



August 6, 2007

Mehernaz Polad
ICF International
9300 Lee Highway
Fairfax, VA 22031-1207

RE: LG Comments on U.S. EPA Draft 1 ENERGY STAR Program Requirements for TVs: Version 3.0

Dear Ms. Polad:

On behalf of LG Electronics USA, I am submitting comments on the proposed U.S. EPA ENERGY STAR specification for TVs, version 3.0. LG Electronics USA, Inc. is the North American subsidiary of LG Electronics, Inc., a \$48.5 billion global force in consumer electronics, appliances and mobile communications. LG Electronics is a leading developer and manufacturer of Liquid Crystal Display (LCD) and Plasma flat panel televisions and is a long-standing partner in the EPA ENERGY STAR program. Note that LG also produces Digital Light Processing (DLP) and Liquid Crystal on Silicon (LCoS) rear-projection televisions, but does not produce Cathode Ray Tube (CRT), LCD rear-projection or LCD, DLP or LCoS front-projection models.

The EPA has invited comments on its "Draft 1 ENERGY STAR Program Requirements for TVs: Version 3.0", due July 27, 2007. LG Electronics welcomes this opportunity and feels that collaboration and consultation will result in the best ENERGY STAR specification for all involved. As a stakeholder in the development of this standard, LG Electronics offers the information and opinions on the following pages in order to aid in the development of fair criteria for evaluation and comparison of the energy efficiencies of televisions. LG Electronics wholeheartedly supports the goals of the ENERGY STAR program and believes that energy efficiency improvements for all electrical and electronic products benefit the consumer and society as a whole. Please feel free to contact us with any comments or questions regarding this information.

Sincerely,

Timothy McGrady
Environmental Manager
LG Electronics USA

I. LG Electronics' Comments on DRAFT 1 ENERGY STAR Program Requirements for TVs: Version 3.0

According to the U.S. EPA ENERGY STAR website, The ENERGY STAR program is “designed to identify and promote energy-efficient products to reduce greenhouse gas emissions.” The website goes on to say that “these products deliver the same or better performance as comparable models while using less energy and saving money.” As an ENERGY STAR partner, LG Electronics supports the goals of the program. With regard to the “Draft 1 ENERGY STAR Program Requirements for TVs: Version 3.0”, LG Electronics supports the proposed maximum power consumption specification for Standby Mode per Section 3) C. LG Electronics has no comments on the proposed Download Acquisition Mode (DAM) specification.

Please note, however, that LG Electronics does not support the proposed specification for maximum On Mode/Active Power consumption per Section 3) A. of “Draft 1 ENERGY STAR Program Requirements for TVs: Version 3.0”. LG Electronics believes that the proposed specification is “technology biased”. That is, the proposed specification favors one or more technologies over other technologies without consideration of market factors, features and performance. If the proposed specification were allowed to go into effect as written, it would preferentially award ENERGY STAR ratings to technologies that are inferior in performance, have fewer features and/or are declining in market share. If the specification goes into effect as is, the EPA statement that ENERGY STAR “products deliver the same or better performance as comparable models” will be falsified, because: 1) the products that will immediately be awarded ENERGY STAR rating do not perform as well as competing models; and 2) the term “comparable” will only be based on screen area and will not take into consideration enhanced features, performance and differences in technology.

LG Electronics believes that the various television technologies should be considered as separate categories: 1) CRT; 2) LCD flat panel; 3) PDP flat panel; 4) Rear-Projection DLP; 5) other Rear-Projection Micro-Device units and 6) Front Projector (note that front projection televisions have not to date been included in the EPA program – since they may also be marketed and/or used as projectors for IT equipment, they may be covered under another market segment).

Furthermore, LG Electronics does not support the use of Internet content to determine On Mode power consumption as given in Section 4) E. 2. b. There are several issues with the proposed On Mode specification that LG Electronics would like the EPA to consider:

1. The EPA dataset used to develop the proposed On Mode specification is incomplete and flawed.

There are many “holes” in the data set, particularly in the “Resolution (pixels x pixels)” and “Name of Factory Picture Controls Preset Used During Test” columns. This data would prove very useful if it could be filled in by the EPA; the data could be used to further support arguments that screen area should not be the only basis for comparison of power consumption of televisions.

In addition, more data should be added for native resolution 1080 televisions, since these models are becoming more commonplace in the market and will soon be in a dominant position. Also, more data should be added for large screen area LCD televisions as opposed to the smaller screen units. Models with inferior features within a technology class should either not be included in the dataset or features significantly impacting

power consumption should have a factor in the power consumption equation. For example, several models of televisions included in the dataset did not have integrated tuners (monitors only); those models, not surprisingly, had lower power consumption than models with otherwise comparable features (screen area, native resolution, etc). Another example is the inclusion of data from one plasma television with low-definition 480 native resolution; again, not surprisingly, that model had the lowest energy consumption of otherwise comparable models. The inclusion of the 480 native resolution plasma television data is a prime example of favoring energy consumption over superior performance and ignoring current market trends toward higher native resolution and improved picture quality.

The underlying assumption that power consumption is primarily a function of screen area is flawed. While this is partially true for most television technologies, it is wholly untrue for DLP technology. There is little or no relationship between energy consumption and screen area with regard to DLP technology (see Chart 2 on page 8). So the inclusion of DLP data in the dataset violates the underlying assumption of the data chart. That is a strong argument for either excluding DLP technology from the dataset or considering technologies as separate categories.

2. The data used to develop the proposed On Mode specification may not be representative of television models currently available for sale in the United States.

