



Appliances Guide

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Energy efficient Colour Television

Country

India

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1 Subtypes and markets

Television in India has been in existence for about four decades. For the first 17 years, it spread haltingly and transmission was usually in black and white. It was on 15th September 1959 the Television in India began as an educational experiment, supported by the United Nations Educational Scientific and Cultural Organisation (UNESCO) and the Ford Foundation. Till 1991 there was only one television channel – *Doordarshan*, the public service broadcaster. With the opening up of the Indian economy in early 1990s, it enabled the entry of private broadcasters in India. The number of television channels has proliferated manifold since then (Rani, 2013). Nowadays, the companies are offering HD displays till the 90-inches range and UHD displays till 110-inches in size. With the increased choice of 1080p HD and now UHD or 4K TVs models (which offer four times the pixel resolution of 1080p displays) available in the market, choosing a TV screen size is tougher than ever.

Televisions can be categorised into three segments depending upon the size (Bijli Bachao Team):

- 1. Small sized (22 inches or lesser):** Televisions having screen size of 22 inches or less are offered in CRTs, LCDs and LEDs. CRTs are much cheaper compared to LED or LCD TVs in terms of cost, although their production has been nearly stopped. However, from the power consumption point of view, LED TVs are most efficient of the lot as they roughly consume one-third of the power used up by a CRT TV for similar dimensions.
- 2. Medium-sized (22 inches to 40 inches):** In this category, buyers have two choices: LED television or LCD television. Although both the LED and LCD television look similar, the internal backlight technology in both of these is quite different. LEDs consume at least 30% less energy as compared to traditional LCDs with Cold Cathode Fluorescent Lamps (CCFL). Most of the LCDs are HD Ready and almost all the LEDs are Full HD. In terms of energy consumption, LED with Full HD consumes less energy compared to a same size HD Ready LCD model. A typical 32-inch LCD would consume about 95-150 Watts, whereas a same size LED would consume only about 55-100 Watts (comparing both HD Ready models).
- 3. Large-sized (size greater than 40 inches):** There are two choices in this category: Plasma TV and LED TV. Plasma TVs consume 30-40% more energy than LED TVs and for this size group, the average plasma TV consumes as much as 500 to 600 Watts (for large TVs). The best of LED TVs in this category consume about 70-80 Watts while comparable sized best plasma TVs would consume about 140 Watts. In terms of cost LED TVs were much more expensive than plasma TVs around 2010 when LEDs were relatively new technology compared to plasma

technology. However, new plasma TVs are not available in the market except for in the resale segment.

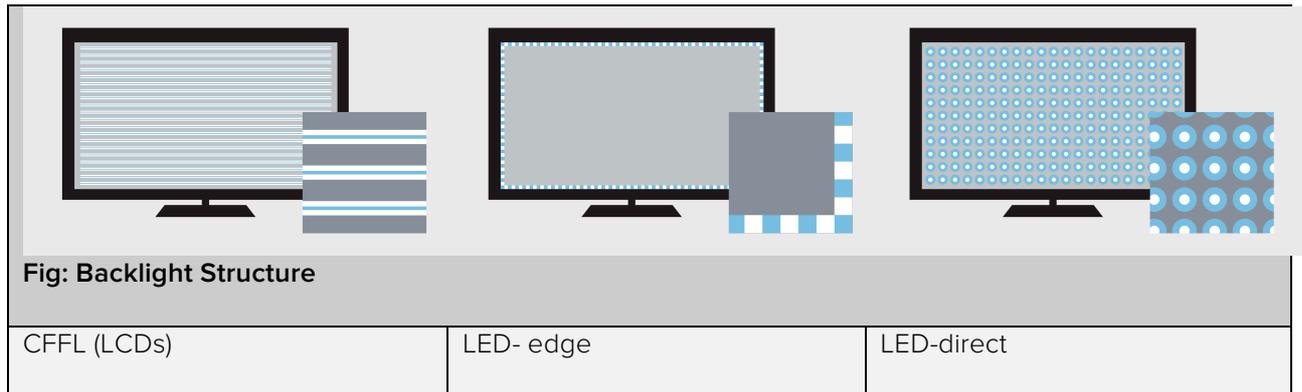
Various technologies available in the market are as follows (including models whose production is now discontinued but still available in the market as used ones):

