

Evaluating the Impacts of Mandatory Policies and Labeling program for Appliances in India

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ABSTRACT

Household appliances are basic essentials in day to day life, important for human wellbeing and increases the productivity and comfort. Over the last decade, India has witnessed continuous growth in usage of home appliances with increase in disposable incomes, availability of innovative products and affordable pricing. The growth in consumer durable market in India has resulted in increase in the electricity demand in the residential sector by two-thirds in the last decade.

To reduce the energy intensity of the economy, India's Bureau of Energy Efficiency (BEE) launched the standards and labeling (S&L) program for residential appliances in 2006. Starting the program with four voluntary appliances and gradually expanding the policies to mandatory administration for cooling, lighting and industrial application products, the labeling program currently covers 23 products. Over the last decade or so, BEE has continuously strengthened the program to eliminate inefficient products from Indian market through mandatory policies to pull the market for efficient products and periodic revisions to increase the stringency of the energy performance standards.

Since the inception, more than 80% of products listed under mandatory labeling policies have resulted in cumulative electricity savings of 175 Billion Units (BU) of the 197 BU of the overall potential electricity savings from the program. This paper analyses and discusses the impacts of mandatory policies and the related trends of market growth, technology improvements, market transformation and climate impacts.

Introduction

Energy is one of the important aspects of the modern economy which makes the energy policies inseparable from the overall national development strategy. India's per capita energy consumption is around one-fourth of the world's average. Since India is an emerging economy, there is a continuously rising demand for energy [1]. Alongside, increasing demand has been perceived in the domestic sector, which accounts 24% of India's gross electricity consumption in 2016-17.

Energy efficiency in household appliances or consumer products plays an important role in averting the rising electricity demand. The mandatory energy efficiency policies for household appliances typical benefits the market by producing efficient products. This paper embodies information on the growing electricity demand in residential sector, national energy policy for appliances, the existing policy status and overall impacts of appliances mandatory policies.

The paper also provides an understanding of whole improvements in product efficiency, increase in market share and estimation of benefits resulting from policies and periodic revisions. Further, the key trends of the market transformation and technology improvements as a result of the mandatory policy under the S&L program and the resultant impact in terms of electricity savings and carbon emission reduction were analyzed and discussed.

Data Collection and Methodology Adopted

The quantitative evaluation of the impact of the S&L program and mandatory policies was done on the basis of the BEE's database of the appliances registered and sold in the market. The overall production data of the labeled product along with the available information of models under the S&L program was considered for the analysis of the market transformation characteristics. Under the program, it is mandatory for the manufacturers to submit the production data in S&L portal of each product on quarterly and annual basis in every financial year to BEE. Accordingly, BEE estimates the actual energy saving of program from the verified data of all equipment/appliances models of manufacturers registered under S&L program. These are further discussed in the energy saving section.

Overview of India's Standards and Labeling (S&L) Program

The Government of India set up the Bureau of Energy Efficiency (BEE) on March 1, 2002, under the provisions of the Energy Conservation (EC) Act, 2001. The Bureau's mission is to develop policies and strategies with the primary objective of reducing energy intensity of the Indian economy [2], to establish the pace and tone for the need of energy efficiency policies to reduce electricity consumption and manage peak demand.

In May 2006, BEE launched the Standards and Labeling (S&L) Program for electrical appliances to improve efficiency of appliances/equipment and to promote the usage of efficient products. The program rates appliances on a scale of 1 to 5, with the 5-star rating being the most efficient appliance on the market. A key objective of this program is to provide the consumers an informed choice about the energy saving and thereby cost saving potential of the products. The program targets high energy use equipment and appliances, lays down minimum energy performance standards and energy performance levels [3].

Star labeling is one of the most cost-effective policy tools to improve energy efficiency and lower energy cost of appliances or equipment for consumers [4]. The program has been developed in a collaborative and consensus driven approach with active participation from all the stakeholders (representation of industry, industry association, consumer organisation, testing laboratory, Non-Government organisations (NGOs), research and development institutions, Government organisations and regulatory bodies). Star Labels are informative labels affixed to products to describe energy performance usually in the form of energy use, efficiency, or energy intensity, these labels are also give consumers the necessary information to make proper purchases. Mainly there are two types of labels, comparative and endorsement labels:

1. Comparative label: This will allow consumers to compare efficiency of all the models of a product in order to make an informed choice. It shows the relative energy use of a product compared to other models available in the market.
2. Endorsement label: This will define a group of products as efficient when they meet minimum energy performance criteria specified.

