

**Verified Energy Savings Related  
with the Activities of  
“Bureau of Energy Efficiency”  
for the year 2008-09**

**BUREAU OF ENERGY EFFICIENCY**



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**National Productivity Council**

**Lodhi Road, New Delhi**

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D. Pawan Kumar  
Group Head  
(Energy Management)  
for, Director General

### TEAM:

Shri T. Sankara Narayanan, Director, B.P. Bhandary Dy. Director  
EM Group, NPC Mumbai.

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**SUMMARY OF VERIFIED ENERGY SAVINGS RELATED WITH  
ACTIVITIES OF “BUREAU OF ENERGY EFFICIENCY”  
FOR THE YEAR 2008-09**

**Electrical Savings**

Programme	BEE		NPC	
	Electricity Saved (MU)	Avoided Generation (MW)	Electricity Saved (MU)	Avoided Generation (MW)
Standard & Labeling	2106.16	567.63	2106.16	599.44
Industry EC Awards	1633.25	239	1633.25	239
Energy Savings - SDA	2807.05	667	2755.48	660.43
ECBC - Green Buildings	33.36	7	33.36	6.1
<b>Total:</b>	<b>6759.82</b>	<b>1480.63</b>	<b>6528.15</b>	<b>1504.97</b>

**Fuel Oil Savings**

Programme	As per BEE (Million MTOE)			As per NPC (Million MTOE)		
	Electrical	Thermal	Total	Electrical	Thermal	Total
Standard & Labeling	0.717	0.0	0.917	0.57	0.0	0.57
Industry EC Awards	0.44	2.20	2.64	0.44	2.20	2.64
Energy Savings - SDA	0.96	1.01	1.82	0.75	1.01	1.76
ECBC - Green Buildings	0.011	0.0	0.01	0.01	0.0	0.01
<b>Total:</b>	<b>2.13</b>	<b>3.21</b>	<b>5.34</b>	<b>1.77</b>	<b>3.21</b>	<b>4.98</b>

## **1.0 Introduction**

- 1.1 The economic development of a country is often closely linked to its consumption of energy. Although India ranks sixth in the world so far as total energy consumption is concerned. It still needs much more energy to keep pace with its development objectives. India's projected economic growth rate is slated at 7.4 % in the period 1997-2012. This would necessitate commensurate growth in the requirement of commercial energy, most of which is expected to be from fossil fuels and electricity. India's proven coal reserves may last for more than 200 years, but the limited known oil and natural gas reserves may last only 18 and 26 years respectively, which is a cause of concern. The continued trend of increasing share of petroleum fuels in the consumption of commercial energy will lead to more dependence on imports and energy insecurity.
- 1.2 Therefore, a paradigm shift in approach to energy policy issues is needed - a shift from a supply dominated approach to an integrated approach incorporating a judicious mix of investment in supply side capacity, operational efficiency improvement of existing power generating stations, reduction of losses in transmission and distribution, end-use efficiency and renewable technologies. The policy goals and concepts will have to be shifted from energy conservation to energy efficiency, and from energy inputs to the effectiveness of energy use and energy services.
- 1.3 Recognizing the importance and benefits of energy efficiency, the government of India has enacted the Energy Conservation Act, 2001 which has come into force from 1st march, 2002.

- 1.4 Under the provisions of the Act, Bureau of energy Efficiency has been established with effect from 1st march, 2002 by merging the erstwhile Energy Management Centre of Ministry of Power. The Bureau would be responsible for spearheading the improvement of energy efficiency of the economy through various regulatory and promotional instruments.
  
- 1.5 The mission of Bureau of Energy Efficiency (BEE) is to institutionalize energy efficiency services, promote energy efficiency delivery mechanisms, and provide leadership to improvement of energy efficiency in all sector of the economy. The esteemed management of the BEE, New Delhi had reposed confidence in the National Productivity Council (NPC) and consequently requested NPC to undertake “Verification of Energy Savings related to the activities of Bureau of Energy Efficiency” spread throughout the country.

## **2.0 Methodology**

### **2.1 Review of Documentation**

To assess the energy savings achieved through the different programmes of BEE, the following documents were reviewed and analysed.