- **CRT (Cathode Ray Tube) TV:** These are out-dated box type televisions that have been in use since 1960s. CRT television sets are bulky and consume high amount of electricity compared to all other models. However, they are very consistent and have a long life with proper maintenance. One of the key benefits of CRT televisions is that the image quality does not decrease with the viewing angle. Their manufacturing has been nearly discontinued.
- **PDP (Plasma Display Panel) TV:** A plasma television has a large screen size typically ranging from 45-inches to 60-inches and uses plasma-ionized gas to display images. They have brilliant picture quality irrespective of ambient light and are thin in appearance just like a basic LCD or LED televisions. Due to advancement in LED and LCD display technologies manufacturers have discontinued manufacturing plasma TVs.
- **LCD (Liquid Crystal Display) TV.** Liquid Crystal Display or LCD uses complex technology of liquid crystals and Cold Cathode Fluorescent Lamps (CCFL) to project images on the screen. These TV sets are sleek, lightweight, and can be wall mounted.
- **LED (Light Emitting Diode) LCD TV:** These television sets use Light Emitting Diode (LED) as a light source instead Cold Cathode Fluorescent Lamps (CCFL) used in traditional LCD TVs. This results in a picture quality, which is comparable to plasma displays but at a much lesser cost. Just like CCFL LCD televisions, these TV sets can be mounted on walls. LED TV sets consume least amount of electricity compared to all other TV models.
- **OLED (Organic Light Emitting Diode) Displays:** This is a new display technology, which is still in research and development stage by most television manufacturers. The OLEDs are expected to be the display technology that will be opted as a substitute for LCD and LED technology in the future.

State of the art technologies involved in colour televisions: State of the art televisions (flat screen television) use Liquid Crystal Display panels for the screen of the television. However TVs can be separated into two categories known as LCDs and LEDs depending upon the backlight source used in the TV. The LCDs generally have Cold Cathode Fluorescent Lamps (CCFL) as the backlight source, whereas the LED TVs use Light Emitting Diode (LED) as the source for backlighting.

Backlight Structure:

LED-edge backlit TVs are expected to dominate the market because they offer more benefits for manufacturers and consumers in terms of cost, design, and energy consumption. LED-direct TV local dimming technology is more effective in reducing power than global dimming or partial dimming, but LED-edge TVs has an advantage over LED-direct TVs in resource use and manufacturing cost (Park W. Y., Phadke, Shah, & Letschert, 2011).



LED-edge backlighting usually consumes less power than LED-direct backlighting at maximum brightness level, while local dimming of LED-direct backlights is more effective than complete or line dimming of LED-edge backlights in power reduction at on-mode.

Although LEDs & LCDs are much brighter than PDP and CRT TVs, LCD TVs' overall efficiency is not greater in terms of change in luminance (cd/m^2) as light travels through the LCD. Assuming that the initial luminance from the backlight unit is 100%, the final luminance is about 4 to 6% of this initial luminance, largely because of the low transmittance of the LCD panel. If panel transmittance and efficiency of optical films improve, the backlight will not be required to produce such high maximum luminance levels. Such improvements would enable reduction of the number of backlight lamps, lowering power consumption.

Typical usage pattern

As per Bureau of Energy Efficiency (BEE) schedule 11 for colour television the daily usage pattern of 6 hours in 'On' mode and 12 hours in 'Standby' mode all through 365 days of the year. For remaining hours, device is considered as 'Switched Off'.

Current numbers for stock and market volumes

Post liberalization the country has seen consistent increase in the income of its citizens and this has led to a major shift in the purchasing power and behaviour of the people. Currently, there are a number of television brands and screen sizes in the market to choose from and this leaves the consumer often confused. There is a noticeable shift in the consumer's preference in favour of advanced, technologically superior branded products. The demand is driven by increasing consumer awareness and preference for latest models. This change is also because of the reduction of the price difference between the branded and non-branded consumer goods. Rivalry between different brands has compelled the companies to offer efficient after-sales service and support, what has influenced buyer's preference for the branded products. To overcome this confusion, most consumers select a brand on the basis of their preference and recognition of the brand in the market.