India's labeling program works on a model in which the manufacturers provide information about the energy efficiency of the product on the label as prescribed in the respective product regulations. A star rating, ranging from 1 to 5 in the ascending order of energy efficiency, is provided to products registered with the Bureau. An endorsement label is also provided for some products.



Figure 1: Comparative and Endorsement Labels

Source: Bureau of Energy Efficiency

Household appliances in India

The household appliances are growing along with rising rural incomes, increasing urbanization, growing middle-class and changing lifestyles in India. Rising disposable incomes have led to shorter product replacement cycles and the changing perception of owning appliances, whereby appliances previously considered luxuries are now considered necessities. Growing awareness of the products available and easier accessibility are driving growth, especially in rural and semi-urban areas [5].

As growth in usage of consumer appliances has increased, electricity demand has increased in the domestic sector. India's gross electricity generation in 2016-17 was 1160 Billion Units (BU), and the projected electricity requirement is expected to increase to 1566 BU by 2022 [6]. Correspondingly, the share of domestic sector electricity use will escalate from 24% in 2016 to 30% in 2022.

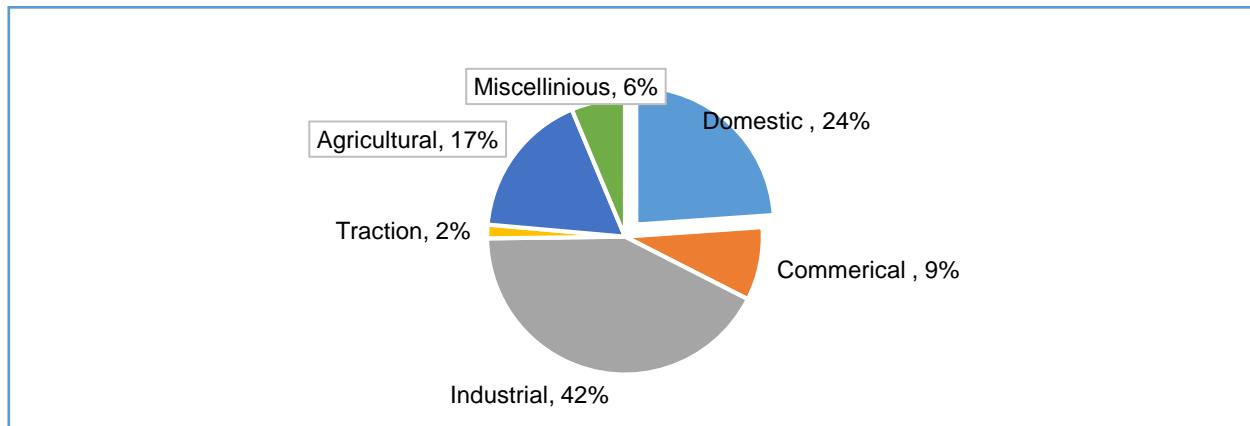


Figure2: India's Electricity Consumption by Sector in 2016-17

Source: Central Electricity Authority (CEA)

Products and Appliances Covered by India's Standard and Labeling Program

As a practice, BEE launches a labeling program for a new product on a voluntary basis. This helps industry or manufacturers to understand the program requirements as well as prepares for adapting to the mandatory scenario in future. The voluntary phase can provide a good learning experience for both the implementing agency and industry, allowing each to adjust and understand its role and responsibilities. These lead times enable the market to optimize any cost implications from increased efficiency requirements by integrating design and manufacturing changes into normal industrial cycles. In mandatory phase, it becomes obligation to display the star rating label on the appliance from the date of commencement of the Government regulations.

The S&L program started in 2006 with voluntary labeling for four products, namely, frost free refrigerator, tubular florescent lamps, room air conditioners (split and window) and direct cool refrigerators. Gradually, the program expanded to lighting, industrial and other categories of appliances/products like pumpsets, transformers, color televisions, electric geysers, ceiling fans and Induction motors.

By 2010, the labeling program covered 10 appliances with four products brought under the mandatory phase. Since, several other categories of products have been covered under the program, which includes cassette ACs, washing machines, computers, inverters, ballasts, office equipment, domestic gas stoves, diesel generators and engine pumpsets, variable speed air conditioners, LED lamps, chillers and microwave ovens. By mid-2019, the program established labeling regulations for 10 mandatory products [7] and 13 voluntary appliances/equipment [8]. Currently, the labeling program covers for 23 products (see Table 1),

