



# Further Analysis of Background Lighting Levels during Television Viewing

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BY

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in Partnership with  
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## Background

In 2008, the U.S. Environmental Protection Agency (EPA) finalized the ENERGY STAR Version 3.0 specification for televisions, which included a modified test procedure for measuring the power consumption of televisions with an automatic brightness control (ABC) feature. This feature reduces television power consumption by adjusting the brightness of the screen in response to changes in background lighting conditions. The test procedure is structured to credit the energy performance of televisions built with the ABC feature enabled as the default setting.

According to the current test procedure, television power consumption is measured with ABC enabled at two luminance test points, 0 lux and 300 lux. On-mode power consumption is then calculated as a weighted average of these two measurements (55% at 0 lux and 45% at 300 lux). Typically, television power consumption with ABC disabled is roughly equivalent to power consumption with ABC enabled at the 300 lux test point and significantly higher than power consumption with ABC enabled at the 0 lux test point.<sup>1</sup> As a result, reporting power consumption with ABC enabled makes it easier for televisions to meet ENERGY STAR requirements.

When EPA developed ENERGY STAR Version 3.0, little was known about actual background lighting conditions during television viewing; as a result, test points were selected that corresponded to high and low lighting conditions. The 0 lux test point represented the darkest possible viewing condition, a complete absence of light, while the 300 lux test point represented a very bright viewing condition, roughly equivalent to a sunlit room. These test points are easy to reproduce without the need for a controlled laboratory environment. The 0 lux test point could be reproduced by covering the sensor with tape and the 300 lux test point could be reproduced by shining a flashlight directly into the sensor.

Over the past several years, television technology has matured and the number of televisions built with the ABC feature has increased. In order to ensure that ENERGY STAR only recognizes the most efficient televisions, an improved test procedure is needed to more accurately represent the background lighting levels that televisions are viewed.

## CLASP Study on Background Lighting Levels during Television Viewing

In 2011, the Collaborative Labeling and Appliance Standards Program (CLASP) launched a study to collect data on background lighting levels during television viewing to provide data to EPA and DOE for the development of a revised television test procedure for ENERGY STAR.<sup>2</sup> Since CLASP published the study

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<sup>1</sup> Jones, Keith, Christopher Stone, [Analysis of Television Luminance and Power Consumption](#). CLASP: 2011, Available:

<http://www.clasponline.org/ResourcesTools/Resources/StandardsLabelingResourceLibrary/2011/Analysis-of-tv-luminance-and-power-consumption>

<sup>2</sup> Wold, Christopher, Keith Jones, Konstantinos Papamichael, Kyle Sills, [Analysis of Background Illuminance Levels During Television Viewing](#). CLASP: 2011, Available:

<http://www.clasponline.org/ResourcesTools/Resources/StandardsLabelingResourceLibrary/2011/Background-Illuminance-Levels>

several new issues have arisen, including the need for specific recommendations on luminance test points. As a result, CLASP has conducted additional analysis of the data collected to provide further technical support to EPA and DOE during the finalization of the revised test procedure.

## Analysis

As described in the section above, the 0 and 300 lux test points were selected because they represented high and low lighting conditions and were easy to reproduce without a controlled laboratory environment. In light of new data on background lighting levels during television viewing, CLASP reassessed these test points to determine whether they correlate with real world television-viewing conditions.

### 0 Lux Test Point

The 0 lux test point does not represent a valid background lighting condition at which television viewing occurs, because the television screen itself will typically generate some light that will be reflected back to the ABC sensor.

Test data shows almost no television viewing occurs with background lighting levels at 0 lux (see Figure 1 below). Due to the difficulty of measuring light levels below 1 lux, it is likely that some light was present when the 0 lux measurements were logged. It is clear that a 0 lux test point does not represent real world viewing conditions and the use of this test point should be reconsidered.

An additional obstacle to using a 0 lux test point is the potential for pre-programmed artificially low energy use. It would be relatively easy for a manufacturer to program a television to dim the screen more than is desirable or necessary when the ABC sensor detects a 0 lux condition. This type of condition would mostly likely not occur during regular television viewing, but could happen in a testing environment. As a result, a manufacturer who designs a television in this manner would have an advantage when reporting their television's power consumption to EPA, making it easier to meet ENERGY STAR requirements. Setting a lower limit test point that corresponds to a more realistic background lighting level would discourage manufacturers from programming the television in this manner, because it could negatively affect a consumer's viewing experience.