During the Financial Year 2008, volume share of all the sold appliances the single largest consumer durable was colour TVs at 34%, followed by refrigerators and air conditioners at 19% and 15% respectively. Washing machines and other assorted consumer durables captured a share in the total volume by 6% and 26% respectively (Vijayakumar, 2012). Till the year 2010 the total number of households that had colour television was 134 million (AIDEM, 2011).

The penetration rate in India is 179 television sets per 1,000 inhabitants, which when compared to the rest of the world is still quite low. The television market in India is expected to grow at a rate of 19% Compound Annual Growth Rate (CAGR) till 2016. In year 2010 the market size of TV in India was accounting to an amount of INR 297 billion (Singh, Lobo, & Karwa, 2014). Television sets were possessed by nearly 50% of rural households in 2011-12 compared to 26% in 2004-05, and by 80% of urban households in 2011-12 compared to 66% in 2004-05 (MOSPI, 2014).

In addition, there has been a tremendous growth in the number of cable & satellite subscriber households. The total revenue generated by the media and advertisement industry through television accounted to an average of INR 290 billion in the year of 2010 out of which the subscription of cable and satellite accounted for INR 187 billion and the rest of the amount of INR 103 billion was spawned by the advertisement market (FICCI-KPMG, 2015).

Market share differentiated according to the main types

The annual total TV shipments for India increased by about 29 % from 2007 to 2011, reaching to about 15.6 million units, which represent about 6.3 % of global TV shipments in 2011. The market share of plasma display panel (PDP) TVs has been less than 1 % of the market, and the shipment is expected to decrease to only 20,000 units (i.e., 0.1%of the market) in 2014. A large-scale global transition from CCFL-LCD TVs to LED-LCD TVs—which are colloquially referred to as “LED TVs” in India—is expected to occur between 2011 and 2015. LED backlights are expected to account for 100 % of the LCD TV market by 2020 (Park, Phadke, & Shah, 2014). As per 2016 the LED TVs have taken over the CRTs and all other technologies for the television. And the expected market future takeover would be done by OLEDs, once they come over the cost barrier and shorter life span.

By the year 2015 it is expected that LED backlight LCD TV will gain popularity and the market share will account around 92% of total TVs present in the stock, and of the CCFL type backlight LCD TV will decrease to 3% making a total market share for LCD TVs around 95% (Park, Phadke, & Shah, 2014).

2 Efficiency range and user savings

Table 1: Efficiency range and user savings of colour televisions

Level	Typical appliance in the stock (over all	Typical Inefficient appliance. If MEPS	Typical appliance purchased	Best Available Technology	Expected future BAT (Best not

	appliances in use)	is implemented: Appliance just complying to minimum requirement (MEPS)	today_(BAU – Business As Usual)	(BAT)	yet Available Technology)
Typical Capacity / Size¹	21 inches	21 inches	20 inches	32 inches	55 inches
Category	CRTs	CRTs	LCDs	LEDs	OLEDs
Type (Backlight Structure)	Cathode Ray Tube	Cathode Ray Tube	Cold Cathode fluorescent Lamp	Light Emitting Diodes	Organic Light Emitting Diodes
Lifetime²(Hours)	60,000	60,000	60,000	60,000	14,000
Qualitative classification of the provided service	<input type="checkbox"/> Poor <input checked="" type="checkbox"/> Low <input type="checkbox"/> Average <input type="checkbox"/> Good <input type="checkbox"/> Excellent <input type="checkbox"/> No information	<input type="checkbox"/> Poor <input checked="" type="checkbox"/> Low <input type="checkbox"/> Average <input type="checkbox"/> Good <input type="checkbox"/> Excellent <input type="checkbox"/> No information	<input type="checkbox"/> Poor <input type="checkbox"/> Low <input type="checkbox"/> Average <input checked="" type="checkbox"/> Good <input type="checkbox"/> Excellent <input type="checkbox"/> No information	<input type="checkbox"/> Poor <input type="checkbox"/> Low <input type="checkbox"/> Average <input type="checkbox"/> Good <input checked="" type="checkbox"/> Excellent <input type="checkbox"/> No information	<input type="checkbox"/> Poor <input type="checkbox"/> Low <input type="checkbox"/> Average <input type="checkbox"/> Good <input checked="" type="checkbox"/> Excellent <input type="checkbox"/> No information
Yearly energy consumption (kwh/Year)	215	208	124	273	164
Yearly energy cost (INR)	2,150	2,080	1,240	2,730	1,640

¹ (Park et al., 2011; pp 18)

² (Park et al., 2011, pp xvii).

