

European TV market 2007 – 2012

Energy efficiency before and during the implementation of the Ecodesign and Energy Labelling regulations

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Index

ABBREVIATIONS	3
1. EXECUTIVE SUMMARY	4
2. INTRODUCTION	6
3. DATA AND METHODOLOGY	9
4. RESULTS AND INTERPRETATION	11
Sales development	11
Screen size developments	13
Price developments	15
On mode power developments	17
Technologies	22
2012: Energy Classes	25
Does efficiency lead to higher prices?	27
5. CONCLUSIONS	32
General	32
Evaluation of Ecodesign requirements and Energy Label	32
Recommendations for revision	34
6. REFERENCES	35
ANNEX: COUNTRY REPORTS	37
Germany	38
France	42
United Kingdom	46
Spain	50
Poland	54
Denmark	58
EU-24	62

Abbreviations

CCFL	Cold Cathode Fluorescent Lamp
CRT	Cathode Ray Tube
EC	European Commission
EEL	Energy Efficiency Index
EU	European Union
EUR	Euro
GfK	Gesellschaft für Konsumforschung, a professional market research institute
HD	High Definition
IEC	International Electrotechnical Commission
LED	Light Emitting Diode
LCD	Liquid Crystal Display
MEPS	Minimum Energy Performance Standard
OLED	Organic Light Emitting Diode
TV	Television Set
W	Watt
"	Inches

1. Executive Summary

In 2010 the first tier of the Ecodesign measures for TVs was implemented, since April 2012 tier 2 applies. The Energy Label has been compulsory since December 2011. Ecodesign and Labelling regulations are both being reviewed by the European Commission, and it is expected that new tiers on Ecodesign requirements will be adopted in the 4th quarter of 2013.

The basis for the decisions on the level of the minimum efficiency requirements in the first Ecodesign regulation for TVs was weak: the data was scarce, the information on energy consumption was not declared based on a defined standard, and the market was in a massive transformation process.

For the revision, the chance to set ambitious Minimum Energy Performance Standards (MEPS) leading to effective energy savings should not be missed. Today all manufacturers declare the On mode power and energy efficiency of their TVs according to the Energy Label, and professional market research companies like GfK possess comprehensive and recent sales data. The present market monitoring report analyses the developments on the TV market regarding screen size, price, power in On mode and technologies for the years 2007 – 2012, based on sales data from GfK. For 2012 the information on energy classes is included. The monitoring covers the EU-24 plus on country level Germany, France, UK, Spain, Poland and Denmark. The results of this report support the decisions on limits for new Ecodesign requirements. It is planned to update the report with 2013 sales data and possibly beyond.

Two technology shifts can be observed from 2007 to 2010: the complete disappearance of CRT TVs, which were replaced by LCD-TVs, and later the shift from CCFL-backlit LCD TVs to LCD-TVs with LED backlight. The EU-sales reached a peak in 2010, when yet CCFL-LCD TVs were dominating. Average TV prices were reduced by 30% over the observed period, while the average screen size increased by 4.5 inches (11.4 cm, +15%). When looking at certain screen size categories instead of the entire market, the price reduction is bigger: around 50%, depending on the screen size. Apart from TV prices also their average power in On mode was reduced. From 2008 to 2012 the average On mode power was reduced by 50% across all screen sizes, and up to 65% for large TVs (40"-50"). Because at the same time the average screen size increased, this actually means an impressive efficiency gain.

The market monitoring report shows that these improvements were not mainly caused by the Ecodesign and Labelling regulations, but that they were the result of a 'natural' technology development, which happened much faster than the Commission expected when deciding on the Ecodesign requirements. The level of both tiers was much higher than the average On mode power, and the regulation was left with very limited effect. Still, the discussions leading to the measures might have lifted energy efficiency into focus and accelerated a bit the process, especially since it became an aspect for marketing activities with the introduction of the Energy Label. In 2012, after the Label had been in place for one year, class A was the most important class regarding sales share. Across the EU, already 39% of the sales were in class A or better.

How the efficiency improvements translate into total electricity consumption, is not clear. First, the actual time in On mode is not known. While it will be different for (larger) living room TVs than for (smaller) secondary TVs, due to increased functionality, it will be on average higher than before the technology shift. Second, once brightness, contrast or other settings have been changed the actual energy consumption of TVs can easily be 30% higher than what is declared. And as a third point, the consequence of the massive sales peak is now in Europe's living and especially also sleeping rooms and will continue to consume electricity in the next decade. The sales peak reached its maximum

before the gains in efficiency could compensate for the increased size and functionality of the new LCD technologies: while by 2012 the average On mode power was back at the level of the old CRT TVs, (70W) during the boom years it had been between 30% (2011: 95W) and 100% (2009: 140W) higher than the 2012 average of 70W.

In the revision, ambitious MEPS should be set, which make sure that the extra energy consumption caused by the huge sales peak due to the technology market transformation to digital and LCD TVs can be compensated for with further efficiency improvements: class A should be defined as MEPS from 2015, A+ as future requirement, following soon. From an LLCC-point of view strict MEPS are favourable: the price of TVs is not related to efficiency, but to screen size (and other functions). Additionally the efficiency approach should be improved to stronger weight absolute consumption. A progressive or even capped efficiency approach (requiring larger TVs to be of higher efficiency than smaller ones to reach the same energy class) for both the Ecodesign requirements and even more importantly for the Energy Label would stop supporting the trend to larger screen sizes. The present report also demonstrates the value of a market monitoring based on sound sales data. A systematic market monitoring in the EU for all products with an Energy Label in place is a relatively easy task, yet it allows to evaluate the impact of implementing measures, to decide on the need for a revision of Energy Labels or Ecodesign requirements in time, and to base decision on the actual design of these instruments on complete and recent market data.

2. Introduction

TVs: market development, standards and product policies

The preparatory study on TVs was started in early 2006, and published in 2007. At the same time, the measurement standard was revised to introduce a different methodology to measure the TVs On mode power. The Ecodesign regulation on TVs was adopted in July 2009 (EC, July 2009), the Energy Labelling regulation in September 2010 (EC, September 2010). During these years and up to now the market changed dramatically: the formerly dominating Cathode Ray Tube (CRT) TVs completely disappeared from the market and were replaced by flat panel TVs – mainly by Liquid Crystal Display (LCD) TVs. This development was to a large extent drawn by the change from analogue to digital TV broadcasting, the trend to high resolution (HD) displays, and went hand in hand with a trend to larger screens (Stobbe et al., 2007). In 2012 Light Emitting Diode (LED)-backlit LCD-TVs are dominating the market, and current driving forces to market development are trends towards internet connectivity, 3D or ultra high definition TVs (European Commission, 2012). It is expected that in the mid-term Organic Light Emitting Diode (OLED)-TVs will start the next fundamental market change.

The most important steps in TV standardisation and policy making since 2007 are briefly presented below.

a) August 2007: preparatory study finalised

Started in early 2006, the preparatory study on TVs was finalised in August 2007 (Stobbe et al., 2007). Sales data used in the study was from 2003 and 2004, when CRT TVs were still clearly dominating the market. The authors of the preparatory study stated that a fast development was happening at the time of research and that it was ‘difficult to give a precise evaluation of the mid to long term situation’ (Stobbe et al., 2007). LCD and Plasma TVs had newly entered the market and started to replace CRT TVs.

The study recommended introducing an Energy Label and a maximum On mode power requirement. The authors suggested defining these requirements along the current average power level for different screen sizes, to gain experience based on the new measurement standard and to adapt the requirements later. A first energy labelling scheme was proposed in the preparatory study.

b) October 2008: Publication of IEC 62087:2008 measurement standard

Already since 2004 experts from major TV manufacturers and independent international experts were involved in the development of the new IEC dynamic test signal methodology. IEC 63087:2008, published in October 2008, was the first international test standard to introduce a test methodology based on a dynamic broadcast signal for measuring the average On mode power of TVs (IEC, 2008). The authors of the preparatory study recommended basing the Ecodesign and Labelling declarations on this methodology (Stobbe et al., 2007). Before 2008, according to IEC 62087:2003, a static three-bar black & white test pattern was used. Many manufacturers however also declared maximum power, established for safety testing (Harrison, 2013).

c) October 2008: Consultation Forum

A working document (WD) on Ecodesign requirements for TVs was discussed at a Consultation Forum (CF). This was not the first WD but a version that had already been updated (ecee, ‘products and status’).

d) March 2009: Final Ecodesign draft

The Regulatory Committee approves the final draft of the Ecodesign regulation.

e) May 2009: Rejection of Energy Labelling draft

The energy labelling proposal is rejected by the European Parliament. The labelling scale in the proposal was based on the 'A-20%' format. The Parliament claimed that the Labelling format was confusing to consumers (the same day however the Parliament adopted a new Energy Label for refrigerators and freezers based on the same format) (Euractiv, 2009).

f) July 2009: adoption of the Ecodesign regulation

The European Commission adopts the Ecodesign regulation on TVs (EC, July 2009). It enters into force in August 2009, and after one year the requirements regarding maximum On mode power apply. The requirements on Standby and Off mode power (max. 1W / 2W) apply already from January 2010.

g) February 2010: new Energy Labelling draft

A new Energy labelling draft is circulated for stakeholders' comments. The labelling scale is now based on the A+ format, which is in line with the recast of the Energy Labelling Directive to be adopted in May 2010 (EC, May 2010). The A class limit has been shifted to a 20% more ambitious level compared to the proposal from 2009. Soon after (in March), a classification scale with an even more ambitious class limit is circulated. This scale will be adopted in September.

h) August 2010: tier 1 On mode power applies

New TV models put on the market after this date are required to have a power consumption in On mode corresponding to class F or better ('normal' resolution). Full HD TVs can have higher power, as defined in the regulation. Thus, class G is partly banned from August 2010.

i) September 2010: adoption of Labelling regulation

The new Energy Labelling regulation for TVs is adopted by the Commission (EC, September 2010). The Energy Label with the classification scale proposed in March enters into force in December 2010. The classification scale of the Energy Label is based on the Energy Efficiency Index (EEI), which is also used in the Ecodesign regulation. The EEI expresses the power of a TV relative to the power of a reference model of the same screen size. The EEI and the Energy Efficiency class are thus indicators of the relative power (and energy consumption, as this is directly linked to power). Consequently, a large TV can be labelled with the same or even better Energy class despite consuming more energy than a small TV. The annual energy consumption is also indicated on the label (Fig. 1). It is however questioned whether consumers are responsive to this secondary information figure (Toulouse et al, 2012).

j) December 2011: the Energy Label applies

The transition phase of the Energy Labelling regulation is terminated and the declaration according to the Energy Label is compulsory.

k) April 2012: tier 2 On mode applies (class D)

The second step of the minimum efficiency requirement of the Ecodesign regulation applies: new TVs put on the market must be in class D or better, for all resolutions.

Present / Future developments:

The Ecodesign regulation for TVs (EC, July 2009) asks for a review of the regulation in 2012. The revision process has started in 2012 with the publication of a discussion paper (EC, 2012) and a Consultation Forum. The adoption of the revised Ecodesign and Labelling regulations is planned for the fourth quarter of 2013 (Grönroos-Saikkala, 2013).

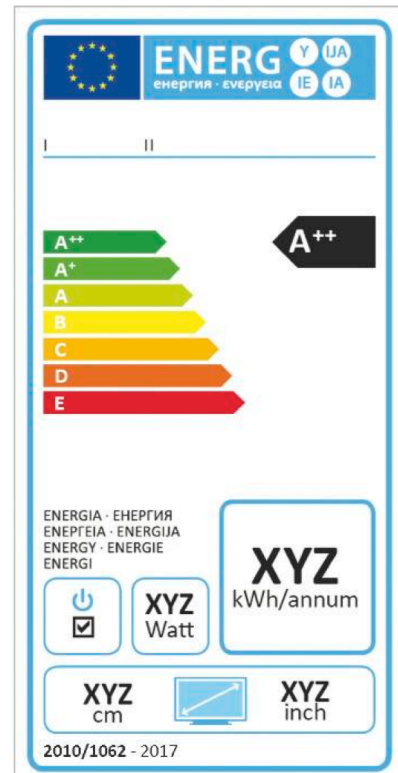


Fig 1: Energy Label for TVs

Development of the Best Available Technology (BAT)

Topten is an online tool to inform about the most energy efficient products. Topten selects its products according to official Labels and Standards. In 2009 the European Topten website (www.topten.eu) started to list TVs according to the Energy Label draft. The rapidly increasing efficiency of the TVs listed on Topten.eu demonstrates the fast technological development that happened along the discussions and already before the introduction of the implementing measures. In September 2010, when the Labelling regulation was adopted, Topten already listed 60 class B and 5 class A TV models. One year later, when the Energy Label applied, there were 110 class A TVs and 17 A+ TVs on Topten.eu. By April 2012 the number of A+ TVs on Topten.eu has climbed to 99 and the lists show that the first A++ TVs had emerged on the market (Topten Focus, 2012). In May 2013, there are more than 200 A+ TVs and 21 A++ TVs on the lists of Topten.eu (Fig. 2; these numbers include all similar models on the market).

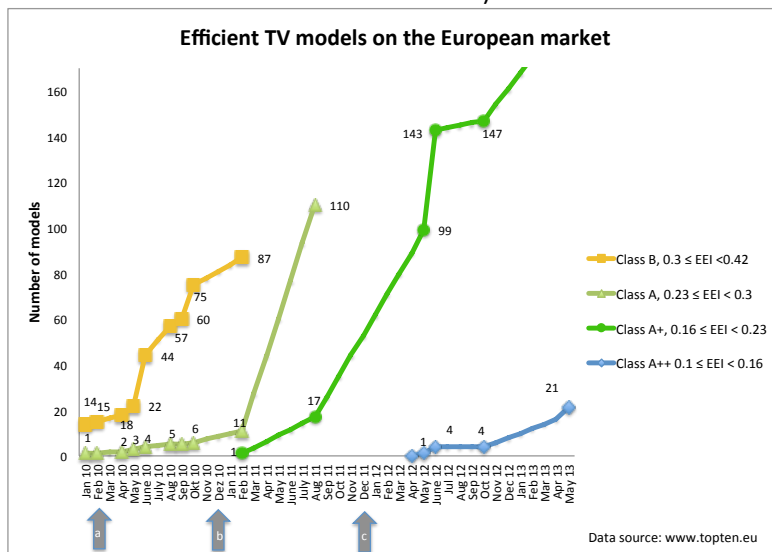


Fig. 2: Increasing number of efficient TVs on www.topten.eu.

3. Data and Methodology

Coverage

GfK is a professional market analysis company present around the world. In Europe GfK covers over 90% of the markets in all 27 Member States. Sales data plus many product characteristics are obtained from retailers. GfK is an expert on market data, Topten has the expertise on Energy issues such as policy and standards. For this market monitoring, TV sales data were obtained from GfK, for the years 2007 – 2012, in the EU-24 plus sales at country level for six countries (table 1).

Table 1: Countries covered and population

Country	Population ¹	Average persons per household ¹
EU-24*	499.3 Mio	2.37
Germany	81.7	2.05
France	64.7	2.35
UK (without Northern Ireland)	62	2.22
Spain	46	2.65
Poland	38.1	2.81
Denmark	5.5	2.38

* EU-24 includes Germany, Denmark, United Kingdom, Italy, Poland, Spain, Austria, Belgium, Bulgaria, Estonia, Finland, France, Greece, Hungary, Ireland, Latvia, Lithuania, Netherlands, Portugal, Czech Republic, Romania, Slovakia, Slovenia and Sweden.

For the years 2007 – 2011 sales numbers, price and annual energy consumption as declared for different size categories and TV technologies were retrieved. As power was not available, it was re-calculated from annual energy consumption. From 2008 - 2010 it is estimated that about 80% of the TVs power were declared according to the IEC 62087:2008 standard. Annual energy consumption was declared according to the calculation formula that was included in the Energy Labelling regulation later ($E = P * 1.46$; E= Annual Energy Consumption, P= Power in On mode) (for more details on measurement and calculation methods see below). After November 2011 the Energy Label for TVs became compulsory (EC, Sep 2010). So, for the 2012 dataset also the energy efficiency class was included. No information on brands or models is included.

On mode power – changing measurement methods

Between 2007 and 2010 the declaration of the TVs On mode power changed, because a new measurement methodology was introduced. IEC 62087:2008 was the first international measurement standard to introduce a testing methodology based on a dynamic broadcast signal for measuring the On mode power of TVs. The Ecodesign regulation (EC, July 2009) refers to a dynamic measurement method. Since 2010 On mode power of TVs on the European market is declared according to this measurement method.

Experts were developing the new test standard since 2004 already. Also the authors of the preparatory study recommended the new method based on the dynamic broadcast content signal to be referred to for the Ecodesign and Energy Labelling regulations in 2006/2007 (Stobbe et al., 2007). At the same time it was decided that annual energy consumption would be declared, based on an assumed daily use duration in On mode of four hours and not considering low power modes. Major manufacturers started to apply this methodology from 2008 (Harrison, 2013).

Which of the On mode power testing methods (static 3-bar signal of IEC 62087:2003, dynamic signal contained in IEC 62087:2008 or maximum On mode power as declared for safety testing) and which

¹ Data from Eurostat: <http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>

annual energy consumption calculation methods were used in the declarations before 2008 is not known. Additionally before 2010 there was no obligation to declare a power or energy consumption value according to a given test standard. Therefore the power values before 2009 / 2010 should be interpreted with caution. It is assumed that for 2008 – 2009 about 80% of the TVs were declared according to the measurement and calculation methods used today in the Energy Labelling regulation for TVs (Harrison, 2013).

Missing detail information for CRT TVs in Poland, Germany and Denmark

Sales of CRT TVs are included in the total sales and in the average price, but no detail information such as size, price or power/energy consumption is available for CRT TVs sold in Poland, Germany and Denmark. This has an effect on the size related figures for the year 2007 – 2009, which therefore have to be interpreted with this gap in mind. After 2010, CRT sales were 0 in these countries, and the missing information concerns only the years before.

For the EU, the information gap is partial: only for a part of the CRT sales the information is missing (2007: 41% of CRT, 2008: 36%, 2009: 25%). The table below shows for which countries and years the information is missing, and to what extent.

Table 2: Missing detail information on CRT sales

Proportion % of Total sales / % of CRT sales	Poland	Germany	Denmark	EU-24
2007	78% / 100%	33% / 100%	8% / 100%	10.5% / 41%
2008	20% / 100%	10% / 100%	2% / 100%	4% / 36%
2009	4% / 100%	2% / 100%	0%	1% / 25%
2010 - 2012	CRT sales near 0 – no gap remaining			

While for Denmark and, apart from 2007, for Germany, the effect of the missing data can be neglected in average figures, it is considerable for Poland. For 2007 for almost 80% of the sale the detail information on size, price and power is not available, and the concerned figures are therefore invalid.

Not included: Standby power and total energy consumption

Information on Standby and Off mode power is not included in the TV Monitoring project. These were certainly relevant modes for the energy consumption before the TVs Ecodesign regulation became effective in 2010, and which limited the power of these modes to maximally 2W. Before 2009 Standby and Off mode power were not declared in a standardised way, and since 2010 these low power modes are no longer crucial for the total energy consumption.

The monitoring project does not present total energy consumption values, even though this figure can be calculated from the On mode power and the sales – based on the calculation formula used for the Energy Label. The Labelling regulation assumes a daily On mode duration of 4 hours (EC, Sep 2009), based on the findings from the preparatory study (Stobbe et al., 2007). The authors of the preparatory study expected that the On mode duration per day would rise to an average of 5 hours in the future. Daily viewing time may differ between countries, but also for different TVs. The DEFRA study 'Powering the nation' from 2012 for instance found an average daily TV watching time of six hours in UK, the average household possessing 2.3 TVs (EST/DEFRA, 2012). The study does not differentiate between different TV sets. Assuming that larger TVs are used in the living room than in the sleeping room and that average viewing times for the two TV types differ, this influences the total energy consumption. Considering this, the different methods used for declaring the On mode power over the years plus the decreasing importance of the low power modes (without having information on it) it was decided to only present On mode power figures instead of annual energy consumption. The data presented however allows deriving estimations on the evolution of TVs' energy consumption in Europe.

4. Results and Interpretation

Sales development

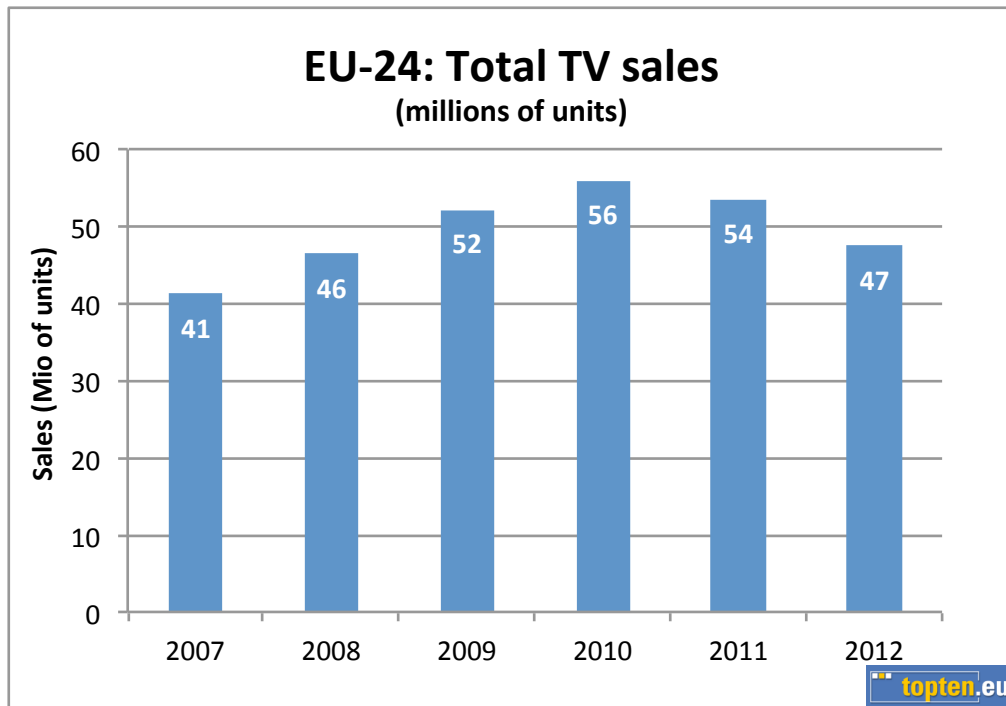


Figure 3: Total annual TV sales in the EU-24

Data source: GfK

From 2007 to 2010 the number of annually sold TVs increased by 50% - from 37 million to 56 million units per year. These figures impressively show the impact the introduction of new technologies had (flat panel TVs, digital and HD TV). We don't know exactly what motivation brought consumers to this increased buying activity: was it the wish to profit from the opportunities the new technologies offered, high definition (HD) picture quality, the slimmer flat panel TVs or additional functions provided by the new TV technologies. Or was it mainly the switch to digital TV, which put some pressure on consumers to replace their old TVs (whether this was necessary or not, certainly some people were afraid not to be able to receive their channels with the change to digital TV)? After 2010 the sales decreased at a similar pace – back to 47 million units in 2012.

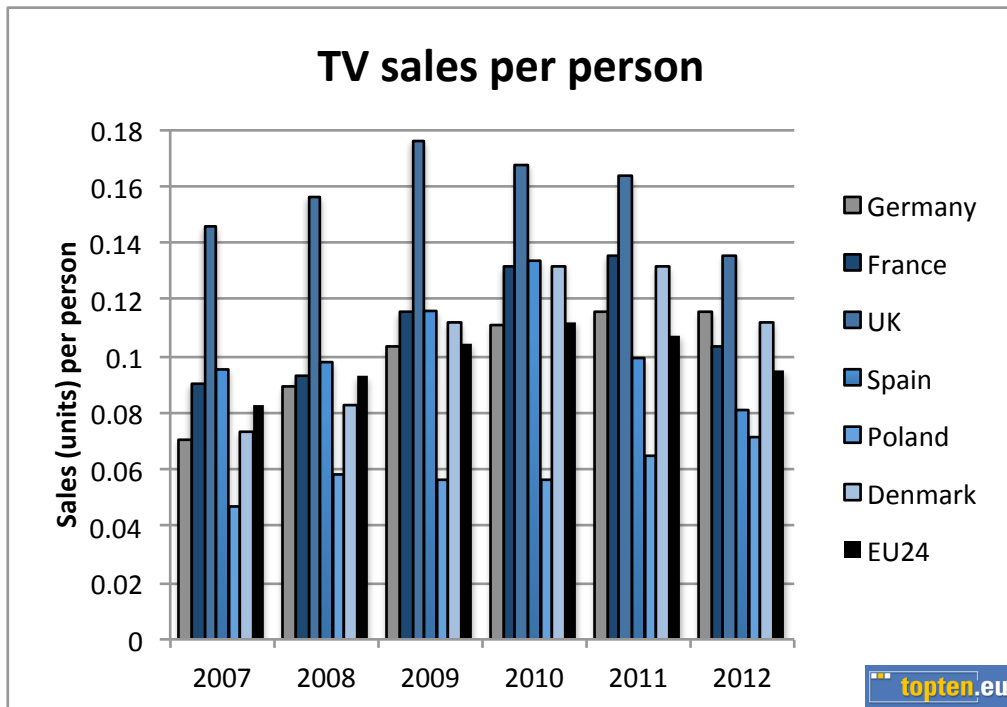


Figure 4: TV sales per person – in countries and in the EU-24
Data source: GfK

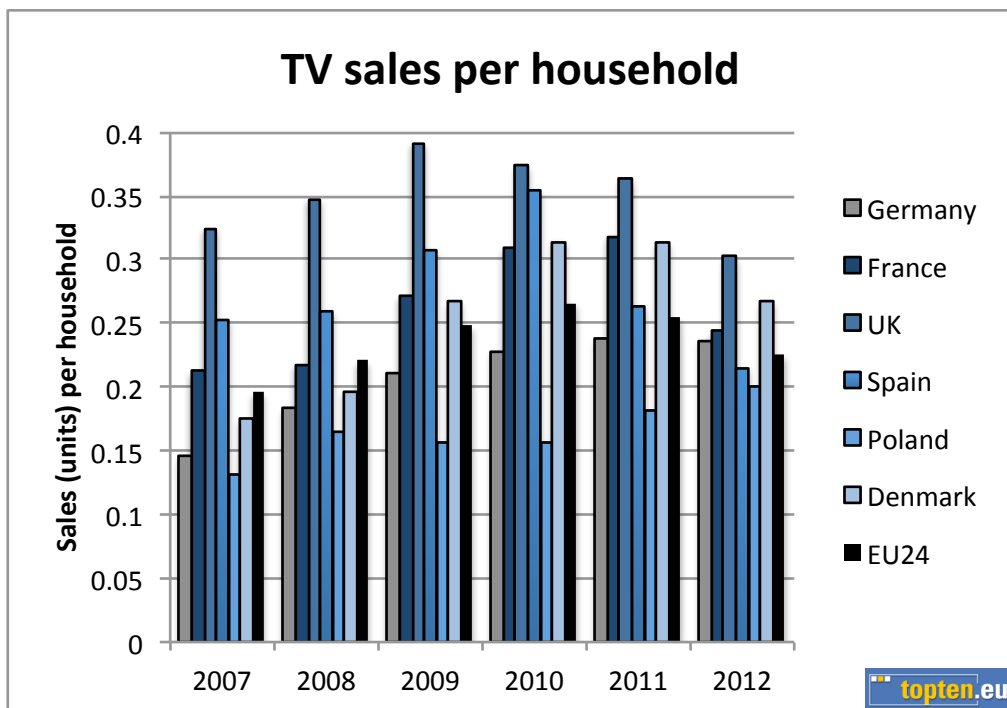


Figure 5: TV sales per household – in countries and in the EU-24
Data source: GfK

People do not show the same readiness to buy new TVs all over Europe; there are considerable differences between countries (Fig. 4). Most striking is the buying behaviour of UK consumers: in 2007 the British bought almost twice as many TV sets per person as the EU average. UK is considered a very mature TV market, with a penetration rate of 2.3 TV sets per household (EST/DEFRA, 2012). At the other end of the scale is Poland: from 2007 to 2011 Polish were around 50% less likely to buy a new TV than the EU average. Contrarily to the other countries however in Poland sales continued to increase until 2012.

