

D2.2 - Topten ACT Criteria Paper

Television sets (TVs)

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Topten ACT aims at transforming the European market of energy-using products towards higher energy efficiency.

Topten ACT identifies the top energy-efficient products in 16 European countries, and makes this information available to consumers and large buyers on tailored national websites. The most energy efficient models in different product categories (such as household appliances, lighting, office equipment, consumer electronics, cars) are presented with comprehensive product information based on official labels and standardized declarations. Topten works with manufacturers and thus increases both market offer and consumer demand of high energy efficiency products. Topten is strictly neutral and independent from manufacturers and retailers, its selection criteria are always published online.

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More information and access to all national websites on the European site: www.topten.eu

WP2 European Product Analysis , Task 2.1 Determining energy efficiency criteria, D 2.2 Periodic Criteria Papers (second set)

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1. Topten.eu: TVs - current selection criteria and products selected

To date, TVs with a high resolution (4K) are less efficient than conventional HD TVs. In order to be able to display also 4K TVs, Topten applies more relaxed selection criteria for these TVs. All television sets have to be declared according to the Commission regulation on energy labelling of televisions from September 2010 and to IEC 62087:2013. TVs complying with the following selection criteria are displayed on topten.eu:

- Max. power in Standby mode: 0.5W

TV models with HD resolution or lower:

Energy efficiency according to the following table:

Screen size (diagonal)	Energy Class	EEI	max. power in On mode
d < 70cm	A or better	< 0.3	64W*
70cm ≤ d < 100cm	A+ or better	< 0.23	
d ≥ 100cm	A++	< 0.16	

*64 Watt is the power a 100-cm TV can maximally have and still be in class A.

TV models with 4K or UHD resolution:

Energy efficiency according to the following table:

Screen size (diagonal)	Energy Class	EEI	max. power in On mode
d < 70cm	A or better	< 0.3	85W
70cm ≤ d	A+ or better	< 0.23	

Numbers* of TV models currently on Topten.eu according to screen size and energy efficiency (last update: August 2015):

	A	A+	A++	Total
< 70 cm	11	6	-	17
70 to 90 cm	-	18	-	18
90 to 100 cm	-	1	-	1
100 to 110 cm	-	-	8	8
110 to 120 cm	-	-	-	-
120 to 135 cm	-	-	8	8
>135 cm	-	-	4	4
4K < 100 cm	-	-	-	-
4K 100 to 120 cm	-	8	-	8
4K 120 to 150 cm	-	34	-	34
4K > 150 cm	-	-	9	9
Total	11	67	29	107

*Similar models have not been counted if from the same brand.

There are 107 TV models of 7 different brands on the Topten.eu product list: LG, Panasonic, Philips, Samsung, Sony, TCL, Thomson.

2. Expected selection criteria in 2019

The fast development towards higher efficiency observed in the first few years of the Label (and before) seems to have slowed. Instead new products have additional performance features like higher resolution ('4k' or UHD) or 3D images, which can increase the energy consumption. Also, the trend towards larger screens is on-going. Therefore, we are cautious with our predictions for the 2019 selection criteria:

- Energy efficiency class A+ for all TVs with screen size less than 100 cm
- Max. power in On-mode: 60W

3. Technical background

Today almost all TVs are Liquid Cristal Displays (LCD) with Light Emitting Diodes (LED) as backlight source. Old technologies like Plasma TVs or LCD TVs with Cold-Cathode Fluorescent Lamps (CCFL) as backlight source have disappeared from the market. LCD is made up 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.

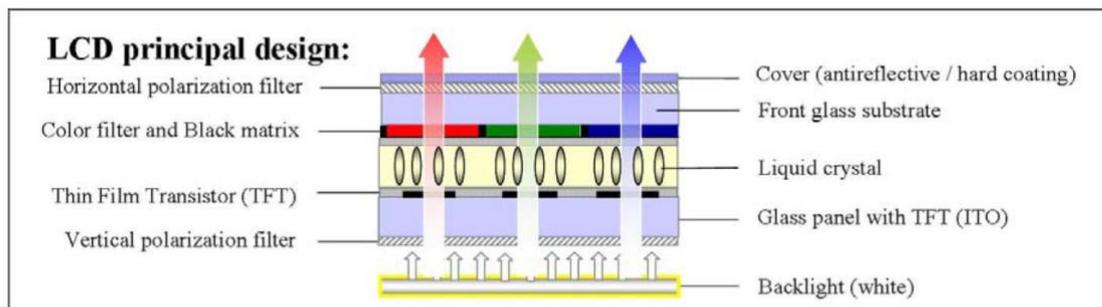


Figure 2: Principle Design of a Liquid Crystal Display (Source: EuP Preparatory Study "Television" (Lot5), Fraunhofer IZM, 2007)