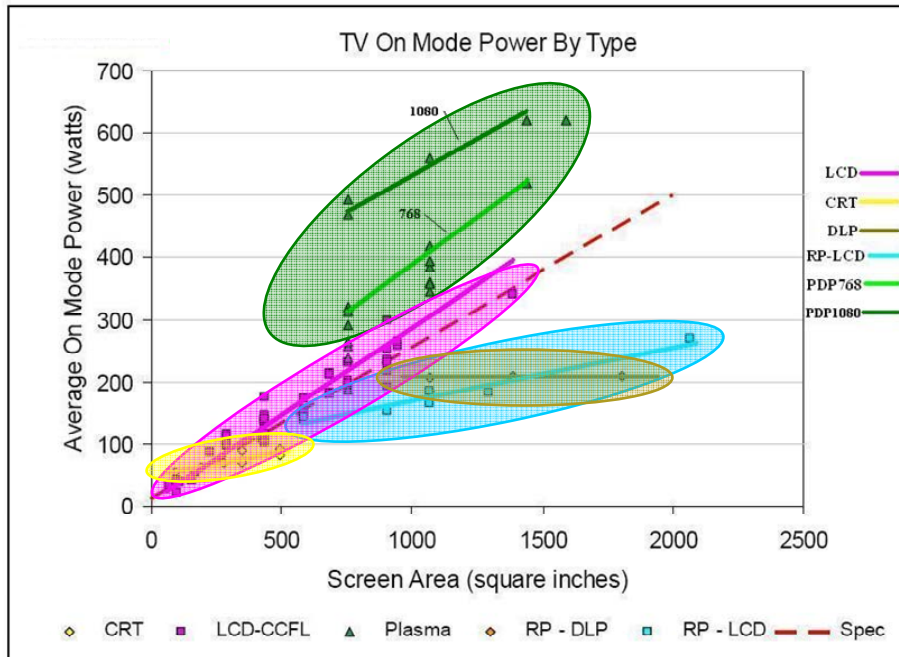
LCD and Plasma TVs are probably over-represented and DLP and CRT under-represented; also, the native resolution 768 is likely over-represented and 1080 native resolution under-represented. The market and popularity of technologies is always changing and changes are rapid; changing the proposed specification to allow different TV technologies to be considered separately would alleviate this problem and remove bias from over- or under-representation of technologies within the dataset.

3. The chart of Average On Mode Power versus Screen Area shows a great deal of scatter in the data.

The scatter is likely due to differences in television technologies, measurement modes (factory presets), features and native resolutions (see information under LCD and Plasma sections).

4. The “technology neutral” approach to development of an On Mode Power specification for televisions is actually “technology biased.”

Groupings of data clearly show that different television technologies and features have different power requirements (see chart below). Any attempt to draw one line through this mixed dataset will show bias in favor of certain technologies and features over others and will result in a lack of incentives to improve energy efficiencies. When drawing lines characterizing data trends, it is expected that the line represents the population of data. In this case, the line drawn through the data by the EPA is clearly not representative of the data as a whole. This suggests the imposition of a preconceived notion on the set of data instead of the data dictating the relationship. In this case, the data itself shows the preconceived idea that power consumption is wholly dependent on screen area is false.



5. There is precedent within the EPA ENERGY STAR program to develop different standards for different configurations and features.

The EPA ENERGY STAR program for refrigerators and freezers has split categories for side-by-side, top freezer, bottom freezer, single door refrigerator and freezer, single door refrigerator only, chest freezer and upright freezer. Furthermore, the refrigerator and freezer program considers whether units have automatic or manual defrost and whether or not units have through-the-door ice service. See the National Appliance Energy Conservation Act information below (taken from the ENERGY STAR website):

Federal Standards (NAECA)

The National Appliance Energy Conservation Act (NAECA) dictates minimum standards for energy consumption in refrigerators and freezers. The standard varies depending on the size and configuration of the refrigerator or freezer.

Refrigerators and freezers are categorized by:

- Configuration (side-by-side, top freezer, bottom freezer, single door refrigerator and freezer, single door refrigerator only, chest freezer, and upright freezer)

- Automatic or manual defrost

- For refrigerators, whether or not they have through-the-door ice service

Adjusted Volume (AV) for refrigerators is calculated as follows: $AV = (\text{Fresh Volume}) + 1.63 \times (\text{Freezer Volume})$.

For freezers, the adjustment factor is 1.73 so the calculation is: $AV = 1.73 \times \text{Freezer Volume}$.

Fresh Volume is the total volume of the main refrigerator compartment.

Freezer Volume is the total volume of the freezer compartment.

LG Electronics therefore suggests that different television technologies should have different equations governing their ENERGY STAR performance, just as refrigerators have different categories within the ENERGY STAR program.

6. The various television technologies should be considered as separate categories for On Mode Power consumption, with individual specifications for each category.

Given precedent for this practice within the EPA ENERGY STAR program, the scatter and groupings of data on the EPA TV On Mode Power by Type chart, the potential to avoid “technology bias” in the program and the potential incentives, it is appropriate to categorize televisions by technology types and features. In addition, splitting technologies into categories will negate any bias introduced into the standard due to variability in market shares held by different technologies, as the market is always in a state of flux with regard to popularity of technologies.

If the current proposal for ENERGY STAR TV requirements goes into effect, there will be no incentive for manufacturers of rear-projection TVs to improve their products’ power consumption, since those products will already meet the ENERGY STAR requirement. Likewise, the LCD manufacturers will have a limited incentive to improve their products’ energy efficiency, since some of their models will already meet the specification when it goes into effect. But the manufacturers of plasma televisions will have an unattainable goal in the new ENERGY STAR standard, so there will be no incentive to improve their products’ energy consumption.

7. The Average On Mode Power Equation slope and y-intercept are arbitrary and are not based on sound technical information or appropriate data evaluation.