When dividing the sales by the number of households instead of persons and thus considering for different household sizes, the outcome is not changed much, but some of the differences between countries become smaller (Fig. 5). For countries with rather large household size like Spain and Poland the relative sales are a bit higher when considered on a per-household than on a per-person basis, while for Germany, having the smallest household size of the EU, the relative sales become a bit smaller.

Figures 4 and 5 cannot be interpreted without also looking at figures 6 and 7, which shows the trends in average screen size in the countries. These figures impressively show the strong and on-going trend towards larger screen sizes.

Screen size developments

Screen sizes are in inches of the diagonal. The table below provides a translation into centimetres.

Table 3: inches-cm conversion (1inch = 2.54 cm)

Inches (")	cm
20	51
30	76
40	102
50	127
60	152

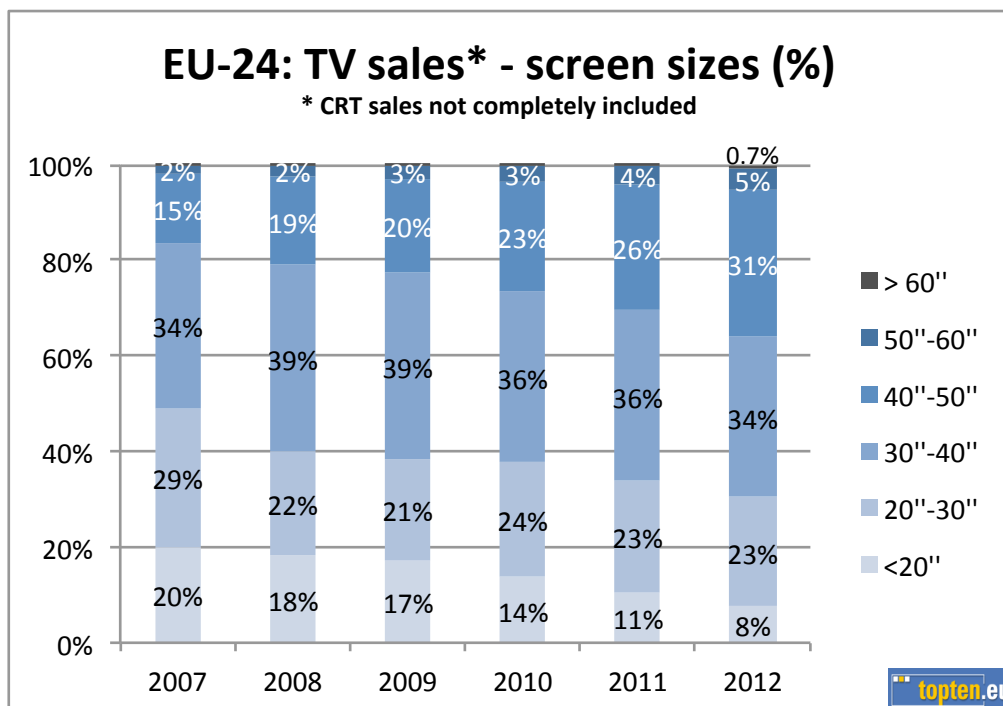


Figure 6: TV sales in the EU-24: percentage of different screen size categories
Data source: GfK. " = inches. Because of rounding the total sales can sum up to 101%.

Not only more TVs were bought, but also larger ones: Figure 6 shows the on-going trend towards larger screens. Between 2007 and 2012 the sales have generally shifted to larger screen sizes. Figure 6 shows a constant decrease of the sales proportion of very small TVs (screen diagonal < 20 inches) and a constant increase for the two largest size categories (screen diagonal between 40 and 50 inches and 50 to 60 inches). Especially TVs between 40 and 50 inches became increasingly popular: the sales proportion of this size category doubled from 15% to 31%. The sales proportions of the intermediate sizes (20" – 30" and 30"- 40") show less clear trends but some fluctuations over the

observed years. This graph can be interpreted with the trend towards two or more TVs per household in mind. While living room TVs are clearly getting larger, TVs bought to be placed in bedrooms will usually be smaller than the former. Most popular over the entire period were TVs between 30" and 40".

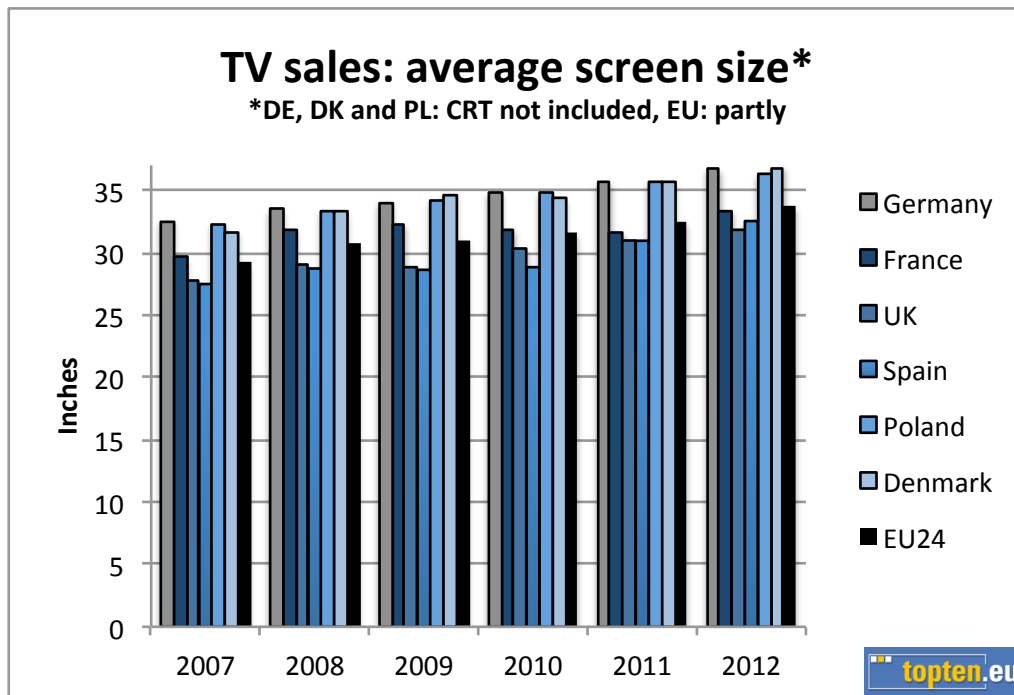


Fig. 7: TV sales in countries and EU – average screen size
Data source: GfK.

Across the EU-24, the average screen diagonal increased from 29.3" (74.4cm) by 4.5 inches (+11.4 cm) to 33.7" (85.6cm) between 2007 and 2012 – equalling an increase of 15%.

Figure 7 also shows that in the UK, where people buy most TVs, they buy smaller TVs than in other countries. The smaller average size will be a result from a high sales percentage of secondary TVs, which are placed in the sleeping room or kitchen. These TVs are smaller than living room TVs. A look at the distribution of the 2012 sales on the detail screen sizes in the country annex supports this thesis: the sales of small TVs (<20") compared to the sales of other sizes is higher in UK than in the other countries, and the 20-22" TVs have a similar popularity only in Spain. The contrary applies to Poland, where comparatively few but rather large TVs are sold. Are these mostly living room TVs, and therefore on average larger? The number of TVs Germans buy is close to the European average, but the average screen size is among the largest. In France the trend towards larger screen size stopped in 2009, and the sales per person remained near the EU-average. Also in Spain TV sales per person were near the EU-average, but dropped to lower values in 2011 and 2012. The average screen size however was higher in these two years, after having been among the lowest before. Danish TV consumers compete with Germans and Polish for the largest average screen size, while sales per person increased to values a bit higher than the EU average.

Looking at the detail screen sizes and the 2012 EU sales, 32" and 40" – 43" turn out to be by far the most popular screen sizes (Fig. 8): these two categories together accounted for 53% of the sales in 2012 (32": 29%; 40" – 43": 24%). A second sales peak is at around 20" – these will be mostly secondary TVs. In all countries these four screen sizes were most popular in 2012, but with different preferences for the two large size categories and different weight of the small TVs (see Annex with country reports).

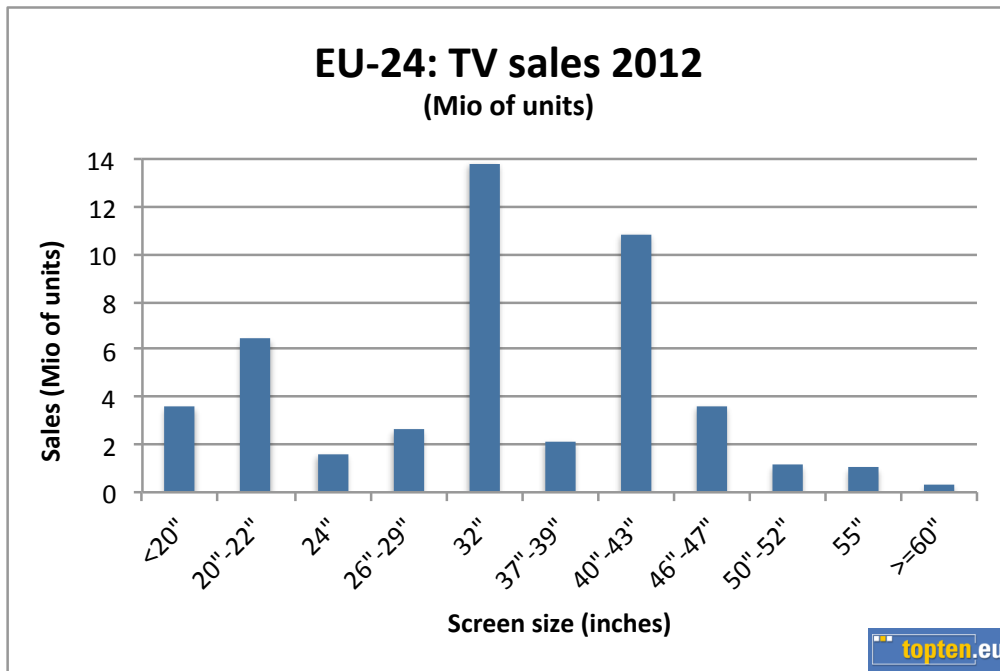


Fig. 8: Sales of TV sizes in the EU-24, 2012.
Data source: GfK.

Price developments

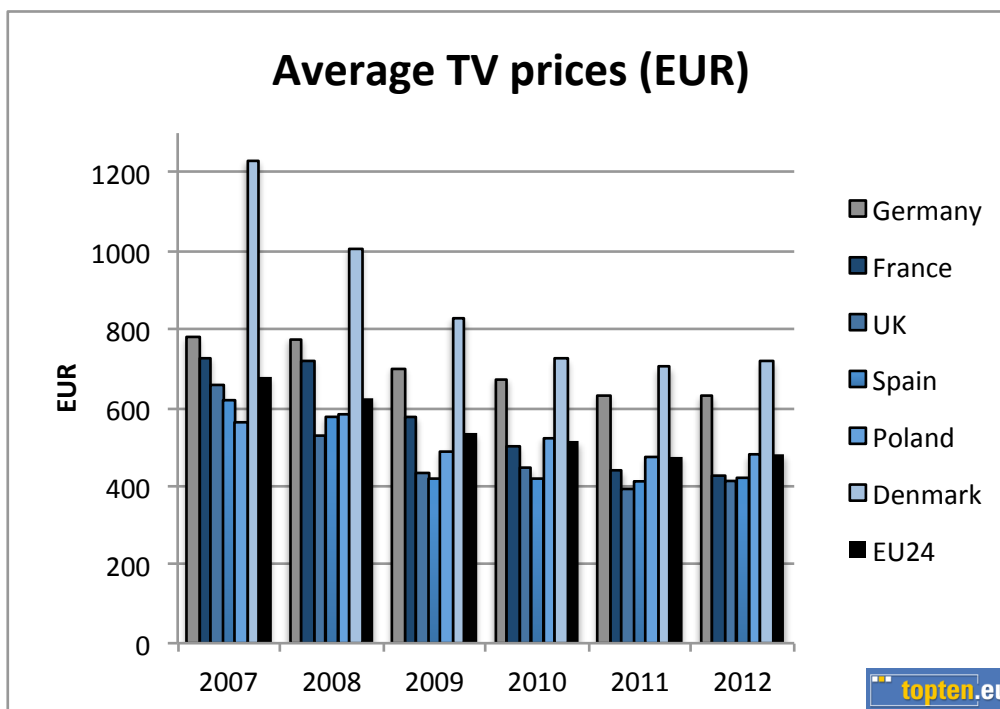


Fig. 9: Average TV prices in EU and countries
Data source: GfK

Despite growing screen sizes, average TV prices in general decreased from 2007 to 2012, at a slowing rate which seems to have stopped in 2011. Average price reduction in the EU was 29% from 2007 to 2012. The price decrease over these years was smallest in Poland (-15%) and Germany (-19%), and strongest in Denmark (-42%) and France (-41%). Not surprisingly, the two countries with lower average screen size, UK and Spain, also pay the lowest average prices for their new TVs. Prices in

Poland have been similarly low, probably mostly due to the relative Purchasing Power (PP)² compared to the other countries. French average prices decreased to be among the lowest after 2010, more or less in line with shrinking screen sizes. In Denmark, which has the highest PP of all EU Member States and where large TVs are favoured, the highest average TV prices are paid.

TV prices became more levelled over the years. In 2007 and 2008 for some large TVs very high prices were paid: e.g. an average of almost 19'000 € for 278 Plasma TVs over 60" in Denmark in 2007, or an average of close to 44'000 € for 6 LED TVs larger than 60" across the EU-24 in the same year (22'200 € for 87 of the same category in 2008). A sensitivity analysis showed that the results on average price and power are not strongly influenced by these few models, so they were kept in the dataset for all calculations. Such very high average prices disappear completely after 2009.

Looking at single screen size categories, the reduction in price is even more impressive: across the EU-24 prices for 20"-30" TVs were reduced by 49% from 2007 to 2012 (Fig. 10), by 57% for 30"-40" TVs (Fig. 11) and by 50% for 40"-50" TVs (Fig. 12). For small TVs below 20" the price reduction in this period was 38%, for large TVs (50"-60") 40%. The price reduction was the strongest in the most popular screen size category of 30"-40" TVs.

Figure 9 includes all screen sizes. The sales of large TVs (with higher average prices) getting higher over time lead to a smaller average price reduction than when looking at specific screen sizes. Figures 10-12 may still include a shift to larger screens within the 10"-categories, but the 50% price reduction in these figures are certainly closer to the 'real' price reduction than the 30% in figure 9.

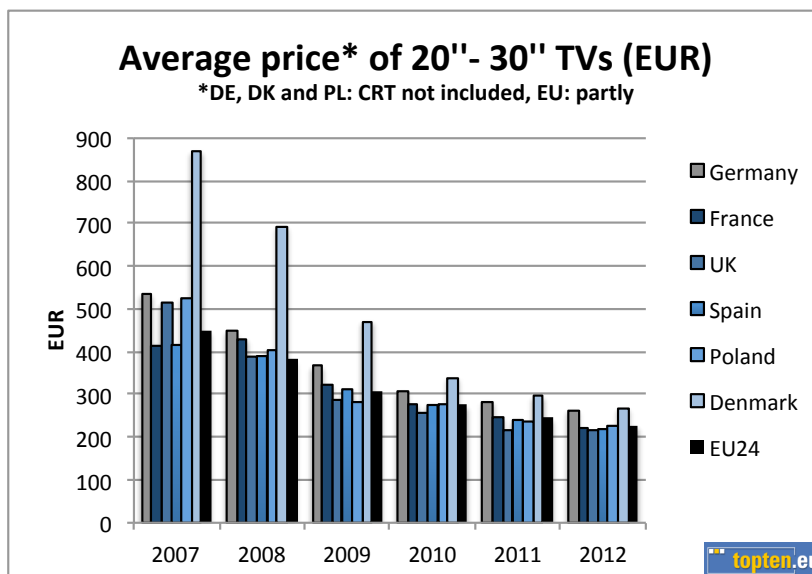


Fig. 10: Average prices of 20'' – 30'' TVs
 Data source: GfK

² Source: Eurostat
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Comparative_price_levels_of_consumer_goods_and_services

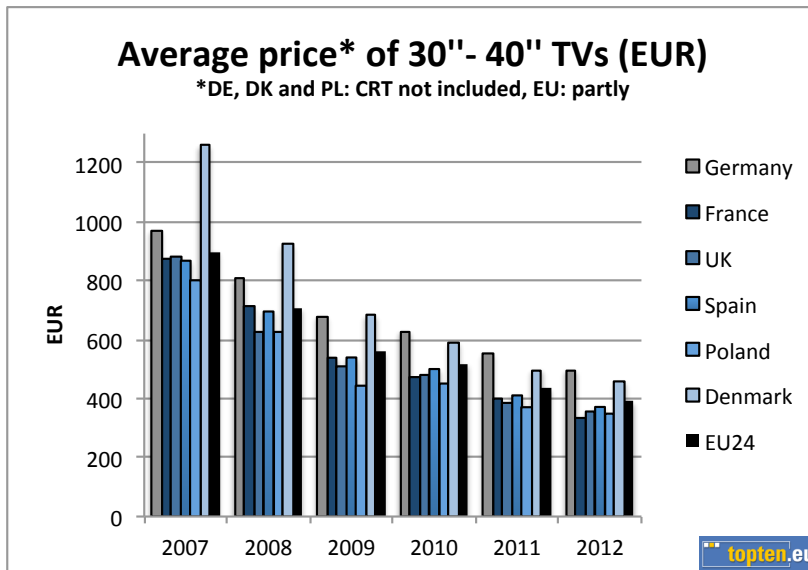


Fig. 11: Average prices of 30'' – 40'' TVs
Data source: GfK

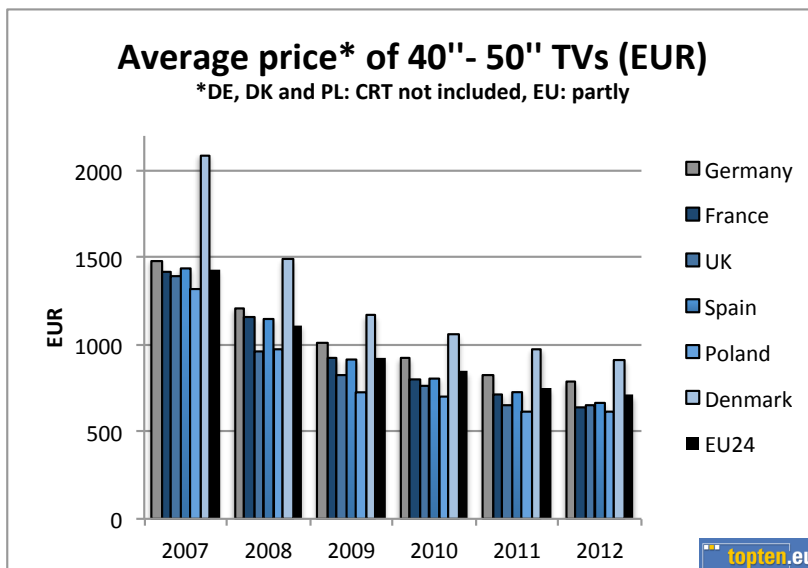


Fig. 12: Average prices of 40'' – 50'' TVs
Data source: GfK

On mode power developments

Larger TVs (of the same technology) have higher power in On mode (Stobbe et al., 2007) – this easy-to-understand rule which is also embedded in the EEL calculation formula of the Ecodesign and Energy Labelling regulations (larger TVs can have higher power), leads us to fearing that the strong trend towards larger screen sizes observed above goes hand in hand with higher average On mode power. Figure 13 makes clear that this fear is not justified: despite the TVs getting larger, the declared average On mode power has impressively decreased, especially between 2008 and 2012.

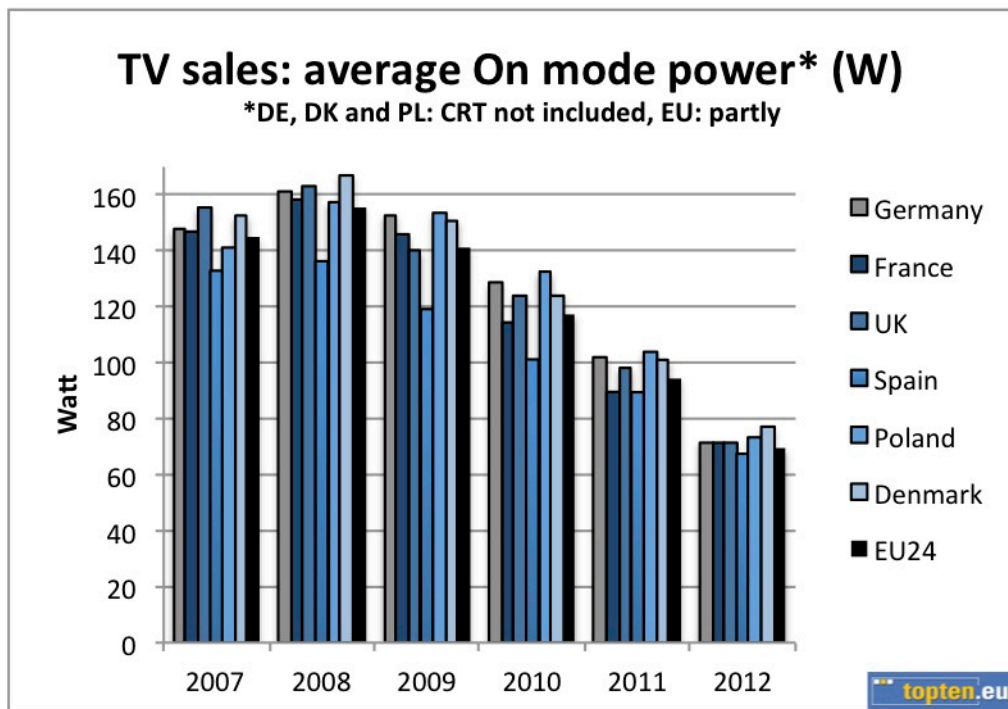


Fig. 13: Average On mode power of TVs
Data source: GfK

As mentioned in the chapter ‘Data and Methodology’, On mode power values before 2010 have to be interpreted with caution. Before 2010 manufacturers were not obliged to declare power values, and before 2009 different and changing measurement standards were used. Despite these restrictions there are no large discrepancies or jumps in the power values from 2007 – 2009. From 2007 to 2008 the declared average power values increase a bit – probably due to the application of the new measurement method IEC 62087:2008.

The graph displaying the power development of the different technologies (Fig. 22) shows that there was a jump for certain TV technologies though: the average declared On mode power of Plasma and Rear Projection TVs did make a jump to higher values from 2007 to 2008, while their average screen size remained the same or even decreased (Fig. 23). For LCD- and CRT TVs there was little change in these two years, or the average power decreased (LED-LCD).

This issue cannot be evaluated further since it is not known according to which measurement standards the On mode power was declared before 2008. When looking at the On mode power development, we only consider the information from 2008, when assumedly most manufacturers use the same method as recommended later for the Energy Label.

After 2008 the average power of TVs decreased continuously: from 2008 to 2012 the average On mode power of TVs sold in the EU-24 decreased by impressive 55% - despite an average screen diagonal increase of 10% over the same period. In 2008 the average TV sold in the EU reached an On mode power of 156W – by 2012 the average On mode power was 70W.