The energy consumption of LCD TVs is defined by the energy use of the backlight: if there's more LEDs (larger screen) and they emit more light (brighter screen), consumption goes up. Today's LED LCD TVs have a dynamic backlight: they can save energy and create darker black colour by switching off specific LEDs. Older LCD TVs' consumption was independent of the image brightness, because this was created solely by the LCD layer, and not by modulating the backlight brightness.

The future display technology is supposed to be based on Organic Light Emitting Diodes (OLED). 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 can be more efficient and much thinner. Each pixel is a small light-emitting diode. OLED TVs are now well represented on the market, but yet are still high-end products with high energy consumption and prices.

Another future technology is quantum-dot LCD TVs. Yet, the materials are very expensive, and most quantum-dots contain cadmium.

Features of modern TVs include (source: CLASP, 2014):

- **Three dimensional (3D) screens** produce sequential left and right eye images by static filtering through polarised glasses or filters, or active shuttering through glasses. This filtering leads to a loss of luminance, therefore the 3D mode uses around 40% more

energy than 2D. According to CLASP (2014), 3D capability is built into 30% of large (≥ 40 inches) TVs – but most of these models are normally used in the 2D mode.

- **Internet-connected TVs** do not necessarily have a higher On-mode power. But smart TVs could accelerate the trend to larger screen sizes because users might want to make use of different functions on their screen at the same time (e.g. checking emails while watching a movie).
- **The Automatic Brightness Control (ABC)** saves energy by reducing the screen brightness if the ambient brightness in the room is low (around 100 lux). Today's Labelling and Ecodesign regulations grant a 5% power discount for the calculation of the EEI and annual energy consumption to models which have the ABC activated in the home mode or as set by the supplier. For the future testing of TVs it is planned to include an ABC test, which would allow for more precise consideration of this function.
- **'Quick start' or 'fast play' modes** are available in some models with long starting times from standby mode (> 10 sec). In a test, the National Resource Defence Council (NRDC, 2015) from the US showed that some models (Sony and Sharp) with starting times from standby (with low standby power) between 11 and 20 seconds consume up to 37W when in 'fast start' mode (which lowers the booting time to around 5 seconds)! On the other hand, a quick start (around 6 – 9 seconds) from a low standby mode is technically no problem, as it is applied in many models (e.g. Samsung and LG in the NRDC test). (Horowitz, 2015)
- **Presence or gesture detection, facial or voice recognition** are other enhanced reactivation functions. These may also have a higher low-power mode consumption but can also help to switch off the TV if no one is around.
- **Ultra High Definition (UHD) TVs** have screen resolutions higher than Full High Definition (also known as FHD, Full HD or 1080p; 1080 vertical pixels; 1920x1080 pixels in the usual 16:9 widescreen aspect ratio): 4K (or UHD-4K) means approximately 4000 horizontal pixels (4096 x 2160 pixels), while 8K screens have 7680x4320 pixels. There are contradictory results regarding the On mode power of UHD TVs: in a test by NRDC in the US, UHD TVs on average had a 40% higher energy consumption than HD TVs (presented by Noah Horowitz at EEDAL 2015). CLASP on the other hand found that there are UHD TVs on the market that do not consume more energy than HD TVs.
- **High Dynamic Range (HDR)**. HDR is a feature for 4K TV and 4K content that increasingly more TVs offer. It is a technique to heighten a picture's dynamic range by increasing the contrast between the brightest whites and the darkest blacks. Currently this feature is not measured, and some televisions automatically change to HDR mode. HDR mode can consume 70% more energy than the normal on-mode (CLASP, 2017)

4. Policy measures, standards and labels

The Energy Label and Ecodesign regulations, as well as the EU Ecolabel for TVs are currently being revised. The revised regulations will be named 'electronic displays' and it will also cover monitors. The reason is that the functionalities of these product categories have merged, with TVs also connected to the internet and used to show pictures and monitors also optimised for watching videos. The regulation for electronic displays was severely delayed and despite the revision having started in 2014, no regulation was yet adopted. The Ecodesign and Energy Label regulation should be voted upon in the end of 2018 or early beginning of 2019.

