

Topten Product Criteria Paper on
Television and television sets

**Revised by Britta Stratmann and Dietlinde Quack,
Oeko-Institut e.V., October 2013**

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The Project in brief

Topten is part of the international Euro-Topten-Max initiative supported by the European programme Intelligent Energy Europe and several national institutions (energy agencies, WWF, consumer associations, research institutes). On global level, Topten is coordinated by TIG, the Topten International Group. This association promotes to the Topten Charter, TIG statutes and Rules of Procedure (www.topten.eu).

Topten is a service that supports the market for energy efficient products. It aims at making energy efficient products the first choice for consumers, by offering them a user-friendly tool for product comparison and selection. The key element is an online information platform for consumers presenting the most energy efficient appliances currently available in various product categories, including household appliances, office equipment, consumer electronics and cars. Information on energy consumption and performance of products as well as several other characteristics (i.e. brand, model, price, picture) is provided. Product data is based on labels and standardized declarations as well as tests from accepted well-known institutions. The service is independent of manufacturers and retailers.

Consortium

The project is co-ordinated by the Agence de l'Environnement et de la Maitrise de l'Energie (ADEME). The other 20 project partners are:

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1 Introduction

The criteria presented in this paper cover the most important TV technologies currently available on the European market, focusing on LCD TV displays.

TVs belong to most and widely used appliances in Europe: in 2009 the average viewing time per person reached 231 minutes¹. Penetration rate of around 150% reflects the market tendency towards 2 TVs per household². The annual electricity consumption of TVs for EU-27 in 2007 approx. corresponds to the electricity consumption of the Czech Republic (60 TWh³). The volumes of sales in the EU-24 in 2012 were 47 million units. .

Quite obviously well-known CRT TVs (cathode ray tube TVs) have disappeared from the market. LCD (liquid crystal display) are dominating the sales. LCD backlighting technologies based on LED (light emitting diode) - having entered the market in 2009 - has led to higher energy efficiency as well as better picture quality. A trend to higher screen sizes is still ongoing.

Huge efforts in reducing the increase in energy consumption of TVs therefore are highly worth to be made. The EC regulation No 642/2009 has set limits both on off and standby mode power (since January 2010) and regarding on mode power (as of August 20, 2010). Since 30 November 2011, energy labelling on TVs is compulsory. The EU Regulation (EU) Nr. 1062/2010⁴ stipulates that television sets must bear the EU Energy label. The regulation regarding eco design requirements for TVs as well as the labelling delegated regulation for TVs serve as perfect background for setting up Topten criteria. Since August 20, 2010 manufacturers are obliged to publish information on TV power consumption on free access websites. This supports Topten site managers in establishing TV Top-lists to a great extent.

The paper starts with an overview on the major TV technologies including some aspects regarding efficiency and quality. It continues with a summary on current legislation and standards relevant for Topten as basis and finally concludes with recommendation on product categorisation and criteria to be used within Topten.

Note: The next update should probably cover all displays, since the scope of the TV Ecodesign and Labelling regulations are extended to cover all displays (mainly: TVs, monitors, digital photo frames).

¹ Bertoldi, P; Hirtl, B; Labanca, N; Energy Efficiency Status Report 2012 - Electricity Consumption and Efficiency Trends in the EU-27; JRC 2012

Download 29.07.2013: <http://www.topten.eu/uploads/File/energy-efficiency-status-report-2012.pdf>

² See above: JRC 2012.

³ 54 TWh in on-mode power consumption and 6 TWh in stand-by/off-mode power consumption (JRC2012).

⁴ COMMISSION DELEGATED REGULATION (EU) No 1062/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of televisions.

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:314:0064:0080:EN:PDF>

2 Product Definition

This chapter provides an overview of television technologies covered in this criteria paper. It also gives a technical analysis of the product type and explains relevant EU and international legislation, labels as well as test standards.

2.1 Product Definition

Television means a television set or a television monitor, referring to Definitions outlined in Commission Regulation (EC) No 642/2009⁵:

“Television set” means a product designed primarily for the display and reception of audiovisual signals which is placed on the market under one model or system designation, and which consists of

- (a) display
- (b) one or more tuner(s)/receiver(s) and optional additional functions for data storage and/or display such as digital versatile discs (DVD), hard disk drive (HDD) or videocassette recorder (VCR), either in a single unit combined with the display, or in one or more separate units;

“Television monitor” means a product designed to display on an integrated screen a video signal from a variety of sources, including television broadcast signals, which optionally controls and reproduces audio signals from an external sound device, which is linked through standardised video signal paths including cinch (component, composite), SCART, HDMI, and future wireless standards (but excluding non-standardised video signals paths like DVI and SDI), but cannot receive and process broadcast signals.

2.2 Product Types

A few established TV technologies are currently widely available on the market: Plasma and LCD-Panels TVs and projectors well known from office application. While LCD TVs dominate the TV sales, CRT⁶ were replaced by the modern display technologies and Plasma-TV hold only 5% of the EU market share in 2012. On average Plasma TVs have an On mode power more than three times as high as the average LED-LCD TV⁷. Projectors represent a niche market segment only and therefore are not laying in the focus of this paper.

⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:191:0042:0052:EN:PDF>

⁶ CRT = Cathode Ray Tube. The CRT system was, until the late 1980s, virtually the only television display.

⁷ Michel, A.; Attali, S.; Bush, E.; European TV market 2007-2012; Topten International Services Zurich, Switzerland, July 2013.

Download 29.07.2013: http://www.topten.eu/uploads/File/TV_market_2007%E2%80%932012_Topten.pdf

The new technology of OLED (Organic LED) TV is currently not yet available on the market. A market launch is planned for this year. However, in January 2013 only LG announced that their first commercial OLED TV is on offer in Korea (for about \$10,000). In addition, Samsung announced an OLED TV, but the company did not reveal their launch plans yet.

2.2.1 LCD Liquid Crystal Displays

LCD at a glance:

Liquid Crystal Displays (LCD) screens exploit the ability of some materials to alter their crystalline structure when a voltage is applied, changing from being transparent to opaque.