Not surprisingly, average power is higher in those countries with large average screen sizes: Germany, Denmark, Poland. In Spain and, from 2010, in France, where consumers preferred smaller TVs, average On mode power is lower. The average power of TVs in UK was close to the European average, even though average TVs are smaller in UK than in the EU average.

The differences between countries became smaller over the years. Especially in 2012, average power is much more levelled across the countries than before. Figures 17 and 18 below show that this cannot be the effect of the Ecodesign requirements (because the level was clearly above the average power). One hypothesis is that the newly compulsory Energy Label had the effect of leading manufacturers to design their models along the energy class limits. Another factor is certainly the

number of market players that was reduced: the number of different TV brands available on the EU market declined from 746 in 2007 to 480 in 2012 (minus 36%; source: GfK). It is thinkable that the market transformation process towards flat panel and especially LED-backlit LCD TVs eliminated a number of market players, who could not keep up with the pace of development and dropped out of the competition. The reduction of competitors may have lead to a reduction of product 'diversity' on the market and thus contributed to a more uniform market also regarding average power in different countries.

Graphs 14-16 below show the development of declared On mode power for the most important size categories. These graphs show that the efficiency gain was the greatest for large TVs: across the EU-24, the declared On mode power of 20" to 30" TVs was reduced by 50% from 2008 to 2012, by 58% for 30" to 40" TVs and by 65% for TVs between 40" and 50".

Differences between countries will be mainly size-dependent, since these size categories are broad and the real average size within the categories can differ quite a lot for different countries.

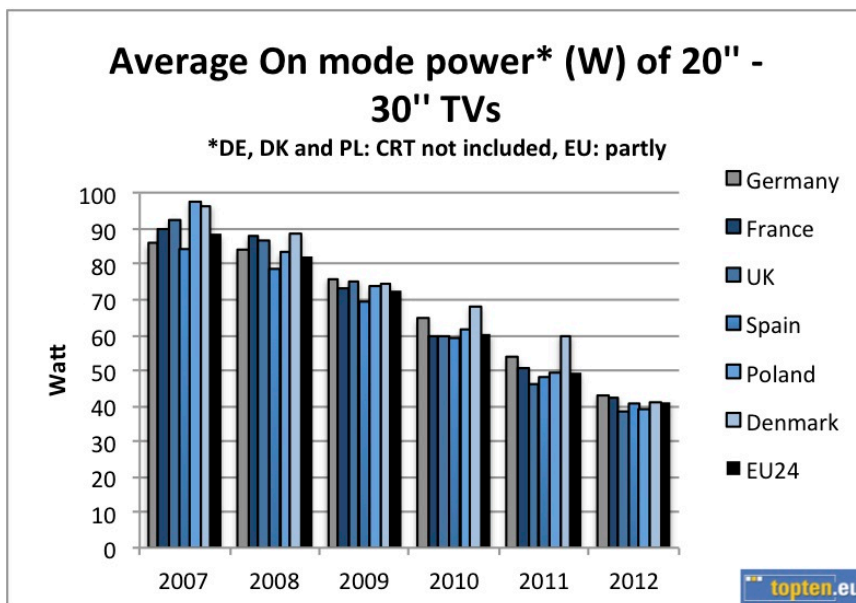


Fig. 14: Average On mode power of 20"-30" TVs
 Data source: GfK

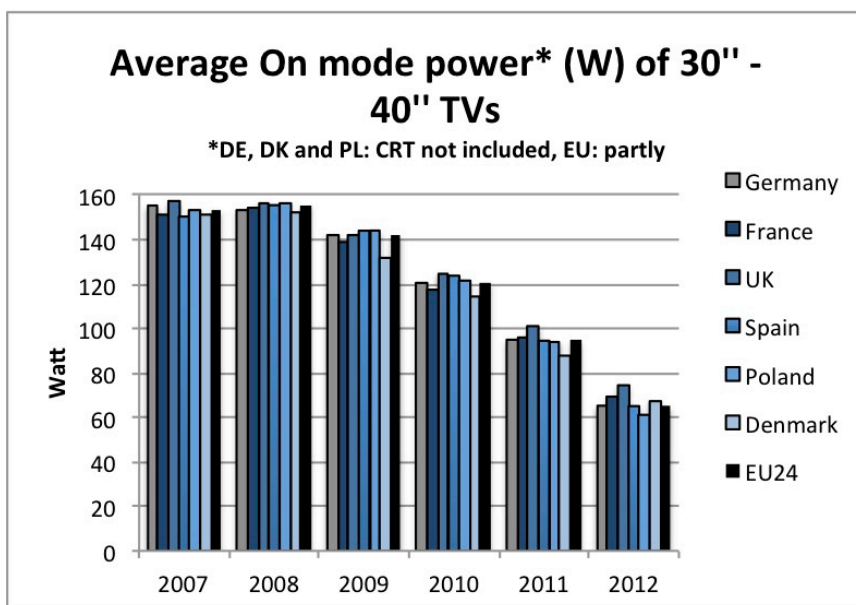


Fig. 15: Average On mode power of 30"-40" TVs
 Data source: GfK

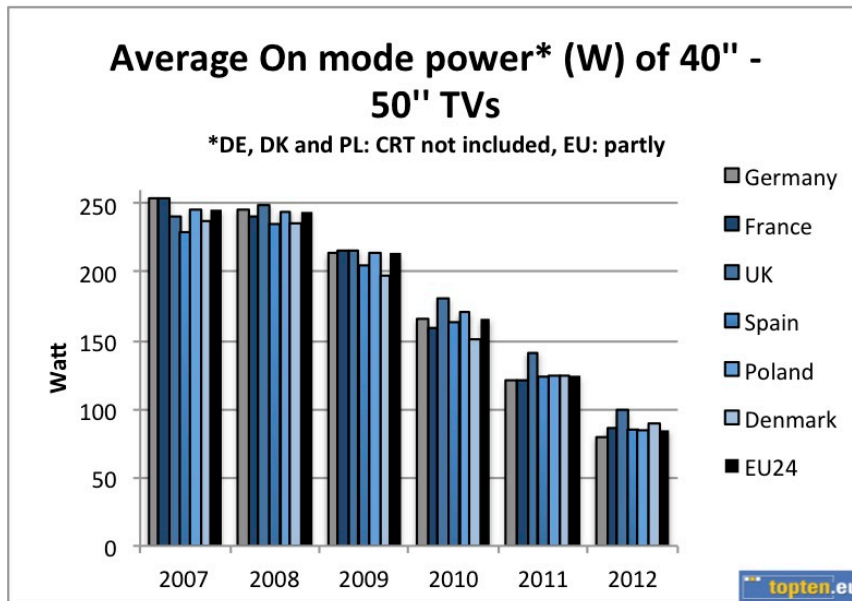


Fig. 16: Average On mode power of 40''-50'' TVs

Data source: GfK

The reduction in average declared On mode power is impressive, and especially in combination with the increased average screen size it is proof of large gains in efficiency (on a power per screen area basis). The graph does however not answer the question on the role of the Ecodesign regulation in this development.

Obviously most of the trends leading to higher efficiency (e.g. flat panel TVs, LED-backlight) had started a long time before the implementation of the Ecodesign regulation. So, does the graph above show a 'natural' market development that would have equally happened without implementing measures, or did the Ecodesign regulation lead to the product improvements? Toulouse et al. (2012) state that the On mode power requirements of the Ecodesign regulation have had practically no impact on the market, because both tier 1 and 2 requirements were already met by most main manufacturers. Also the Evaluation of the Ecodesign Directive from 2012 (CSES, 2012) concludes that the Ecodesign requirements for TVs were at a lower level (in terms of energy efficiency) than many products already on the market, and that more ambitious requirements could have been introduced.

The detail market data on power for specific screen sizes allows to investigate this question further. In order to find out more about the effect of the Ecodesign regulation we need to look at certain screen sizes, since the 'cut-off' level of the Ecodesign regulation is dependent on the screen size. The two most popular screen sizes in 2012 (32'' and 40'' – 43'') are selected for the detail analysis regarding On mode power development. The arrows in figures 15 and 16 indicate the progress in standardisation and policy

- Overview on steps in standardisation and policy making and implementation for TVs**
- a) August 2007: preparatory study finalised
 - b) October 2008: Publication of IEC 62087:2008
 - c) October 2008: Consultation Forum
 - d) March 2009: Final Ecodesign draft
 - e) May 2009: Rejection of Energy Labelling draft
 - f) July 2009: adoption of Ecodesign
 - g) February 2010: new Energy Labelling draft
 - h) August 2010: application of tier 1 On mode power
 - i) September 2010: adoption of Labelling regulation
 - j) December 2011: application of Energy Label
 - k) April 2012: application tier 2 On mode power (class D)

making and implementation. It should be noted that before decisions were taken, yearlong discussions including the industry (and other stakeholders) took place. Most manufacturers were thus aware of the standards' and regulations' content some time before their publication.

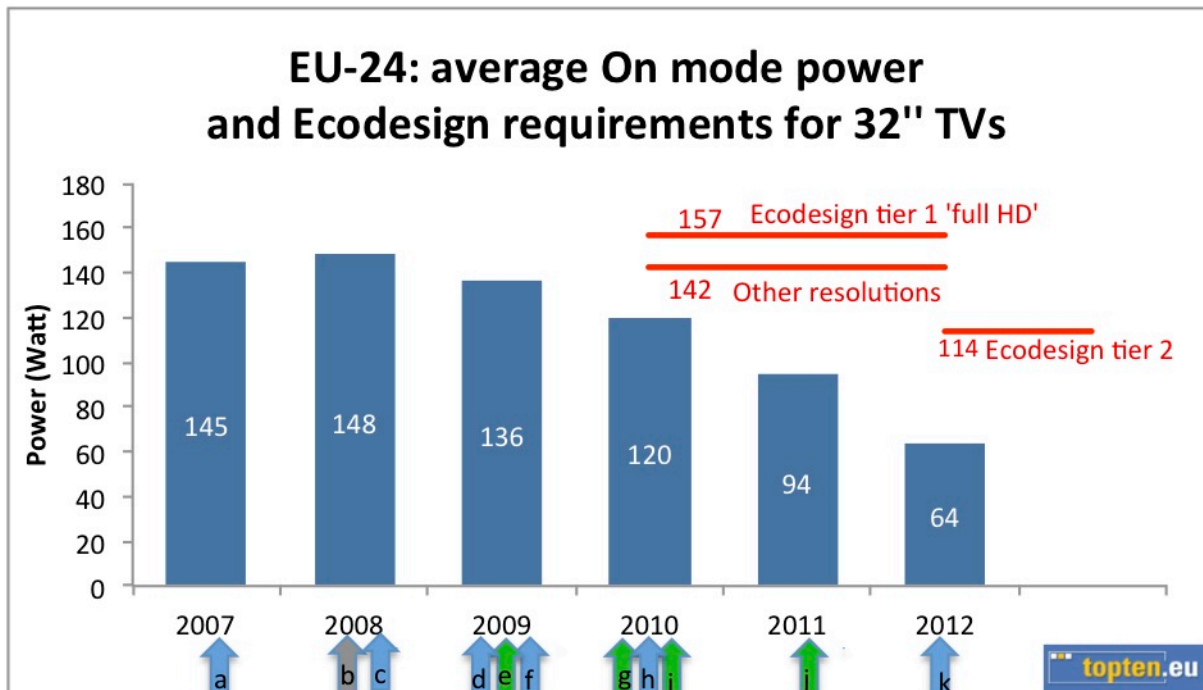


Fig. 17: Average On mode power of 32" TVs, with Ecodesign requirements tier 1 (Aug 2010) and tier 2 (April 2012). Data source: GfK

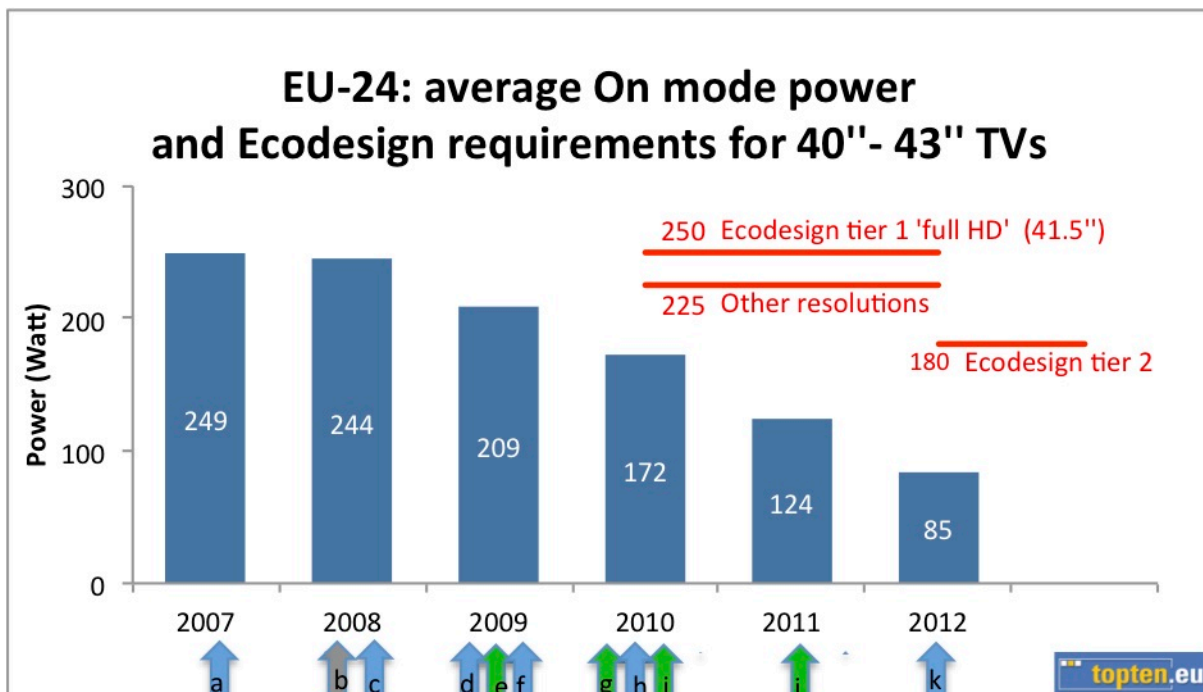


Fig. 18: Average On mode power of 40"-43" TVs, with Ecodesign requirements tier 1 (Aug 2010) and tier 2 (April 2012). Data source: GfK

For the 40" – 43" TVs, the Ecodesign limits were calculated for a screen size of 41.5 inches. The average On mode power of 32" TVs shows an increase from 2007 to 2008, which is not the case for 40" to 43" TVs. Then the average On mode power started to drop continuously for both size

categories, as for the total sales average (Fig. 8). Between 2008 and 2012 the average On mode power decreased by 57% to 64W for 32" and to 85W (-65%) for 40" – 43" TVs.

Tier 1 of the Ecodesign requirements on On mode power applied from August 2010. For both screen sizes considered here, the level of tier 1 was close to the average power from 2008, but clearly higher than the average power in 2010. For 32" TVs the limits were 31% (full HD) and 18% (other resolutions) above the average power, for 40" – 43"-TVs 45% (full HD) and 31% (other resolutions). The percentage of full HD TV sales was not assessed in this study.

In April 2012 the tier 2 On mode power requirement applied, corresponding to class D. A quick glance forward at fig. 24 shows that class D had almost entirely disappeared from the EU-market in 2012, and that this measure must have been of very little impact: only 1% of the TVs sold in the EU in 2012 were class D TVs – the least efficient class still allowed on the market. For both screen size categories in figs. 9 and 10 the average power of the complete 2012 sales was even more below the Ecodesign limit than for tier 1: for 32" TVs the average On mode power was 78% lower than the second Ecodesign limit, for 40" – 43" TVs the average was even 113% lower. The average power of this latter size category was below the tier 2 limit in 2010 already.

Based on these figures we can agree with the studies mentioned above (Toulouse et al, 2012, and CSES, 2012) and conclude that, for the two most important screen sizes, all On mode power limits of the Ecodesign regulation had practically no impact on the market. The efficiency development was happening anyway, the Ecodesign regulation did not have any effect on it. The discussions about energy efficiency may however have supported the technological development to focus also on this aspect, and not only on increasing screen size and additional functions. (The impact of the energy labelling regulation is discussed below).

Technologies

From 2007 to 2012 two interesting market transformations regarding technology happened: Cathode Ray Tube (CRT) TVs disappeared completely from the market and were replaced by flat panel TVs (LCD and Plasma), and the first generation of Liquid Crystal Display (LCD)-TVs (with Cold Cathode Fluorescent Lamps (CCFL)-backlight) was replaced by the next LCD-generation, using Light Emitting Diodes (LED) for the backlight (Figs. 19 and 20).

Yet in 2004 CRT TVs were dominating the market with 89% of the EU-sales, LCD TVs did only account for 8% of the sales (Stobbe et al., 2007). Three years later the market had changed completely and more than two thirds of the sold TVs were LCD-TVs. After 2008 CRT TVs were virtually gone from the EU market - the last few CRT TVs were sold out in 2011. In 2009 the domination of CCFL-backlit LCD-TVs reached its peak with 87% of the sales. The first LCD-TVs with LED backlight had already been on the market in 2007: these were luxury products of large size (Fig. 23), high power (Fig. 22) and very high prices (Fig. 21). Screen size and especially the prices and the power of LED-LCD TVs were lowered in the coming years, and this technology started to replace CCFL-LCD TVs. Again within three years the market transformation has been widely completed: in 2012 LCD-TVs with CCFL-backlight accounted only for one quarter of the sales – now LED-LCD TVs are dominating the market. What will the market look like in 2015 - especially since the entry on the market of OLED back lighting products has been announced for some years but is not yet on the market – where does this technology stand within the industry labs and production lines?

In 2007, the Plasma technology was yet considered to have a promising future in the market segment of large TVs (36" and larger) (Stobbe et al., 2007). But this technology never reached the breakthrough and the sales share always remained below 10%. In 2012, mainly three brands are left on the market (Samsung, LG, Panasonic), and the number of models is going down.

Rear Projection (here: Rear Pro) TVs had been on the market already in 2000 (Stobbe et al., 2007), but it seems that the production was discontinued by the last manufacturer (Mitsubishi) in 2012.

Rear Projection TVs had been of large screen size (Fig. 23), and never reached a noteworthy market share.

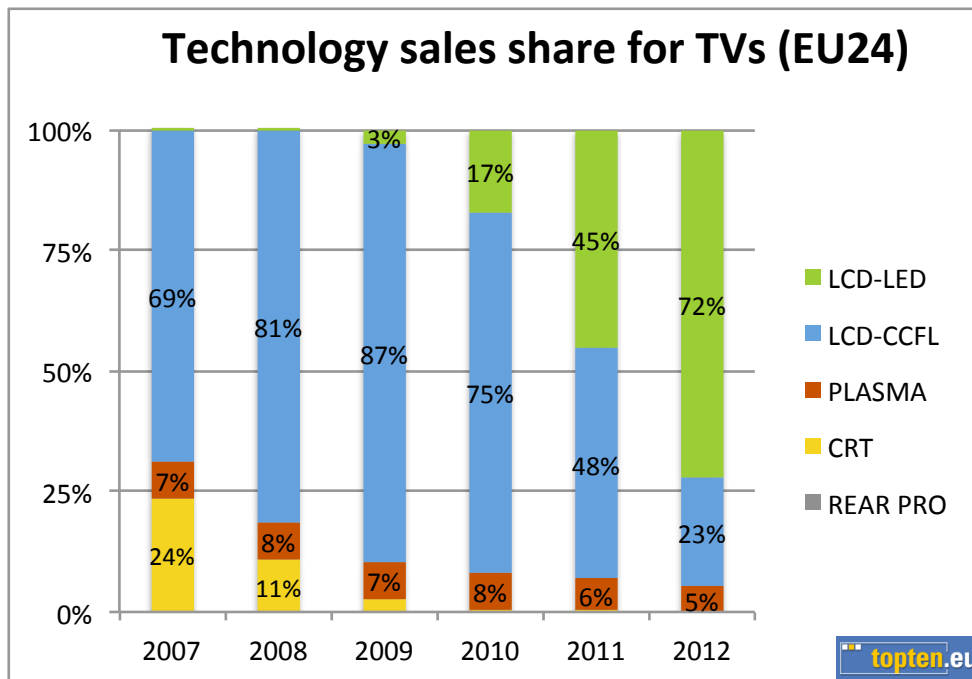


Fig. 19: Sales shares of different TV technologies
Data source: GfK

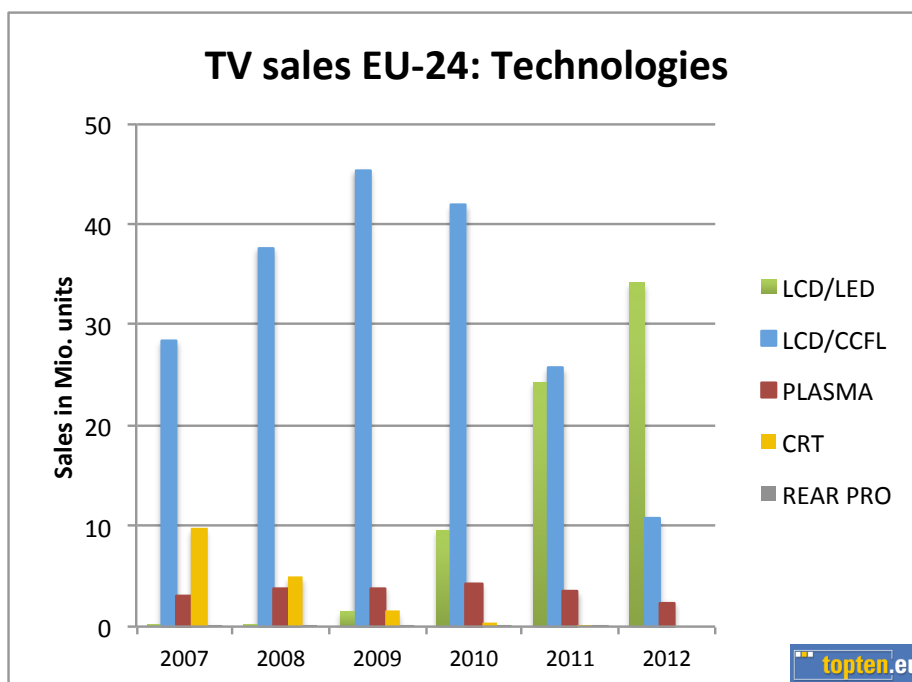


Fig. 20: Sales of different TV technologies
Data source: GfK

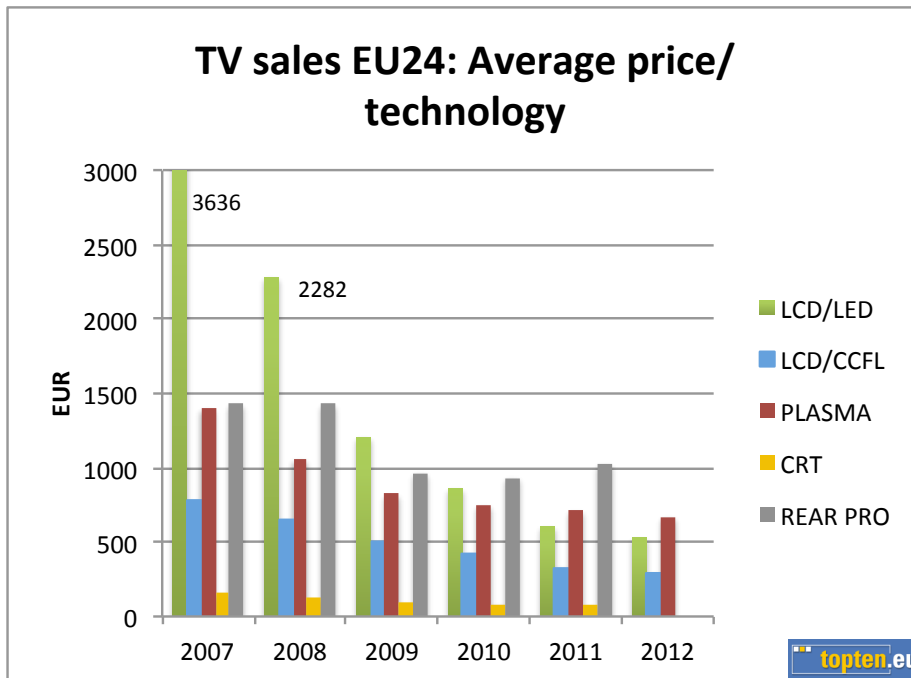


Fig. 21: Average price of different TV technologies
Data source: GfK

LCD-LED TVs were large and very expensive in the years of their appearance on the market (2007-2009), then with the new technology maturing prices came down quickly (Fig. 19). Prices of CCFL-LCD TVs have been and still are at a lower level than those of LED-LCD TVs. Plasma TVs have still relatively high prices, but this may be linked to their large average screen size (Fig. 21).