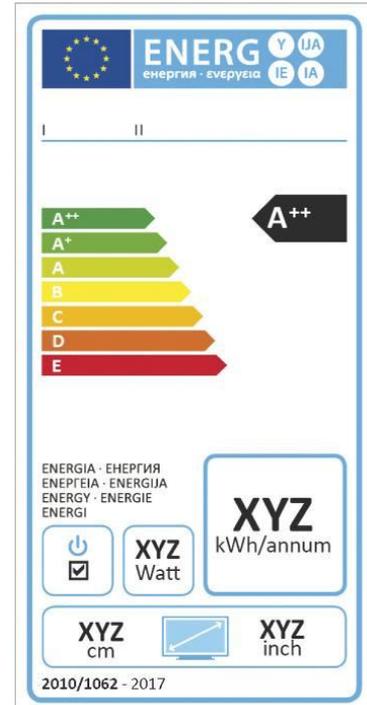
The Ecodesign regulation for TVs is expected to realise savings of 28 TWh in 2020. The revision of both regulations and the inclusion of monitors shall lead to additional savings of 35 TWh in 2030.

Energy Label

The Energy Label for TVs has been compulsory since December 2011, based on the Labelling regulation No. 1062/2010. As shown on the right, the Label features the efficiency class, Power in On-mode (W), annual energy consumption (kWh/year), the screen diagonal in inches and cm and an icon showing if the model has a hard off-switch. The Fiche must additionally declare the standby and off mode power (W) and the screen resolution.

The top classes of the Label are introduced stage by stage: only since January 2014 the classes A+ to F must be shown on all labels (G is no longer shown). From January 2017 the scale shown on all Labels will be A++ to E. Until then, A+ models can seem to be in the best class that's on the market. The Label of better models can of course show the better classes.

The annual energy consumption is calculated from the measured On-mode power by multiplying it with 1.46. This is based on the assumption that the TV is in On-mode 4 hours every day, while neglecting any standby or off mode power. The efficiency class is based on the energy efficiency index (EEI).



Efficiency class	EEI
A+++	EEI < 0.1
A++	< 0.16
A+	< 0.23
A	< 0.3
B	< 0.42
C	< 0.6
D	< 0.8

Ecodesign requirements

The Ecodesign regulation for TVs No. 642/2009 has banned efficiency classes below class D since April 2012. Additionally, it requires TVs to automatically switch into standby mode after 4 hours without user interaction and limits the standby power to 1W (with information or status display) / 0.5W (no display) and in Off-mode to 0.3W (0.5W if there is a hard off-switch going below 0.1W) since August 2011. And the min. peak luminance ratio of 65% requirement makes sure that TVs are tested with at least 65% of their highest luminance – preventing manufacturers to test the products in a dark setting, which would lead to a lower energy consumption.

Regulation No. 801/2013 on networked standby requires networked TVs (TVs with network connection) to switch into a networked standby mode (max. 12W for TVs with 'high network availability' (HiNA), 6W for 'low network availability') max. 4 hours after the last user interaction, since January 2015. The max. networked Standby power will be lowered to 8W (HiNa) / 3W (no HiNA) in January 2017.

The EEI is calculated by dividing the measured power in On-mode by the reference power: $EEI = P / P_{ref}$. The reference power depends on the screen size and functions like integrated hard disc and number of tuners.

When the new Ecodesign regulation is adapted, the EEI formula will be simplified with the area (A) as the only variable in the determination of the EEI.



Measurement standard

The power of TVs is measured based on IEC 62087:2011 Methods of measurement for the power of audio, video and related equipment. The power is measured while a dynamic video is played for 10 minutes, which is supposed to simulate typical TV programme contents and brightness. The average power is what is declared and used for the EEI and energy consumption calculations.