Typical Screen size range: 20 – 55 “	
Pros	Cons
Lower energy consumption Best suitable for lighter rooms	Weak colour representation of black image elements. This is not true for dynamic LED-LCD TVs Viewing angle might be a problem

LCD in detail:

Liquid Crystal Displays (LCD) are the most mature and commercially successful flat panel display technology (FDP) today. More lightweight than the old CRTs and with an increasing picture quality, LCD-TVs t a market have a market share of 95 % in 2012⁸. LCD and other FPDs are incorporating fixed matrix technologies, but create the images using different methods. LCD – in contrast to PDP or SED⁹ – is a non-emissive technology using a backlight (CCFL¹⁰, HCFL¹¹ or LED¹²) as a light source. LCD is made up of any number of pixels consisting of materials (liquid crystals) that can alter their crystalline structure or orientation when voltage is applied. The transparency is changing through this principle. The light from the light source first passes through a polarization filter, gets then modulated by the liquid crystals, and creates a blue, red or green pixel after passing through another polarization and colour filter. Thin Film Transistor (TFT) technology on glass is used to drive or control the orientation of the liquid crystals (pixels). The display is protected on the front side with an antireflective hard coating. The Figure 4 shows the principle design of a liquid crystal display.

⁸ Michel, A.; Attali, S.; Bush, E.; European TV market 2007-2012; Topten International Services Zurich, Switzerland, July 2013.

⁹ SED – Surface-Conduction Electron-Emitter Display

¹⁰ CCFL – Cold-Cathode Fluorescent Lamp (standard technology for LCD backlighting)

¹¹ HCFL – Hot Cathode Fluorescent Lamp (backlighting technology only used by Sony, more efficient than CCFL)

¹² LED – Light Emitting Diode (new rapidly emerging backlighting technology, highest efficiency compared to CCFL and HCFL)

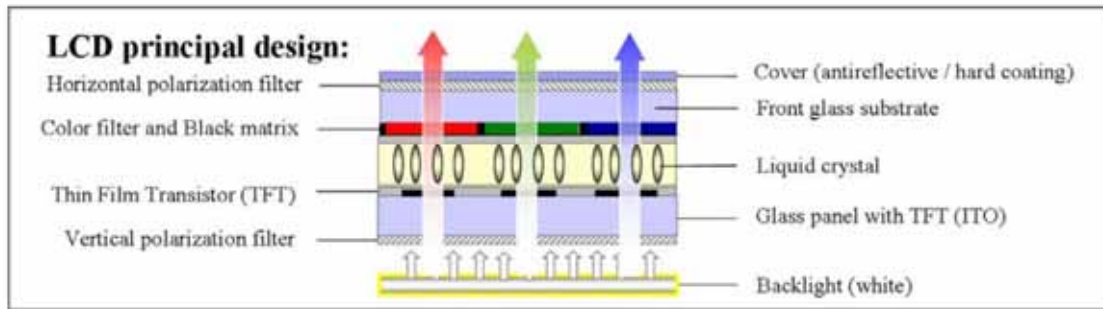


Figure 1: Principle Design of a Liquid Crystal Display (Source: EuP Preparatory Study “Television” (Lot5), Fraunhofer IZM)

Figure 2 shows the principle design of a LCD-TV in exploded view.

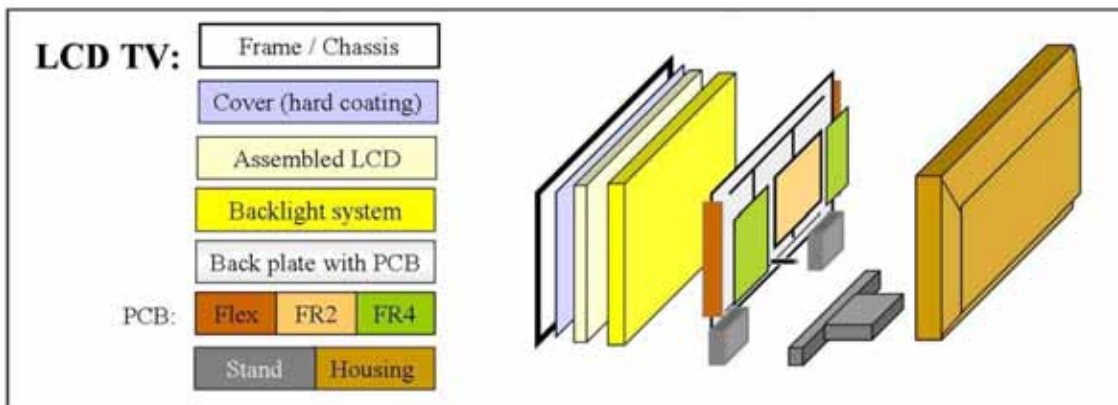


Figure 2: Principle Design of LCD-TV (Source: EuP Preparatory Study “Television” (Lot5), Fraunhofer IZM)

A new technology for backlighting of LCD-panels was brought to the market mid 2009. The so-called LED TVs use LED instead of CCFL or HCFL for backlighting purposes. However, the picture itself is generated similarly to common LCDs (therefore, the denomination "LED TV" is rather a communication term). Figure 6 shows a simplified scheme for both concepts:

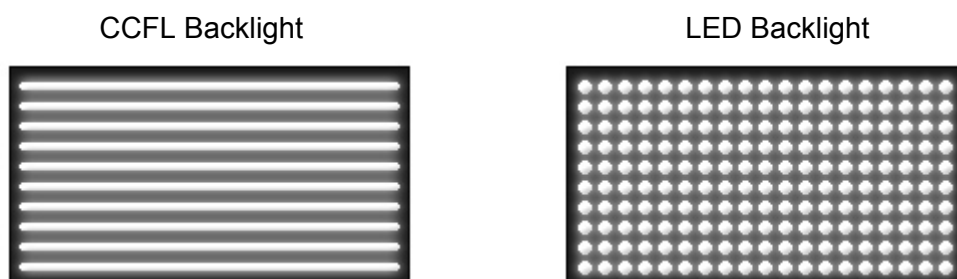


Figure 3: CCFL vs. LED-Backlighting of LCD-TVs (Source: tvfacts.de, 2010)

Up to now three different types for LED backlighting have been developed for marketability:

- edge LED backlight
- full LED backlight
- full RGB LED (red, green, blue) backlight

Figure 4 show the principles of edge and full LED backlight.



Figure 4: Two different types of LED-Backlighting: Edge LED resp. Full LED (Source: tvfacts.de, 2010)

Main advantage of edge resp. full LED backlighting is a more constant illumination level throughout the image and the ability to adapt the backlighting level according to specific parts of the image shown. Given the example, a picture showing a complete dark night sky with full moon, the lighter parts will then be backlit with full intensity, the darker parts only with very low or no backlighting. This technique – often called local dimming – results in enhanced contrast and significantly reduced energy consumption. This is also called ‘dynamic backlighting’. The power input in this technology depends on the picture brightness, while for LCD TVs without dynamic backlight, power remains constant whatever the picture brightness.

For this purpose white LED are used most commonly. A more performing (and expensive) approach is using RGB LEDs (a LED each for the colors red, green, blue). RGB LED backlighting yield a better color representing additional to the benefits mentioned above.