The inclusion of the DLP data and variability of the data due to differences in factory picture controls presets and native resolutions skews the slope and y-intercept of the proposed standard line.

8. The proposed On Mode Power specification includes measurement of power consumption using Internet content, which is not a current use for televisions by most consumers.

While it is anticipated that further in the future Internet and broadcast content will converge and consumers will view much more Internet content on their televisions, most customers in the U.S. do not currently use their televisions to receive and view internet content. Thus, basing a power consumption test on Internet content does not seem to reflect reality. LG Electronics recommends that the proposed internet content power consumption test be dropped from the measurement requirement.

9. The U.S. EPA currently has a Memorandum of Understanding (MOU) with other countries on ENERGY STAR standards for certain products; the potential exists that there could be two or more energy efficiency standards for televisions in Europe.

The current regulatory situation, with different limits and timelines being established for all kinds of requirements, makes it difficult for manufacturers to plan and execute those plans. LG Electronics recommends that energy efficiency requirements and timelines be harmonized between the U.S. and Europe. LG Electronics suggests that a tiered approach to the ENERGY STAR requirements may help accomplish such harmonization.

10. The proposed effective date for such stringent requirements is much too soon, considering that most manufacturers have geared their design toward the minimum EuP requirements.

It will be exceedingly difficult to meet the proposed requirements within approximately one year (by September 2008). LG Electronics suggests that the technology does not currently exist to allow its plasma products or those of other manufacturers to meet the proposed requirements, particularly considering the introduction of the new 1080 native resolution products. LG Electronics asks that a delay in the proposed effective date be sought. Alternatively, or in addition, LG Electronics seeks to minimize the impact of the proposed power consumption requirements through a separate technology approach, a tiered approach, an increase in the slope of the equation and/or an increase in the offset (y-intercept) value.

II. Information on Television Technologies

The information in this section is intended to help EPA employees and their consultants understand the various television technologies, their energy consumption and the sales trends for each technology. Charts showing plots of the EPA's Average On Mode Power versus Screen Size data are used to characterize and contrast the power consumption of each technology.

A. Cathode Ray Tubes (CRTs)

CRT technology was developed a century ago. The first commercially available televisions, based on a hot cathode within an electron gun (thermionic emission), became available in the late 1930s. CRT remained the primary television technology available to the general public through the early 2000s, when flat panel LCD and Plasma product prices had dropped to a competitive value. CRT shipments to the United States were approximately 19.3 million units in the U.S. in 2004; shipments are projected to drop to 5.3 million units by the end of 2009. In contrast, LCD TV unit shipments were about 2.75 million in 2004 and are projected to be 21.8 million in 2009. Likewise, Plasma TV shipments to the U.S. in 2004 were only 750,000 units, but were expected to reach 6 million units by the end of 2009 (Source: EPA consultation document "Preliminary Television Market and Industry Research" (January 6, 2006)). As of 2007, many manufacturers have stopped making CRT televisions or have severely curtailed production; some retailers have announced that they will not sell CRT televisions after 2007.

As the popularity of CRT televisions has waned, most manufacturers have stopped including premium features on the sets. Most CRT-based sets are now offered as standard definition models; only a few current (2007) models still offer high definition. It would be interesting to determine the power usage of high definition CRT models for comparison with the standard definition CRT models, but that would be purely an academic exercise (Note that all seven CRT units included in the EPA dataset were 480i, or standard definition, televisions).

In general, television power usage increases with screen size (but not in every case – see DLP information). This is true of CRT televisions. But the power consumption of CRTs also depends upon image brightness; the brighter the image, the more power is used by a CRT set. However, if the power consumption of two equal size CRT-based sets is compared using the same image source (as is required per the draft IEC 62087 ED 2.0 test specification), the power consumption due to brightness variations cancels out, given similar brightness settings on the sets. So when comparing standard definition CRT-based sets, one would expect to see a direct relationship of power increasing as screen size increases. Referring to the EPA chart of Average On Mode Power versus Screen Area data for CRT televisions, a direct relationship does indeed exist between power consumption and screen size. (See Chart 1 below).