EU Ecolabel

The EU Ecolabel for TVs is officially still in force, but its criteria are from 2009 and – at least the energy criteria – rather out-dated: it requires TVs to be at least in class B and to have an On-mode power below 200W. The criteria are currently being revised, and they will be aligned to the future Ecodesign and/ or Energy Label requirements.

5. Market analysis

In July 2014, Topten has published its second TV market monitoring report based on GfK sales data, complemented with 2013 sales data to cover the years 2007 – 2013 (Michel, Attali, Bush, 2014). The report shows the following main results:

- **The Ecodesign requirements for TVs from 2009 were not ambitious enough** and without visible effect on the market. The data, based on which the EC had to decide on the level of the MEPS and the Labelling scale in 2009/2010, was scarce and out-dated. Because the measurement standard was published only in 2008 and because of the fast market transformation from CRT to flat panel TVs, the future development was impossible to be predicted.
- **Today the situation is much better:** there is an obligation to declare according to a certain measurement standard, and there is the Energy Label, strongly facilitating a market monitoring.
- **The average power of TVs has decreased by 65% from 2008 to 2013** (Fig. 5). In 2013, the average TV had an On-mode power of 55W. However, before this the new flat screen TVs had brought along a massive power increase, and only in 2012 the level of the old, smaller CRT TVs was reached again after many years of high-power TVs.
- **TV sales peaked in 2010** (50% sales increase!), when TVs were yet of high power, and before the Energy Label became compulsory. This high number of energy-hungry TVs will be in Europe's living or sleeping rooms for many years.
- **In 2013, nearly 70% of the sold TVs were in classes A and better** across the EU (Fig. 4). Class D has disappeared from the market, and with only 3% of the sales in 2013, also class C is probably gone by now. Because LED-LCDs are moving away from class B and the other technologies are soon gone from the market, also class B will not be on the market much longer. This leaves 3 populated classes on the market (A to A++, with A+++ as a potential fourth class).
- **Average screen size has increased by 20% from 2007 to 2013.** The trend towards larger screen size is on-going (Fig. 5) and supported by the current EEL calculation formula used in the Labelling and Ecodesign regulations. TVs consuming the least energy are not in class A++, but in class A. As a consequence, the average power of TVs will soon start to increase, if the trend to ever-larger TVs is not stopped.
- **TV prices are not linked to energy efficiency, but to screen size.** In spite of higher energy efficiency, TV prices have decreased by between 40% and 62% for specific screen size categories from 2007 to 2013.
- **UHD Televisions are pushing the market towards bigger screen sizes.** Market data from Topten.eu shows that UHD televisions are on average larger than HD televisions as shown by the number of available models in larger screen size categories. The energy consumption per surface unit is indeed smaller but the absolute energy consumption is larger.

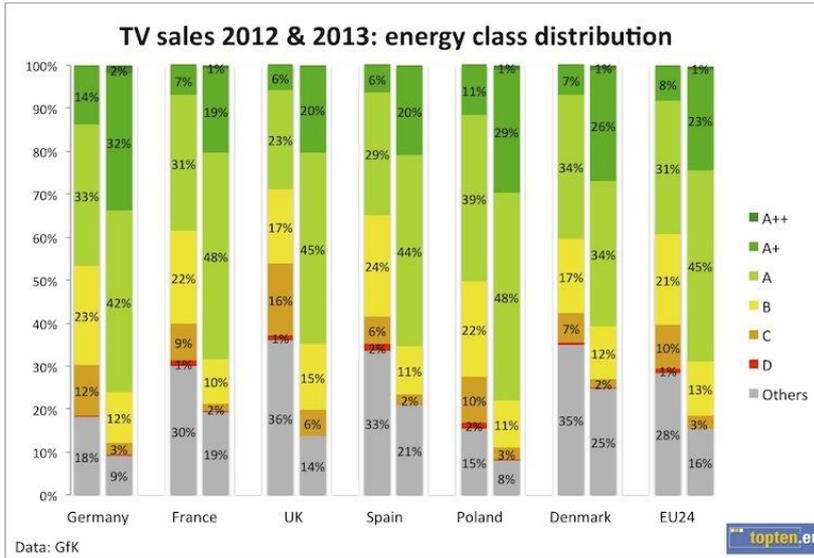


Fig. 3: Distribution of Energy Classes of TV sales in 2012 and 2013. Data: GfK, published in (Michel, Attali, Bush, 2014)