2.2.2 Rear projection TV

For the very biggest screen size, a television projector projects pictures across a room onto a screen. These projectors are often based on LCD or DLP (Digital Light Projection) technologies and are capable of displaying images several meters wide. Unlike plasma and LCD televisions, there is no direct relationship between screen size and energy consumption. Large or small, they use about the same amount of electricity, so the largest are relatively very efficient in terms of watts per centimetre of screen. The production of Rear projection TVs was discontinued by the last manufacturer (Mitsubishi) in 2012.

2.2.3 OLED

OLED TVs with the new display technology called OLED (Organic Light Emitting Diodes) are more efficient, thinner and feature better refresh rates and contrast than either LCD or Plasma. OLEDs are made by placing thin films of organic (carbon based) materials between two conductors. When electrical current is applied, a bright light is emitted. The OLED materials emit light and do not require a backlight (unlike LCDs), so they are more efficient and much thinner. Each pixel is a small light-emitting diode, in fact. Currently OLED TVs are terribly expensive, and will only be produced in small quantities, e.g. LG's 55" OLED TV is already on offer in Korea for \$10,000, and it's also headed for the US soon. However, the start of a real mass production of OLED TVs from LG and Samsung is expected to happen during 2013-2014. Other companies (such as Sony and Panasonic, AU Optronics and others) are expected to enter the OLED TV market too in the coming years¹³.

2.3 Overview on basic terms and aspects regarding efficiency criteria for TVs

2.3.1 Glossary

Automatic Brightness Control (ABC)

Automatic brightness control automatically reduces the overall brightness of the whole screen when the light level of the room (ambient light) is low. This is more comfortable for the viewer and can also reduce power consumption.

Average picture level (APL)

APL represents the video signal level, i.e. it is a metric for the brightness of a "video image". Giving an example, the APL of a ski race is quite higher than the APL of video sequence of a night sky. APL is defined as a percentage of the range between reference black and reference white level and is mathematically averaged over the period of a frame to come up with APL. Television programme material is said to have a 15% average picture level over a long period of time.

Forced menu

A set of televisions settings pre-defined by the manufacturer, of which the user of the television must select a particular setting upon initial start-up of the television.

¹³ <http://www.oled-info.com/>, 02.2013.

Full HD resolution

Full HD (FHD) refers to the possibility that devices may represent the **currently** maximum HD resolution of 1920 x 1080 pixels. The number 1080 represents 1,080 lines of vertical resolution (1080 horizontal scan lines), while the letter p stands for progressive scan (meaning the image is not interlaced).

Only 1080p (progressive) can be referred to as full HD or full high definition although 1080i (interlaced) is also 1920x1080 pixels. The term usually assumes a widescreen aspect ratio of 16:9, implying a horizontal resolution of 1920 pixels. This creates a frame resolution of 1920x1080. "HD" or "HD ready" is widely used for TVs which can process HD 1080p signal but feature a resolution below 1920x1080. Please see Section 2.3.2 for further details.

UHD (4K)

Ultra High Definition Television (4K or Quad Full HD (QFHD)) is a display resolution of 3840x2160 pixels in the same 16:9 aspect ratio. It represents exactly four x as much resolution as Full HD, or 1080p vertical. Therefore the name, "quad," meaning, "four."

Home Mode

"Home mode" means the television setting which is recommended by the manufacturer for normal use.





Peak luminance ratio

Ratio of the peak luminance of the home-mode condition or of the on-mode condition of the television as set by the supplier and the peak luminance of the brightest on-mode condition. According to the Ecodesign regulation 642/2009 the peak luminance in the home mode or in factory settings must be at least 65% of the maximum brightness. This makes sure that TVs can't reach high efficiency by very dark factory or home mode settings.

Shop Mode

"Shop mode" means the television setting which is recommended by the manufacturer to be used on point of sale with usually much higher brightness and contrast levels compared to the home mode setting.

2.3.2 Established industry Labels for High definition Television (HDTV)¹⁴

	<p>HD Ready</p> <p>Designed for display devices - including integrated digital TVs, monitors and projectors - that can accept, process and display High Definition 720p and 1080i (interlaced) (but not 1080p - progressive) signals. To enjoy HDTV broadcasts, these devices will need to be used in conjunction with an ("HD TV") device that can receive and decode the signals.</p>
	<p>HD TV</p> <p>Designed for television receivers - including set-top boxes and integrated digital TVs - that can receive and decode HD (720p, 1080i) satellite, cable or terrestrial broadcast transmissions.</p>
	<p>HD ready 1080p</p> <p>Designed for display devices - including integrated digital TVs, monitors and projectors - that can in addition to 720p and 1080i also accept, process and display High Definition 1080p signals. Display devices bearing the "HD ready 1080p" logo feature a 1920 x 1080 screen resolution. To enjoy HDTV broadcasts, these devices will need to be used in conjunction with an "HD TV" device that can receive and decode the signals.</p>
	<p>HD TV 1080p</p> <p>Designed for "HD ready 1080p" display devices that can also receive and decode HD (720p, 1080i) Satellite, Cable or Terrestrial broadcast transmissions. Display devices bearing the "HD TV 1080p" logo feature a 1920 x 1080 screen resolution.</p>

¹⁴ Definitions established by DIGITALEUROPE (former EICTA - European Information, Communications and Consumer Electronics Industry Technology Association), Jan. 2013.

2.3.3 Technical aspects regarding power consumption in on mode

For long time power consumption of TVs was measured using static test patterns (full white display, color bars, etc.). The main purpose for the declaration of on mode power values was for security reasons (thus quoting maximum values) not for actual comparability of different models in terms of energy efficiency. However state of the art measurements are based on dynamic test patterns (video sequences) facilitating “real world” tests. For strict comparability, it has to be provided that the influencing factors for power consumption in on mode

- brightness setting and other settings such as contrast, sound volume, dynamic backlight, and automatic brightness control and
- the characteristics of the broadcast signals

have to be specified properly.

Beyond brightness setting and the characteristics of the broadcast signals the type of technology used (PDP, LCD), the screen size and the duration of usage self-evidently determine the actual energy consumption of a certain TV.

UK observations ¹⁵ have shown that the standard (“home mode”) viewing mode is between 55% and 90% of maximum luminance mode with the majority of models falling between 60% and 70% of maximum luminance mode. This survey also highlighted that TV on-mode power savings moving from an average bright room to a dark room with Ambient lighting control (ALC) enabled could be between 18 to 30% of the average power without ALC.

