



LCD-TV Association White Paper #2

TV Power Consumption: Is There a Problem? (and Can LCD TVs Help?)

It doesn't seem as though consumers are basing their TV purchases on power consumption – at least not yet – so why does the industry seem so obsessed with it?

The amount of energy consumed by TV sets is breathtaking. According to the Consumer Electronics Association (CEA), the 237 million analog TVs operating in the U.S. in 2006 consumed 53 terrawatt-hours (TWh) of electrical energy. In case this is not a familiar unit of measure, a TWh is 10^{12} Wh; that's a million millions of watt-hours. That amounted to about 3.6% of all residential consumer electrical energy consumption in 2006. The primary analog TV in each household that year had an average screen size of 30 inches and consumed 115 watts of power.

Power authorities, utilities, and government organizations — such as the U.S. Environmental Protection Agency (EPA) and the New York State Energy Research and Development Authority (NYSERDA) — are concerned that TV energy consumption is in the process of growing rapidly. On average, the power consumption of a direct-view TV set is in the vicinity of 500 W/m^2 (0.32 W/in^2). In other words, power consumption increases with screen area.

Now, it's no secret that one result of the flat-screen revolution is to make larger screen sizes practical. That 30-inch analog set of 2006 is likely to be replaced with an LCD-TV measuring 40 or 42 inches and consuming 200 to 250 watts. TV energy consumption is rising sharply because the average screen size is rising sharply. Energy Star, a joint program of the EPA and the U.S. Department of Energy, says 10% of residential consumer electrical energy consumption is now used by TV sets. (At about 10 cents per Kw-hr that would be over \$5 Billion in retail power costs!)

Giving Consumers the Tools

As TV energy consumption and energy costs increase, it is likely that consumers would start to use TV power consumption as one factor in making a purchasing decision if they had the tools to do so. There are two possible approaches. The first is to provide a power consumption specification that is standardized and meaningful for all TV technologies, so that consumers can compare them directly. The second is to use this specification to create a pass-fail stamp of approval. If a set consumes less than a certain amount of power, it passes. If it exceeds this limit, and it fails.

This stamp-of-approval approach is the one the EPA takes with its Energy Star rating. But the current Energy Star rating for TV and video products covers only stand-by power



consumption. (It now has to be 1 watt or less.) That's about to change, but why has it taken so long to extend Energy Star to active-mode consumption?

First, You Have to Measure It

Although TV sets come with their power consumption specified, the ratings are not generally comparable for sets using different technologies, and not even for sets using different variations of the same technology. The measurement process is not standardized, but in general, the specification is based on the maximum power consumption: the amount of power that would be drawn for a white screen at maximum luminance. The problem is that this measurement does not represent the average power consumed in normal use.

Initial attempts to arrive at representative power consumptions involved mathematical calculations based on the maximum consumption. This didn't work because different display technologies make their images in very different ways and use the power to do it in very different ways. And the power consumption differed, depending on the images being displayed (which in turn depend on the input signal).

The current standard for measuring TV power consumption is contained in the International Electrotechnical Commission's (IEC's) document 62087, "Methods of Measurement for the Power Consumption of Audio, Video, and Related Equipment." The current version of IEC 62087 was finalized in 2002, and its TV standard was designed only for CRT-based TVs. When a maintenance team (MT) was established in 2006 to update 62087 with power measurements for LCD, plasma, and microdisplay rear-projection TVs — not to mention TVs based on technologies that had not been commercialized such as OLED and SED — they realized "after considerable analysis," according to team member Larry Weber, "that TV power was very dependent on the input signal and that each of the present and future technologies would respond to the input signal in a very non-linear way."

The MT's solution was to create a 10-minute test video containing a wide variety of television programming that represents a global average of what people watch on their TVs. Since the content of the loop could strongly favor one technology over another, the final content was arrived at only after extensive negotiations. The final video, edited by Weber, has an average picture level (APL) histogram that matches the APL histogram of 200 hours of live TV broadcasts measured in 5 different countries.

When this work was started, the feeling was that dark images — those with low APL — would favor plasma TVs, since a plasma pixel draws significant power only when it's lit. Most LCD-TVs of the time had backlights that were always on, so power consumption was relatively constant with across high- or low-APL content, but maximum consumption was less than for plasma, so high APL was felt to favor LCD.