Table 1: Status of Labeling program

S.no	Appliances/ Products	Year Standards First developed	Nature of Labeling program
1	Frost Free Refrigerator (FFR)	2006	Made Mandatory in 2009
2	Tubular Florescent Lamp (TFL)	2006	Made Mandatory in 2009
3	Room Air Conditioners- RAC (Split, window)	2007	Made Mandatory in 2009
4	Direct Cool Refrigerator (DCR)	2007	Made Mandatory in 2016
5	Pump Sets	2008	Voluntary
6	Distribution Transformer	2009	Made Mandatory in 2009
7	Color Television (CTV)	2009	Made Mandatory in 2016
8	Electric Geysers	2009	Made Mandatory in 2016
9	Ceiling Fans (CF)	2009	Voluntary(to become Mandatory in 2020)
10	Induction Motors	2010	Voluntary
11	RAC (Cassette, Floor Standing)	2011	Made Mandatory in 2015
12	Washing Machine	2011	Voluntary
13	Computer (Notebook/Laptops)	2011	Voluntary
14	Solid State Inverter	2013	Voluntary
15	Ballast (Electronic/Magnetic)	2013	Voluntary
16	Office Equipment's	2014	Voluntary
17	Domestic Gas Stoves	2014	Voluntary
18	Diesel Generator Sets	2014	Voluntary
19	Room Air Conditioners – RAC (variable speed)	2015	Made Mandatory in 2018
20	Diesel Engine Mono-set Pumps	2015	Voluntary
21	LED Lamps	2016	Made Mandatory in 2018
22	Chillers	2018	Voluntary
23	Microwave Oven	2019	Voluntary

Source: Bureau of Energy Efficiency [6]

Market Share of Labeled Products

In 2009, BEE transitioned from voluntary to mandatory labeling for the four major appliances (room air conditioner, frost free refrigerator, transformers and TFL). With parallel outreach efforts towards building consumer awareness, the market responded positively with a significant increase in efficient products and created a conducive environment for labeled products as it provided a win-win situation to the manufacturers and consumers. BEE's star label is well recognized by consumers who benefitted from reduced electricity bills and established a demand for efficient products, while the manufacturers benefitted from the increased demand for efficient products and competitiveness.

Since the introduction of the mandatory program, the average share of the products registered under the mandatory phase is 87% while the voluntary segment is limited to 13% from 2011-2017 (see Figure 3). The overall label products registered with BEE in 2007-08 were close to 40 million and exponentially increased to 136 million in 2016-17. A total of 1,029 million household products/appliances in 21 categories have been registered by 2016-17.