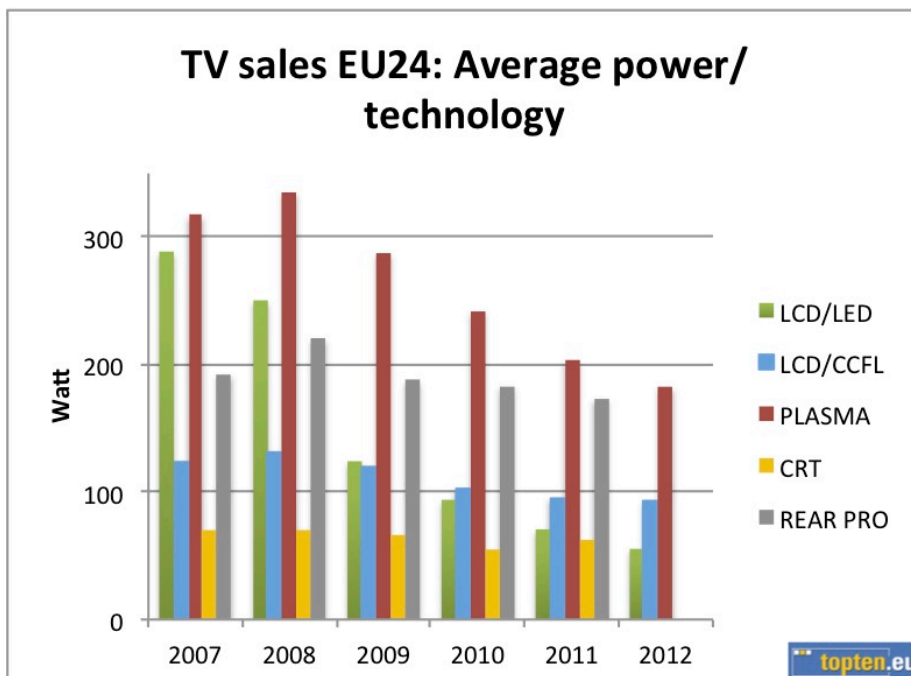


Fig. 22: Average power of different TV technologies
Data source: GfK

As mentioned above, the average power of Plasma (and rear projection) TVs increased from 2007 to 2008 (Fig. 20). Also for CCFL-LCDs it increased a bit, and stronger than the average screen size. These 'jumps' are most probably due to the changing methods for measurement and declaration. After

2008 assumedly most manufacturers used the same measurement standard (IEC 62087: 2008) to declare the TVs On mode power.

Plasma TVs have the highest power in On mode. The technology with lowest On mode power in fig. 20 is not the new LED-backlit LCD technology, but CRT TVs, now gone from the market. Early LED-LCD TVs had high power, by 2012 the average power of this technology was lower than that of CRT TVs had been – but with a larger average screen size (Fig. 21). This implies that the shift from CRT TVs to flat panel TVs probably caused an increase in average power before 2007/2008. The preparatory study assumed a higher power for the CRT TVs (130W – but the study used a CRT TV larger than the average (29" instead of 22")) than the 70W our data reports on average in 2007. The average power assumed for LCD TVs however was even higher (150W for a 32" LCD TV – while our data reports an average power of 124W for an average size of 29") (Stobbe et al., 2007). Since the measurement standards used before 2008 are not known, in our data as well as in the preparatory study, the On mode power values cannot be compared. Figure 20 however strongly implies that the shift from the old CRT TVs to LCD TVs before 2007 / 2008 lead to an increase in average power. The average power of old LCD TVs was between 20% (according to the data used in the preparatory study) and 80% (average power difference in our data for 2007 and 2008) higher than that of CRT TVs. Only after 2011 did the average power level of the most popular technology reach similarly low levels as the previously dominating CRT TVs.

The average power of all remaining technologies decreased from 2008 to 2012: by 29% (from 132W to 93W) for CCFL-LCD TVs, by 46% (from 336W to 183W) for Plasma TVs and by 78% (250W to 55W) for LED-LCD TVs. In the case of LED TVs in the same period also the average screen size became smaller, but only by 26%. For CCFL-LCD and Plasma TVs the screen size increased (3% for CCFL-LCDs, 8% for Plasma) during this period. For all technologies the efficiency on a power per screen area basis improved during this period.

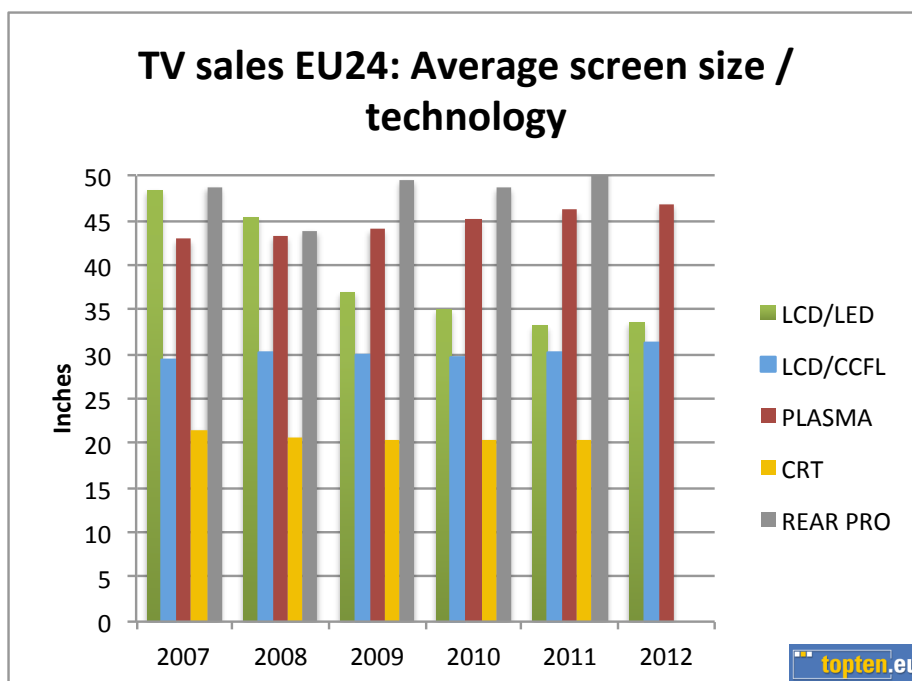


Fig. 23: Average screen size of different TV technologies
Data source: GfK

2012: Energy Classes

From the beginning of December 2011 the Energy Label for TVs was compulsory, so for the sales in 2012 the information on the Energy Class is available. Figure 24 shows the distribution of Energy Classes of the 2012 sales in the countries and the EU-24. 'Others' include sales of models that were

marketed before December 2011 and were not required to have a label, and new models, for which the label information was missing. Looking at only the models that were put on the market in 2012 and thus required to have the Label, the percentage of TVs that were sold without Label ('Unknown') is lower for all countries, but still astonishingly high (Fig. 25).

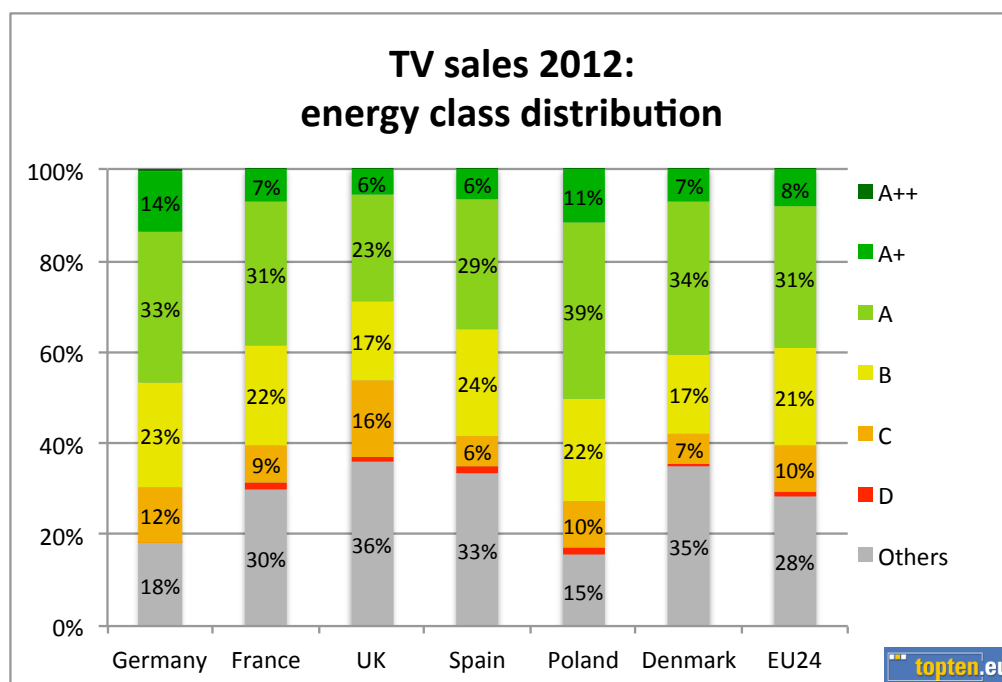


Fig. 24: Distribution of Energy Classes of TV sales in 2012

Data source: GfK

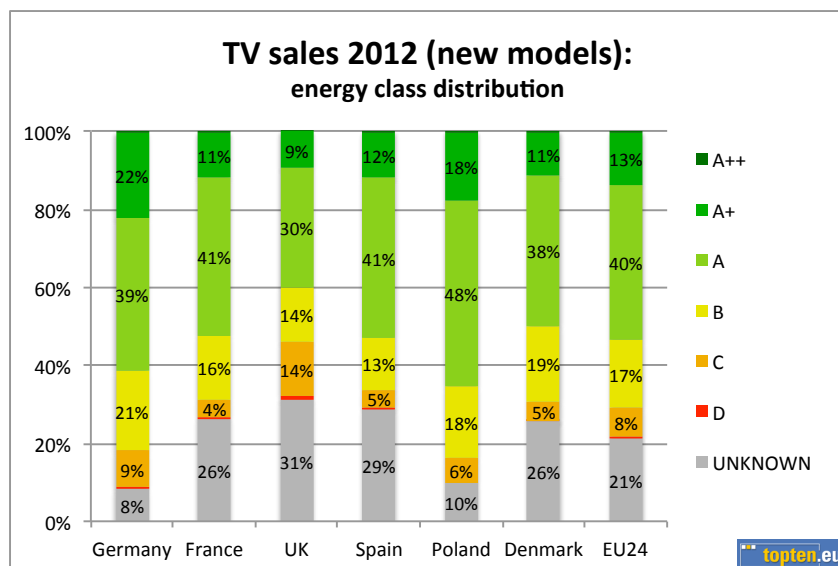


Fig. 25: Distribution of Energy Classes of TV sales in 2012 for new models put on the market in 2012

Data source: GfK

Table 4: Classification scale of the TV Energy Label. EEI = Energy Efficiency Index

Class	EEI
A++	0.16
A+	0.23
A	0.30
B	0.42

C	0.60
D	0.80

Figures 24 and 25 show the following main results:

- In the first full year of the new Energy Label, between 29% (UK) and 50% (Poland) of the sold TVs were in class A or better. Across the EU 39% were classes A or better. When considering only models that entered the market in 2012 (Fig. 25), these figures are higher: the market continues to develop towards higher efficiency.
- Class D is no longer visible on the market (EU: 1%). Class D corresponds to tier 2 power limit enforced in April 2012 and is the least efficient class still allowed on the market.
- 6% (UK) to 14% (Germany) of the sales were in class A+; Across the EU A+ accounted for 8% of the sales. This class was not expected to appear on the market before 2014; only then will this class have to be shown on the Energy Label for all TVs, i.e. also less efficient TVs (EC, Sep 2010).
- For many models the information on the Energy Class was missing: between 8% (Germany) and 31% (UK) of the 2012 models sold were not labelled correctly, even though the Label was compulsory for these new models. The EU-average lacking Labelling information is 21%. The recent IEE project 'Come On Labels' found in shop visits between 2011 and 2013 57% of correctly labelled TVs. 33% were not at all labelled, 10% only partly (Come On Labels, 2013). The Intelligent Energy Europe (IEE)-project 'ComplianTV' will undertake compliance tests for TVs and further investigate the topic.
- The most important class regarding sales share in 2012 is class A in all countries observed. Across the EU, 31% of all TV sales were class A TVs.
- Once again, differences between countries are considerable. Quite surprising is the high sales share of A and A+ TVs in Poland, and the comparatively few sales without Label. The explanation might be linked to the findings above that consumers in Poland buy larger (but fewer) TVs than in other countries. Larger TVs reach better efficiency classes (see below). Many efficient TVs are also sold in Germany, which meets our expectations from an economically stable country with a high sensitivity to environmental issues. A bit surprising is Denmark, where a similarly high sales share of efficient TVs as in Germany would have been expected. Especially the high share of TVs without Label is surprising (35% of the total sales, 26% for new models which should bear the Label). This is more than the EU-average. Regarding efficient TVs, France and Spain have similar sales shares as Denmark, even though in Denmark with a higher average screen size also a higher efficiency would be likely. The least efficient market and the highest percentage of TV sales with missing Label are found in the UK. An explanation for this might be the strong focus on the competition over price, with little interest to aspects like quality or environmental performance, which was identified in a study looking at different household appliances in 2009 (Attali et al., for DEFRA, 2009).
- The presence of an Energy Label provides the possibility to easily observe the market evolution based on the sales shares of the different energy classes. Labels force the industry to declare values (more market transparency) based on the same measurement methods (data more comparable). Once the label has been in place, development graphs will be possible based on data similar to what is presented here for 2012.

Does efficiency lead to higher prices?

Will consumers have to pay more for their TVs if new, ambitious Ecodesign requirements on efficiency are introduced during the revision of the Ecodesign regulation for TVs, which is currently on-going and expected to lead to a new regulation before the end of 2013? Fig. 26 suggests 'Yes' at

the first glance: the average price of TVs in efficient classes was clearly higher than of less efficient TVs in 2012, except for class C. But, as figure 27 shows: efficient TVs are larger than less efficient TVs. From class B to A++ the average screen size increases by 20 inches (half a meter!). Figure 28 shows that the price is not only getting higher with better efficiency, but more importantly with increasing size.

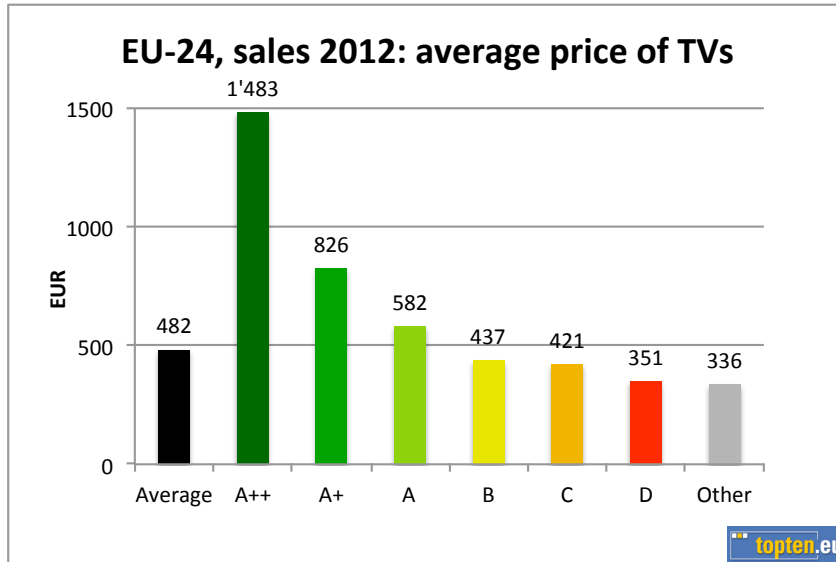


Fig. 26: TV average price according to energy classes in 2012
Data source: GfK

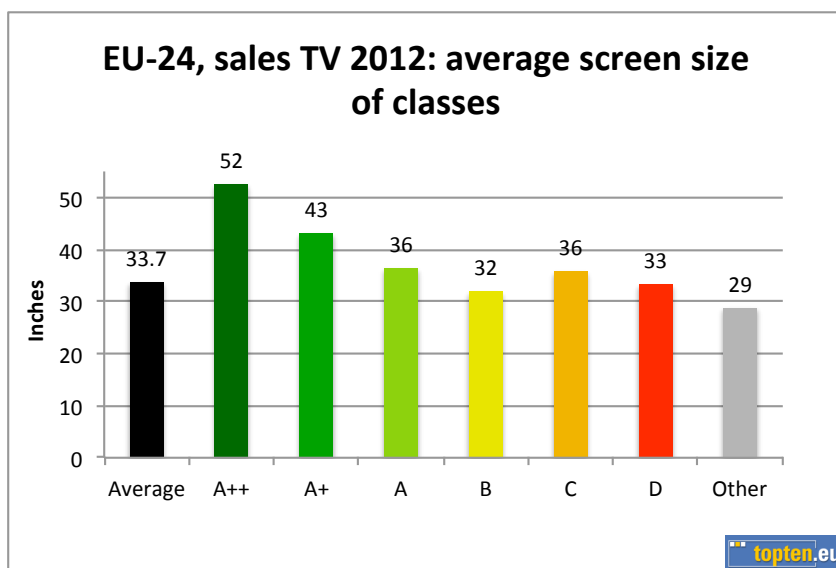


Fig. 27: TV average screen size according to energy classes in 2012
Data source: GfK

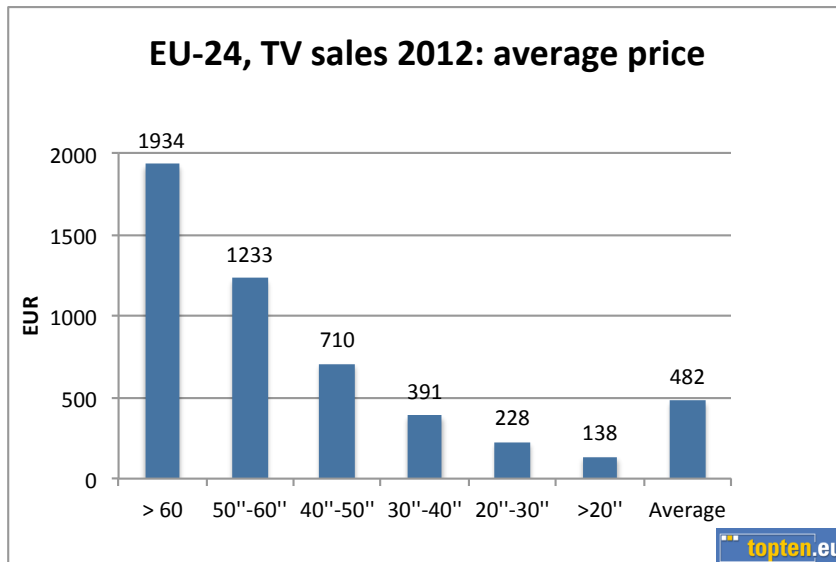


Fig. 28: TV average price according to screen sizes in 2012
Data source: GfK

Figures 29 and 30 explore if there is a price correlation with energy efficiency for certain size categories. The best energy class on the market for 30''-40'' TVs in 2012 was A+. For A+ TVs, the highest average price was paid, which was clearly higher than for less efficient TVs (Fig. 29). For the other energy classes A to D, average prices are becoming smaller with lower efficiency, but with the exception of class B and with smaller differences.

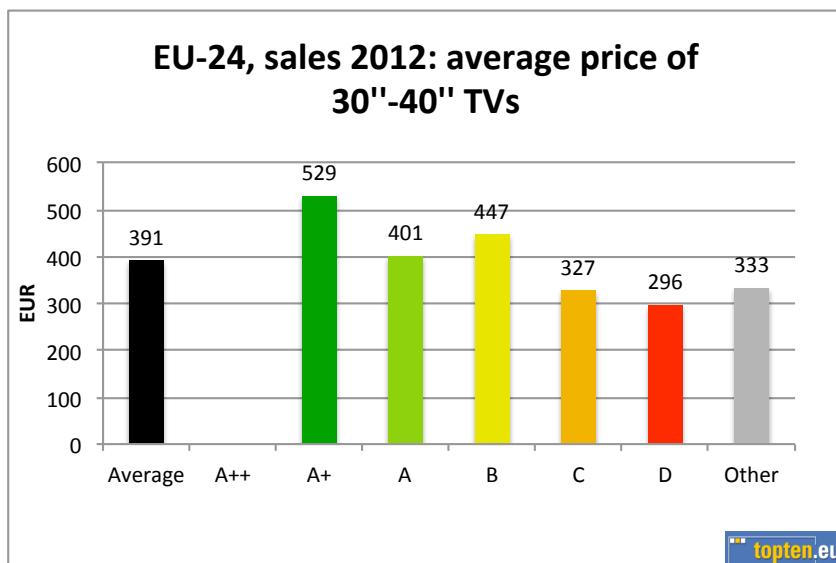


Fig. 29: 30''-40'' TV average price according to energy classes in 2012
Data source: GfK

For the screen size category of 40''-50'' there are already A++ TVs on the market in 2012. But instead of these, A+ TVs obtained the highest prices. Even the average price of TVs in class A was higher than of those in class A++. The lowest average prices were not paid for class D TVs, but for class C. Summing up the two graphs: there is no clear correlation between energy efficiency and the price in the case of TVs.

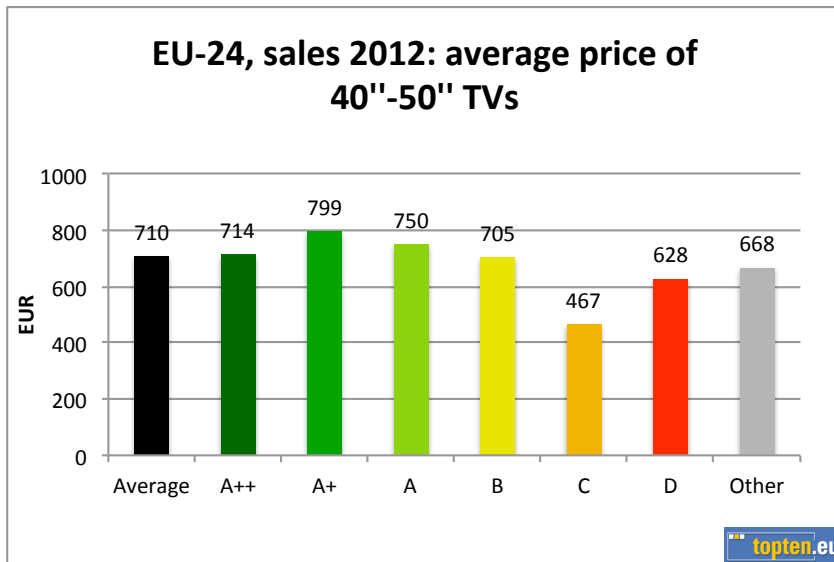


Fig. 30: 40"-50" TV average price according to energy classes 2012
Data source: GfK

The figures 31 and 32 look at the size dependency of the TV prices for certain energy classes. For class A, there is a very clear correlation between the screen size and the price of the TVs. Figure 32 shows the same clear correlation for A+ TVs. Only for very small TVs (<20") the average price is higher than for TVs between 20" and 30". For class B the situation is similar: with the exception of 40"-50"-TVs, there is a clear size dependency of the price.

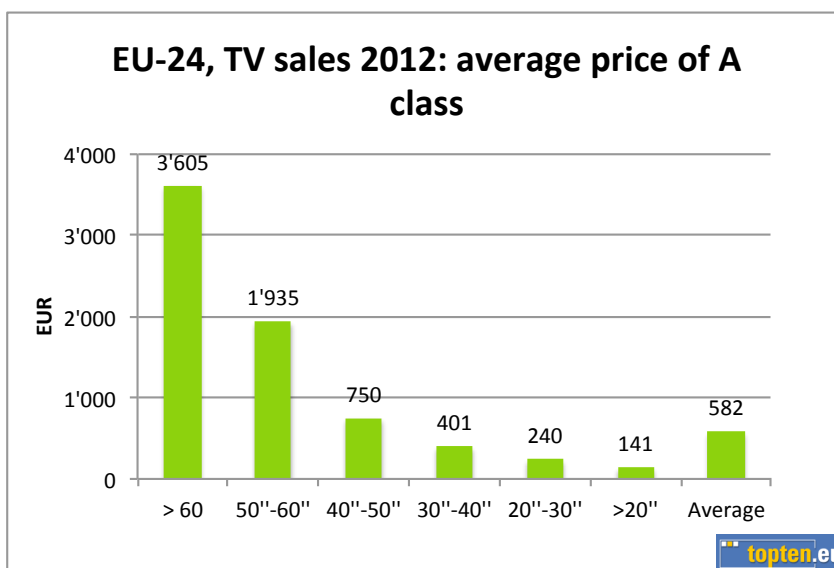


Fig. 31: A class TV average price for different screen sizes in 2012
Data source: GfK

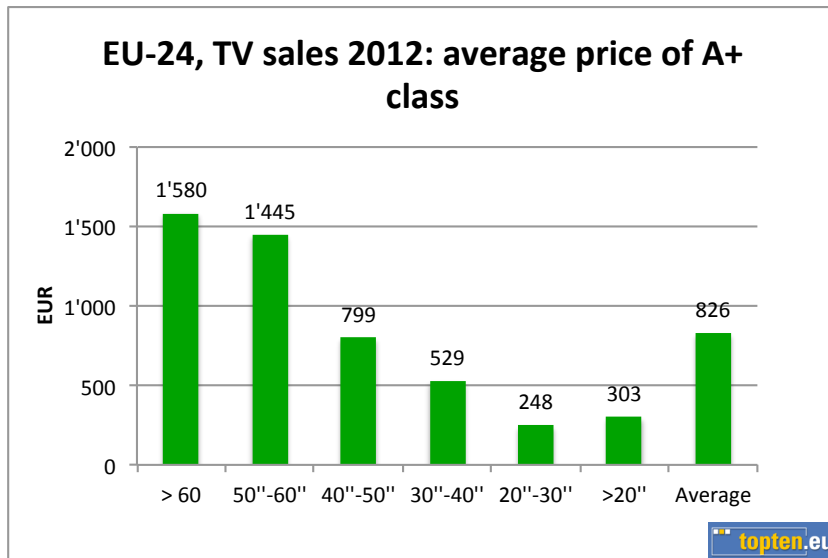


Fig. 32: A+ class TVs average price for different screen sizes in 2012
Data source: GfK

The series of figures above (26 to 32) lets us conclude that energy efficiency is not affecting the price of TVs, but size is. So, unless the definition of efficiency and the level of requirements only allow large TVs on the market, ambitious efficiency requirements should not lead to increasing TV prices and make life harder for consumers. But this discussion leads to question another aspect: the correlation of size and efficiency. The European Commission expresses the TV efficiency with the Energy Efficiency Index EEI, which compares the On mode power of a TV to the power of a reference TV of the same size. Thus, TV efficiency is On mode power relatively to screen size: larger TVs can have higher power and still be more efficient than smaller TVs with lower power.