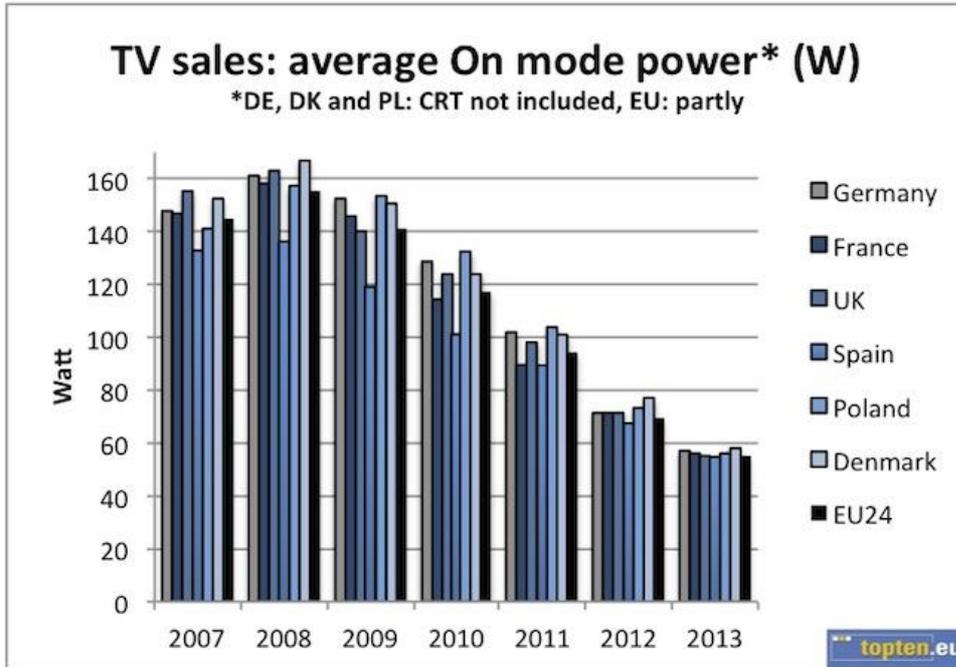


Fig. 4: Average On mode power of TVs. Data: GfK, published in (Michel, Attali, Bush, 2014).

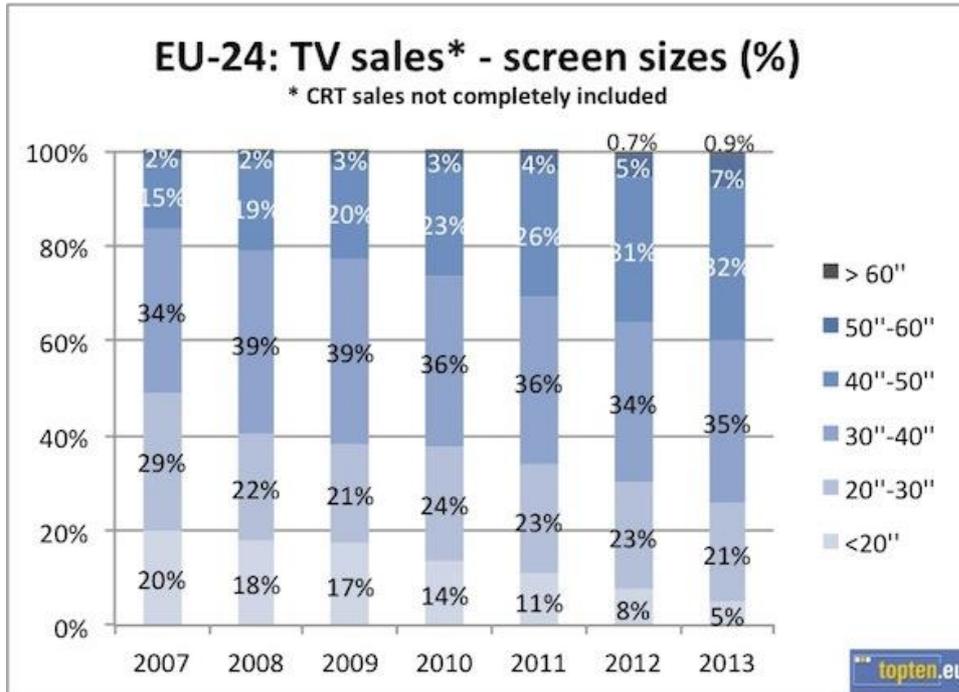


Fig 5: TV sales in the EU-24: percentage of different screen size categories
 Data: GfK, published in (Michel, Attali, Bush, 2014). " = inches



6. FAQ

It seems there are many more A++ TVs on the market. Why are they not on Topten?