- Standard & Labeling – Basis for energy saving calculation due to star labeled products and sales data of Air-conditioners, Refrigerators, Tube Lights & Distribution Transformers from reputed manufacturers.
- State Designated Agencies – Data collected by SDAs under different programmes.
- ECBC – Energy savings achieved in Green Buildings.

### **2.2 Review of BEE Methodology**

The methodologies adopted by BEE/SDA for the calculation of energy savings in the different programmes were reviewed and necessary corrections were made where necessary.

### **2.3 Visits to Stake Holders**

For the data verification from the various stake holders, visits were made to select stake holders. Data and back up calculations were analyzed and necessary corrections were made in the energy saving calculations.

### **2.4 Conclusion**

After review of the methodologies adopted by BEE and analysis of data, necessary corrections were incorporated for evaluating Energy Savings. The same is highlighted in this report.

### **3.0 About BEE Schemes**

**3.1** The major schemes that Bureau of Energy Efficiency is implementing during XI plan are:

- (a) **Bachat Lamp Yojana** to promote energy efficient and high quality CFLs as replacement for incandescent bulbs in households.
- (b) **Standards & Labeling Scheme** targets high energy end use equipments and appliances to lay down minimum energy performance standards.
- (c) **Energy Conservation Building Code (ECBC)** that sets minimum energy performance standards for new commercial buildings.
- (d) **Operationalising EC Act by Strengthening Institutional Capacity of State Designated Agencies (SDAs)**. The scheme seeks to build institutional capacity of the newly created SDAs to perform their regulatory, enforcement and facilitative functions in the respective states.

In addition, four more schemes are under consideration. They are:

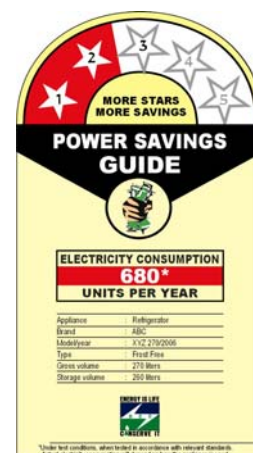
- (a) **Agricultural and Municipal DSM** targeting replacement inefficient pumpsets, street lighting, etc.
- (b) **Energy Efficiency in Small and Medium Enterprises** targeting 25 clusters
- (c) **Institutional Strengthening of BEE** and other related energy efficiency institutions
- (d) **Contribution to State Energy Conservation Fund.**

**3.2** The Standards and Labeling (S&L) Programme have resulted in electricity saving of 2106.16 million units, equivalent to avoided capacity generation of 599.44 MW.

- 3.3 The National Energy Conservation Award Programme has resulted in electricity saving of 1633.25 Million units, equivalent to avoided capacity generation of 239 MW. Apart from this, these programmes were able to reduce 2.20 Million MTOE of thermal energy.
- 3.4 The Energy Conservation & Demand Side Management (DSM) programmes at state level have resulted in electricity saving of 2755.48 Million units, equivalent to avoided capacity generation of 660.43 MW. Apart from this, these programmes were able to reduce thermal energy equivalent to 1.01 Million MTOE.
- 3.5 The ECBC programme has given a fillip for the construction of green buildings. During the current year about 11 green buildings (LEED rated) were in operation. The estimated energy savings in these buildings is about 33.36 Million Units, equivalent to avoided generation capacity of 6.1 MW.
- 3.6 During the year 2008 – 09, about 54 lac CFLs have been distributed in the state of Himmachal Pradesh between Nov.'08 and March '09. The estimated energy savings due to the same is 40.7 MU (up to 15<sup>th</sup> March '09) and the avoided generation capacity is 164 MW. This programme is likely to be extended to all the other states in the near future.

## 4.0 STANDARD & LABELING (S & L)

The standards and labeling programme was launched in May, 2006 on voluntary basis for Air Conditioners, Refrigerators and Tube lights. To widen the scope for energy savings, BEE has included several widely used equipments & appliances such as Distribution Transformers, Motors, Colour TVs, Ceiling Fans, Geysers, LPG Stove and Agricultural Pumps under S&L programme in 2008-09.