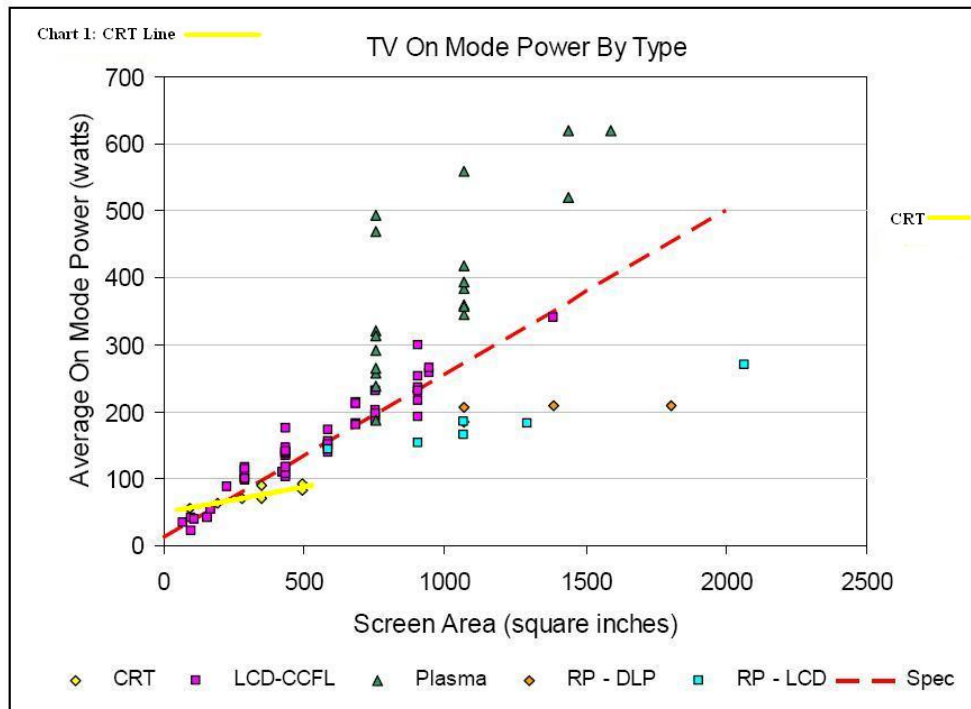


Chart 1: Line Characterizing CRT Energy Consumption vs Screen Area

B. Rear-Projection Digital Light Processing (RP-DLP)

DLP is a relatively new technology, having been invented in 1987 by Dr. Larry Hornbeck of Texas Instruments. The heart of DLP TVs is one or more microchips, called Digital MicroMirror Devices (DMDs). A DMD is essentially a collection of very tiny mirrors that can be quickly moved from one position to another, allowing light from the mercury vapor lamp to shine through the lens (the mirrors essentially act as on/off switches). In a

single DMD unit, light from the lamp goes through a color wheel prior to impacting the DMD. In a triple-DMD RP-DLP TV, the light is split by a prism into primary colors and each color is directed to a DMD prior to being recombined to form the image. The power output of the mercury vapor lamp is constant, with the DMD(s) being used to vary the color and brightness of the image via changes in position. Note the term “DLP” is a trademark registered by Texas Instruments.

Because only a small amount of energy is used to vary the positions of the mirrors on the DMD(s), RP-DLPs should show a relatively constant power output given a constant image source. The DMDs are the source of resolution, since the number of mirrors is directly proportional to the number of pixels on the screen. Since the light source is constant, RP-DLP televisions should show relatively constant power consumption without regard to screen size, resolution or brightness. Referring to the EPA chart of Average On Mode Power versus Screen Area data, the RP-DLP televisions do indeed show constant power consumption, independent of screen size (see Chart 2 below).

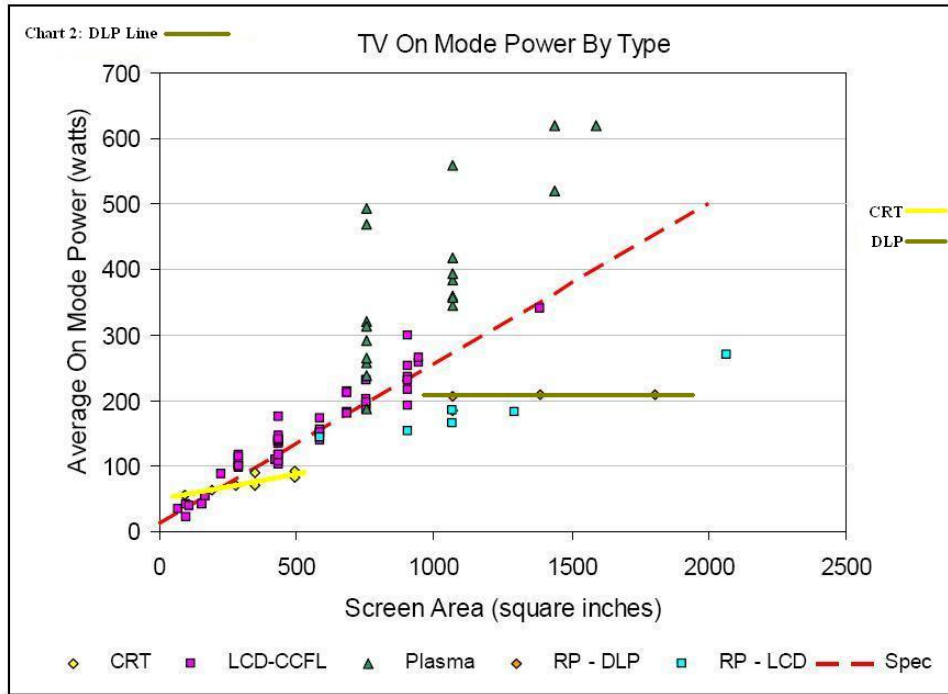


Chart 2: Line Characterizing RP-DLP Energy Consumption vs Screen Area

Note that even though sales of RP-DLP units were projected to increase by the study “Preliminary Television Market and Industry Research” (January 6, 2006), sales figures from the Consumer Electronics Association (CEA) show that DLP sales were actually flat or in decline; according to CEA data, sales of “digital projection sets and monitors” were approximately 3.5 million units in 2004, but were projected to be only about 2.5 million units in 2007. Note that “digital projection sets and monitors” data includes RP-DLP, RP-LCD and other digital projection technologies, but the conclusion that RP-DLP sales are flat or in decline is in line with LG Electronics’ internal market evaluation.

C. Rear-Projection Liquid Crystal Display (RP-LCD)

RP-LCD is a similar technology to RP-DLP, but the DMDs used in DLP technology are replaced with LCD chips. As the resolution and size of the RP-LCD screen increases, power consumption also increases, because each pixel consists of several LCDs and operation of each LCD requires a certain amount of power. As image brightness decreases, power consumption increases; LCDs have to block the light from the constant light source in order to create dark pixels. The image source was the same for determination of power consumption versus screen size data in the EPA study, so the results should show a direct relationship between screen size and energy consumption. Referring to the EPA chart of Average On Mode Power versus Screen Area data, the RP-LCD televisions do show such a direct relationship (see Chart 3 below).