Now, increasing numbers of LCD-TVs have dynamic backlight control (or dynamic contrast control), so they too consume less power with low-APL content. And more sophisticated forms of dynamic backlight control are on the way which will save even more power with low-APL content.

The test video has been incorporated in the current draft of IEC 62087 Ed. 2, and is not expected to change much, if at all, by the time the draft is finalized, which committee members believe will be later in 2008.

The method for measuring on-state energy consumption will be straightforward. A meter — whose specifications will be part of the standard — will measure the energy consumed by the set during the running of the 10-minute video, with all adjustments of the TV set to factory defaults. With the test video defined, measurements can be performed anywhere, and are performed in exactly the same way regardless of set technology.

The subsequent debate involved what to do with these measurements.

Technology Neutrality

In mid-2007 the EPA issued a draft TV Energy Star specification based on the IEC 62087 Ed. 2 video. The Energy Star Program Requirements for TVs: Version 3.0 was finalized early in February 2008, and products will begin carrying Energy Star labels based on this spec on November 1, 2008



The Energy Star Program has set a threshold level of on-state energy consumption that varies with screen size. If a TV consumes less energy than the threshold level, it will be able to carry the Energy Star logo. The threshold is defined by several equations, but it's simpler to show the threshold for common screen sizes. (See table.)

Energy Star set these thresholds expecting they would permit about 25% of the sets on the market to receive the Energy Star label. Bruce Berkoff, Chairman of the LCD TV Association, believes that substantially more than 25% of LCD-TVs will pass, and this is supported by initial testing.

Two different approaches were proposed during the development of the Energy Star requirements. The first was the apples and oranges approach, which said it wasn't fair to compare apples and oranges, and that each TV technology — in particular, microdisplay rear-projection (MD-RPTV), LCD, and plasma — should each have their own thresholds. With this approach, a PDP-TV with an Energy Star label could easily consume more energy than an MD-RPTV that failed to receive an MD-RPTV. Proponents said this was the best way to encourage low-energy technologies in each segment.

The Environmental Defense Fund urged a policy of technology neutrality, in which the same threshold applies to all technologies in each screen-size category. The LCD TV Association has strongly supported this approach, and this is the approach that Energy Star adopted.



According to Bruce Berkoff, "this program is great for consumers and thus great for all of our members, as it clarifies how we can save more energy in flat HDTVs and helps to educate consumers about this issue. That's important to our planet as we look for Green solutions in our everyday lives. It also highlights another advantage of LCD TV technology; it requires less energy to build, view, and dispose of LCD TVs than for CRTs or plasma. And LCD TVs will be getting even better in this regard. We look forward to tougher standards in the future since that is how engineers are encouraged to make better products for consumers. When they do that, we all win."



GreenTV

The LCD TV Association has gone a step further than Energy Star with its GreenTV logo program. The Association believes that automatic adjustment of screen brightness in response to ambient room brightness can contribute a great deal to energy saving at minimal expense and user effort. So, any LCD TV from a member company that contains automatic brightness control and meets certain preagreed specifications for this "Green" attribute will be able to carry the Association's "GreenTV" logo. The LCD TV Association is already working on the next version of the GreenTV program, which will have additional requirements and specifications.

Energy Star also recognizes the benefits of automatic brightness control, but not in a way that makes the presence of this feature clear to the consumer. If automatic brightness control is enabled by default, Energy Star will assume the TV set is used three quarters of the time in average ambient light conditions and one quarter of the time in low ambient light conditions for the purpose of calculating the set's power consumption.

Thanks to IEC 62087 Ed. 2.0, it is now possible to compare the energy consumption of TV sets, regardless of technology. And thanks to the Energy Star Program for TVs Ver. 3.0, the issue of TV power saving is about to become far more visible. That's good for consumers and good for the industry. As the LCD TV Association's Bruce Berkoff put it, "it's about time they brought this great EPA program to the TV arena. We also think that many more "Green" TV attributes can be defined and improved upon in the future, but pushing for lower energy usage is a good start."



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