Regulation (EC) No 642/2009 states that testing has to be carried out at the default luminance setting recommended by the manufacturers for the home use of the TV. And measurements shall be made with the Automatic Brightness Control function, if such a function exists, made inactive. If the Automatic Brightness Control function exists and cannot be made inactive, then the measurements shall be performed with the light entering directly into the ambient light sensor at a level of 300 lux, or more.

2.4 Best Available Technology

Best available technology is currently represented by LCD displays with full LED-backlighting, reaching an Energy Efficiency Index below 0,15 (Source: topten.info, 2013) corresponding to an Efficiency Class of A++ according to Commission delegated regulation (EU) No 1062/2010¹⁶.

The new technology OLED (Organic LED) is announced to be very efficient and high performing. By now OLED TVs are not available on the broad market, but have been presented as

¹⁵ MTProg Briefing Note BNCE7: 2008 testing of TV luminance and ambient lighting control, <http://efficient-products.defra.gov.uk/spm/download/document/id/780>; 14.01.2010

¹⁶ COMMISSION DELEGATED REGULATION (EU) No 1062/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of televisions

prototypes and high price niche products. A broad commercial launch of OLED TVs affordable for wide consumer segments is still pending.

2.5 Legislation and Labelling

2.5.1 Ecodesign regulation (EC) No 642/2009

The current implementing measure Commission regulation (EC) No 642/2009 of 22 July 2009 with regard to eco design requirements for televisions stipulates the following requirements, setting values for maximum energy consumption in different modes.

Criteria “On mode power consumption”

Product type	Full HD resolution	All other resolutions
TV sets	16 W + A x 3,4579 W/dm ²	
TV monitors	12 W + A x 3,4579 W/dm ²	

Visible screen area A expressed in dm²

This requirement corresponds to a minimum efficiency of class D.

Criteria “standby / off mode power consumption”

Off mode	Standby mode
0,3 (0,5) W ***	0,5* / 1** W

** power consumption in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function*

*** power consumption in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display*

**** Power consumption of any off-mode condition shall not exceed 0.30 watts, unless the following condition is fulfilled: For televisions with an easily visible switch putting the television in a condition with power consumption not exceeding 0,01 Watt when operated to the off position, the power consumption of any other off-mode condition shall not exceed 0,5 Watt*

Requirement regarding peak Luminance ratio:

The peak luminance of the home mode condition for televisions with forced menu shall not be less than 65% of the peak luminance of the brightest on-mode condition provided by the television. (TVs without forced menu: peak luminance of the on mode condition of the TV as delivered by the manufacturer not less than 65 %)

Information requirements:

Information to be made publicly available on free-access website from 20 August 210

Data	Specification
On mode power consumption	Data in watts [Format XX,X W for values up to 100 W, format XXX W for values above 100 W]
Standby / off mode	Data in watts (Format X,XX W)
Ratio of peak luminance	%
In the case the TV contains mercury and lead	Content as X,X mg and the presence of lead

“On mode average” vs. “on mode maximum”

Please note that the term “On mode power consumption” used in the Regulation is the average power over 10 minutes when displaying the test video of EN 62087, in the factory settings or home mode. While the maximum on mode value reflects the maximum power draw of a TV set if all brightness and contrast levels are set to the maximum. In contrary to the “On mode power consumption” defined as a real life average value the maximum value has no relevance for everyday usage but for security reasons (are wiring and fuses strong enough?).

Ecodesign requirement Automatic power down:

TVs after no more than 4 hours in on mode following the last user interaction and/or channel change shall be switched automatically from on mode to standby mode or off mode.

2.5.2 Commission Delegated Regulation (EU) No 1062/2010 with regard to energy labelling of televisions

The Commission Delegated Regulation with regard to energy labelling of television¹⁷ came into force on 30th November 2011.

Hence, energy labelling on TVs is compulsory as of 30 November 2011. The labelling range is A to G and will change to A+ to F after 1 January 2014; as of 1 January 2017, the range will be A++ to E; A+++ to D as of 1 January 2020. This labelling scheme can be used prior to these dates, namely as soon as a more efficient device in a higher class is introduced on the market. The best TVs today are A++, but only up to A needs to be shown on all labels. The result is that different labelling schemes are on the market.

¹⁷ COMMISSION DELEGATED REGULATION (EU) No 1062/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of televisions.

After the adoption of the current revision of the TV Energy Labelling regulation, which is expected to be completed in the fourth quarter of 2013, all classes up to A+++ will be shown on the label. On the other hand, classes that have been eliminated by the Ecodesign regulation, will no longer be shown (or may be in gray colour).

Table 1 gives an overview on the Energy Efficiency Classes corresponding to the Energy Efficiency Index. The calculation of the Index is presented right below.

Table 1: Energy efficiency class of a television

Energy Efficiency Class	Energy Efficiency Index
A +++	$EEI < 0.10$
A ++	$0.10 \leq EEI < 0.16$
A +	$0.16 \leq EEI < 0.23$
A	$0.23 \leq EEI < 0.30$
B	$0.30 \leq EEI < 0.40$
C	$0.40 \leq EEI < 0.50$
D	$0.50 \leq EEI < 0.64$
E	$0.64 \leq EEI < 0.80$
F	$0.8 \leq EEI < 1.00$
G (least efficient)	$1.00 \leq EEI$

The Energy Efficiency Index (EEI) is calculated as $EEI = P/P_{ref}(A)$, where:

$$P_{ref}(A) = P_{basic} + A \cdot 4.3224 \text{ watts/dm}^2;$$

- $P_{basic}^{18} = 20$ Watts for television sets;
- $P_{basic} = 15$ Watts for television monitors;
- A is the visible screen area expressed in dm²;
for screen aspect 4:3 use formula $A = 0,480 \cdot d^2$
for screen aspect 16:9 use formula $A = 0,427 \cdot d^2$
(where d is the diameter in [dm])
- P is the on-mode power consumption of the television in watts

The annual on-mode energy consumption E in kWh is calculated as $E = 1.46 \times P$.

¹⁸ P_{basic} can vary between 20W and 28W depending on number of tuners and hard discs. The number of tuners is the number of different tuners that can be used in parallel. Since this is not declared, it is difficult to calculate the precise EEI from the product information.

This calculation formula assumes a daily On mode duration of 4 hours and neglects low power modes.

For the purposes of calculating the Energy Efficiency Index and the annual on-mode energy consumption respectively, the on-mode power consumption is reduced by 5% if all of the following conditions are fulfilled:

- “the luminance of the television in the home-mode or the on-mode condition as set by the supplier, as applicable, is automatically reduced between an ambient light intensity of at least below 20 lux,
- the automatic brightness control is activated in the home-mode condition or the on-mode condition of the television as set by the supplier, as applicable (i.e. if the TV is equipped with automatic brightness control feature), when the television is placed on the market.”