Figure 33 shows which TVs are the ones with lowest declared power: it's class A. A+ and A++ TVs are more efficient according to the definition used in the Ecodesign and Labelling regulations for TVs (EC, July 2009 and September 2010), but have higher power because of the larger average screen size. Class B is on average smaller but less efficient, while classes C and D are both less efficient and on average larger than class A (see also Fig. 27).

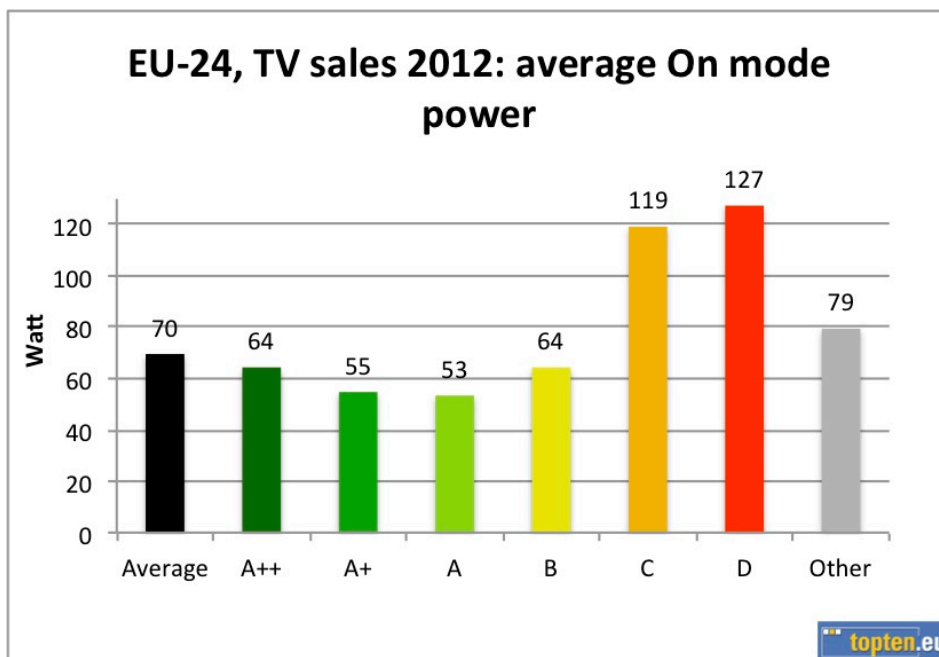


Fig. 33: TV average On mode power according to energy classes in 2012
Data source: GfK

5. Conclusions

General

The reduction in average declared On mode power by 55% between 2008 and 2012 is impressive. The gains in efficiency on a power per screen area basis have been clearly stronger than the trend to larger screen sizes. What this means for the effective electricity consumption by TVs is however not clear. Several factors drive the electricity consumption to higher values than declared for single TVs or to higher values than some years ago for the entire EU:

- **Use duration in On mode:** For the TV declaration of the annual electricity consumption on the Energy Label, a daily On mode duration of four hours is assumed (EC, September 2010). Several studies suggest a longer TVs use duration in On mode: the preparatory study from 2007 (Stobbe et al., 2007) expected the On mode duration to rise to five hours in the future, a recent study from the UK (EST/DEFRA, 2012) found an average daily TV watching time of six hours. Additional functions in TVs certainly lead to more usage opportunities, e.g. looking at pictures, surfing on the internet, streaming online videos or music etc. and to longer On mode times. Average time in On mode is likely to be different for TVs in living rooms, in sleeping rooms or kitchens.
- **Power depends on settings:** a TV test in 2012 showed that manufacturers optimise their products very much to standards and labels, and that changing settings such as brightness or contrast can lead to a power increase by 30% compared to the test settings (Michel et al., 2013). TVs are measured and declared the way they are shipped, which in most cases combines the settings ensuring the lowest possible power in On mode. Often the brightness is rather low in these factory settings, close to the minimum of 65% of the maximum brightness which is stipulated by the Ecodesign regulation (EC, July 2009). Still, for many viewers the factory settings will be considered suboptimal, and all changes will most probably lead to an increase in power. So, the real-life On mode power is likely to be higher in most cases than the declared value, by up to around 30%.
- **Sales peak of energy hungry TVs:** The high sales in the observed period, especially between 2009 and 2011, lead to an increased TV stock. The penetration rate across the EU was expected to be around two TVs per household in 2010 (Stobbe et al., 2007), the UK study (EST/DEFRA, 2012) found an average of 2.3 TV sets per household in 2010/2011. After this sales peak there are not only more TVs in European households, but the TVs sold in the boom years 2009 – 2011 were yet less efficient than today's TVs: average On mode power was decreasing from 141W (2009) to 118W in 2010 and to 95W in 2011. In 2012, it was 70W – probably back to the power level of the average CRT TV in 2007 (Fig. 22). It took the new technologies a while to compensate for their larger screen size and increased functionality with higher efficiency, and the sales peak was reached before they were mature regarding energy efficiency.

Evaluation of Ecodesign requirements and Energy Label

Ecodesign requirements on On mode power

According to the Ecodesign Directive (EC, 2005) the minimum requirements should be placed at a level which aims at the Least Life Cycle Cost (LLCC) for consumers. Because the question on the credibility of the data provided by the industry lead to intense discussions and because it was difficult to predict the market development based on available data, the Commission decided to define cautious minimum requirements but to include an early revision date (Toulouse et al., 2012).

The results show that the development towards lower On mode power has started in 2008 / 2009 and that the development was much faster than the European Commission had anticipated. The development towards better efficiency seems mainly to be linked to the new technologies that were introduced, especially LED-backlit LCD-TVs. The efficiency development clearly outran the Ecodesign regulation, which was left without any impact. The average market provides lower life cycle costs to

consumers than the level of the Ecodesign regulation, because the average market is more efficient and leads to lower electricity costs than the level of the Ecodesign limit, while more efficient TVs are not more expensive than less efficient ones.

The discussion about the good level for future minimum efficiency requirements must also include the method for defining the Least Life Cycle Cost. A recent paper suggests to consider experience (or learning) curves when predicting the price level of a product: taking into account the decreasing product cost with cumulative production leads to lower prices and would allow for much more ambitious minimum efficiency performance standards (MEPS) (Siderius, 2013). Market data in our paper shows that actual TV prices have decreased by 50% from 2007 to 2012 (Figs. 10 -12), but also that the product price is mainly linked to screen size and not to the efficiency of TVs (Figs. 26 – 32). The authors of the preparatory study (Stobbe et al., 2007) did already report decreasing prices and found that all options for improving the energy efficiency would be cost-neutral. In the case of TVs, lack of data and the difficulty to predict a fast and completely changing market were the main barriers for setting more precise and more ambitious MEPS, and not so much too high price estimations. However, for the future of the TV market and for other products, which prices are more linked to efficiency the consideration of experience curves in policy making or revising processes would allow to a better understanding of the market, or the regulation's impact and in many cases for more energy savings.

Would the Commission have been able to define more appropriate Ecodesign limits, had sound market data like what is presented here, been at hand? It seems not, since when the Ecodesign regulation was adopted in mid-2009, the trend towards lower power started only in that year, and because of changing measurement standards and no obligation to declare standardised power values, also the data up to 2008 would not have allowed to predict the fast development of the years to come. Only manufacturers might have been able to make more adequate estimations.

Energy Label

With the Energy Label for TVs, a brand new Label was designed. Since there was no existing older Label, there was no resistance about possible downgrading of existing products, and clearly the original A to G scale should have been aimed at. This is what the Energy Labelling Directive (EC, May 2010) stipulates: *“The format of the label shall retain as a basis the classification using letters from A to G (...)”*. And only the next paragraph adds the possibility to go beyond A if needed: *“Three additional classes may be added (...) if required by technological progress. Those (...) will be A+, A++ and A+++ ...”* (p. 7). However, already in the first year of the Label being compulsory, 8% of the products were in class A+ across the EU and 39% of the sold products in classes A or better. A+ was not expected to be reached before 2014 and therefore does not have to be displayed on the Label (EC, September 2010). Obviously the development towards higher efficiency has been faster than anticipated when the Energy Label was designed in 2010.

However, also when the Energy Label was adopted, the rate of improvement to come was difficult to be predicted – even if more up-to-date data had been at hand. With data up to 2009, only the beginning of the efficiency development could have been observed; the sales share of LED-LCD-TVs was only 3% in that year and just starting to grow. The number of TV models on the Topten.eu product lists published on-line and in a Topten Focus (June 2012) shows that a rising number of models met the class B limit, but only very few the class A limit at the time of adoption.

A positive point is that, contrarily to the situation for most Labels that have been recently revised (refrigerators, washing machines, dishwashers, tumble driers), the top class of the TV energy Label is still empty by today (Topten.eu; best TVs are in A++). Also the A++ limit seems yet to require a lot of technological efforts and the use of the discount granted for Automatic Brightness Control (ABC) (Michel et al., 2013). The current Energy Label continues to provide an incentive for further efficiency developments.

In addition the Label now provides a basis for a continuous and easy market monitoring, and it will be interesting to see if the market continues to evolve at the current pace – or even faster, now that the Label is in place.

Combined effect

The Ecodesign regulation and Energy Label did have only a faint influence on the trend towards TV higher efficiency. It can however be questioned whether without power and energy consumption of TVs being a topic of interest, information obligation, minimum requirements, and the possibility to market high efficiency TVs with a good label class, manufacturers would have used the new technologies to improve the efficiency of TVs to the same extent. The improved measurement standard combined with the introduction of the implementing measures will at least have supported the market development towards better efficiency.

Recommendations for revision

The revised Ecodesign regulation on TVs must avoid setting not ambitious enough requirements only leading to administrative efforts without effect. The market overview provided in the present paper can be used for more precise prognoses about the future market development. The insights gained here can support the setting of ambitious minimum requirements. By 2012 class A has become the most important class regarding sales share (Fig. 24) - class A level should be defined as minimum requirement from 2015, and class A+ level announced as next future step which can follow soon. At the same time the Energy Label should be revised to restore the original A to G scale. Several studies show that classes like A+, A++ and A+++ have only little effect on consumers' decisions. Consumers perceive the efficiency gains between similarly looking (similar colour, same letter) classes to be only small and not worth the extra cost, and manufacturers get a lower return on their R&D investments with products in A+-classes (e.g. Heinzle, Wüstenhagen, 2011; Meissner et al., 2013; Waide and Watson, 2013).

Class A could be the 'incentive' to be reached by future, even more efficient TVs, and correspond to today's class A+++ . Today's best TVs are in A++ (www.topten.eu). Considering the fast efficiency development of the last few years and the even more efficient OLED technology, which is expected to enter the market in the future, a future-oriented labelling scale is appropriate.

Another point that should be tackled is the strictly linear relative efficiency approach. The current EEI formula and Labelling classification scale allow large TVs to reach a good Energy Class despite consuming more energy than smaller TVs (which can get a worse classification). This approach does nothing to stop the continuing trend towards larger screen sizes, which is shown in figures 6 and 7. Since 2007 and up to now, the increasing efficiency of the products has the stronger effect on average power than the growing screen sizes, and the average declared power has been decreasing dramatically in the last few years despite TVs getting larger. At some point however the efficiency potential will become smaller, and a Labelling / Ecodesign approach favouring large TVs will lead to missed energy savings. Therefore a digressive or even capped approach (similar to Energy Star Version 5.0 for TVs, which introduced a maximum On mode power of 108W in 2011) should be considered for this revision, for the Ecodesign requirements, and most importantly for the Energy Label (because it is the Label that drives innovation).

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European TV market 2007 – 2012

Development of energy efficiency before and during the implementation of the Ecodesign and Energy Labelling regulations

Annex: Country reports (including EU-24)

A set of 8 figures is included here for each of the countries that are considered, plus a short description which is pointing out the main differences of the countries to the EU average. Figures for comparison are those for the EU-24, included in the last chapter of the Annex. Many of these Figures are also included in the main report.

Germany

In Germany the TV sales increased until 2011 and remained constant in the last two years, while across the EU sales decreased after 2010. TV sales per person were 0.12 units in 2012, and 0.24 TVs were sold per household.

Of the countries observed here, Germans are among the consumers with the smallest affinity for small TVs (< 20" and 20-22") (together with Polish and Danish). In Germany only 19% of the TVs are 30" and smaller – across the EU it is 31%.

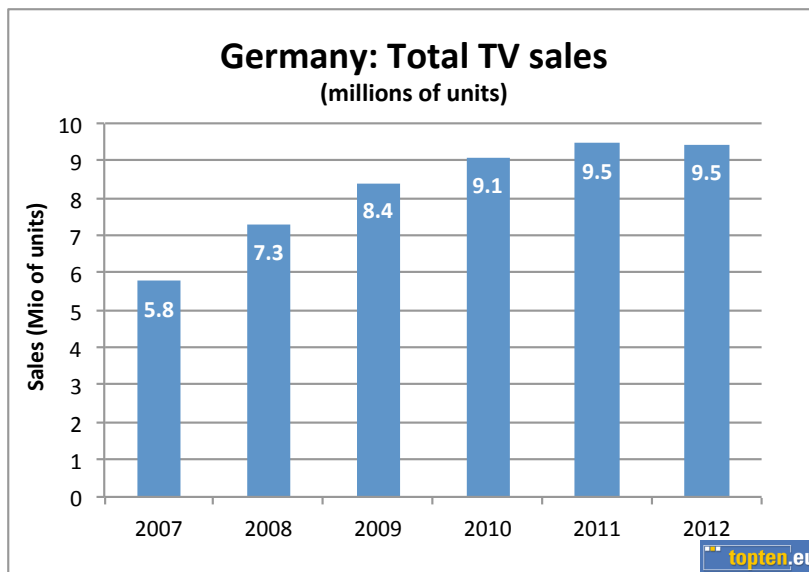
Average TV prices decreased from EUR 779 in 2007 to EUR 629 in 2012 (-19%). At the same time the average screen size increased from 32.5" to 36.6" (+13%) (see also main report).

The average On mode power decreased from 161W to 72W from 2008 to 2012 (-56%). In the same period the average screen size increased by 9%.

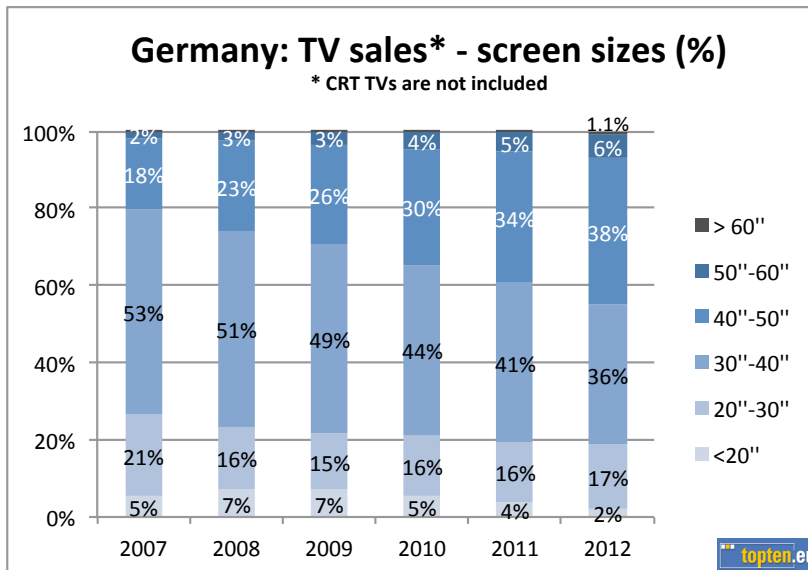
Technologies: LED-LCD-TVs reached a bit higher sales shares in Germany than across the EU-24 since 2010.

In 2012, a higher A+ percentage was sold in Germany than across the EU and, interestingly, also a higher percentage of class C. Like across the EU, the share of non-labelled TV is highest for the small TVs (<20"), but in Germany it is still smaller than in the EU.

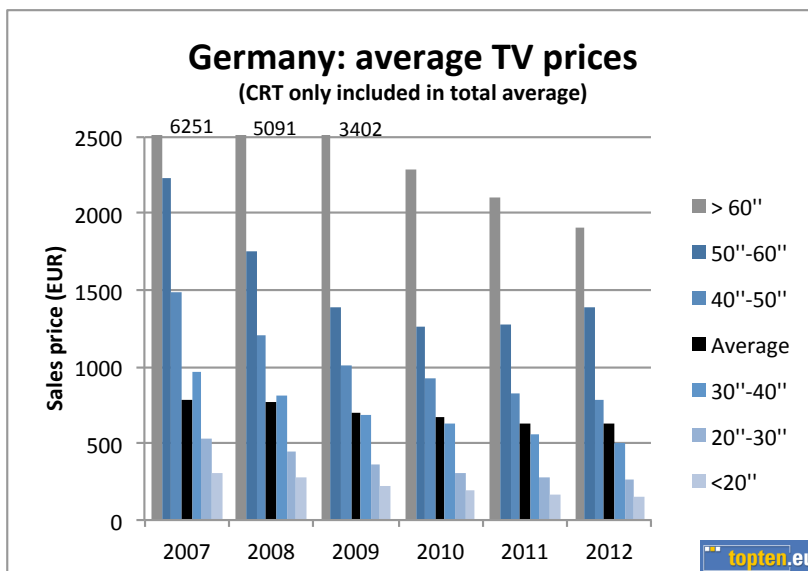
Small TVs (around 20") are less popular in Germany than across the EU, while large ones are more popular: 40" – 43"-TVs, but also the 'intermediate' sizes 37"-39" and 46"-47".



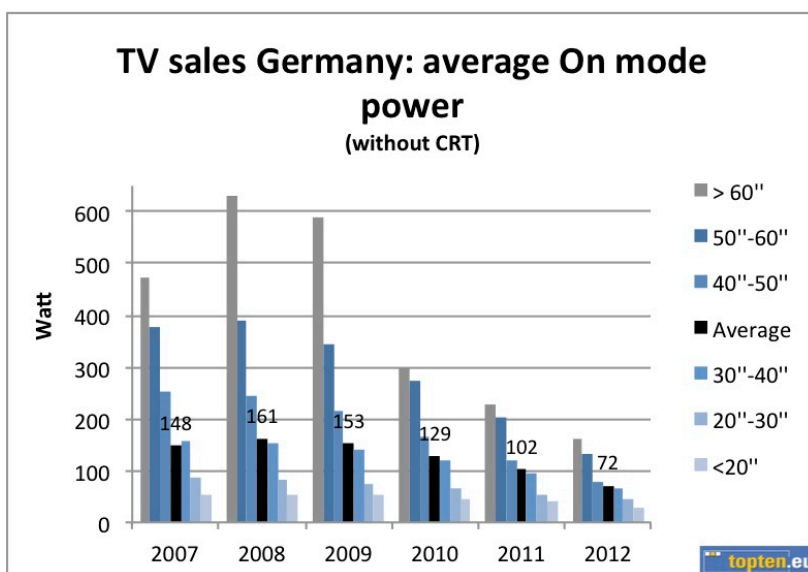
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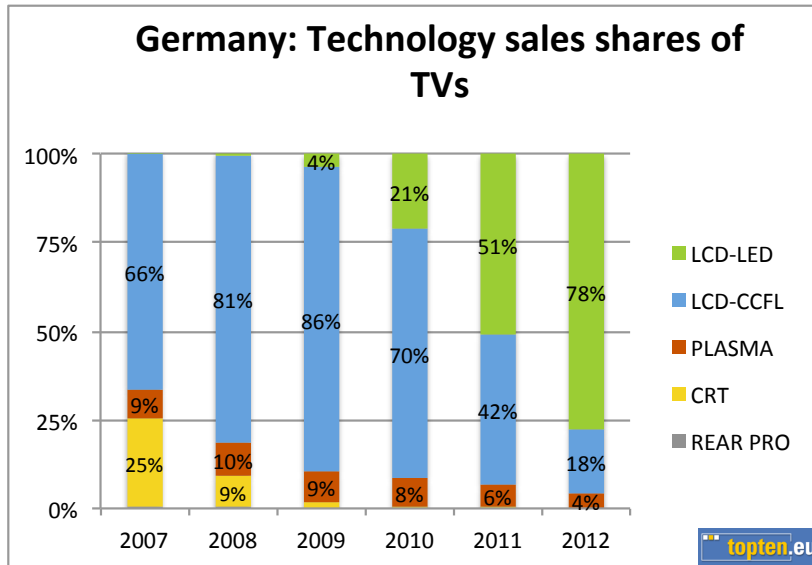
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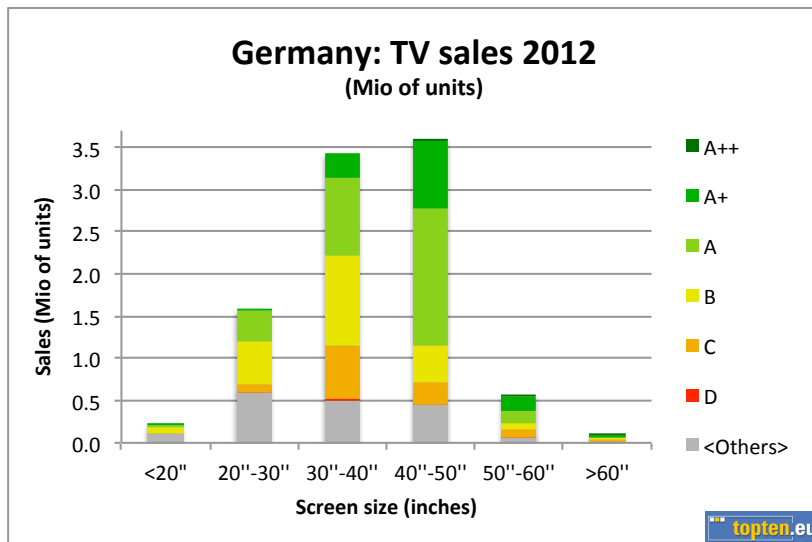
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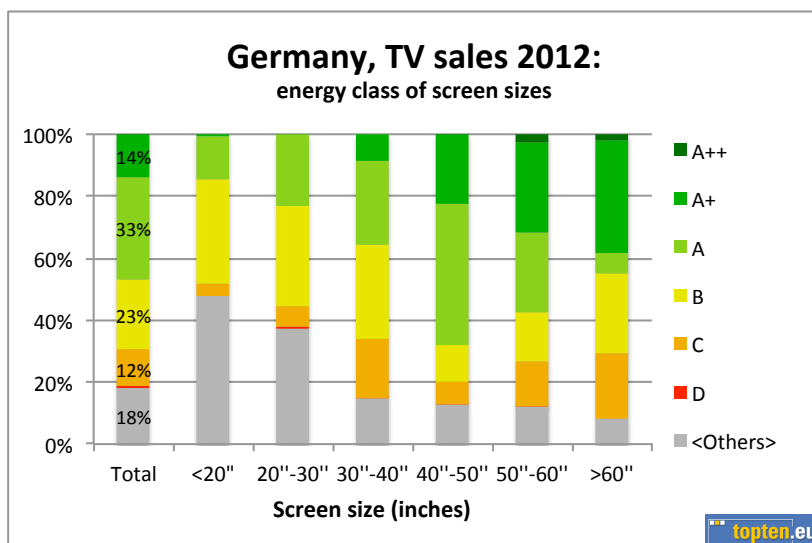
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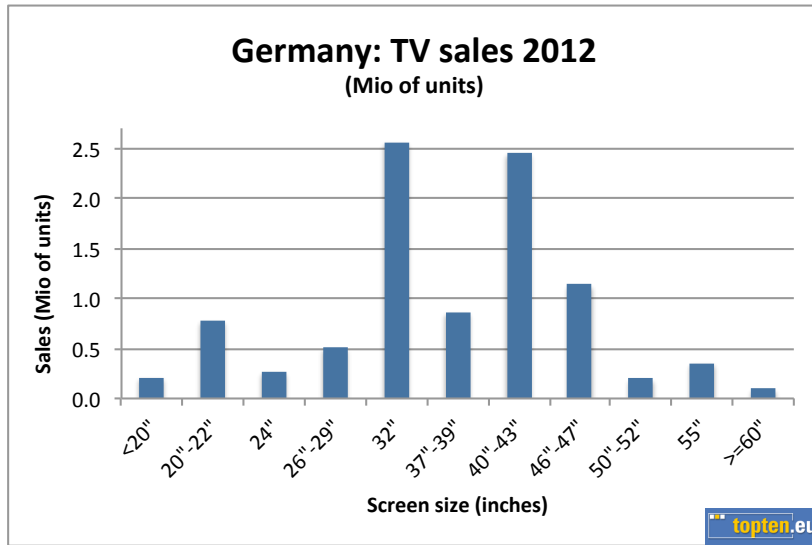
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France

Many characteristics of the French TV market from 2007 to 2012 resemble the average developments across the EU. With a few exceptions: while across the EU TV sales started to decrease after 2010, in France they increased until 2011. The sales reduction from 2011 to 2012 however was impressive. In 2012 TV sales per person were 0.10 units, and 0.24 TVs were sold per household.

The sales share of the screen size categories looks similar to that of the European average.