### 4.1 AIR CONDITIONERS

In order to estimate the savings of electricity from star labeled Air-



conditioners, following methodology has been used:

#### ◆ BEE Methodology:

- The actual number of products manufactured in each Star category was taken from manufacturers
- The Energy Efficiency Ratio (EER) has been considered individually for all the products.
- The Star 0 (EER – 2.2) has been used as baseline for the calculation of Energy Savings due to the star rated products.
- Total Power Savings is the product of Savings by single product (With Average EER) in each star category and the total number of products sold
- An average of 150 working days in a year was considered.
- An average of 8 working hours in a day was considered.

Table 4.1: Energy savings by Star labeled Air Conditioners

Category	Total BEE labeled AC's Sale (2008-09)	Total Energy Saving of all BEE labeled AC's in 2008-09 (MU)	Avoided Capacity in MW	
			As per BEE	As per NPC
1 Star	94988	38.96	17.67	14.56
2 Star	370531	177.47	158.9	158.9
3 Star	162848	122.59	105.08	105.08
4 Star	21823	25.69	22.23	22.30
5 Star	5937	4.2	4.64	4.64
<b>Total</b>	<b>656127</b>	<b>368.90</b>	<b>308.53</b>	<b>305.47</b>

- ◆ The estimated energy savings due to star labeled Air-conditioner is 368.9 MU. The corresponding reduction in avoided generation capacity is 305.47 MW.
- ◆ The variation in estimated MW savings in Star 1 and Star 4 labeled products is due to the difference in the number of products considered by BEE / NPC. The variation in the number of Star labeled products considered for energy savings by BEE & NPC is given in Table 4.2.

Table 4.2: No. of Star labeled Air-conditioners considered

Sl. No.	Rating	Capacity	Sales data considered	
			By BEE	By NPC
1	1 Star	1.5 TR	83803	64904
2	4 Star	2.0 TR	8319	8369

## 4.2 Refrigerators

In order to estimate the savings of electricity due to star labeled refrigerators, following methodology has been used:

### ◆ BEE & NPC Methodology:

- The actual number of products sold in each Star category was taken from manufacturers
- Yearly Energy Consumption has been considered individually for all the products sold
- The energy consumption in Star 1 has been used as baseline for the calculation for Energy Savings by other star rated refrigerators.
- Total Power Savings is the sum of Power Savings from all the individual products sold. The details are summarized in Table 4.3.

Table 4.3: Energy savings by Star labeled Refrigerators

Star Rating	Total BEE labeled sold (2008-09)	Total Energy Saving by all BEE labeled Refrigerators, MU (2008-09)	Avoided Capacity in MW
1 Star	0	0	0
2 Star	4659	0.76	0.10
3 Star	604046	176.41	18.77
4 Star	3646241	1395.26	146.85
5 Star	58955	30.27	3.17
<b>Total:</b>	<b>4313901</b>	<b>1602.70</b>	<b>168.89</b>

- ◆ The estimated energy savings due to star labeled refrigerators is 1602.70 Million units of electricity. The corresponding reduction in avoided generation capacity will be 168.89 MW.

### **4.3 Fluorescent Tube Lights (FTLs)**

In order to estimate the savings of electricity from FTLs, the penetration of Star Labeled 36W Fluorescent Tube Lights (FTLs) were considered. Data from the manufacturers were collected for 36 W FTL sold. In the year 2008-09, 27.94 Million 36W Tube lights were sold in comparison to 70.83 Million 40W tube lights. Thus there was electricity savings of 4W per FTL for 1200 hours of operation in the year. The estimated energy savings is about 134 Million units.

- ◆ The estimated avoided generation capacity as per BEE is 90 MW, considering a coincidence factor of 0.5. However, as the lighting requirement during evening peak hours will have a coincidence factor of 1.0, the average coincidence factor considered by NPC is 0.7 resulting in avoided generation capacity of 125 MW.

### **4.4 Distribution Transformers (DTRs)**

The Standards & Labeling programme of BEE has also included Distribution Transformers in 2008-09. Distribution Transformer is one of the primary electrical equipment used in large quantities by all the electricity distribution companies. Energy efficiency improvement in these transformers will have a significant impact in reducing distribution losses. The energy savings by Star labeled transformers is estimated based on losses in Star 1 rated transformers at 80% loading.