This is another factor that makes it difficult to calculate the precise EEI without actually buying and unpacking a TV model.

The label layout and the timetable is presented in Figure 5 and Figure 6.

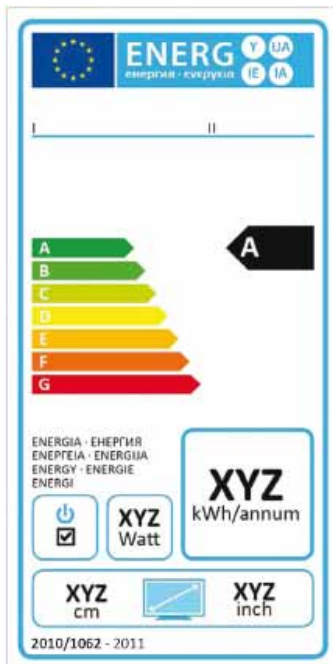


Figure 5: Layout of Energy Efficiency Labelling for TVs (Source: Commission delegated regulation (EU) No 1062/2010)

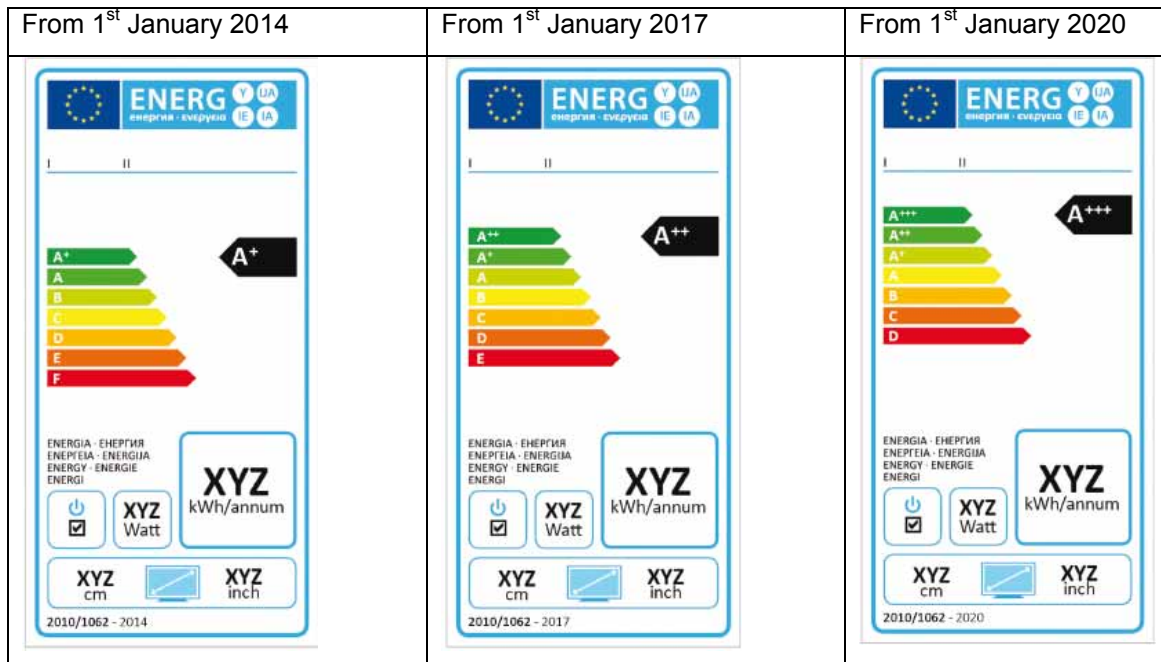


Figure 6: further versions and timetable of Energy Efficiency Labelling for TVs (Source: Commission delegated regulation (EU) No 1062/2010)

The following information shall be included in the label:

- I. supplier's name or trade mark.
- II. supplier's model identifier
- III. the energy efficiency class
- IV. on-mode power consumption in Watt
- V. annual on-mode energy consumption
- VI. visible screen diagonal in inches and centimetres.
- VII. for televisions with an easily visible switch, which puts the television in a condition with power consumption not exceeding 0.01 watts when operated to the off position, the symbol (marked in figure 13 below) may be added.



Figure 7: Switch logo on the label (Source: EC, 2010)

2.5.3 EU Eco-Label for televisions (C(2009) 1830)

The Commission decision of 12 March 2009 establishing the revised ecological criteria for the award of the Community Eco-label to televisions has been applied since 1 November 2009 (and shall be valid until 31 October 2013). Eco-labelled TVs are by 36 % less efficient than recent A labelled models. The criteria for the TVs are currently being revised.



Figure 8: Logo EU-Ecolabel (Source: European Commission, 2010)

The criteria stipulated in the specification for this eco label on a voluntary basis aim at:

- reducing environmental damage or risks related to the use of energy (global warming, acidification, depletion of non-renewable energy sources) by reducing energy consumption,
- reducing environmental damage related to the use of natural resources,
- reducing environmental damage related to the use of hazardous substances by reducing the use of such substances

Eco Label Criteria regarding Energy consumption

Passive Standby

- i. The passive standby consumption of the television shall be $\leq 0,30$ W except where the condition in part ii is fulfilled.
- ii. For televisions with an easily visible hard off-switch, such that when the switch is operated to the off position, the television's energy consumption is $< 0,01$ W, the passive standby consumption of the television shall be $\leq 0,50$ W.

Maximum energy consumption

Televisions shall have energy consumption in on-mode of ≤ 200 W.

Energy Efficiency

Validity period	Energy Efficiency Index	Corresponding to Class
From 1 January 2013	EEI $\leq 0,41$	Approx. Minimum B

Beyond these criteria the following aspects are also defined:

- mercury content of fluorescent lamps
- design for disassembly
- heavy metals and flame retardants
- user instructions
- information appearing on the Ecolabel

Currently the brand Toshiba has claimed the EU Ecoflower for several of their TVs.

2.6 International Legislation and Labelling

2.6.1 Energy Star Programme Requirements for TVs

The US labelling programme Energy Star defines qualification criteria for a broad range of product categories (contrarily to the EU based Energy Star programme in which only office equipment is covered), amongst other home electronic products also televisions¹⁹.

Requirements are in place for on mode power consumption setting specifications for effective date September 30, 2011 (Version 5.3). From September 30, 2011 there is also a maximum allowable energy in DAM (kilowatt-hours/day).