Indeed, there are several new large TV models that meet the A++ class. They are not on Topten because they have a power in On-mode greater than 64W or 85W for UHD televisions. Topten has introduced this criterion because large TVs can easily meet A++ efficiency while still having high power. Examples are Sharp models with 131W at 2m diagonal or 166W at 2.3m diagonal. We don't want to support the trend to wall-filling screens, because it opposes our aim of contributing to lower energy consumption. Large TVs that are super-efficient and use less than 64W or 85 Watt for UHD televisions can still be listed on Topten.

7. References and links

Useful links

Topten.eu TV product lists:

http://www.topten.eu/english/consumer_electronics/tv/90cm.html

http://www.topten.eu/english/consumer_electronics/tv/70 - 90 cm.html

http://www.topten.eu/english/consumer_electronics/tv/90 to 100cm.html

http://www.topten.eu/english/consumer_electronics/tv/110 to 120 cm.html

http://www.topten.eu/english/consumer_electronics/tv/120-to-135-cm.html

http://www.topten.eu/english/consumer_electronics/tv/135-cm.html

Topten.eu TV selection criteria:

http://www.topten.eu/english/criteria/selection_criteria_television_sets.html&fromid=

Topten policy recommendations:

http://www.topten.eu/?page=recommendations_tvs&fromid=

Michel, Attali, Bush: European TV market 2007 – 2013. Energy efficiency before and during the implementation of the Ecodesign and Energy Labelling regulations. Second report, complemented with 2013 sales data. Topten International Services, 21st July 2014.

http://www.topten.eu/uploads/File/European_TV_market_2007-2013_July14.pdf

References

Energy Labelling regulation for TVs, No 1062/2010

<http://www.topten.eu/uploads/File/Energy%20Label%20regulation%20TVs%202010.pdf>

Amendment regarding Online Energy Labels: Regulation No. 518/2014

<http://www.topten.eu/uploads/File/Online-Energy-Labels-518:2014-EN.pdf>

Ecodesign regulation for TVs No 642/2009

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

Ecodesign regulation No 801/2013 on networked Standby, amending regulation No 642/2009. It defines also maximum Standby power requirements for networked TVs. The amendment applies from 1 January 2015.

http://www.topten.eu/uploads/File/Networked-Standby_Ecodesign-regu_801-2013.pdf



IEC 62087:2008: Methods of measurement for the power consumption of audio, video and related equipment.

Energy Label framework Directive No 2010/30

<http://www.topten.eu/uploads/File/Energy%20Label%20Directive%202010:30.pdf>

Ecodesign framework Directive No 2009/125

<http://www.topten.eu/uploads/File/Ecodesign%20Directive%202009:125:EC.pdf>

EU Ecolabel: <http://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html>

Criteria for TVs (from 2009): <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009D0300&from=EN>

EuP preparatory studies 'Televisions' (lot 5), Final Report. August 2007, Fraunhofer IZM.

Noah Horowitz, NRDC: What do we know now about the energy use of Ultra High Definition (UHD) and 'smart TVs'? Presented at EEDAL conference in Lucerne, August 2015.

CLASP, ECOS, EEB, Topten. Closing the "reality gap" – Ensuring a fair energy label for consumers, June 2017. <https://clasp.ngo/publications/closing-the-reality-gap-ensuring-a-fair-energy-label-for-consumers>

Review of ecodesign and energy labelling regulations for televisions and draft regulations for electronic displays. Discussion paper. Bob Harrison, Mike Scholand, CLASP, November 2014. <http://clasp.ngo/Resources/Resources/PublicationLibrary/2014/EU-Ecodesign-and-Energy-Labeling-of-Electronic-Displays>