Purchase cost in (INR)	7,000-9,000	7,000-9,000	5,000-10,000	13,000-35,000	Above 100,000
Labelling class (for the aforementioned labels)	No Star	1 Star	1 Star	5 Star	5 Star

3 Performance and information requirements

The Energy Conservation Act was legislated in year 2001. In the year 2002 the Bureau of Energy Efficiency (BEE) was established as the nodal central agency for the implementation and monitoring of the Act. The act empowered BEE and the central government to specify energy consumption standards, prohibiting the manufactures from selling or importing equipment that do not meet the energy consumption standards in India. The Standards & Labelling Program was launched in May, 2006. The main objective of the programme was to provide information to the consumer about the energy saving and cost saving potential of the household appliances and other equipment. Presently the Standard and Labelling scheme covers 21 appliances in India. Till the year 2016 only Frost Free Refrigerators, Tubular Fluorescent Lamps, and Room Air Conditioners (RAC)(Window and split type) were in the mandatory list, now the Direct Cool Refrigerator, Colour Television and RAC (Cassette, Floor Standing Tower, Ceiling, Corner AC), have also been added to the mandatory appliance category for the residential appliances, making 7 appliances come under the mandatory category and 14 in the voluntary category.

Annual Energy Consumption (E): Annual Energy consumption of the televisions shall be calculated using the following equation (Schedule No. 11 for Colour Television, Revision 6 Bureau of Energy Efficiency) (Bureau of Energy Efficiency , 2014):

$$\text{AEC}^3 (\text{E}) = (6 \times \text{Pa} + 12 \times \text{Ps}) \times 0.365 \text{ kWh/Year}$$

Where:

- **Pa:** On Mode power consumption in Watts
- **Ps:** Standby Mode power consumption in Watts

Star rating

The formula for determining the star rating (Energy Label) of Colour Television is shown below (Schedule No. 11 for Colour Television, Revision 6, Bureau of Energy Efficiency):

$$\text{E} = (\text{X} \times \text{A}) \times \text{Y}$$

Where:

- **E** (in kWh/year) = Annual Energy consumption
- **A** (in square inches) = the effective/viewable screen area calculated by multiplying the display/screen width by the display/screen height

³ This annual energy consumption is estimated based on a daily usage pattern of 6 hours in 'On' Mode and 12 hours in 'Standby' Mode and for remaining 6 hours, device is considered as 'Switched Off'.

- **X** (in kWh/year) = ON Mode power consumption in (W/sq.inch) x hours of operation in ‘**On Mode**’ x 365/1000
- **Y** (in kWh/year) = Standby Mode power consumption in W x hours of operation in ‘**Standby Mode**’ x 365/1000

Table 2: Star rating equations for Televisions (from January 01, 2016 to December 31, 2017)

	1 – Star	2 – Star	3 – Star	4 – Star	5 – Star
CRT	$E = (0.578 \times A) + 4.38$	$E = (0.526 \times A) + 4.38$	$E = (0.473 \times A) + 4.38$	$E = (0.421 \times A) + 4.38$	$E = (0.368 \times A) + 4.38$
LCD (with CCFL backlight) /	$E = (0.386 \times A) + 3.50$	$E = (0.350 \times A) + 3.50$	$E = (0.315 \times A) + 3.50$	$E = (0.280 \times A) + 3.50$	$E = (0.245 \times A) + 3.50$
LCD (with LED backlight)	$E = (0.193 \times A) + 2.63$	$E = (0.175 \times A) + 2.63$	$E = (0.158 \times A) + 2.63$	$E = (0.140 \times A) + 2.63$	$E = (0.123 \times A) + 2.63$