It is worth considering that the power values for on mode consumption derived from the Energy Star specifications are not comparable to values based on the EU regulation No 642/2009 as definitions for luminance differ:

¹⁹ ENERGY STAR Requirements for TVs: Versions 5.3
http://www.energystar.gov/index.cfm?c=tv_vcr.pr_crit_tv_vcr

Energy Star Definition:	Specification in EU regulation
the peak luminance of the product in the “home” mode, or in the default mode as shipped, shall not be less than 65% of the peak luminance of the “retail” mode, or the brightest selectable preset (!) mode , of the product. “	peak luminance of the home mode condition [...] shall not be less than 65% of the peak luminance of the brightest on-mode condition provided by the television (!)

Hence a more thorough discussion of specific criteria is not done in this paper.

2.7 Test Standards

2.7.1 IEC 62087:2011

The IEC Standard 62087: “Methods of Measurement for the Power Consumption of Audio, Video and Related Equipment” is the state of the art test standard for determining on mode power consumption of TVs. Conditions relevant for measurement are defined in section 11, “Measuring conditions of television sets for On (average) mode. This standard also includes dynamic broadcast-content video signal sequence (mean APL’ histogram is 34%).

3 Economic and Market Analysis

3.1 Stock, Sales, Market Trends and Energy Efficiency

According to the Energy Efficiency Status Report 2012,²⁰ the market for televisions is growing and changing rapidly. The most important trends are: bigger screen sizes, flat panel displays, digital television broadcasting and high-resolution television (HD).

Television sales have been increasing substantially during the last years: from a total of 34.7 million TV units in 2006 (EU-15) to already 51.4 million units in 2010 (GfK). In 2006 flat screens already made more than 50% of total sales in the EU-15. Only a few years later, in 2010, this share was 100%.

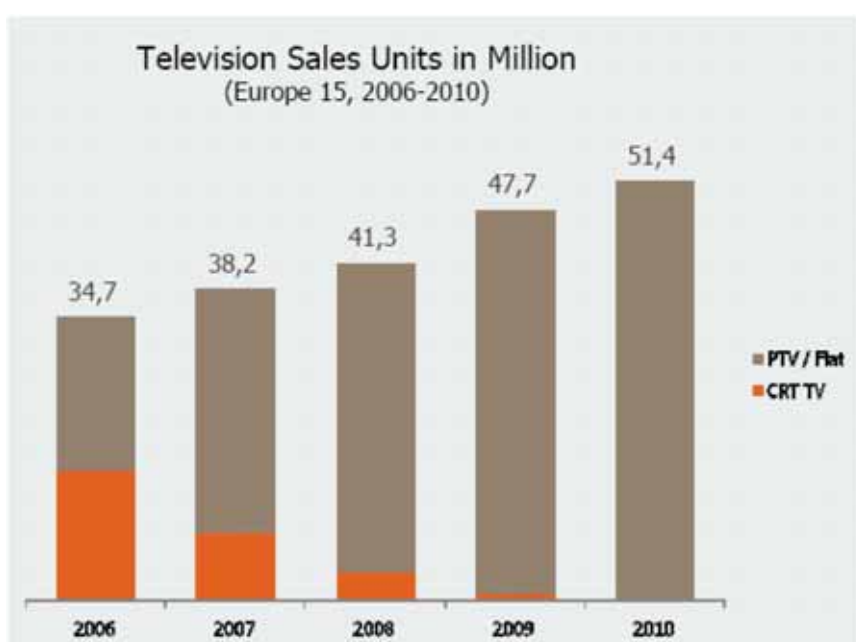


Figure 9 Television Sales (million) in the EU-15: Growth 06-10 = 48,1%; Total 06-10 = 213,4 Mio (GfK 2011²¹)

The annual electricity consumption of TVs for EU-27 in 2007 is estimated at 60 TWh, approx. corresponding to the electricity consumption of the Czech Republic, and the expected electricity consumption by 2020 corresponds approx. to the electricity consumption of Sweden (130 TWh).

Following the findings of the preparatory study for the Ecodesign Directive, JRC estimates indicate that the installed stock of TVs in the EU—27 residential sector is over 310 million units with a penetration rate of around 150% (Bertoldi et al 2012).

²⁰ Bertoldi, P.; Hilr, B.; Labanca, N.: Energy Efficiency Status report 2012. Electricity Consumption and Efficiency Trends in the EU -27. Report EUR 25405 EN. European Commission, Joint Research Centre, Institute for Energy and Transport. European Union, 2012

<http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/26929/1/lbna25405enn.pdf>

²¹ Market Trends on the TV Market and their Impact on Energy Consumption. GfK Retail and Technology, Copenhagen, May 2011.

http://www.eedal.dk/Conference/~media/EEDAL/Sessions/Session%204/042_Thilo_Heyder_Presentation_Slides.ashx

Another market trend is a big screen size, as the following figure shows: TV sets with screen size 40 inch and higher gain market share.

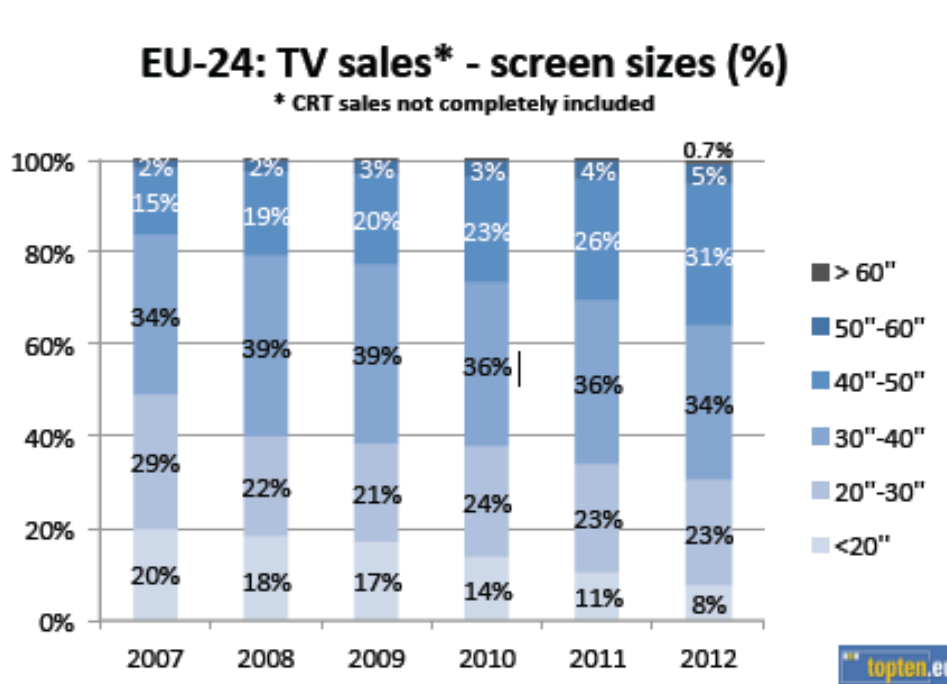


Figure 10: TV sales in the EU-24: percentage of different screen size categories 2007-2012 (topten.eu 2013²²).