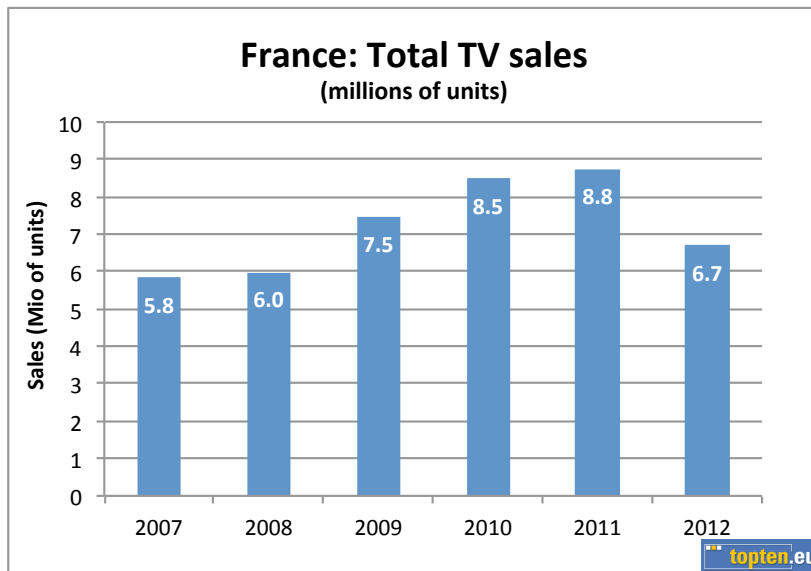
Average TV prices decreased from EUR 728 in 2007 to EUR 430 in 2012 (-41%) – this is (together with Denmark) the strongest price reduction we can observe in this study. The average screen size increased by 13% from 29.6" to 33.3" over this period.

The average On mode power decreased from 158W to 72W (-55%) from 2008 to 2012. In the same period the average screen size increased by 5%.

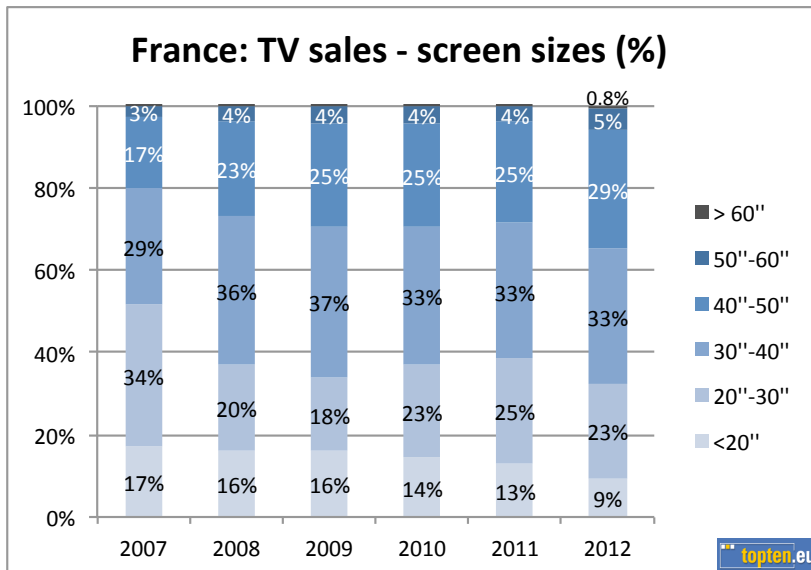
The development regarding technology looks similar as across the EU. In 2007 Plasma TVs had a bit a higher sales share in France than across the EU.

Also the Energy Classes distribution in 2012 looks similar in France as across the EU. Only the share of non-labelled small TVs (<20") is even higher in France than in the rest of the EU.

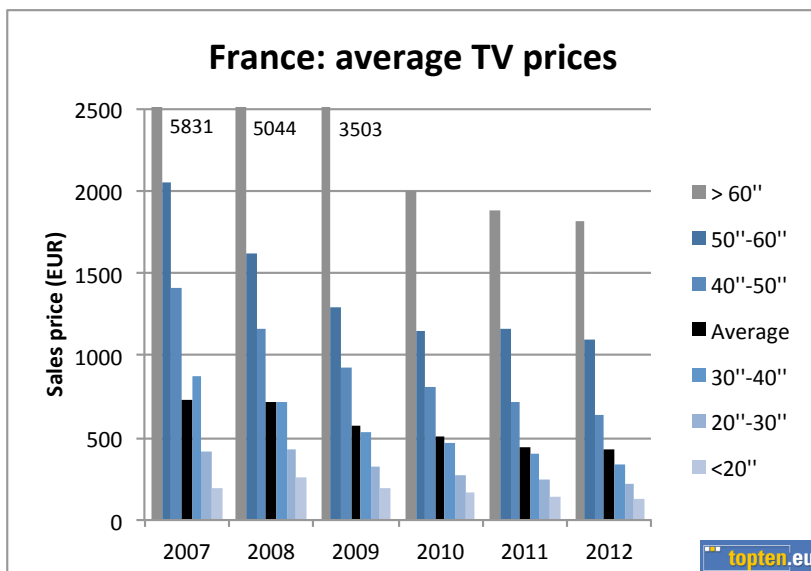
France's screen size profile for 2012 looks very similar to the EU average: a main peak at 32", a lower one at 40"-43" and a third peak for small TVs (20-22" and <20").



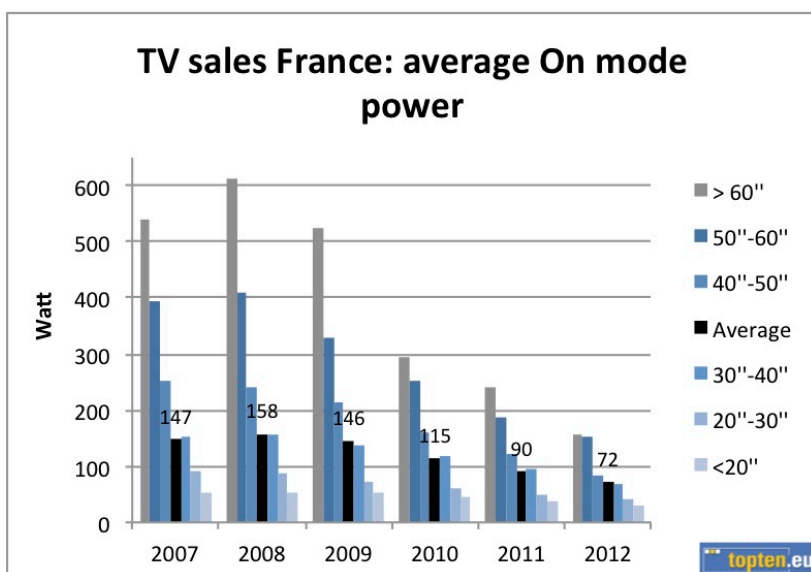
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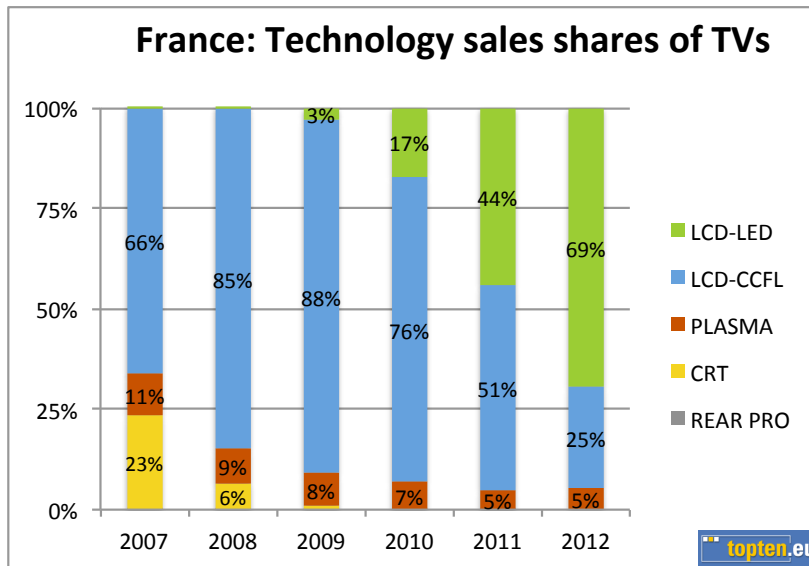
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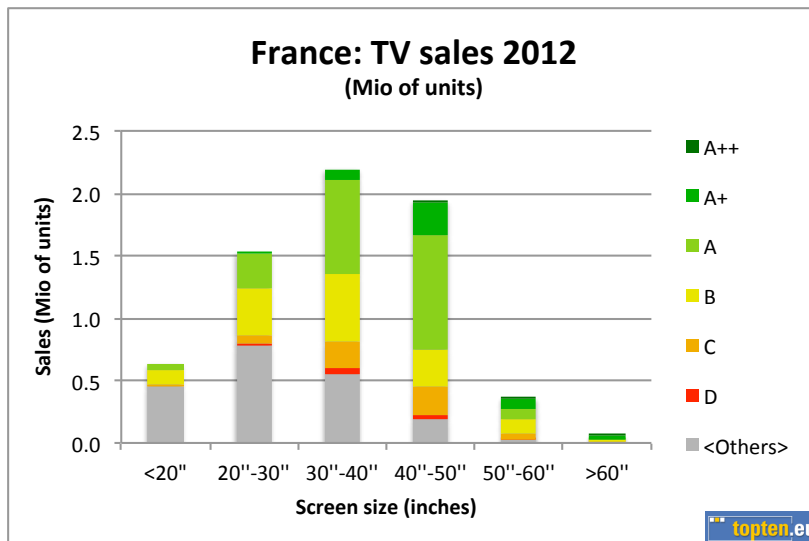
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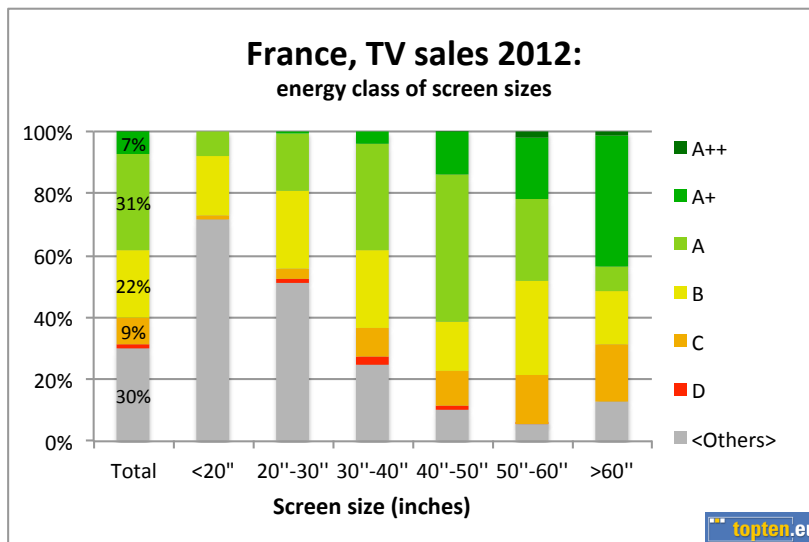
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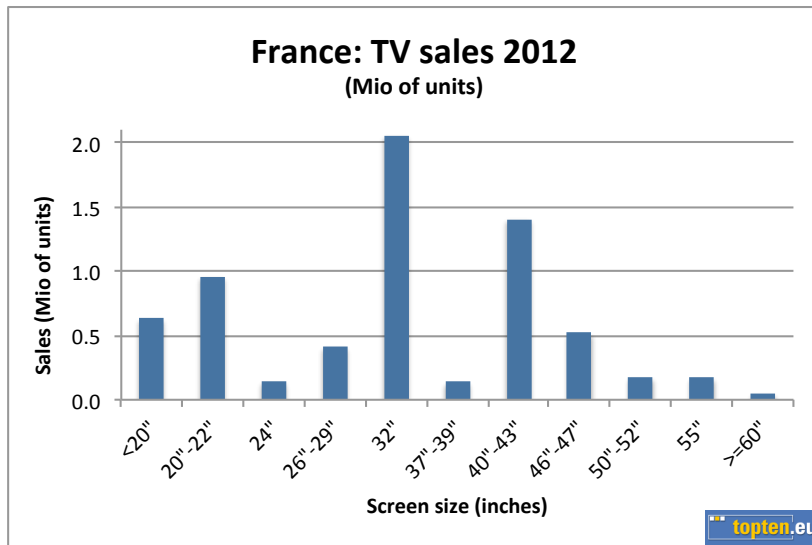
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United Kingdom

In the UK TV sales reached a peak a year earlier than in most other countries, but they remained at a relatively high level on a per person scale (see also main report). TV sales per person were 0.14 units in 2012, and 0.30 TVs were sold per household – clearly the highest relative sales of the countries included here. The UK TV market is very mature with a penetration rate of 2.3 TVs per household (EST/DEFRA, 2012). The high sales are combined with a small average screen size – assumedly due to a high share of (smaller) secondary TVs that are not placed in living rooms, but in kitchens and sleeping rooms.

The UK TV market is further characterised by low average prices (linked to small screen sizes) and rather low energy efficiency.

The UK has the most balanced screen size distribution of the countries included here: TVs with screen sizes between 20" and 30", 30" and 40" and 40" and 50" are almost equally popular in 2012, and also small TVs (<20") are with 13% more popular than in any other country.

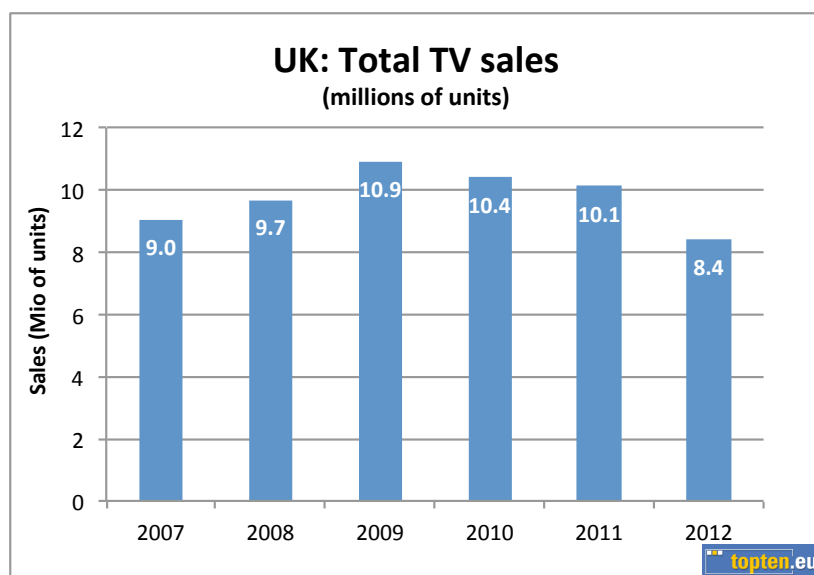
Average TV prices decreased from EUR 661 to EUR 414 by 37% from 2007 to 2012. In the UK, the lowest average prices are paid of all countries included here (EU24: 482.- in 2012). The average screen size in 2012 is also the lowest of the countries looked at here: 31.9" (EU-24: 33.7"), having increased by 14% from 27.8" in 2007.

Average power decreased from 163W to 71W (-56%) from 2008 to 2012. Over the same period the average screen size increased by 10%. UK has the lowest average screen size in 2012, but Spain has a lower average power in that year.

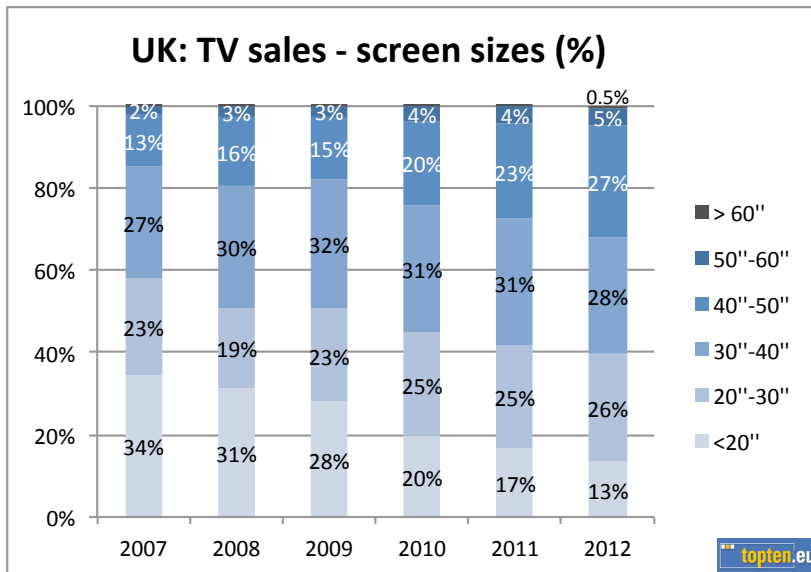
Technologies: CRT TVs disappeared faster from the market than across the EU, while CCFL-LCD TVs are replaced by LED-LCD TVs slower than in other countries.

In UK the share of non-labelled TVs is higher than in the EU, especially in the popular screen size categories (30"-40" and 40"-50"). The share of efficient TVs (A and A+) is smaller in the UK than in other countries, while the share of class C and those without label is higher.

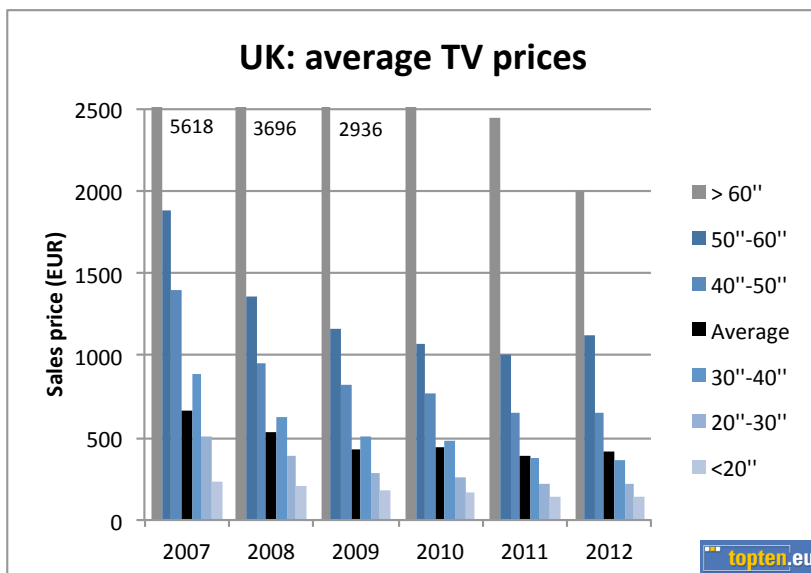
The sales peak for small TVs (<20" and 20"-22") is clearly higher for UK than across the EU.



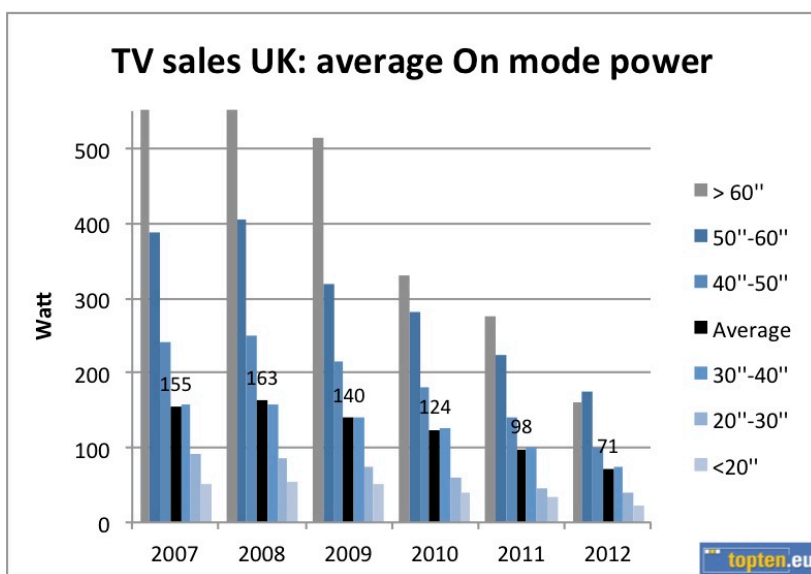
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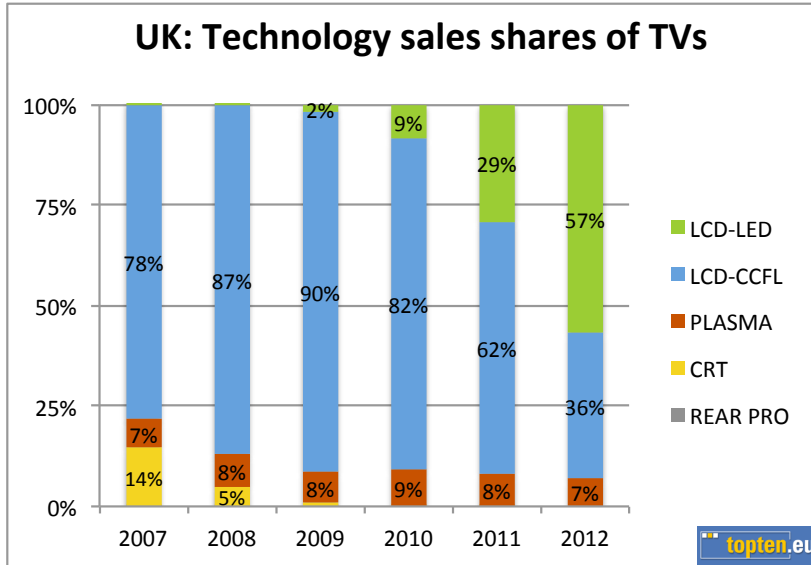
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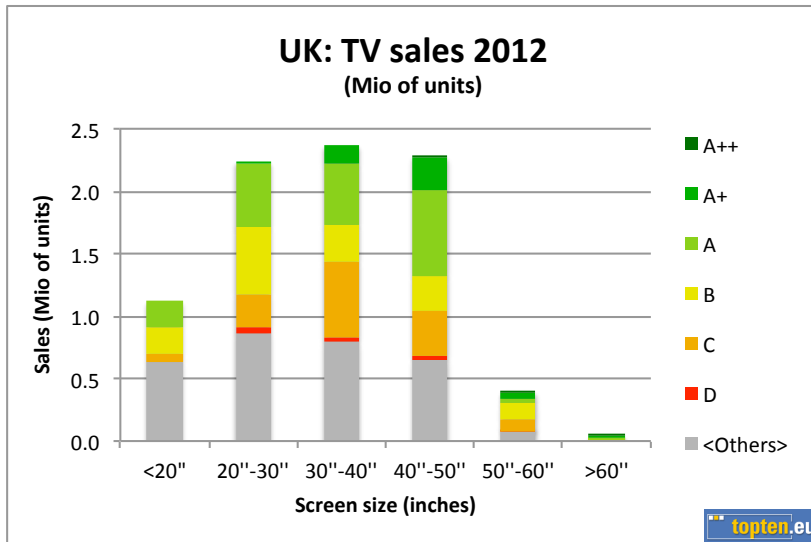
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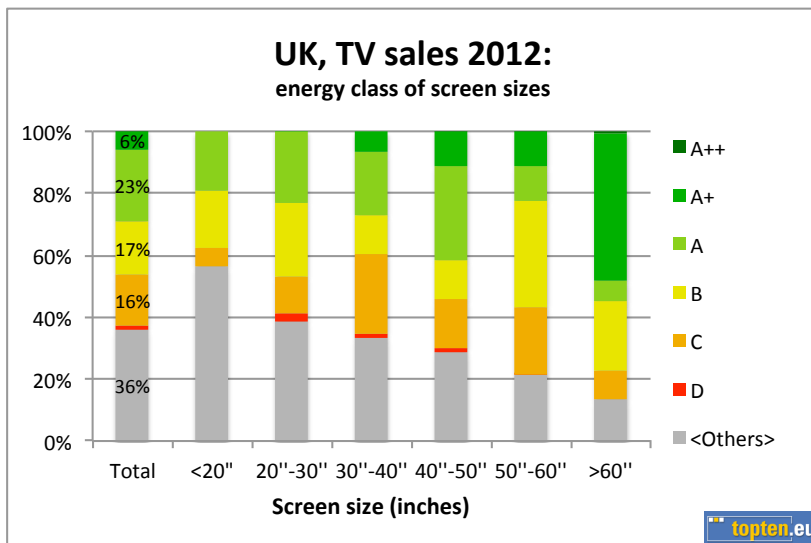
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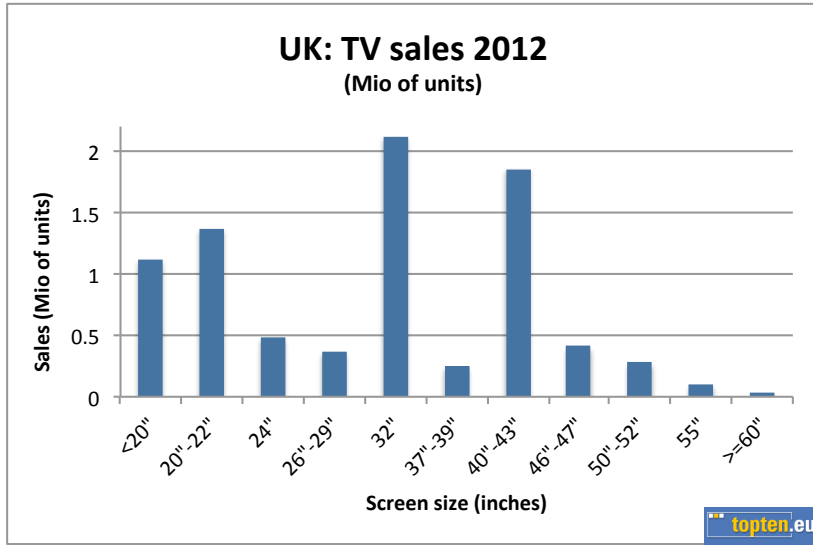
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Spain

TV sales in Spain from 2007 to 2012 show the ‘classic’ sales pyramid with a clear peak in 2010. After 2010 the sales dropped stronger than in other countries – we suppose that the economic crises is reflected in this development. TV sales per person were 0.08 units in 2012, and 0.21 TVs were sold per household.