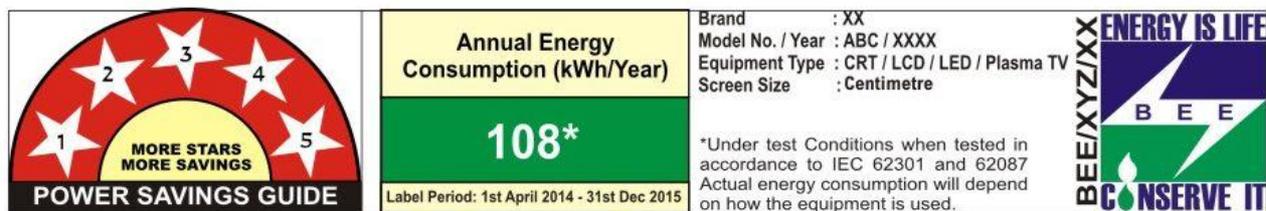


Figure 1: Sample star label for television

The star label for the colour television is shown above and this label has been designed after extensive research. Although the ‘number of stars’ are the main highlight, the labels also contain a number of other items. In general, a higher number of Stars indicates more efficient appliances. There are two kinds of labels – a big label and a smaller label version. For ceiling fans, tube-lights, computers/laptops and televisions the smaller labels like the one shown above are used while for refrigerators, air conditioners, geysers and washing machine the big labels are used.

Table 3: Star wise Annual Energy Consumption for preferred screen sizes and different screen types (From January 01, 2016 to December 31, 2017) (Bureau of Energy Efficiency , 2014)

Screen Size (inches)	Screen Area* (sq inches)	Maximum Annual Energy Consumption in kWh/Year														
		1-Star			2-Star			3-Star			4-Star			5-Star		
		CR T E =	LC D E =	LED E =	CR T E =	LC D E =	LED E =	CR T E =	LC D E =	LED E =	CR T E =	LC D E =	LED E =	CR T E =	LC D E =	LED E =
		(0.5 x A) + 4.38	(0.3 x A) + 3.50	(0.1 x A) + 2.63	(0.5 x A) + 4.38	(0.3 x A) + 3.50	(0.1 x A) + 2.63	(0.4 x A) + 4.38	(0.3 x A) + 3.50	(0.1 x A) + 2.63	(0.4 x A) + 4.38	(0.2 x A) + 3.50	(0.1 x A) + 2.63	(0.3 x A) + 4.38	(0.2 x A) + 3.50	(0.1 x A) + 2.63
14	94.1	59	N/A	N/A	54	N/A	N/A	49	N/A	N/A	44	N/A	N/A	39	N/A	N/A
20	170.9	N/A	69	36	N/A	63	33	N/A	57	30	N/A	51	27	N/A	45	24
21	211.7	127	N/A	N/A	116	N/A	N/A	104	N/A	N/A	93	N/A	N/A	82	N/A	N/A
26	288.9	N/A	115	58	N/A	105	53	N/A	95	48	N/A	85	43	N/A	74	38
29	403.7	238	N/A	N/A	217	N/A	N/A	195	N/A	N/A	174	N/A	N/A	153	N/A	N/A
32	437.6	289	172	87	263	157	79	237	141	72	211	126	64	185	111	56
37	585	N/A	229	115	N/A	208	105	N/A	188	95	N/A	168	85	N/A	147	74
42	753.8	N/A	294	148	N/A	268	135	N/A	241	121	N/A	215	108	N/A	188	95
46	904.2	N/A	352	177	N/A	320	161	N/A	289	145	N/A	257	129	N/A	225	113
50	1068.2	N/A	415	209	N/A	378	190	N/A	340	171	N/A	303	152	N/A	265	134
55	1292.6	N/A	502	252	N/A	456	229	N/A	411	206	N/A	366	184	N/A	320	161

*Aspect Ratio considered in the example for CRT is 4:3 and for LCD and LED it is 16:9; N/A is used if the screen size is not available for that particular type of the TV i.e. CRT, LCD, LED.

4 Test procedures and standards

The test procedure and standards for colour television in India, follows the schedule 11 of BEE ratings and specifies the energy labelling requirements for diagonal screen till 215 centimetre and native vertical resolution till 1920 X 1080 pixels, of CRT, LCD (with CCFL Backlighting), LCD (with LED Backlighting), Plasma technologies and the television types including TV combination unit being manufactured, imported or sold in India .The S & L schedule for television (schedule 11) in India does not cover monitors with computer capability (e.g., a computer input port, such as VGA) that are marketed and sold as computer monitors (Bureau of Energy Efficiency , 2014).