The energy consumption of TV sets depends to a large extent on the screen size. The bigger the screen size the bigger is the energy consumption. In the last five years (2006 – 2010) the average energy consumption per TV set decreased for all screen sizes. Since 2009 especially devices with bigger screen sizes became more energy efficient. However there are still large differences in consumption between the different sizes (Bertoldi et al 2012).

Large A++ TVs have higher power than smaller A+ or A TVs, due to the linear EEI calculation formula (defining Efficiency on a linear power per screen area basis), which makes it easier for large TVs to reach good energy classes.

²² Michel, A.; Attali, S.; Bush, E.; European TV market 2007-2012; Topten International Services Zurich, Switzerland, July 2013.

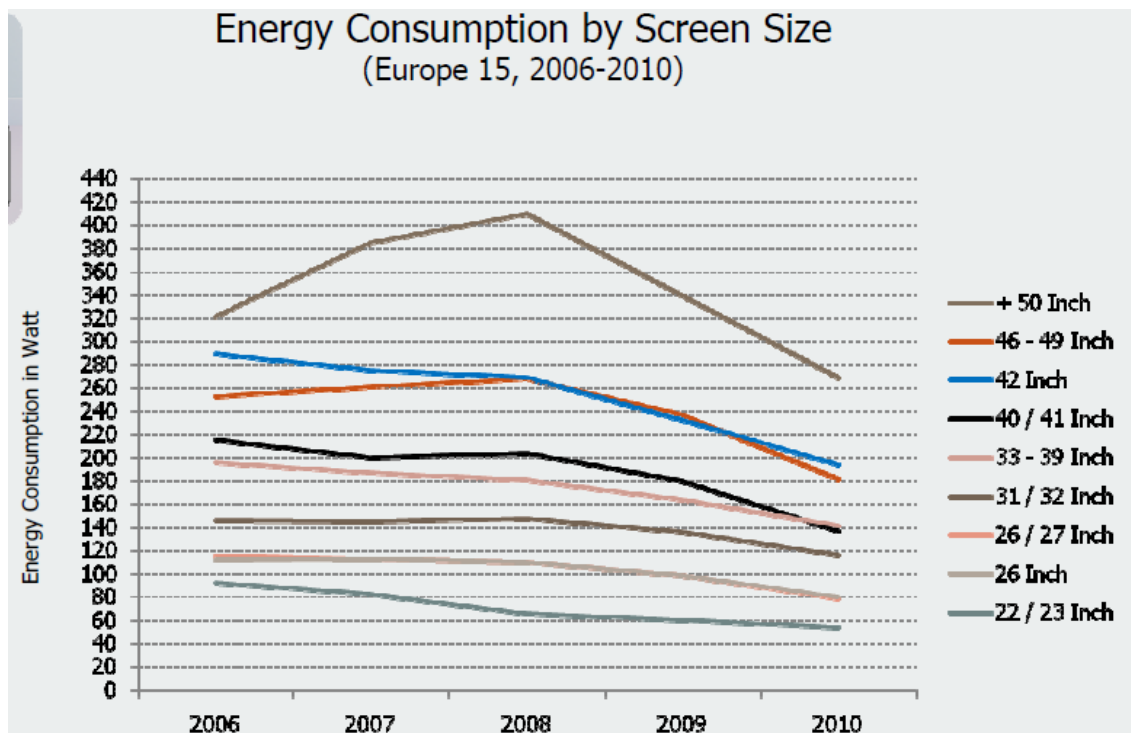


Figure 11: Energy Consumption by Screen Size (Europe 15, 2006-2010) (GfK 2011).

Up to date data on more detailed level regarding market and stock data as well as for growth and trends is not available.

Another factor which influences the market development is Digital TV. Digital TV, in the form of digital cable, satellite, digital terrestrial (DTT), and IPTV (Internet Protocol Television), is fast replacing the analogue technologies. The adoption of digital television in Europe should grow strongly over the next years, providing enhanced image quality and advanced features (greater breadth of content and bundled communications). Apart from enhancement, the switch-off analogue transmission is a further key driver for the transition to digital TV. The EU is leading in switching from analogue to digital television (Bertoldi et al 2012). TV sets without integrated digital receiver need a set-top box to decode the digital signals. Thus the development towards digital TV is expected to lead to a considerable increase of set-top boxes.

Since the last two years the influence of the Energy Label for television on the market has been tremendous. In 2010 the first TV models complying with the announced class A emerged on the market, now the first A++ class TVs are available. This means that the energy consumption of the most efficient TVs has been reduced by almost 50% in those two years (EEI of 0.16 instead of 0.3). The graph impressively illustrates the development of high efficiency TVs with data from Topten.eu. After February 2011 Topten stopped to list all class B TVs, and since August 2011 no longer all of class A are listed (A+ required for TVs > 100cm). So with the Energy Label for TVs the European Commission has implemented a very effective instrument to accelerate market transformation towards more efficient products.