It may be appreciated that the loading on the DTRs varies widely during the day with maximum loading @ 80% occurring mostly during evening peak periods. Therefore for a more realistic saving estimation, the average loading on the DTRs is considered @ 50% on 24 hour basis. The estimated savings are given in Table 4.4.

Table 4.4: Energy savings by Star labeled DTRs

Rating in KVA	Total No. of BEE Labeled Transformers Sold	Total Energy Saving Kwh / Yr.	
		As per BEE	As per NPC
16	0	0	0
25	200	158381	140160
63	298	361813	287153
100	24	42132	37843
160	0	0	0
200	0	0	0
<b>Total</b>	<b>522</b>	<b>562325</b>	<b>465156</b>

The estimated annual energy savings due to star labeled DTRs is 0.46 MU and the corresponding avoided generation capacity is 0.08 MW.

#### 4.5 Overall S & L Programme

The Standards and Labeling (S&L) Programme has resulted in electricity saving of 2106.16 Million units, equivalent to avoided capacity generation of 599.44.4 MW. Details are shown in Table 4.7

Table 4.5: Energy Saving and Avoided Generation Capacity

Item Reference	Units	AC	Refrigerators	FTLs	DTRs	Total
Annual Electricity Saved	Million Units	368.9	1602.7	134.0	0.46	<b>2106.16</b>
Avoided Electricity Generation	MW	305.47	168.89	125.0	0.08	<b>599.44</b>
Equivalent Fuel Saved	MTOE	100230	435454	36408	125	<b>572217</b>

#### 4.6 Avoided Generation Capacity

The avoided generation capacity for Star label products are calculated based on the following:

$$\text{Avoided capacity at Generation end, MW} = \frac{\sum_{N=0.75T}^{2T-5\text{ Star}} \left[ \sum_{i=1} \{ \text{CLUS} - \text{CLi} \} \right] \times \text{CF}}{\text{PLF} \times (1 - \text{T\&D})}$$

- CLUS = Connected Load for Un-starred Product
- CLi = Connected Load for Star Labeled Products
- PLF = Plant Load Factor = 78%
- T & D = Transmission & Distribution Loss = 20%

It may be noted that the avoided generation capacity indicated is during peak load periods.

## **5.0 NATIONAL ENERGY CONSERVATION AWARDS SCHEME (NECA)**

Ministry of Power, through BEE, organizes the annual energy conservation awards function on the occasion of National Energy Conservation Day on 14<sup>th</sup> December. These awards recognize innovation and achievements in energy conservation by the Industry; Commercial Buildings, Railways and help raise awareness



Railways and help raise awareness about the need and efficacy of energy conservation and efficiency. The Hon'ble Minister of Power, Shri Sushil Kumar Shinde, presented the Awards to sixty seven (67) industrial units, buildings and Zonal Railways selected from 368 nominations received. The awards are recognition of the demonstrated commitment to energy conservation and efficiency.

### **5.1 Methodology Adopted**

- The award scheme is voluntary and participation is invited through a national announcement in the mass media. A template of filing the nominations has been prepared and the applicants are required to send the data in them.
- The nomination received by BEE are then evaluated for completeness and thereafter it is examined by an expert committee comprising of officers drawn from CEA, NPC, BIS, Industry Association, etc, under the overall supervision of BEE.
- The claim of the industry is verified by relevant documents, or if need be, by inspection.

- The recommendations of the technical committee are then considered by an inter-ministerial National Award Committee under the chairmanship of Secretary, Ministry of Power.

5.2 The estimated energy savings is based on the individual savings achieved by all the units participating in the National Energy Conservation Award Programme. Energy Savings from the award scheme is shown in Table 5.1.

Table 5.1: Energy Savings through National Energy Conservation Award

<b>Savings Achieved</b>	<b>2008-09</b>
In all the Sectors	1633.25 MU
Avoided Electricity Generation Capacity Addition	239 MW
Factor for Avoided Capacity*	$\frac{\text{Million Units} \times 1000}{365 \times 24 \times 0.78}$

\* As Industries are having HT service connection, the distribution loss is not considered for calculating avoided capacity.