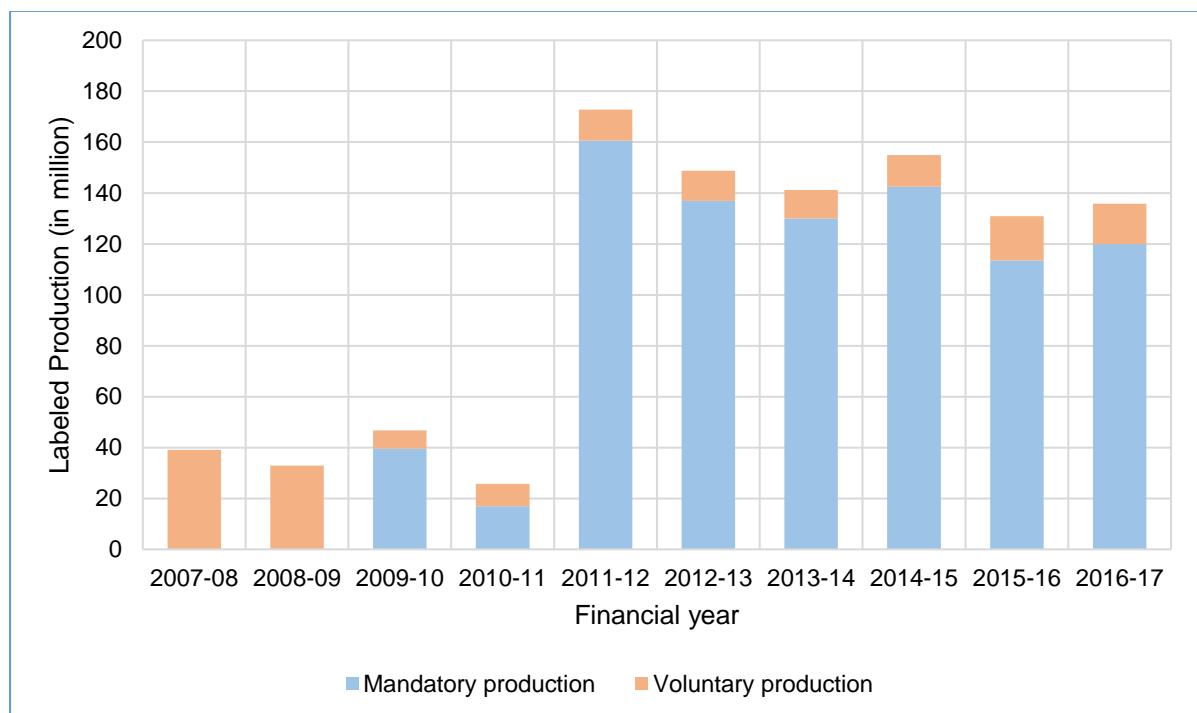


Figure 3: Mandatory and Voluntary Share of Overall Labeled Products, 2007- 2016

Source: Bureau of Energy Efficiency

MEPS Improvement of Mandatory Products

To keep pace with technological advancements and the best available products internationally, BEE revises the energy performance levels of products under both mandatory and voluntary phases on a regular basis. Several aspects like market growth, penetration of higher efficiency levels, and availability of best technologies are considered when ratcheting up the energy performance levels at periodic intervals.

As shown in Figure 4, the minimum energy performance standards (MEPS) of various appliances were made more stringent since their introduction into the labeling program. MEPS of frost-free refrigerators were improved by almost 60%, followed by direct cool refrigerators by 49%, color televisions and electric geysers by 40% each, room air conditioners by 35% and transformers by 33%. The lowest MEPS improvement is seen in the case of TFLs, which increased by only 7%. These revisions are transforming the market towards more efficient technologies and super-efficient products; for example, in case of air conditioners and refrigerators, the market shifted toward variable speed compressors. These are discussed in the next section.

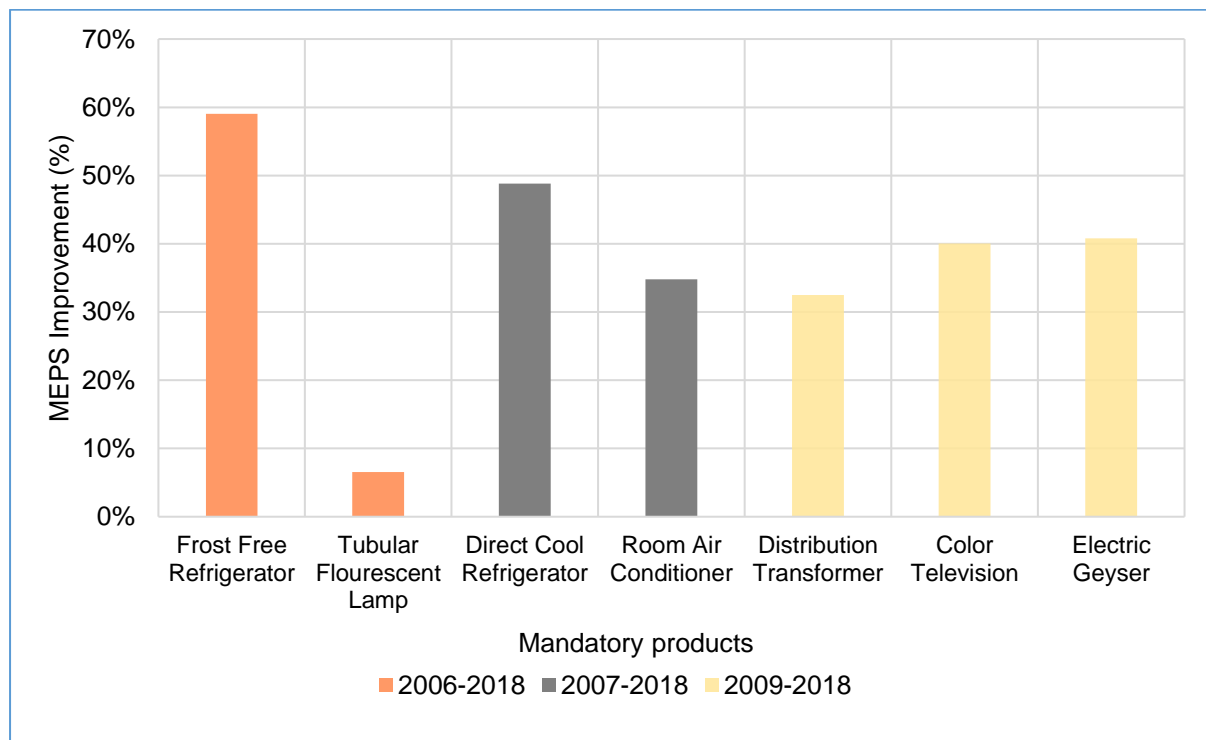


Figure 4: MEPS Improvement of Mandatory Products, from 2006- 2018

Source: Bureau of Energy Efficiency

Market Transformation Towards More Efficient appliances from mandatory policies

(a) Room Air Conditioner labeling program

Earlier considered a luxury product, the number of RACs is increasing rapidly due to extremely high ambient temperatures and rising incomes and standards of living. The annual sales of RACs in India have grown exponentially in the last 10 years, from 0.3 million in 2007 to 7.6 million in 2017. These trends have resulted in a rapid increase in electricity demand and energy consumption in the commercial and residential sectors.