With the sales decrease after 2010 TVs of 40” to 50” became much more popular. While across the EU the sales share of this category doubled, in Spain it even tripled. In 2007 -2010 the share of small TVs (<20”) had been higher than across the EU (around 25%, EU: around 18%). Did people mainly stop to buy secondary TVs? Or had people increasingly bought small TVs because they were fearing not to be able to receive their TV channels after the digital switch-over, but had not enough money to buy large TVs?

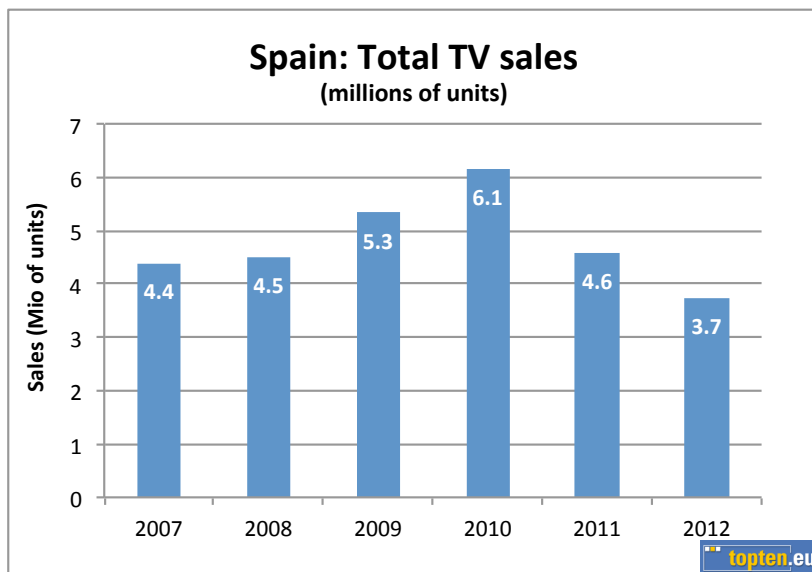
Average TV prices have decreased from EUR 619 to EUR 422 (-32%) from 2007 to 2012, while at the same time the average screen size increased from 27.5” (the lowest in 2007) to 32.5” (only UK is smaller on average) by 18%.

The average On mode power decreased from 126W to 67W (-50%) from 2008 to 2012. Spanish TVs have the lowest average power among the countries looked at in this monitoring (EU-24: 70W in 2012). From 2008 to 2012 the average screen size increased by 13%.

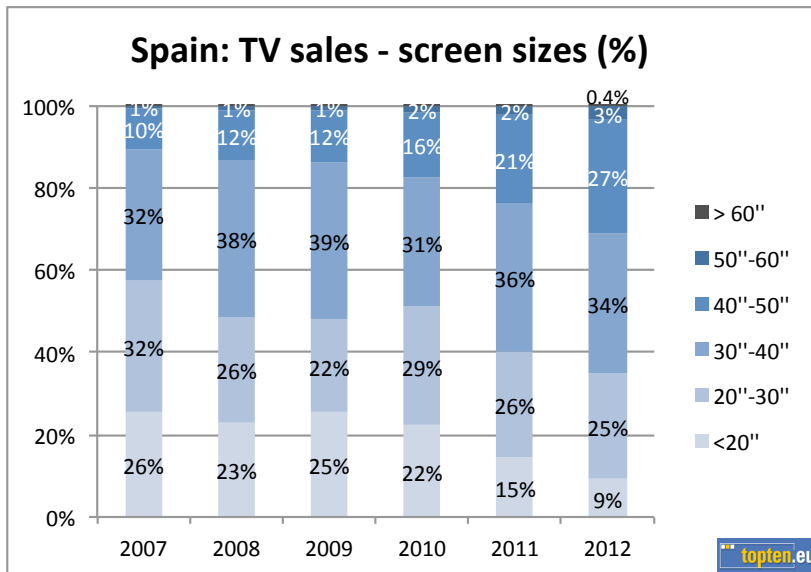
LED-LCD TVs have had a higher sales share in Spain than in other countries since 2011.

Similar to France, the share of small TVs is high in 2012, and among these the share of TVs sold without label is very high.

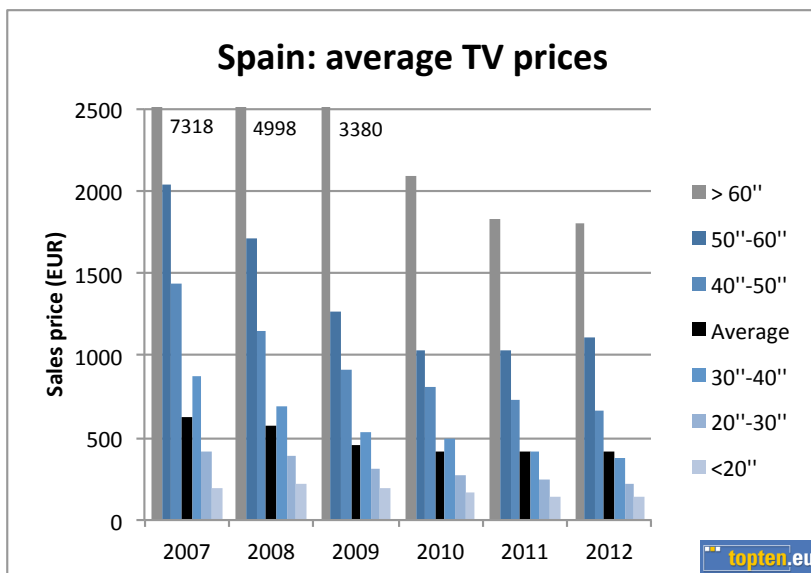
Also the peak for small TVs (20”-22”) is higher than in other countries, but not as high as in the UK.



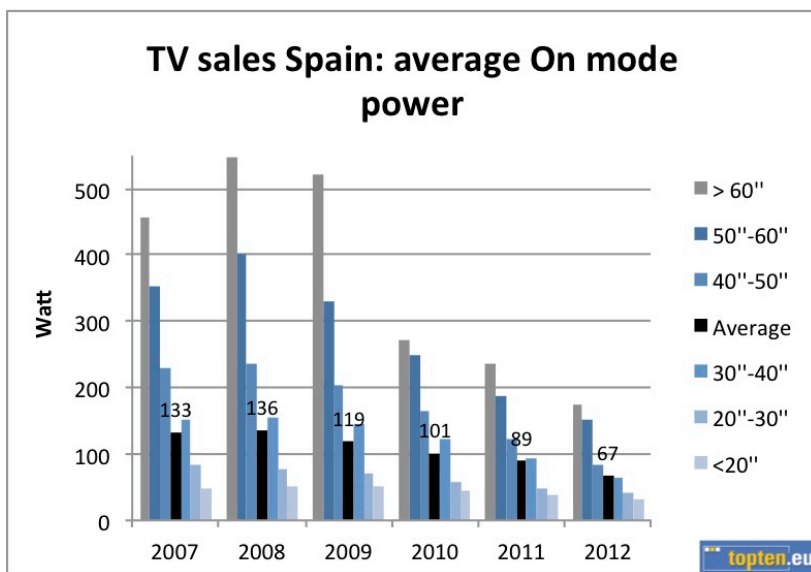
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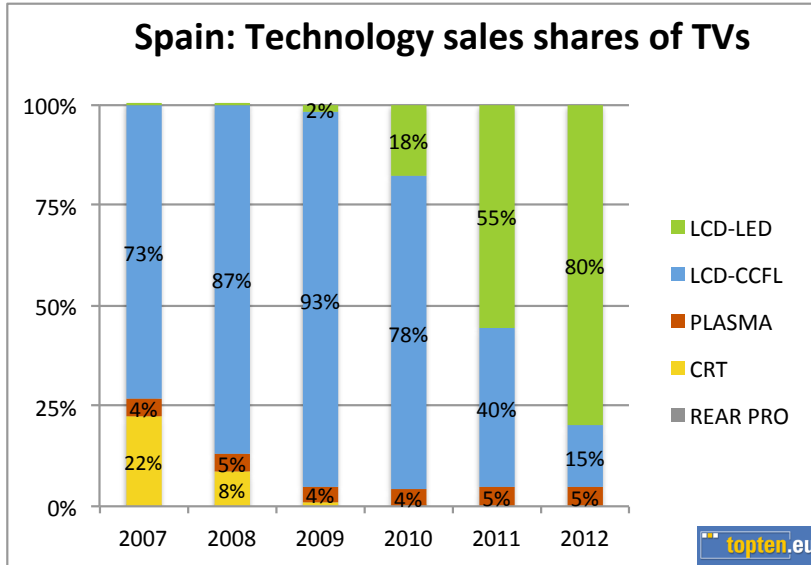
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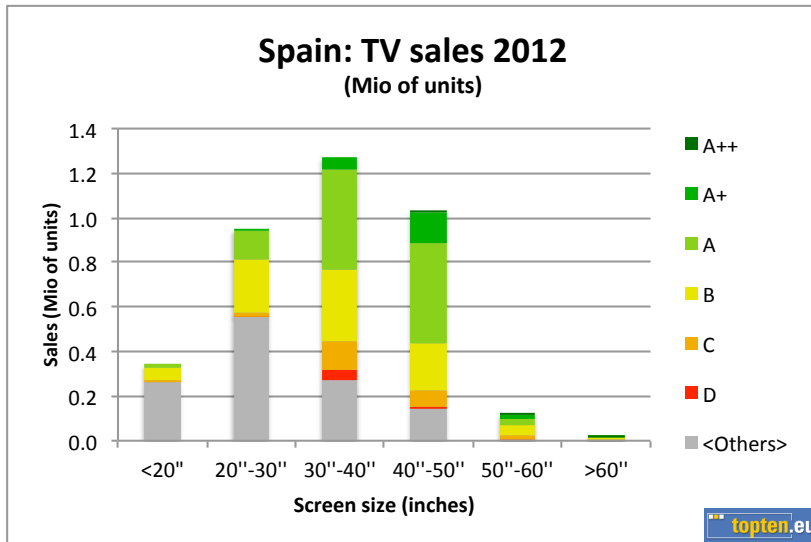
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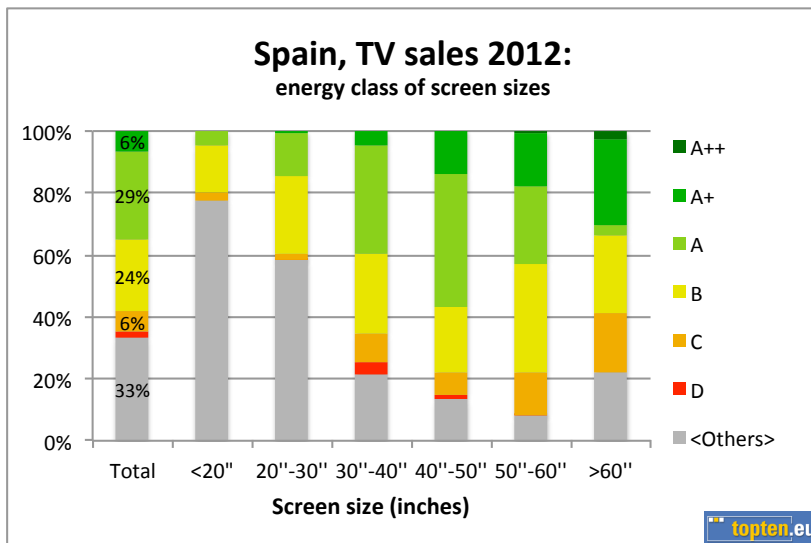
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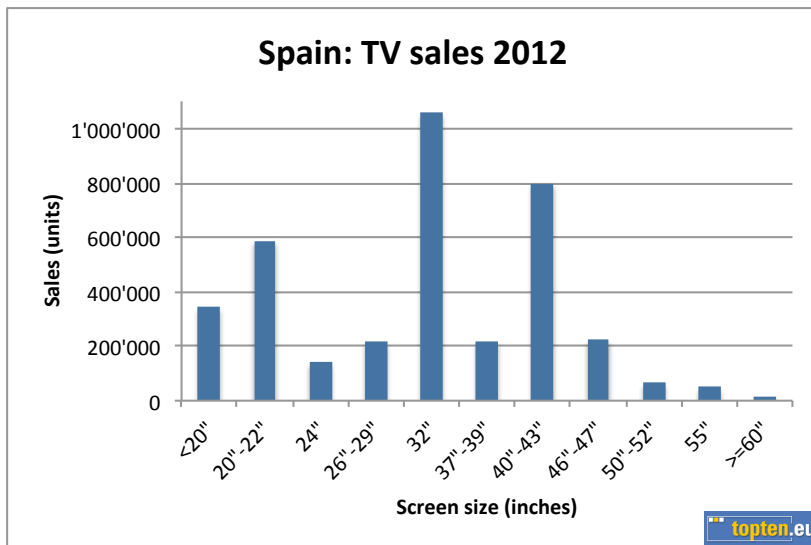
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Poland

In Poland the TV sales kept increasing until 2012, while most other countries saw a reduction after 2010. But TV sales are still at a comparatively low level in Poland: per person were 0.07 units were sold in 2012, and 0.20 TVs per household – the lowest relative sales of the countries included here. In Poland few TVs but large ones are bought – assumedly the market penetration is still rather lower than in other EU-countries and a low share of (small) secondary TVs for sleeping rooms or kitchens are bought:

Almost 80% of the sales are TVs with screen sizes between 30” and 50”. Smaller TVs are unpopular in Poland – less popular than in any other country considered here. In 2007 30”-40” were dominating, by 2012 these and the larger category (40”-50”) were almost equally popular.

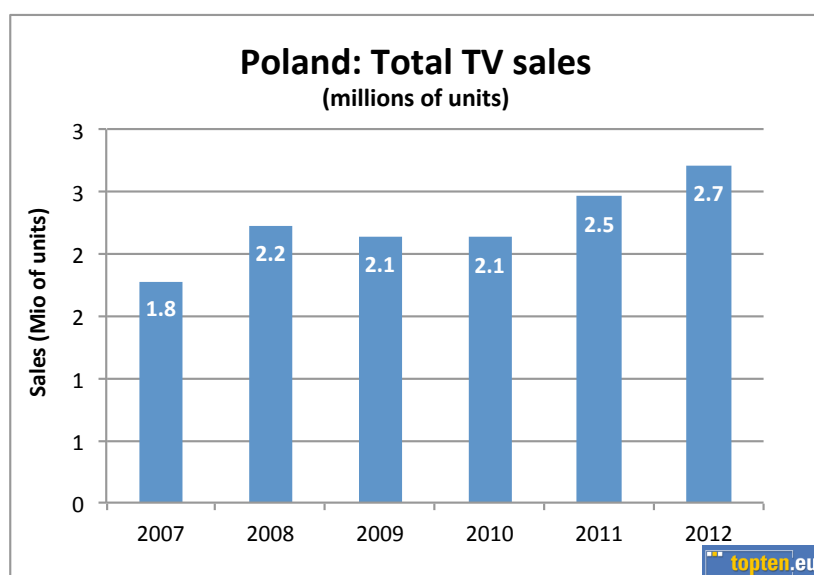
The average TV price decreased from EUR 560 in 2007 to EUR 479 in 2012 – a reduction of 15%, which is the smallest reduction in price of the countries looked at here. At the same time the average screen size increased from 32.3” (only Germany was larger) to 36.2 (similar to DE and DK) by 12% over this period.

The average power decreased from 157W in 2008 to 73W in 2012 (-53%). During this period the average screen size increased by 9%.

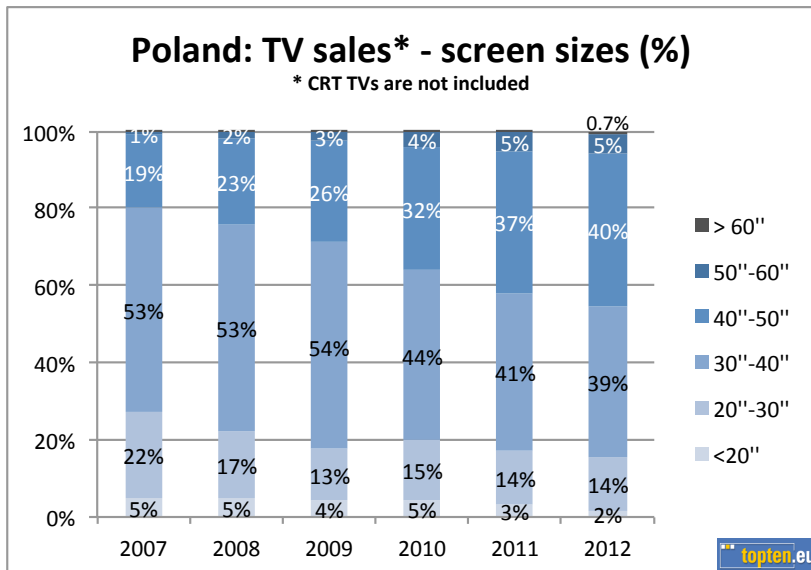
TV technology: CRT TVs had a much higher sales share back in 2007 than across the EU, and from 2009 to 2011 Plasma TVs were more popular than in other European countries. Apart from that, the technology sales shares correspond more or less to the EU average.

Poland has few sales in the size categories that are in danger to have a high percentage of missing labels, but also for the popular screen sizes (30”-40”, 40”-50”) Poland has a low share of non-labelled sales.

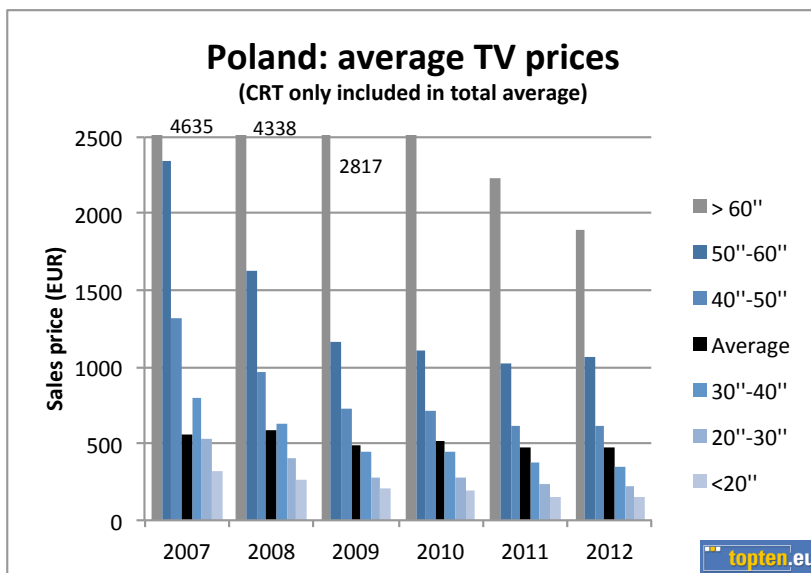
The preference for certain screen sizes is most obvious in Poland: TVs of 32” and 40”-43” are the clear favourites. The peak for small TVs can hardly be called a ‘peak’ for Poland – TVs of 46”-47” have as many sales as those of 20”-22”.



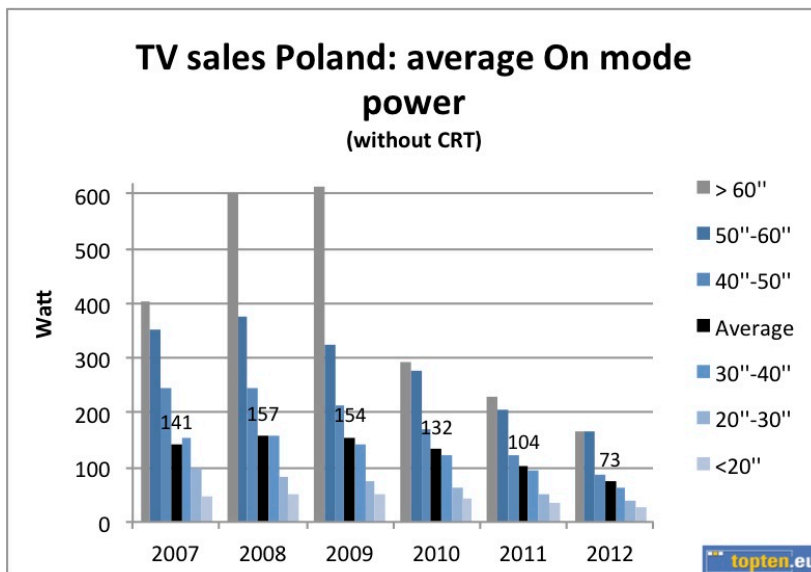
Data source: GfK



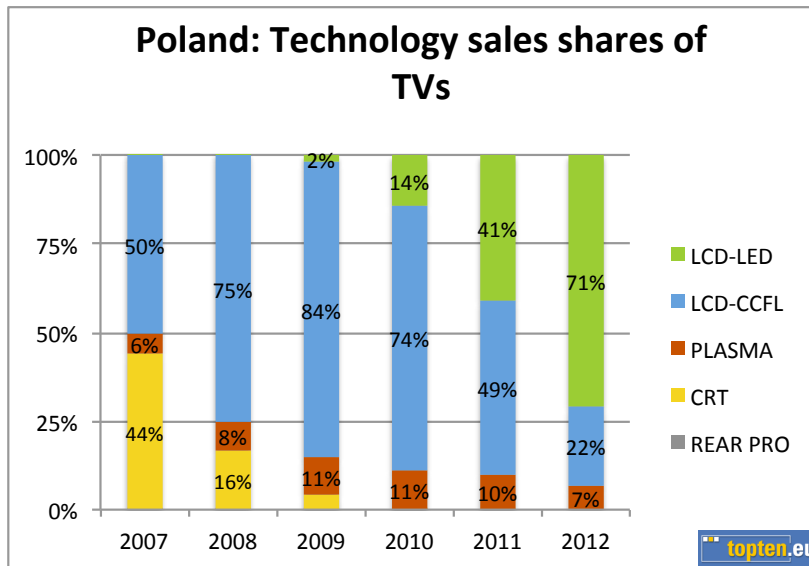
Data source: GfK



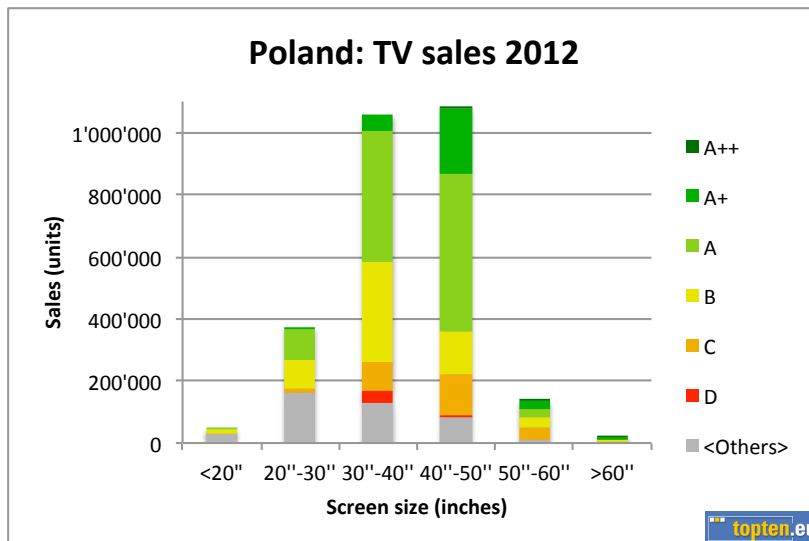
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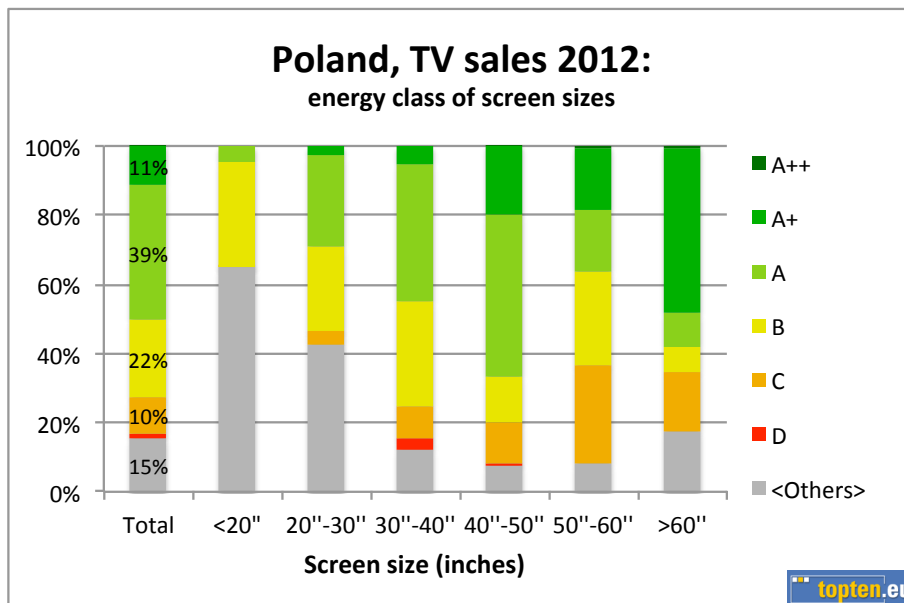
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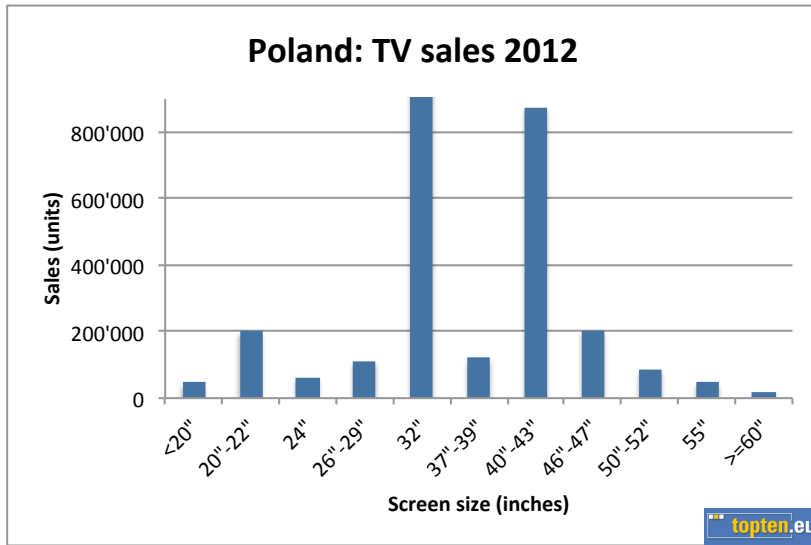
Data source: GfK



Data source: GfK



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Data source: GfK

Denmark

In Denmark TV sales decreased in 2012, one year later than in the EU average. In 2012 TV sales per person were 0.11 units, and 0.27 TVs were sold per household.