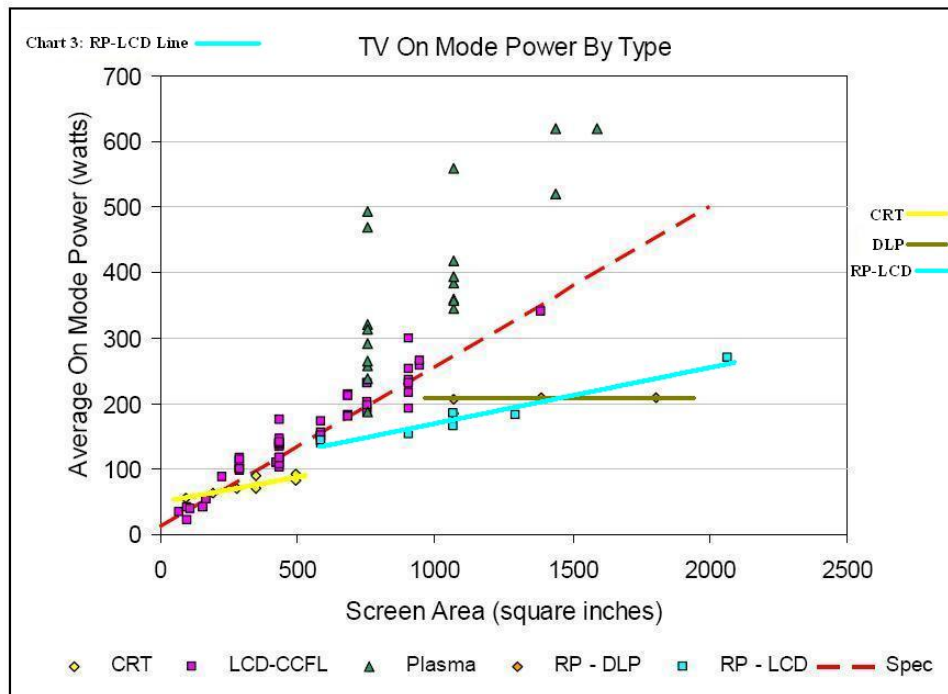


Chart 3: Line Characterizing RP-LCD Energy Consumption vs Screen Area

Note that as with RP-DLP televisions, RP-LCD sales appear to be flat or on the decline. A relatively new technology, Liquid Crystal on Silicon (LCoS), promises to solve some of the imaging issues associated with RP-DLP and RP-LCD technologies, so there may eventually be an upswing in the rear-projection television market. Another factor negatively impacting RP-DLP and RP-LCD sales has been the relatively large size of rear-projection units compared to flat panel televisions; as rear-projection televisions become thinner, they may see an upswing in sales. But for now, RP (also called “micro-device) technologies are only about 10% of US television sales.

D. Liquid Crystal Display-Cold Cathode Lamp Flat Panels (LCD-CCFL)

LCD-CCFL technology for televisions is relatively new compared to CRT technology; the first commercially available televisions employing LCD-CCFL became available in late 2000. In 2006, LCD televisions began to dominate television sales in the 40” and

under screen size range; sales of LCD TVs in 2006 were estimated at 10.5 million units in the U.S., representing about 30% of U.S. television sales. It is estimated that sales of LCD TVs in the U.S. will reach 20 million units by 2009, or about 65% of U.S. television sales.

The basic design of an LCD-CCFL television is shown in Figure 1. The light source is constant (given a particular brightness setting) and is provided by a number of CCFLs. The number of CCFLs employed depends upon the size of the display and up to 40 CCFLs may be used to backlight today's largest LCD televisions. The light is passed through a diffuser for even distribution and then passes through a polarizer. The light then passes through liquid crystal array, goes through another polarizer and finally reaches the viewer. The liquid crystal array is controlled such that when power is supplied to individual cells, the crystals twist to block some or all of the incident light. Thus the darker the image, the more power is applied to the LCD cells and the array as a whole. Maximum power usage in an LCD TV is when the screen is completely black.

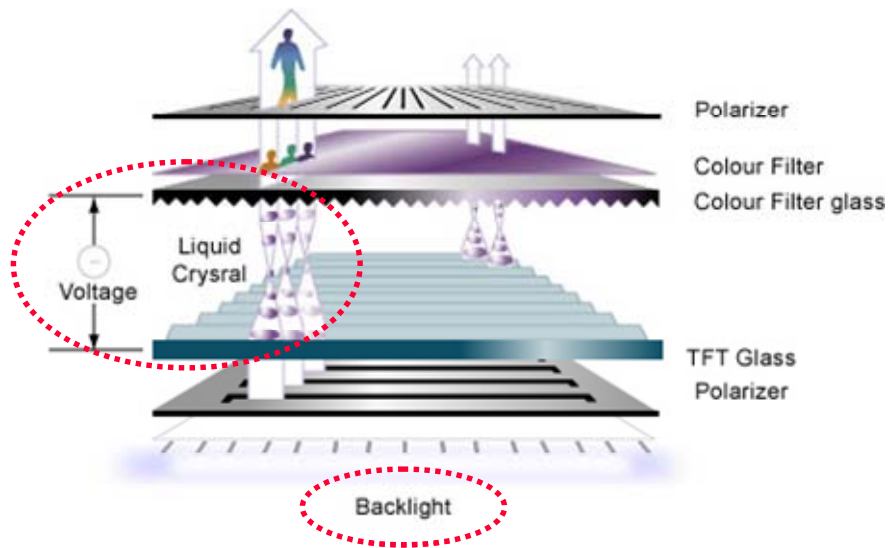


Figure 1: Schematic of an LCD-CCFL Television

The power usage of the LCD display is directly proportional to the number of LCD cells (pixels) in the display; given the same image input, comparison of LCD television On Mode Power consumption should show a direct relationship to screen area, and the EPA chart of data confirms that it does (see Chart 4 on page 11). Note that there is some scatter in the LCD data about the line for LCD power consumption versus screen area.