To qualify as BEE Star labelled product, all TVs and TV Combination Units shall not exceed maximum Annual Energy Consumption (AEC max) derived from the equations mentioned in table 1 and table 4 based on the unit's native vertical resolution and visible screen area. The maximum Annual Energy Consumption is expressed in kilowatt hours per year (kWh/year). The standard used by BEE to define the test procedures of colour television for energy star rating is IS 13384:1992 (Part 1 & Part 2) and IS 13900:1993 for CRT's. The products under this standard shall meet the requirements of IS 616:2010 or IEC 60065:2005 (International Electrotechnical commission) for safety in order to qualify for the BEE label. The test results must be reported to BEE as per the test report format given in Annex I of the schedule 11 of BEE. To qualify for a BEE Star label a Colour Television, which is capable of being powered from either a power outlet or a battery source that is sold with an external power supply, shall fulfil the following eligibility criteria and luminance requirement:

- **Eligibility**
 1. The televisions shall confirm to the relevant standards as specified in above (IS 13384:1992, IS 13900:1993 for CRTs measurements and performance and IS 616:2010 or IEC 60065:2005 for the safety requirements).
 2. The televisions shall meet the standby power consumption requirement of TVs as specified in Table 4 below.

Table 4: Standby power consumption requirement of TVs

CRT TVs	$\leq 1.0 \text{ W}$
LCD (with CCFL backlight)/ Plasma TVs	$\leq 0.8 \text{ W}$
LCD (with LED backlight)	$\leq 0.6 \text{ W}$

- **Luminance Requirements**

1. To qualify for a BEE label, a television's measured peak luminance in the default, as-shipped picture mode (home mode) shall be greater than or equal to 65% of the measured peak luminance in the brightest selectable pre-set picture mode (factory or retail picture mode).

Testing Guideline

Manufacturers are required to perform tests as per the standards mentioned below:

Table 5: Test Standards for Measuring Operational Modes

Test Parameters	Test Standards
Standby	IEC 62301, Ed 2.0: Household Electrical Appliances – Measurement of Standby Power
On Mode	IEC 62087, Ed 3.0: Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment, Section 11, "Measuring conditions of television sets for On (average) Mode."

Test Conditions

The general conditions of test shall be as mentioned below:

Table 6: General Test Conditions

Supply Voltage:	230 ($\pm 1\%$) Volts AC, 50 Hz ($\pm 1\%$) (Note: For other products rated for $> 1.5 \text{ kW}$ maximum power, the voltage range is $\pm 5\%$)
Total Harmonic Distortion (THD) (Voltage):	$< 2\%$ THD (Note; $< 5\%$ for other products which are rated for $> 1.5 \text{ kW}$ maximum power)
Ambient Temperature:	$23^\circ\text{C} \pm 5^\circ\text{C}$
Relative Humidity:	10 – 65 %

Testing at Factory Default Settings

In measuring the On Mode power consumption, the energy consumption of products shall be measured as they are shipped from the factory. TV Models need to provide a forced menu at the initial start-up and shall be shipped in the home picture mode. TV models that do not make use of a forced menu at initial start-up, and are shipped in a “retail” or equivalent mode, must be tested in that “retail” mode for qualification. Picture level adjustments that need to be made prior to testing On Mode power consumption should be made per section 11.4.8, “Picture level adjustments, of IEC 62087 Edition 3.0, if applicable.

Measuring Instruments:

Measuring instruments shall have the attributes as given in IEC 62301 Edition 2.0: Household Electrical Appliances – Measurement of Standby Power, and Section 5 – General Method of Measurement of IEC 62087 Edition 3.0: Methods of measurement for the power consumption of audio, video and related equipment.

Accuracy in measurements

Measurements of power of 0.5 W or greater shall be made with a relative uncertainty of less than or equal to 2% at the 95% confidence level. Measurements of power of less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level.

Requirement for TVs with ‘Automated Brightness Control’ (ABC):

ABC functionality shall be disabled before testing of TVs with ABC sensors and this feature shall not be taken into account during measurement of power consumption. The test shall be performed while the TV is in the home viewing mode.

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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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