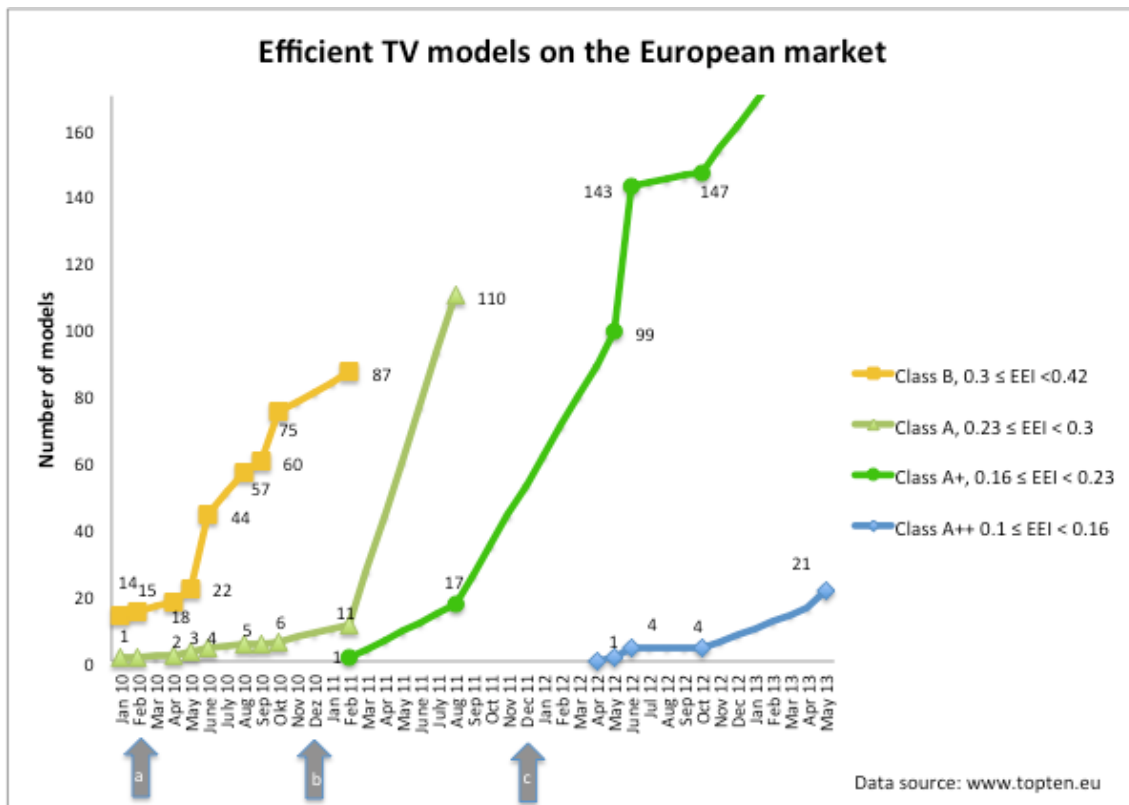


Figure 12: Efficient TV models on the EU market (topten.eu) (a) Feb 2010: Discussions on a TV label were resumed, based on the recast of the labelling directive. b) Dec 2010: The Energy Labelling regulation was put into force (transition period). c) Dec 2011: The Energy Label became compulsory).

Note: this graph shows similar models.

3.2 Manufacturers and Distributors

3.2.1 List of Manufacturers

List of manufacturers relevant for the entire EU market

Brand	Website	EU-Headquarter
BANG & OLUFSEN	www.bang-olufsen.com	Denmark
JVC	www.jvc-europe.com	United Kingdom
LG Electronics	www.lge.com	Netherlands
LOEWE	www.loewe.de	Germany
PANASONIC	www.panasonic-europe.com/home.aspx	Belgium
PHILIPS	www.philips.com	Netherlands
PIONEER	www.pioneer.eu	Belgium
SAMSUNG	www.samsung.com	United Kingdom
SANYO	www.sanyo.co.uk	United Kingdom
SHARP Electronics	www.sharp-eu.com	Belgium
SONY	www.sony-europe.com	Belgium
TOSHIBA Information Systems	www.toshiba.co.jp/worldwide/europe.html	United Kingdom

3.3 Data sources and Databases

According to Regulation (EC) No 642/2009 manufacturers are obliged to provide information for the purpose of consumer information. The following information is to be made publicly available on free-access website from 20 August 2010:

- Power consumption in On mode, Standby / off mode, Ratio of peak luminance.

4 Selection Criteria

The proposed Topten TVs have to be declared according to the Commission regulation on energy labelling of televisions from September 2010 and to IEC 62087:2011 and shall comply the following criteria.

4.1 Energy Efficiency Criteria

The energy efficiency criteria shall include:

- Energy Efficiency Index and Energy Efficiency Class (covering On mode power consumption)
- Max. power in On-mode

4.2 Recommendation for value setting

Criterion “Energy Efficiency Class (covering On mode energy consumption)”

We suggest following value settings for on mode energy consumption depending on screen diagonal:

Television sets have to be declared according to the Commission regulation on energy labelling of televisions from September 2010 and to IEC 62087:2011 and must comply with the following criteria:

- Energy efficiency according to the following table:

Screen size (diagonale)	Energy Class	EEI
$d < 70\text{cm}$	A or better	< 0.3
$70\text{cm} \leq d < 120\text{cm}$	A+ or better	< 0.23
$d \geq 120\text{cm}$	A++	< 0.16

- Max. power in On mode, for all screen sizes: 64 Watt. (this corresponds to the max. power of a 100cm-A-class TV)
- Available in at least one European country (topen.eu) resp. in the specific country of the website.

4.3 Quality related product features

The following product specification may qualify for additional quality criteria or are recommended for additional user information

Product specification	Qualifies for quality criterion	Only for user information
DVB-T Tuner integrated	✓	
Full HD	✓	
Ambient Lighting Control (ALC)	✓	
Viewing Angle	✓	
Format		✓
Response time		✓
Equipped with interconnect Common Interface (CI+)		✓
Contrast (Dynamic)		✓
Max Brightness		✓
Interfaces (including Numbers) HDMI Input Component Video Input PC Input Audio Input 21-Pin Input/Output LAN Port		✓
Presence Sensor		✓
Content of hazardous substances: Mercury, Lead (if applicable)		✓
Certified for EU Eco Label (EU flower)		✓

5 Additional Considerations

Optimal distance for viewing

Manufacturers' recommendation regarding suitable distance for viewing high definition images on a Full HDTV is about two to three times the diagonal measurement of the TV. Conventional standard definition images required a viewing distance of about four to five times the diagonal measurement of the screen. This rule of thumb seems to be for a minimum distance avoiding pixellated images.

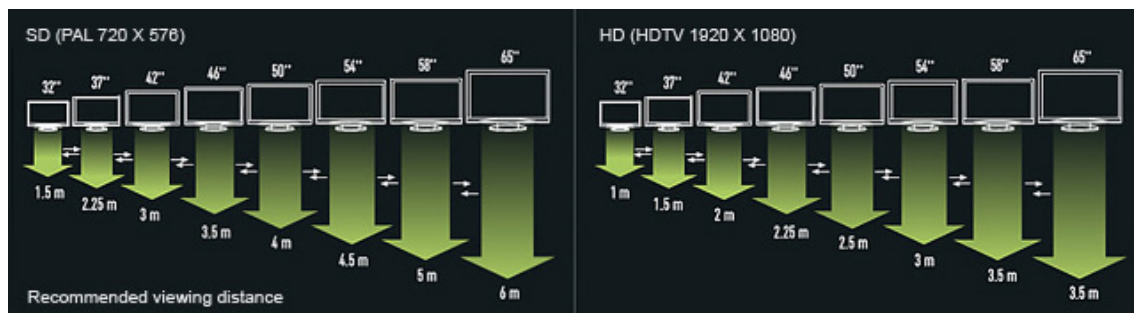


Figure 13: suitable distance for viewing (Source: Panasonic, 2009)