Large TVs are more popular in Denmark than in any other country considered here: 44% of the sales are TVs between 40" and 50", also the even larger ones hold larger shares in Denmark than in other countries: 7% (50" – 60") and 1.1% (>60").

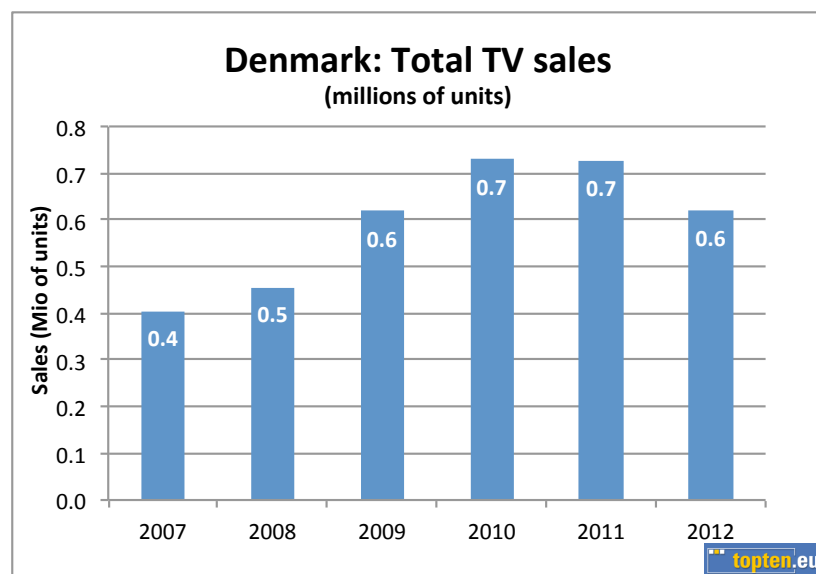
Average TV prices decreased from EUR 1230 in 2007 to EUR 718 in 2012 (-42% - the strongest reduction observed in this monitoring). The prices however still remain at a high level: 50% higher than across the EU. The average screen size increased from 31.6" to 36.8" by 17% over this period. Danish buy the largest TVs from the countries looked at here: on average they're 3.14" (8cm; 9%) larger than across the EU in 2012.

The average power decreased from 167W in 2008 to 77W in 2012 (-54%). Over the same period the average screen size increased by 11%. Denmark has the largest average screen sizes and the highest average power of the countries considered here, at least in 2012.

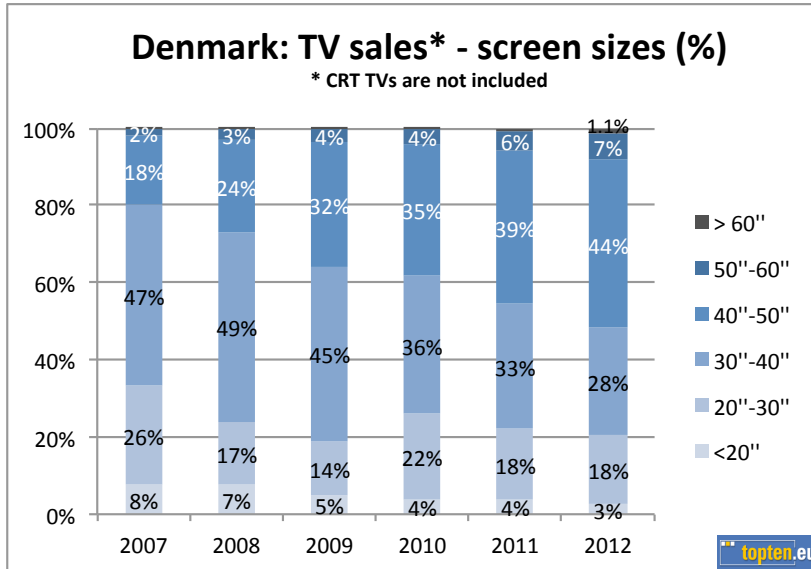
CRT TVs disappeared from the Danish market faster than from other countries' markets. LED-LCD TVs have been a bit more popular here than across the EU.

Denmark has an astonishingly high share of non-labelled sales across all screen size categories.

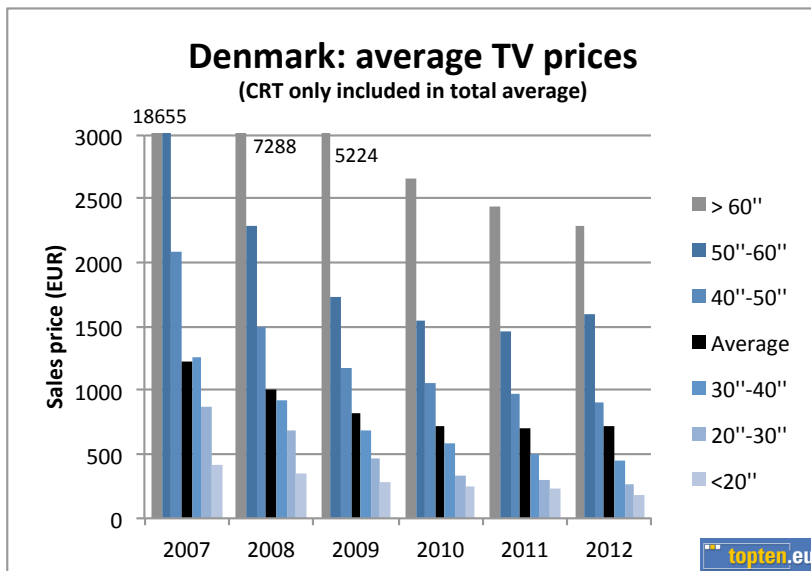
Unlike most other countries Danish prefer TVs of 40"-43" to those of 32". And large TVs (46"-47") are more popular here than across the EU.



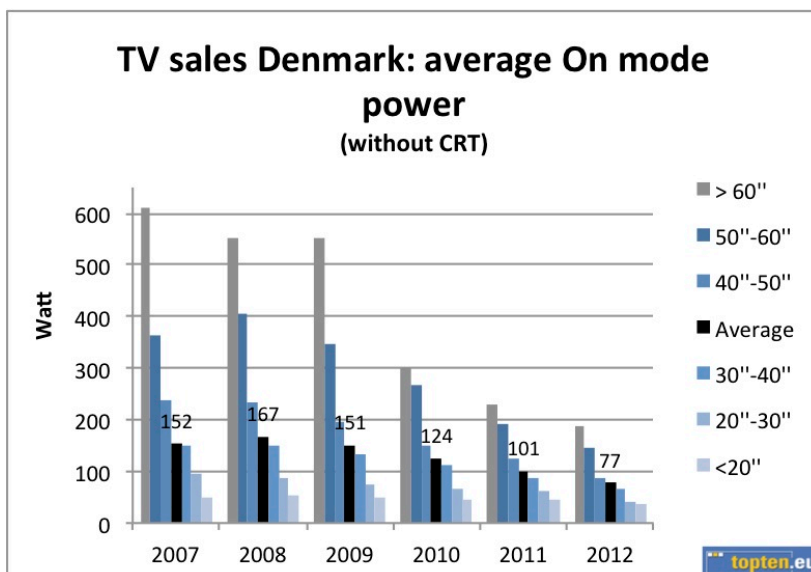
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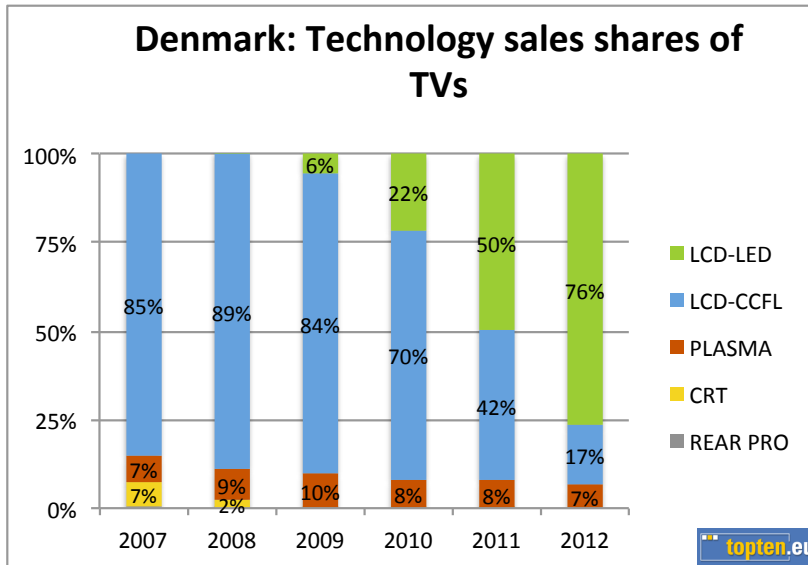
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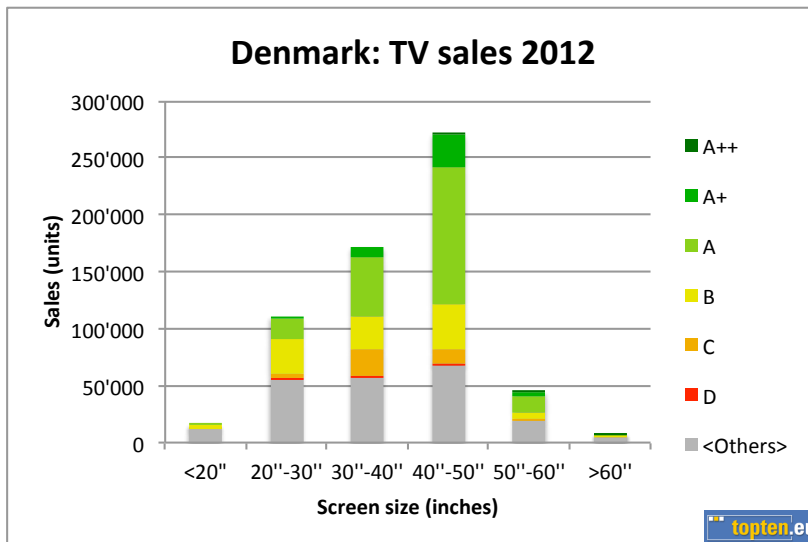
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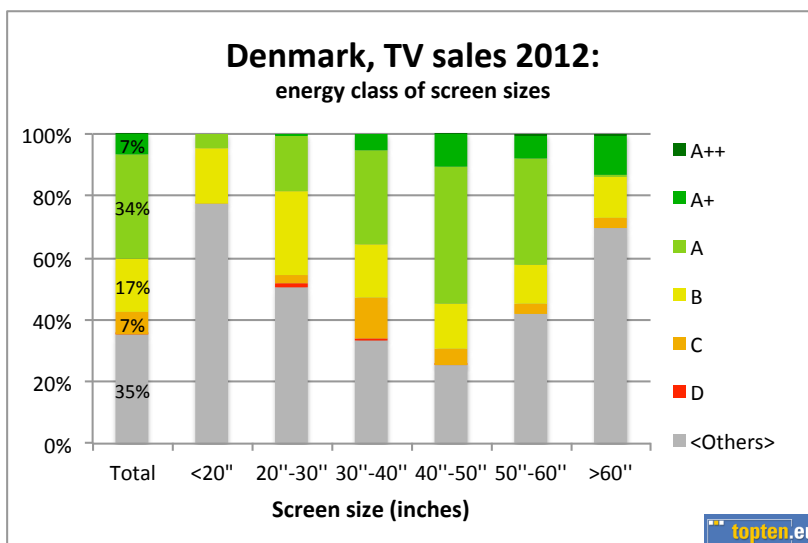
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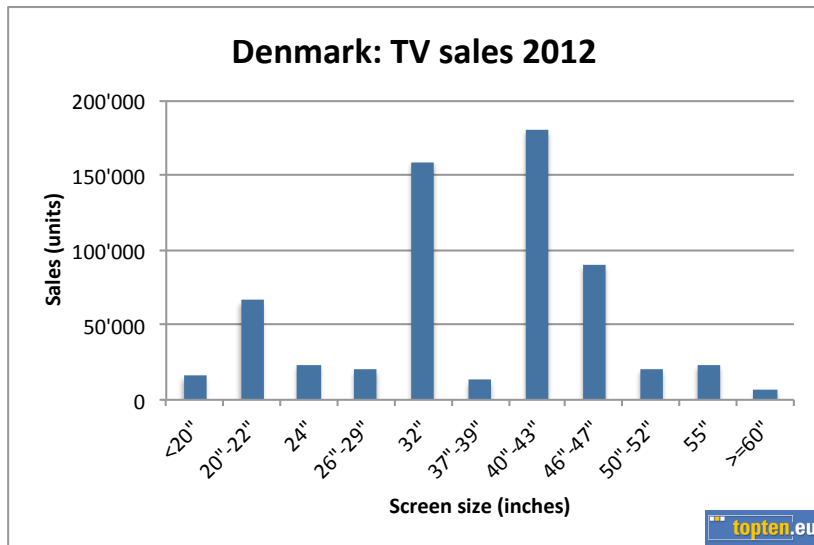
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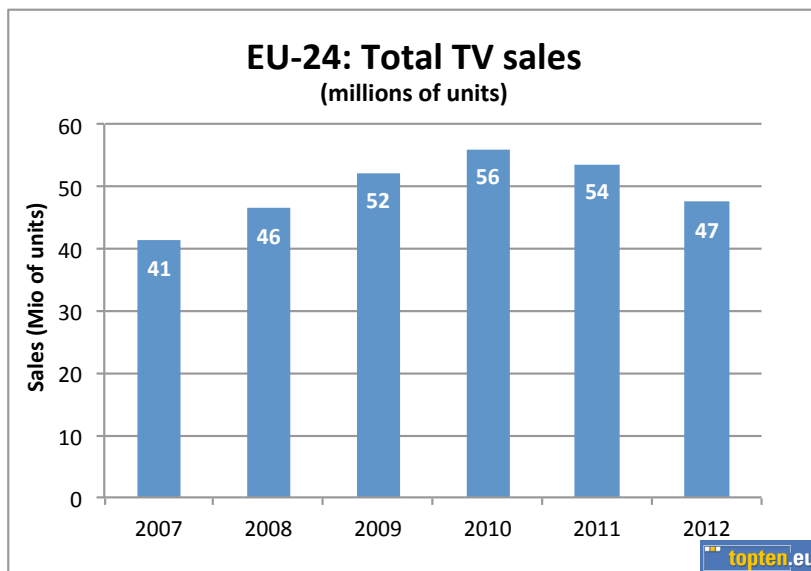
EU-24

Most results for the EU-24 are presented in the main report.

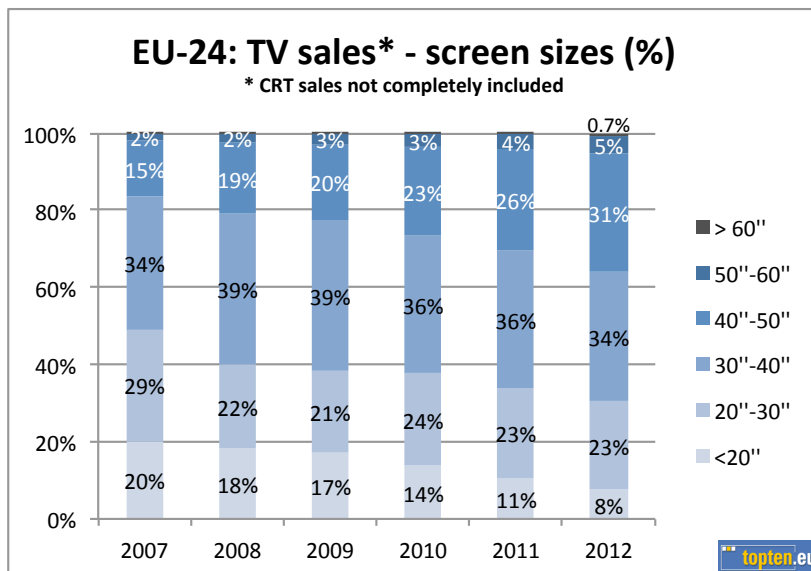
Average sales per person across the EU in 2012 was 0.10, and 0.23 TVs were sold per household.

Across the EU average TV prices decreased from EUR 679 in 2007 to EUR 482 in 2012 by 29%. At the same time the average screen size increased from 29.3" to 33.7" by 15%.

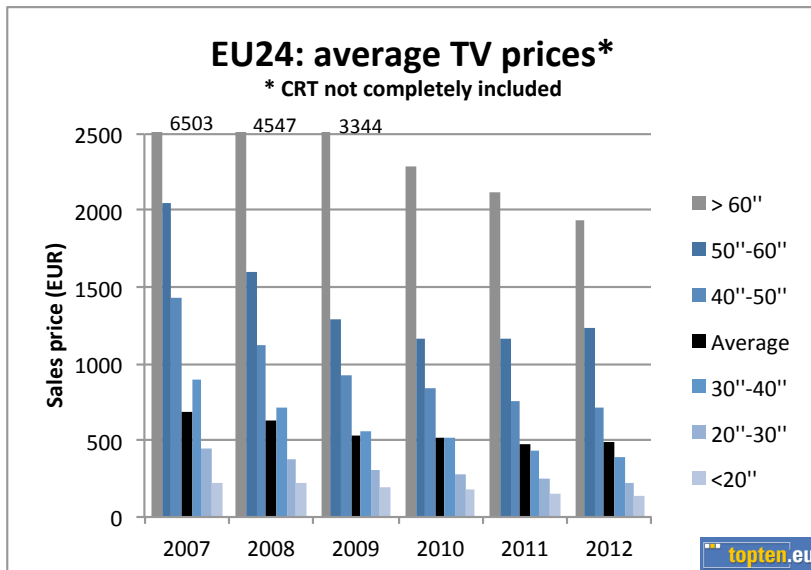
From 2008 to 2012 the average On mode power decreased from 156W to 70W (-55%), while at the same time the average screen size increased by 10%.



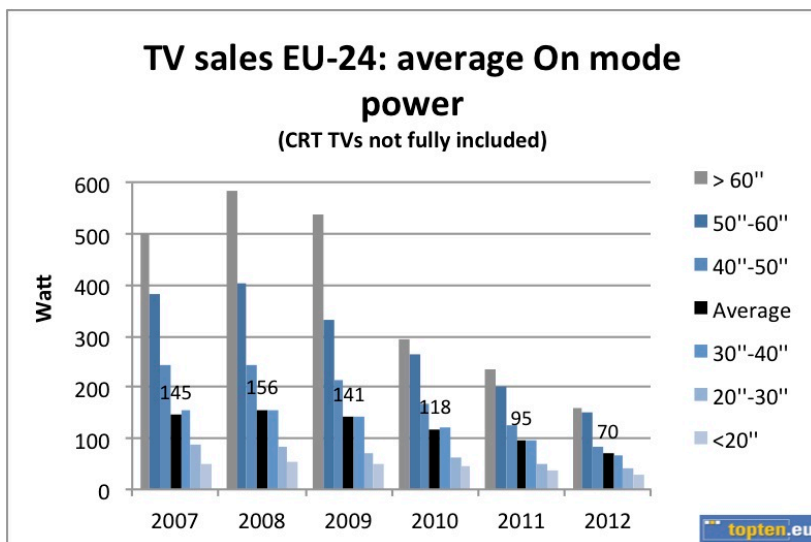
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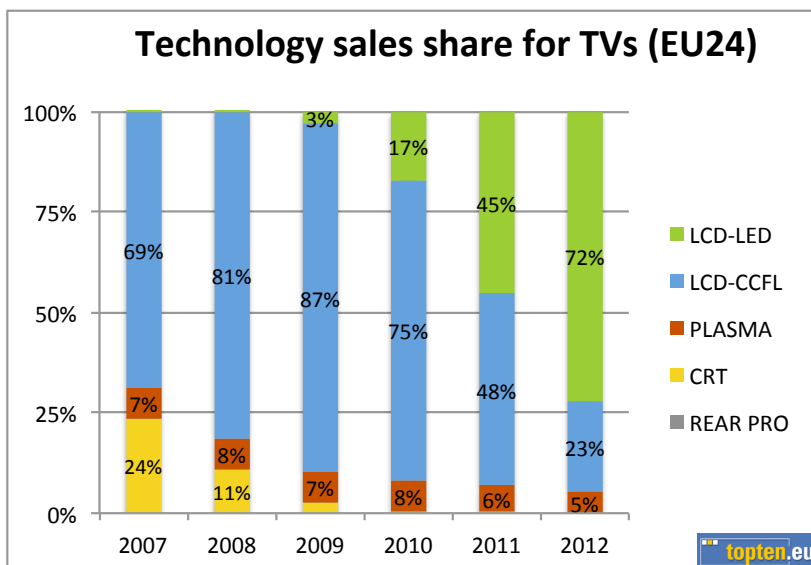
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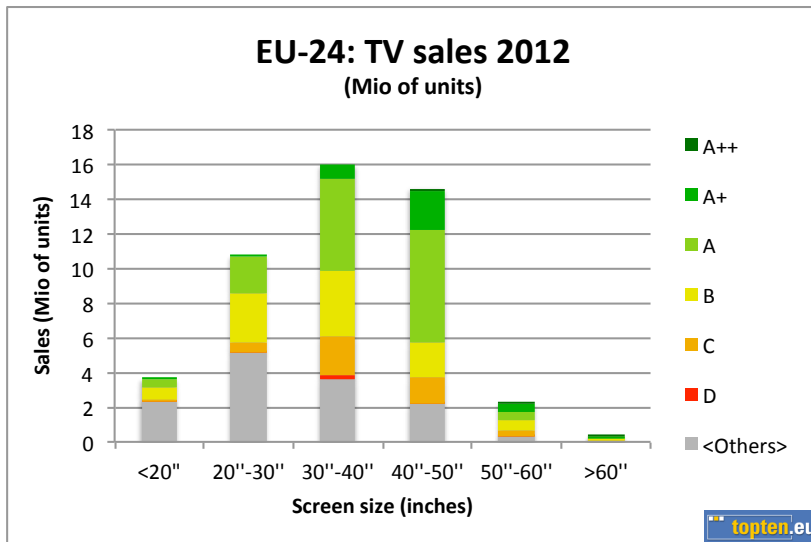
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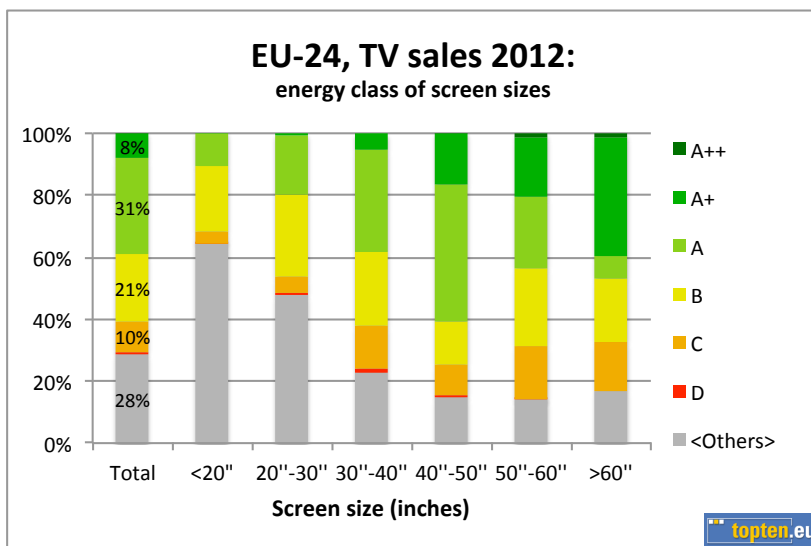
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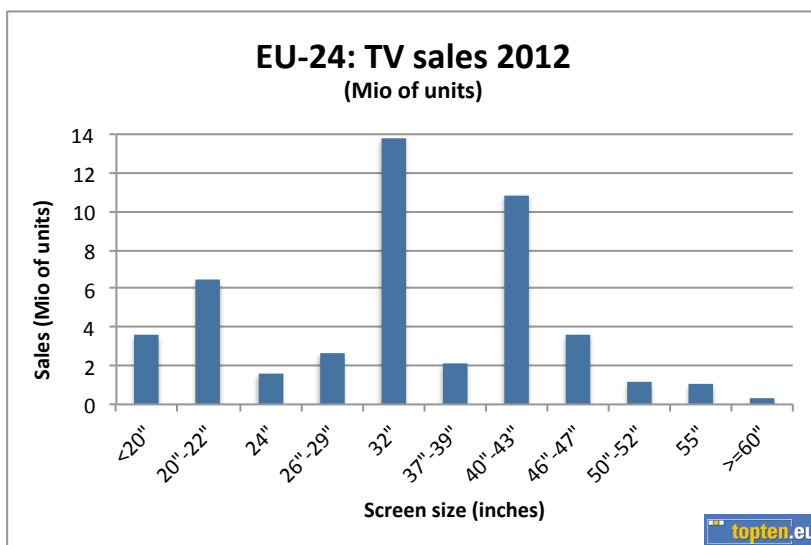
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