	36	28	22	16	12	9	6	3	**1600**

The current fixed speed split system follows BIS 1391 – 1 & 2 test procedures to declare cooling capacity and energy consumption. This is done at a single point condition: indoor 27°C DBT/19° WBT and outdoor 35°C DBT/24° WBT, irrespective of the fluctuating space loads and ambient. Hence the efficiency is measured in EER (W/W). In fact, the more appropriate parameter would be SEER (seasonal energy efficiency ratio) measured in Wh/Wh. This is based on the total annual cooling in watt-hours to the annual energy consumed in watt-hours. For this, we need annual temperature profile data for Indian cities. Refer *Table 3* from BEE Schedule.

BEE, along with BIS working group for Standard 1391, released reference outdoor temperature bin distribution based on the weather profile for 54 cities across India. Currently, for energy labeling of variable capacity RACs, BEE has referenced ISO 16358-1: 2013 to calculate ISEER (Indian Seasonal Energy Efficiency Ratio). In ISO 16358-1, this parameter is referred as CSPF (cooling seasonal performance factor).

Table 3: Calculation of ISEER (source: BEE)

To be Filled by the Laboratory/Manufacturer			
S. No.	**Parameters**		**35°C**
a	Cooling Load		
b	Cooling Capacity	Full Capacity	**3500**
		Half Capacity	**1750**
		Minimum Capacity	
c	Power Consumption	Full Capacity	**900**
		Half Capacity	**460**
		Minimum Capacity	

ISEER is calculated as the ratio of cooling seasonal total load in Whr (CSTL) to the cooling seasonal energy consumption in Whr (CSEC).

This method of evaluation is based on bin temperature range of 24°C to 43°C and 1600 operating hours of cooling per annum. The importance of this methodology is that varied cooling load and the respective energy consumption is accounted because of the seasonal variation, which gives a better metric than single point EER values.

BEE has released an Excel table to calculate ISEER based on testing as per BIS 1391 and ISO 16358-1 (see *Table 3*).

Conclusion

As the RAC market is poised for faster growth and the residential sector would account for much of building energy consumption in the future, it is important to address efficiency measures early. As most of the air conditioner stocks that will be in use in 2020 are yet to be purchased, this is the right time to address energy efficiency. A rational approach and a well-laid policy on power infrastructure and utilization measures will drive manufacturing of efficient air conditioners. Considering the overall energy forecast for 2020 and 2030, energy labeling measures by BEE will go a long way towards addressing India's energy shortfall, and lowering pollution and the overall carbon footprint.

References

1. *Room Airconditioners at an inflection point: Capital Goods, Motilal Oswal April 2016.*
2. *LBNL: Avoiding 100 new power plants by increasing efficiency of room airconditioners in India: Opportunities and Challenges.*
3. *BEE: Inverter AC schedule final, 29-June-2015.*
4. *Trane: UP-2 Refrigeration systems simulation software.*