Launched under a voluntary labeling program in 2006, and made mandatory in 2009, BEE revised the energy performance thresholds for RACs on a biennial basis from 2010 - 2018. These improvements in stringency have resulted in substantial efficiency improvement of 35% to the minimum energy performance standards for split units, the most popular RACs. In 2015 BEE launched a voluntary labelling program for inverter RACs, and made the program mandatory in January, 2018.

The production-weighted average EER/ISEER of RACs has increased from 2.8 in 2011-12 to 3.70 in 2017-18, which represents a 32% increase in efficiency due to tightening of standards and further introduction of a labeling program for variable speed RACs in 2015. These market transformations were possible due to mandating product category in the country and the high-efficiency products introduced to meet revised efficiency levels.

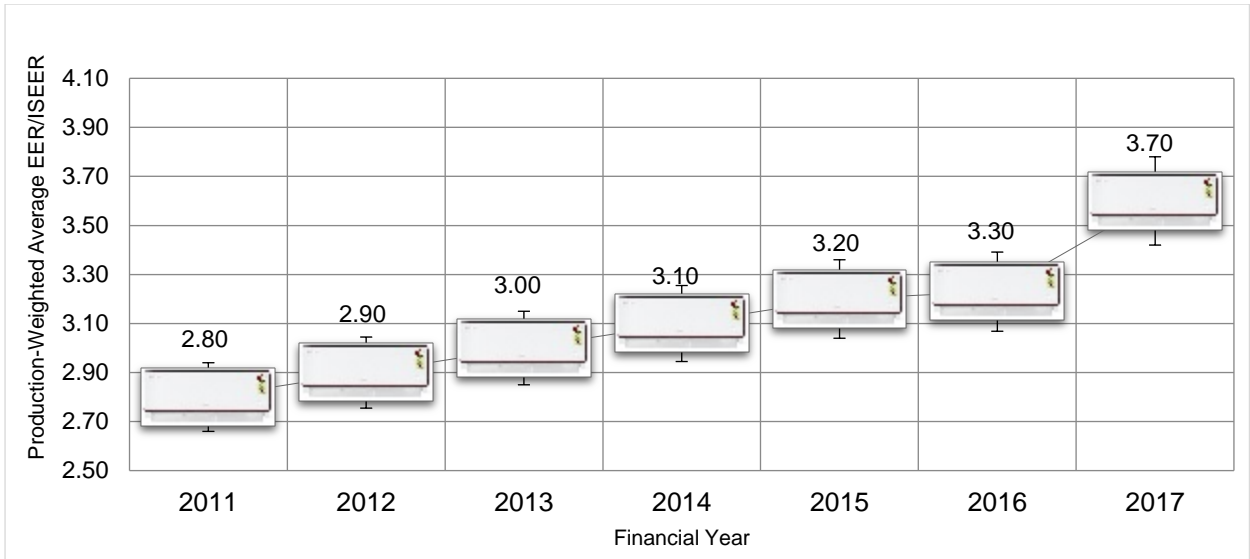


Figure 5: Production-Weighted Average EER/ISEER of RACs, 2011-2017

Source: Bureau of Energy Efficiency

(b) Refrigerator labeling program

Residential refrigerator is another appliance that witnessed rapid growth in last decade. The refrigerator market is divided into two segments: direct cool (DC) and frost free (FF). The overall market for refrigerators was 2.8 million in 2007-08 and increased to 12 million in 2017-18, with direct cool refrigerators representing 80% of the market.

BEE launched the voluntary labeling program of these refrigerators separately: frost free refrigerators in 2006 and direct cool refrigerators in 2007. Looking at the energy saving potential in the cooling segment, frost free refrigerators were brought under the mandatory phase in 2009. The market volume of direct cool refrigerator was growing exponentially and the program was made mandatory in 2016. BEE revised the energy performance levels of refrigerators on a regular basis, which resulted in increase in minimum energy performance standards by about 60% for frost free and close to 50% for direct cool type.

The average annual energy saving by each refrigerator (frost free) has increased from 595 kWh in 2011-12 to 764 kWh in 2017-18. In case of direct cool type, similar progressive trend is observed with 373 kWh in 2011 -12 to 445 kWh in 2017-18. These represents a 28% increase in market average energy saving in frost free and 19% in direct cool type since 2011.