E. Plasma Display Panels (PDP)

Plasma Display Panel (PDP) televisions are also relatively new to the consumer market in comparison to televisions based on CRT technology. While plasma technology was developed in the 1960s and 70s, the first commercially available PDP was introduced in the US in around 1999. At that time, plasma TVs were quite expensive (average price = \$11,300) but by 2005, prices had fallen to around \$2,000 each for an average size unit and 1.6 million units were sold in the U.S. It is estimated that 3.9 million units will be sold in the US in 2007. PDP televisions range in size from about 32" to over 100"; since

the maximum size of a CRT is about 36", PDPs compete with LCD flat screens in the 37" – 70" category and they compete with rear- and front-projection televisions above 70".

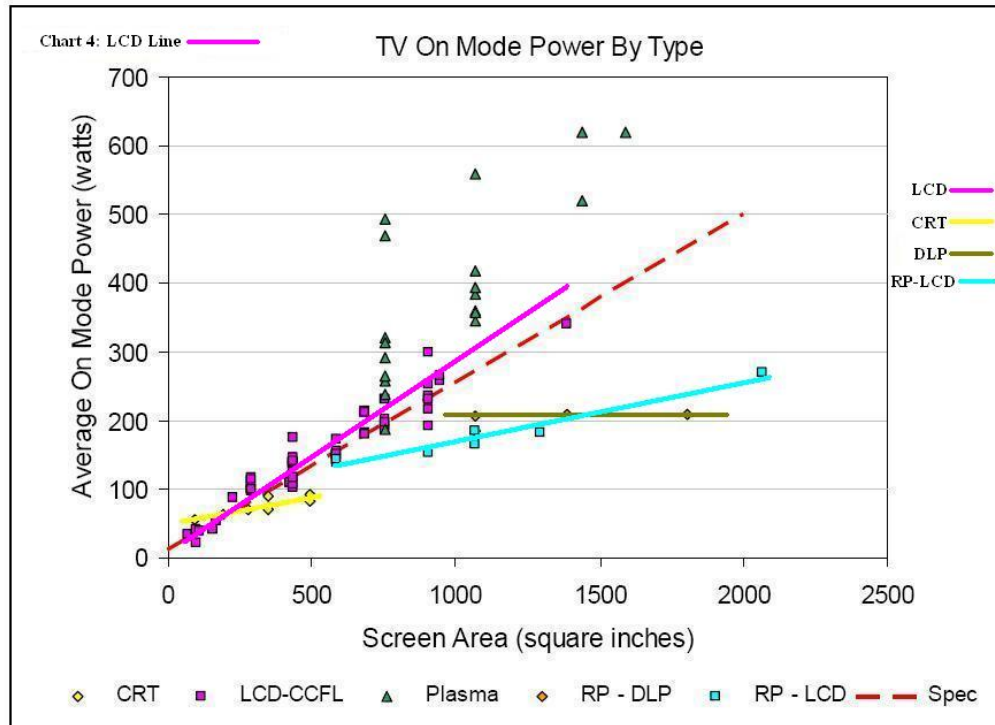


Chart 4: Line Characterizing LCD-CCFL Energy Consumption vs Screen Area

A diagram of a plasma cell is shown in Figure 2. Each cell (pixel) consists of three sub-pixels, each containing either a green, red or blue phosphor. The array of pixels is sandwiched between two layers of glass and the inner layer is filled with a mixture of inert gases, usually xenon and neon. To cause light to be emitted from a cell, the television's computer causes the address and display electrodes to charge, causing current to flow through the gas in the cell. The gas is excited such that it emits ultraviolet light photons, which in turn impact the phosphors and cause them to emit visible light photons. By varying the pulses of current through the sub-pixels, the control system can increase or decrease the intensity of light from that cell, thus forming different color combinations and forming a variety of colors across the display. In order to form white, all of the sub-pixels in the cell must be excited in a series of 128 pulses. On the other hand, black requires no excitation of the cells. Thus in plasma displays a full white screen would require the greatest energy to produce, while a black screen requires little or no energy input. This is exactly the opposite of LCD technology (black requires full energy in an LCD).

As the number of cells (pixels) in a plasma TV increases, the amount of energy required to produce the image increases, given the same image input, so a direct relationship between screen area and power consumption should exist. Referring to Chart 5 on page 13, the Average On Mode Power versus Screen Area data for plasma televisions shows a great deal of scatter. While a line representing the average power consumption per screen area has been drawn, it is not representative of the data. As it turns out, there is another fundamental relationship causing the scatter in the data: On Mode Power

consumption depends upon the *native resolution* of the PDP. Since a 1920 x 1080 pixel array (1080 native resolution) contains about 2 million pixels and a 1360 x 768 display (768 native resolution) contains about 1 million pixels, it might be expected that the 1080 display would require twice as much energy as a 768 display. It doesn't quite work out that way – see Charts 6 and 7. In “Vivid” mode, it turns out that a 768 native resolution TV with a 753.8” screen area requires 314 watts average on mode power while a 1080 native resolution TV with the same screen area requires 468.5 watts, for a difference of about 155 watts. For a 1437.4” screen area, the difference in power usage in “Vivid” mode between 768 and 1080 resolution TVs is about 100 watts.