## 6.0 ENERGY CONSERVATION BUILDING CODES (ECBC)

6.1 Energy Conservation Building Codes (ECBC) set minimum energy performance standards for commercial buildings. Under section 14 (p) of the Energy Conservation Act, 2001, Central Government has powers to prescribe ECBC for commercial buildings (at present having a connected load of 500 KW) or building complex for efficient use of energy and its conservation. The state governments have the flexibility to



modify ECBC to suit local or regional needs. The ECBC was launched by Hon'ble Minister of Power on 27th May, 2007 and is presently in vogue on voluntary basis. ECBC is expected to be made mandatory in future.

6.2 During the current year, 11 LEED Certified Green & ECBC compliant commercial buildings were in operation. The data on annual energy consumption and energy savings achieved in these buildings has been provided by CII. The details are given in Table 6.1.

Table 6.1: Energy Savings in Green/ECBC Compliant Buildings

Sl. No.	No. of Buildings	Energy Consumption (MU)	Energy Savings (MU)	Avoided Generation Capacity (MW)
1	11	55.63	33.36	6.1

6.3 To encourage adherence to ECBC code, BEE has supported the following activities in Government/Public Sector buildings.

- **Ministry of Health and Family Welfare** – Ministry of Health and Family Welfare is developing six AIIMS like institutions under the “Pradhan Mantri Swasthya Yojana”(PMSSY) scheme at Bhopal, Jodhpur, Rishikesh, Patna, Bhubanshewar and Raipur. These are being developed as ECBC compliant buildings. BEE is providing assistance to them through their empanelled ECBC expert architects.
- **NTPC** - BEE is providing assistance to NTPC for their Administrative cum Lab Building of Energy Technologies at Greater Noida for being compliant to ECBC. The expert architect is providing suggestions on their existing plans for building envelope, electrical systems, HVAC and lighting to meet with the code requirement to the extent possible.

## **7.0 ENERGY SAVINGS - STATE DESIGNATED AGENCIES**

- 7.1 The Energy Conservation Act was enacted in 2001 to spearhead the improvement in energy efficiency of the economy through various promotional and regulatory measures. State Designated Agencies (SDAs) are statutory bodies set up under section 15 of the Energy Conservation Act (EC Act), 2001 at the state level to implement the Act. They are the nodal agencies at state level that need to coordinate and cooperate with BEE at the central level to ensure a balanced implementation of the Act in the country. Although no direct energy saving target has been put for the central scheme for building capacity of SDAs, they have been encouraged to take up energy efficiency projects with due monitoring and verification. The action plan of SDAs prepared is a step in this direction.
- 7.2 In order to strengthen the SDAs in Energy Efficiency programmes BEE has formulated a procedure for providing assistance to the SDAs during the financial year 2007-08 based on 19 point deliverables prepared for the SDAs. The 19 point deliverables also forms the basis for preparation of the comprehensive Five year Action Plan. About 14 SDAs have submitted the avoided capacity addition due to implementation of energy efficiency measures. The avoided capacity addition is based on only those which are achieved through implementation of energy efficiency measures and not those achieved through renewables like biomass, biofuel or biogas.

7.3 As directed by BEE, NPC visited/collected details from the following SDAs to review the Energy Efficiency activities carried out at the state level. The data provided by the SDAs to BEE was verified and the observations are highlighted below.

**7.3.1 Chhattisgarh State Renewable Energy Development Agency (CREDA)**

The major energy savings achieved in the state of Chhattisgarh is by power generation through waste heat recovery in Sponge Iron plant and other steel industries. CREDA has compiled district wise data on energy saved in these industries and submitted the same to BEE. The savings considered by BEE are in order.

**7.3.2 Energy Management Centre (EMC), Kerala**

The Energy Management Centre at Kerala has initiated Energy Conservation Award (EC Award) scheme for different category of energy users in the state. During the year 2008 – 09, the state level EC Award was given in 13 categories on 14<sup>th</sup> December 2008. A total of 120 organisations / Individuals participated in the awards programme. The energy savings reported by the participating industries is 29.68 MU.