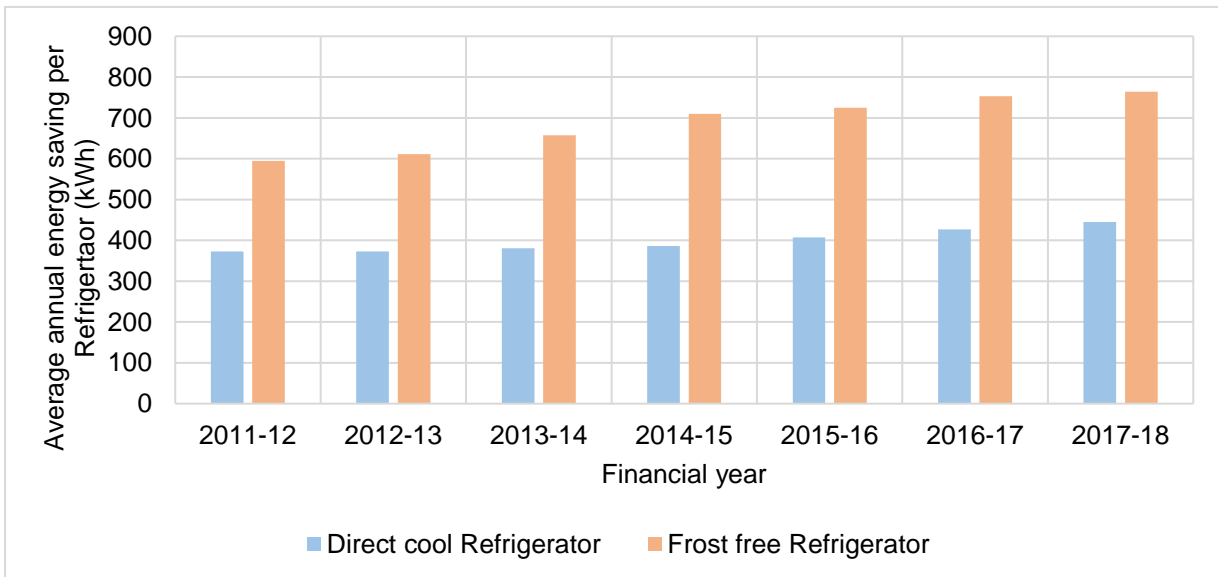


Figure 6: Average Annual Energy Saving in Refrigerators, 2011-2017

Source: Bureau of Energy Efficiency

Products Share in Labeling Program

In 2016-17, the overall production registered under the labeling program was close to 136 million for 21 product categories, in which 88% of registrations were recorded for mandatory segments for eight products. As shown in Figure 7, majority shares were seen in TFL lights (72%), followed by cooling appliances like FF and DC refrigerators (8%) combined, RAC (fixed speed) 4%, and 2% share for televisions and electric geyser each. In comparison, only 12% of voluntary products were registered for LED lamps and ceiling fans together. This clearly indicates that the mandatory regulations for individual appliance played a key role in transforming the marketing and achieving higher penetration of energy efficient products.