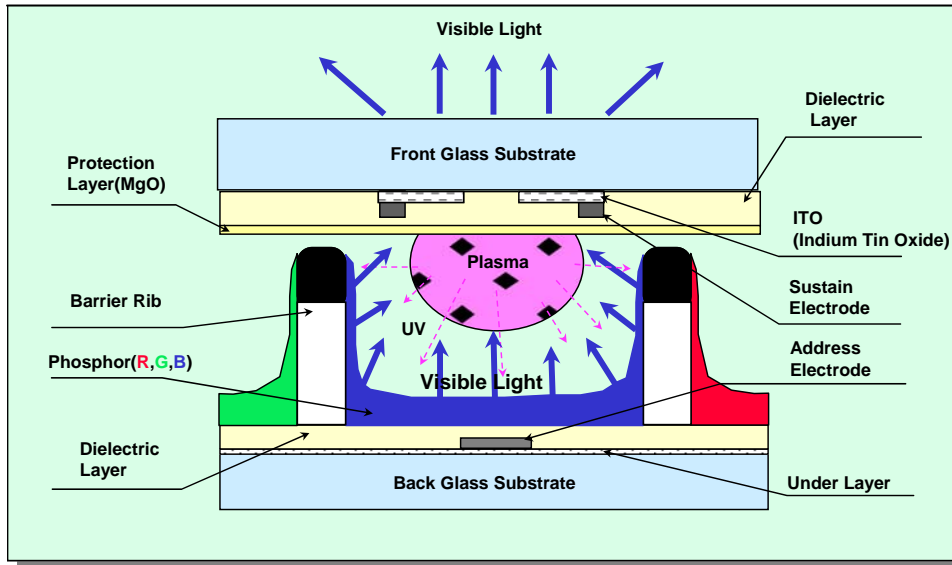


Figure 2: Schematic of a Plasma Television

The same is true of LCD TVs, although the difference is probably not as pronounced (see Chart 8 – note that there is barely enough data to draw any valid conclusions). These findings suggest that screen size as well as native resolution play a major role in the On Mode Power consumption of LCD and Plasma TVs and thus native resolution should be factored into the proposed standard equation for those technologies. Note that the factory picture control setting also has an impact on power consumption; this is true for LCD TVs as well as plasma TVs. Other factors impacting energy consumption include the features offered with the television; for example, a television offered without a tuner will consume less energy than the same unit with a tuner, all else being equal.

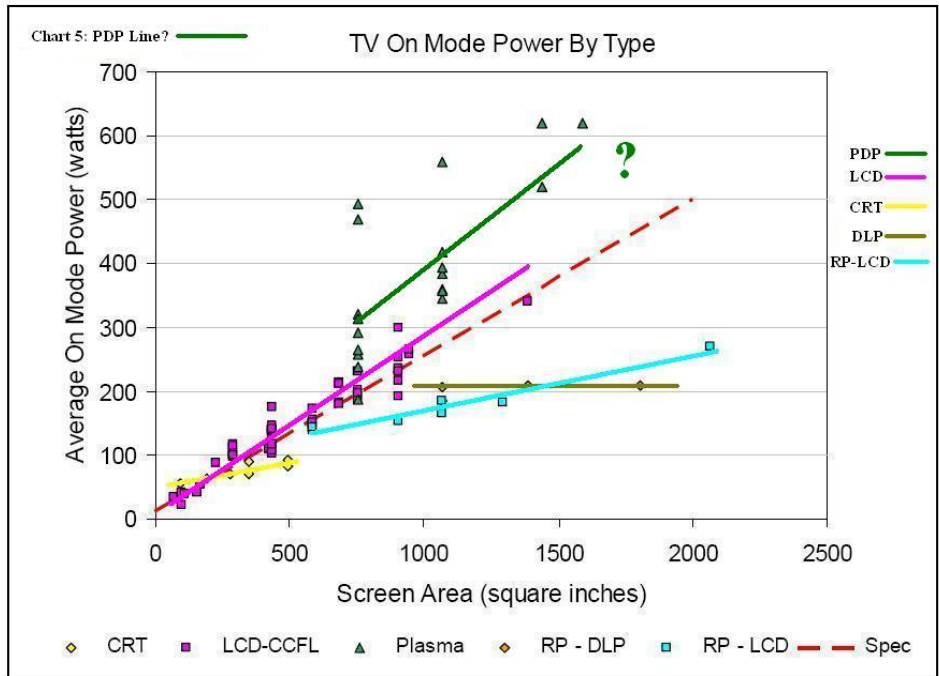


Chart 5: Possible Line for PDP Energy Consumption vs Screen Area?

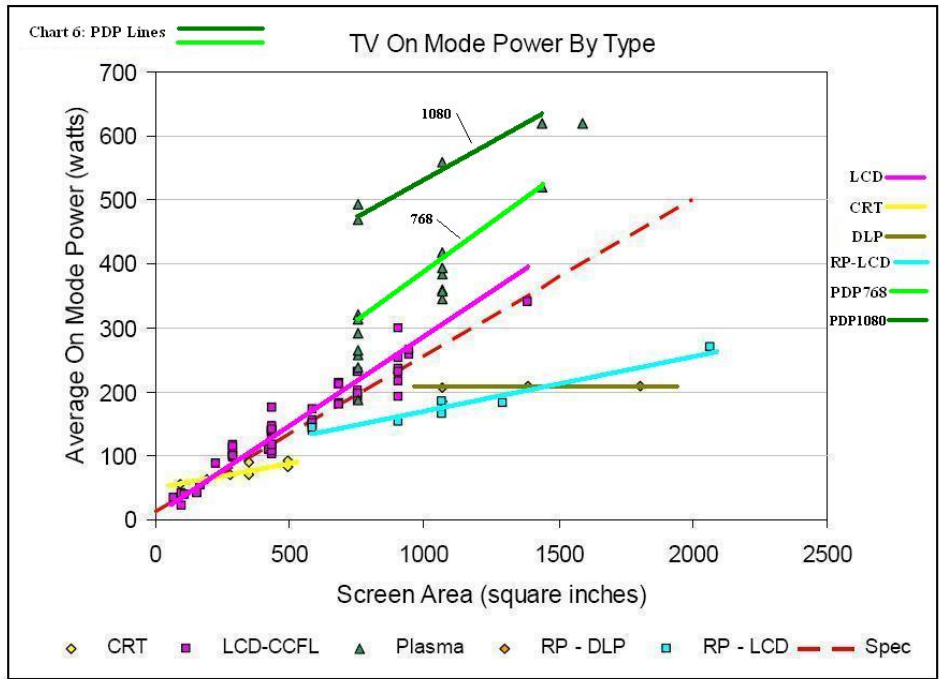


Chart 6: Lines for PDP Energy Consumption vs Screen Area, Split by Native Resolution and Preset Mode