### 300 Lux Test Point

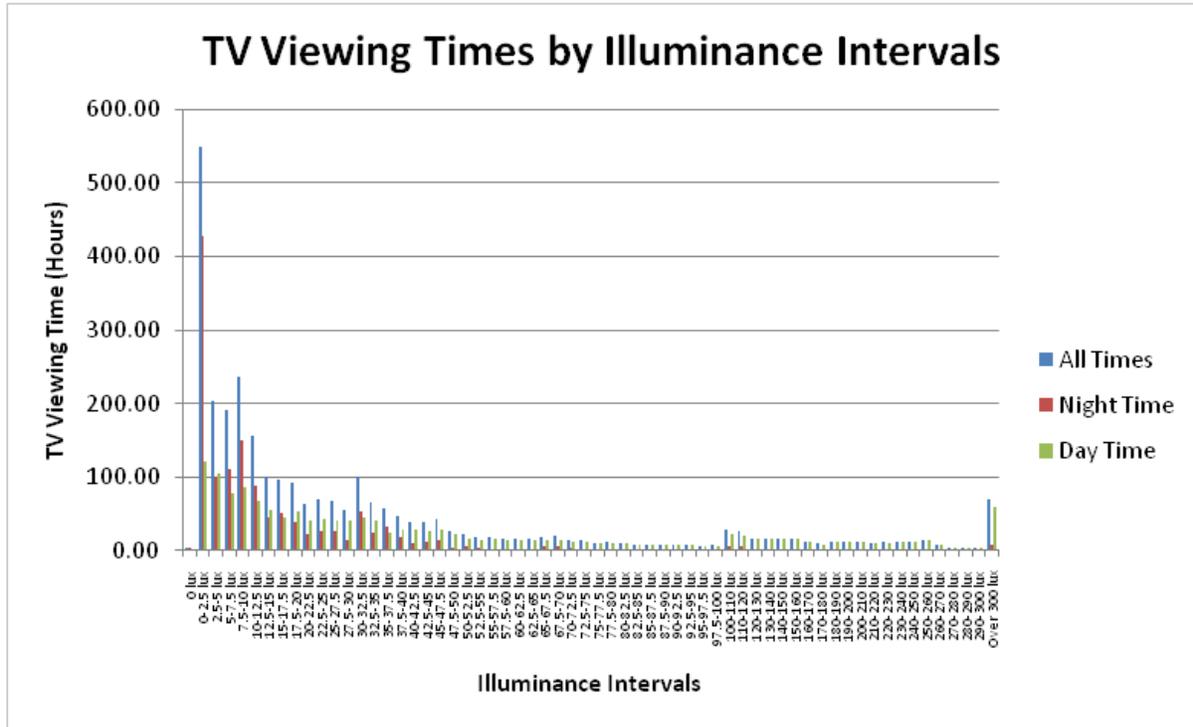
Test data indicates that some television viewing occurred at the 300 lux level (see Figure 1 below); therefore, this test point does represent an actual television viewing condition. However, given the small proportion of actual viewing in these conditions, the weighting of this test point in the power consumption calculation should be reconsidered.

### 2.5 Lux Test Point

Test data indicates a significant amount of television viewing occurred near 2.5 lux (see Figure 1 below). Setting a test point at 2.5 lux is not advisable; most ABC sensors are accurate to within about 1 lux, so measurement fluctuations will be more pronounced at lower light levels. As a result, a 1 lux fluctuation at a light level of 2.5 lux will account for a 40% difference in the amount of light measured by the ABC

sensor. The same fluctuation at 10 lux will account for only a 10% difference in the amount of light measured. While it is possible to build televisions with ABC sensors that accurately measure low light levels, they are more expensive and may not be cost-effective for manufacturers. A test point at or above 10 lux should result in a more reliable measurement.

Figure 1: TV Viewing Time by Illuminance Intervals



### 10 Lux, 35 Lux, 100 Lux, and 300 Lux Test Points

Test data shows three peaks where a majority of television viewing occurred; the first peak is near 2.5 lux, the second near 12 lux, and the third near 35 lux (see Figure 1 below). Based on an analysis of this data, the following test points are recommended for measuring television power consumption with the ABC feature enabled: 10 lux, 35 lux, 100 lux, and 300 lux (see Table 1). Each test point accounts for a different percentage of television viewing; as a result, each test point has been weighted accordingly.