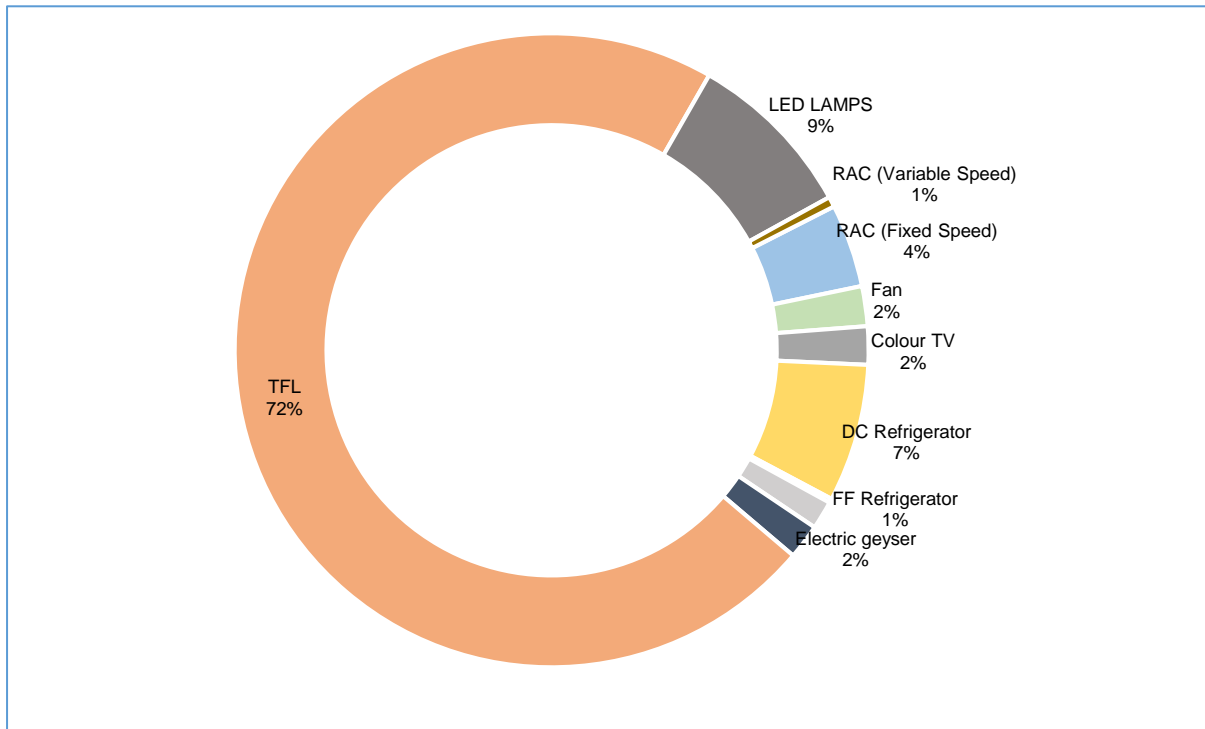


Figure 7: Products Share in Labeling Program, 2016

Source: Bureau of Energy Efficiency

Models Registration for Labeling Program

The number of models registered under the labeling program with BEE, for each product category, has increased substantially. In 2010-11, the overall models registered for 10 product categories were 8,502. While in 2016-17, the overall models registered for 21 product categories increased to 14,209, of which 44% accounted for mandatory segment (that is room air conditioner, refrigerators, geyser, transformer, television) and 56% for voluntary products (for Pumpset, LED lamps, ceiling fans and domestic LPG stove etc), as seen in Figure 8.

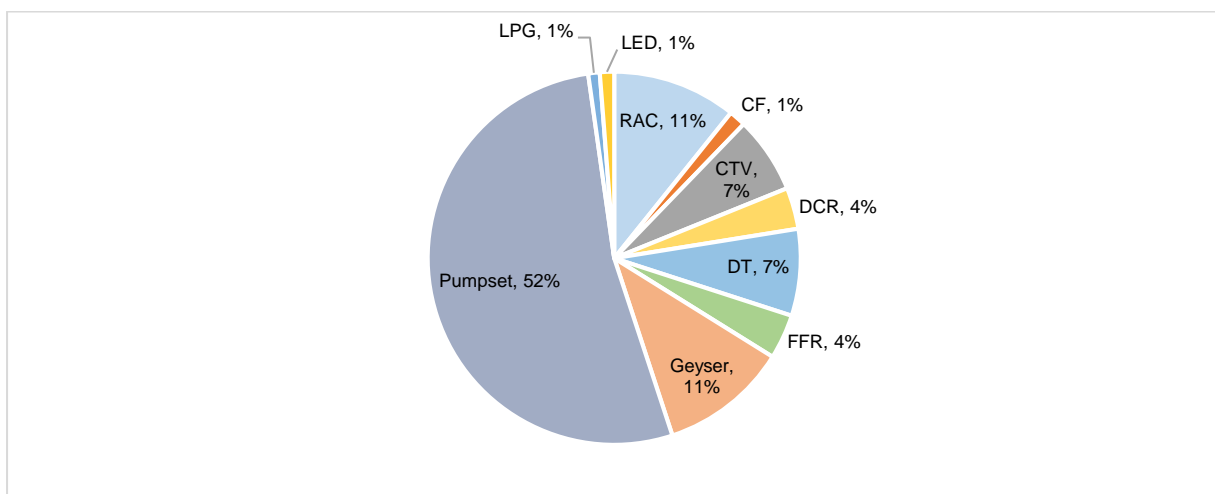


Figure 8: Segmentation of Models Registered for Labeling Program, 2016

Source: Bureau of Energy Efficiency

Impact of Labeling Program

Energy saving and Emission reduction

BEE estimates the actual energy saving attributable to S&L program by factoring in verified annual/quarterly productions for all equipment/appliances models produced by the manufacturers registered with it and actual energy consumption, annual hours of usage and accounting the average life of each appliance. This energy saving approach is adopted for mandatory & voluntary households' appliances/equipment.