To promote energy conservation in domestic sector EMC has initiated a novel campaign christened SAVE by inducting school students for residential Energy Audits/Conservation. The programme was supported by Malayala Manorama, a leading daily of Kerala with a circulation of about 17 lakhs prints per day. The impact of the programme was monitored in 1650 residences and the energy

savings was estimated for a total of 6.73 lakh residential units in the state. The estimated savings through SAVE campaign is 276 MU corresponding to 50.6 MW of avoided generation capacity.

### **7.3.3 Maharashtra Energy Development Agency (MEDA)**

The Maharashtra Energy Development Agency has been giving Energy Conservation Award (EC Award) under different categories for the last 5 years. During the year 2008 – 09, the state level EC Award was given in 11 categories on 4<sup>th</sup> July 2009. A total of 112 organisations / Individuals participated in the awards programme. The energy savings reported by the participating industries is 743 MU.

### **7.3.4 Electrical Inspectorate Department, Government of Tamil Nadu**

The Electrical Inspectorate Department is monitoring the Energy Conservation activities in the state of Tamil Nadu. The energy savings achieved by 15 Industrial units during the year 2007 – 08 is reported at 32.08 MU. The corresponding avoided generation capacity is 5.86 MW.

### **7.3.5 Madhya Pradesh Urja Vikas Nigam Limited (MPUVNL)**

MPUVNL has initiated energy conservation programmes in Industries & Buildings. The energy savings achieved is in the order of 10.71 MU corresponding to an avoided generation capacity of 1.76 MW.

### **7.3.6 Himachal Pradesh State Electricity Board, HP**

As part of demand side management programme Himachal Pradesh State Electricity Board has taken up one of the largest energy efficiency programme through the distribution of Compact Fluorescent Lamps to domestic consumers. HPSEB has distributed 546906 CFL lamps from the period 23<sup>rd</sup> November 2008 to 1<sup>st</sup> March 2009. The estimated annual energy savings is 40.7 MU for the above period. The estimated reduction in avoided peak generation capacity is 164 MW.

7.4 In addition to Energy Savings – SDA's National Energy Conservation Awards, state level awards are also being given by atleast 3 SDAs. It is observed that about 70 to 100 units are participating in these award programmes in each State. It is further noted that the energy savings report prepared by BEE considers only energy savings achieved by Industries participating in the National Awards programme. It is our considered opinion that the energy savings achieved by units participating at state level but not at the National level, should also be considered for the assessment of energy savings. This would require preparing a comprehensive list by BEE of all the units participating in both State and National level programmes along with the energy savings achieved.

7.5 It may be mentioned here that most of the designated consumers as per EC Act at state level have been identified. It would be desirable to prepare a separate list of designated consumers participating in National & State level Energy Conservation Awards programme. Further, with e-filing of energy data, the energy savings achieved by all the designated consumers, who have not participated in EC Awards would be available, which should also be considered in the overall energy savings.

- 7.6 It is observed that some of the SDA's convert thermal energy savings into electrical units. The SDA's have been advised to calculate electrical savings in electrical units alone and all thermal energy savings in terms of tons of oil equivalent (MTOE).

## Conversion Factors

S. No	Item Reference	Equivalent to
1	1 kWh	860 kCal
2	1 TR	3024 kCal/hr
4	1 CFM	1.697 m <sup>3</sup> /hr
5	1 kg/cm <sup>2</sup>	98.08 kPa
6	1 kg/cm <sup>2</sup>	10 mWC
7	1 BTU	0.252 kCal
8	1 kCal	4.179 kJ

## Abbreviations

S & L	Standard & Labeling
AC	Air Conditioning
TR	Ton of Refrigeration
EER	Energy Efficiency Ratio
FTL	Fluorescent Tube Light
CFL	Compact Fluorescent Lamp
DTR	Distribution Transformers
KWh	Kilo Watt Hour (Unit of Electricity)
MU	Million Units (Million kWh)
MW	Mega Watt
DSM	Demand Side Management
MTOE	Metric Tonnes of Oil Equivalent
Million MTOE	Million Metric Tonnes of Oil Equivalent
BEE	Bureau of Energy Efficiency
NPC	National Productivity Council
SDA	State Designated Agency