Table 1: Measuring Point Recommendations

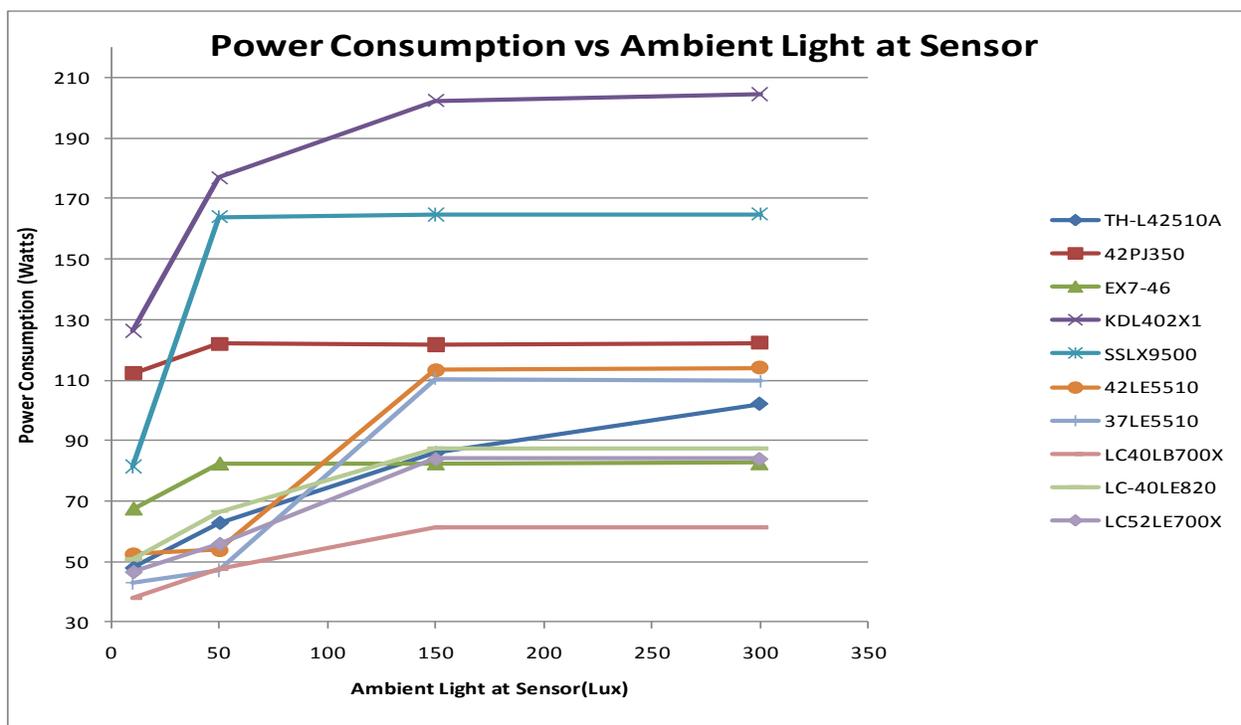
Recommended Measurement Point	Range of Illuminance Levels Represented	Number of Hours Viewed During the Day	Number of Hours Viewed at Night	Total Number of Hours Viewed	Percentage of Total Viewing	Recommended Weighting
10 lux	0-20 lux	498	1114	1612	54%	55%
35 lux	>20-50 lux	445	210	655	22%	20%
100 lux	>50-150 lux	441	39	480	16%	15%

<b>300 lux</b>	>150-300+ lux	230	0	284	8%	10%
<b>Total</b>		1612	1363	2975	100%	100%

As described above, setting a test point at 2.5 lux may result in unreliable measurements. To avoid this issue, a measuring point of 10 lux could represent the range of viewing that occurs between 0 lux and 20 lux.

The performance of the ABC feature varies from television to television; therefore, some televisions will begin to adjust screen brightness and power consumption at higher illuminance levels than others (such as Television TH-L43510A in Figure 2). A test point at 100 lux will recognize and reward manufacturers who build televisions that begin to reduce power consumption at light levels above 50 lux.

Figure 2: Television Power Consumption with the ABC Feature Enabled



## Conclusion

This paper is intended to support EPA and DOE in the finalization of a revised television test procedure. The recommendations provided are based on data collected by CLASP. This analysis should be considered in light of other studies also assessing background lighting levels during television viewing. For further information about this paper or either of CLASP's television-related studies, please contact the project manager, Christopher Wold, at [cwold@clasponline.org](mailto:cwold@clasponline.org).