The baseline energy performance level for each appliance is established with following criteria:

- Minimum efficiency levels at the time of launch of appliance are used in case of appliance where energy performance parameters have been defined for each star level without any variable function. (example: Air Conditioner etc, where minimum level is fixed, which is 1-star)
- Minimum efficiency levels for the variable factor (at the time of launch of appliance) are used in case of appliance where energy performance parameters have been defined for each star level with any variable function. (example: Refrigerator, Transformers etc, where minimum level is based on capacity)

Energy Savings Calculation Procedure

$$\text{Annual Energy Savings}_{(\text{Appliance Name})} = (\text{Baseline Value} - \text{Actual Value}) \times \text{Production} \times \text{Operation Usage} \times (1 - \text{T\&D Losses})$$

For Operation Usage of each appliance

In Billion Units

Since the inception of S&L program, 197 TWh of electricity has been saved by 2016-17 [9], with the equivalent carbon emission reduction of 162 Million tons CO₂. The majority share of 89% of energy savings accrued is from products under the mandatory labeling, whereas in share of 11 % is constituted by energy savings from products under the voluntary program (see figure 9).

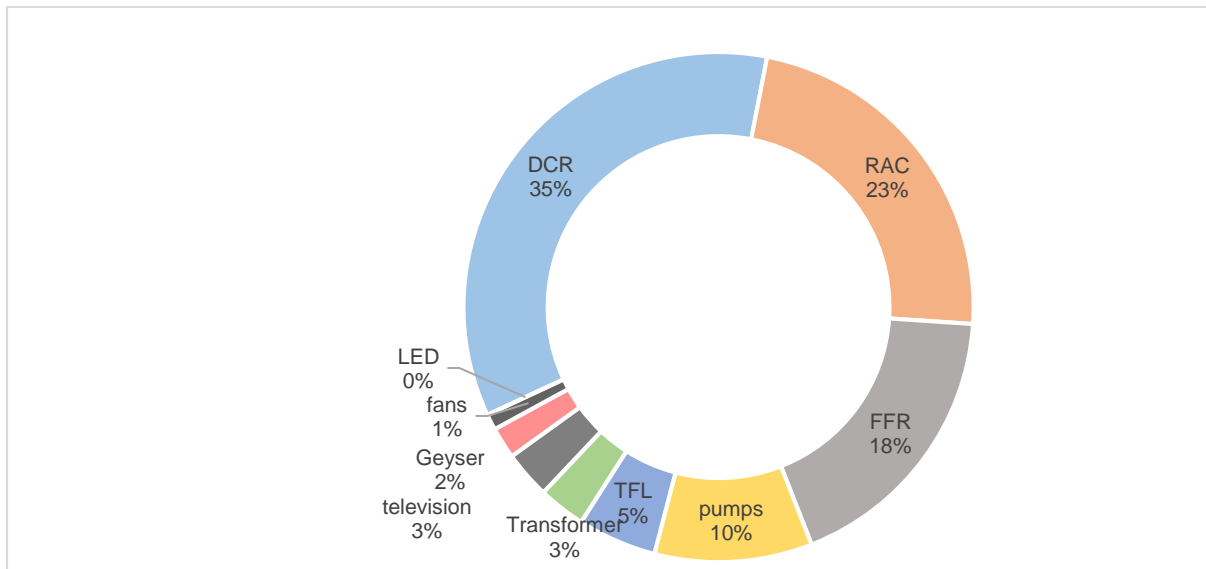


Figure 9: Percentage of Products Energy Saved Since Inception of Program

Source: Bureau of Energy Efficiency

Conclusions and Recommendations

Household appliances in India is set to exhibit steady growth resulting in increasing demand for electricity. The appliance energy efficiency policy, as evidenced by the results presented in this paper, is one of the most important instruments to curtail the growing demand as well as drive the demand for end use appliances over the period.

The S&L program in India has come to be considered as BEE's 'flagship' program and has been instrumental in transforming the market towards efficient appliances. Considering the growth trajectory, it is vital to increase the energy efficiency performance of the appliances and equipment as well as coverage of the labeling program. The analysis and data show that voluntary phase prepares the market to respond to the energy performance parameters and transitioning to the mandatory phase helps to transform the market towards high efficient products and catalyse technological improvements. While the efficiency improvements in some appliances such as refrigerators, color television, electric water heater, room air conditioner and transformer has been very aggressive, there is a huge potential for efficiency improvements in agricultural pumps and ceiling fans. In addition, the products in the voluntary phase such as agricultural pumps, induction motor, domestic LPG stove, etc should be transitioned to the mandatory labeling program in order to realize the huge potential of energy saving resulting from these policy measures.

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