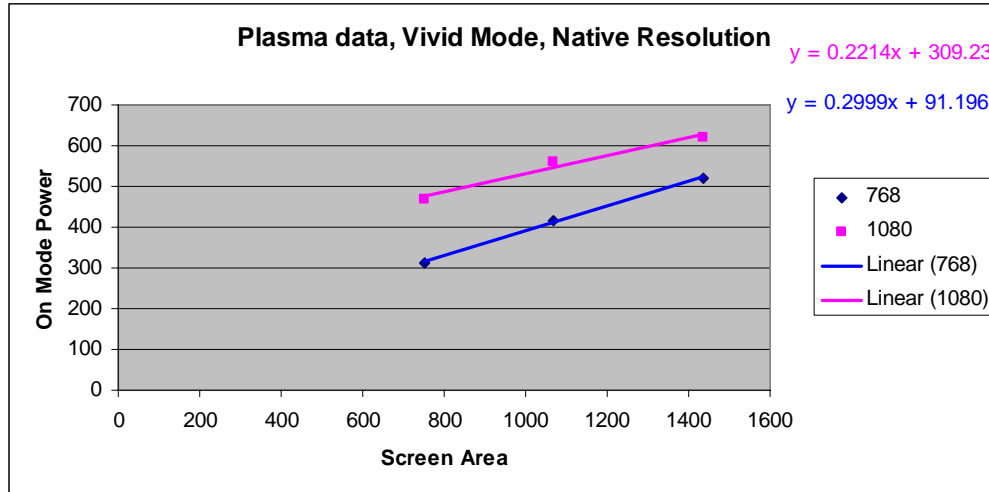


Chart 7: Lines for PDP Energy Consumption vs Screen Area, Split by Native Resolution and Preset Mode

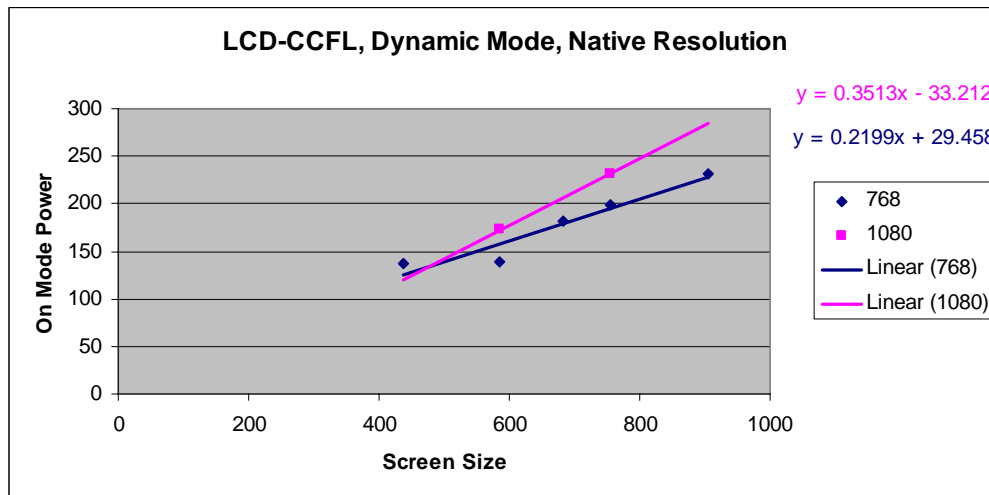


Chart 8: Lines for LCD Energy Consumption vs Screen Area, Split by Native Resolution and Preset Mode

III. Conclusion

Note that there were a lot of “holes” in the EPA dataset, particularly in the resolution and factory preset columns, so it was difficult to work with the data since it could not be properly evaluated without the missing information. Also note that the data was likely skewed because most participants measured their products’ energy consumption in the default mode; it is understood that the idea behind the new ENERGY STAR program is that the default mode for televisions be set at the ENERGY STAR-rated energy efficient mode, *but the ENERGY STAR program is not yet in place*. It would have been better to have all the participants measure their products’ energy consumption in all modes or in the mode in which they would attempt to obtain ENERGY STAR rating for their products. Instead, the data has many more variables and omissions than is desirable to determine trends and set limits.

The underlying assumption in the EPA graph of television On Mode Power data was that power consumption is primarily a function of screen area. That assumption is not true for DLP

televisions and is more or less true of other television types depending on the display technology, performance characteristics and features. There is precedent for separate energy efficiency requirements within ENERGY STAR product categories and therefore LG Electronics recommends that On Mode Power equations be developed separately for each display technology type: CRT, LCD, Plasma, RP-DLP, other Rear-Projection Micro-Device units and Front-Projection televisions. Furthermore, LG Electronics recommends that the separately-developed requirements include consideration of native resolution and features as well as screen area, as appropriate to the display technology of the television type. The result would be a fair, balanced specification with the potential of affecting improvements in energy efficiency across the spectrum of available television technologies.

Respectfully submitted,

Timothy McGrady
Environmental Manager
LG Electronics USA
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632

T: 201.408.9181

C: 201.663.3692

F: 201.816.2003

