

June 3, 2021

Mr. James Kwon  
EPA Product Manager  
ENERGY STAR for Consumer Electronics  
U.S. Environmental Protection Agency  
*Via e-mail (televisions@energystar.gov)*

Dear Mr. Kwon:

The Consumer Technology Association™ (CTA) is providing this letter in response to the Environmental Protection Agency (“EPA”) ENERGY STAR Television Version 9.0 Draft 2 Specification released for public comment on April 22, 2021 (“Draft”). CTA represents over 2000 of America’s most innovative companies, including the manufacturers of the vast majority of televisions sold in the United States. As you know, many of our members have participated in EPA’s TV ENERGY STAR program and CTA has strongly supported efforts to improve energy efficiency in TVs and other consumer electronics.

**I. ENERGY STAR LIMITS SHOULD BE BASED UPON DATA COLLECTED USING A COMPLETED, VALIDATED, REPEATABLE TEST METHOD.**

CTA appreciates EPA’s proposal that any new Version 9 program for televisions would use the forthcoming CTA-2037-C test method (Determination of Television Set Power Consumption and Average Luminance) when it is completed.<sup>1</sup> There appears to be universal agreement among stakeholders that a new television test method is necessary, and a wide range of parties have been engaged intensively in the challenging task of developing, refining and validating a new test method through CTA’s Video Systems Committee Working Group 13. The CTA standards program is accredited by the American National Standards Institute (“ANSI”), and CTA-2037-C is expected to become an American National Standard.

The completion of that process and the readiness of the new test method is of course necessary to accurately and consistently measure TV power consumption against satisfaction of new ENERGY STAR efficiency limits in the future. While CTA and its members appreciate EPA’s eagerness to move the process of setting new efficiency levels now in parallel to that process, the efficacy of the program depends not only on the precision of a test method but also on the quality of the metrics that the test method will measure. Unfortunately, the Draft’s proposed energy limits are based upon test data

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<sup>1</sup> See Draft at Lines 476-484 (“Since publishing the Draft 1, EPA has begun to work with stakeholders in the Consumer Technology Association (CTA) R4 Working Group 13 to develop the CTA-2037C: Determination of Television Set Power Consumption and Average Luminance test procedure that is based on the same approach to measuring TV power and projected luminance as the additional test procedures outlined in Draft 1. As such, and as long as the working group continues to make timely progress towards the finalization of CTA-2037C, the Agency intends to reference it for use in this specification. This will allow ENERGY STAR to align with the industry accepted approach to measuring TV efficiency and reduce the test burden of having an additional test method.”)

provided by Pacific Crest Labs (PCL) and DOE that were collected using what CTA will call in these comments a “Preliminary Draft Test Method” that EPA’s own proposal acknowledges is not yet validated or complete.<sup>2</sup>

It would be problem enough if the energy limits were set at proper levels but without a proven accurate and repeatable test method for implementation. But the problem here is compounded because the Preliminary Draft Test Method employed by PCL and DOE very likely produced results that were skewed for some devices more than others, and for some tests of some devices more than other tests of those same devices. Setting ENERGY STAR targets based on such unreliable test results would undermine the credibility and effectiveness of the program. It was for the same reason that the parties to the Voluntary Agreement to Promote New Test Method for Measuring the Energy Usage of Television Sets, including the Natural Resources Defense Council and the American Council for an Energy-Efficient Economy (ACEEE), agreed as a fundamental principle that “a *prerequisite* to the development of more meaningful energy efficiency commitments [for TVs] is the establishment of new and revised test methods to improve the pertinence of the data upon which commitments would be based and measured.”<sup>3</sup>

The Preliminary Draft Test Method was never an adopted test method but was merely a draft that is referenced by CTA’s Working Group as *version 8* of the draft CTA-2037-C that has been under development and remains under discussion. The Working Group is now evaluating *version 25* of the draft test method, with many key points still being refined. For the reasons explained more fully below, EPA should wait for test results using the actual final version of the CTA-2037-C test method.

## **II. THE PRELIMINARY DRAFT TEST METHOD VERSION USED IN THE PCL/DOE ROUND ROBIN DID NOT INCORPORATE KEY SUBSEQUENT REFINEMENTS**

In between versions 8 and 25, the Working Group has made many consequential revisions to the draft test method including:

- refining measures to assure that the selection of the brightest preset picture setting is consistent, including:
  - changing the test clip used when identifying brightest preset picture setting from three-bar pattern to dynamic video; and
  - adding a requirement for ambient light when identifying brightest preset picture setting;
- adding a requirement to defocus the camera photometer on the TV screen to minimize moiré patterns that would otherwise understate luminance;

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<sup>2</sup> Draft at lines 485-490 (“EPA developed the specification levels based on a dataset of TVs tested in accordance with the NEEA test method being used as the starting point for developing CTA-2037C. EPA understands that as the CTA-2037C test procedure continues to be developed, some changes are likely to be made to the test method that may impact power measurements. As changes are made, the Agency will reevaluate the criteria presented in this specification to determine whether corresponding modifications to the specification levels are necessary.”).

<sup>3</sup> Voluntary Agreement to Promote New Test Method for Measuring the Energy Usage of Television Sets and Letter of Intent to Establish Additional Energy Commitments to Improve the Energy Efficiency of Televisions (September 9, 2020), available at <https://cdn.cta.tech/cta/media/media/advocacy/pdfs/industry-advocate-tv-agreement-updated-signatory,-12-11-20.pdf> (emphasis added).

- adding minimum requirements for the HDMI cable that connects the signal source to the TV being tested;
- changing test clip video playback (from a USB stick plugged directly into the TV) to a USB stick plugged into a Blu-ray player with defined capabilities and connected to the TV through an HDMI 2.0 or higher connection; and
- adding requirements for uncertainty, repeatability, resolution, etc. of the camera photometer, and defining “default preset picture setting,” “dynamic luminance,” “high dynamic range,” and other key terms.

The consequences of relying on a preliminary test method that had not yet incorporated these changes and that has still not yet been finalized or validated are evident in the significant inconsistencies in the test results from nearly half (44%) of nine TVs tested by both PCL and DOE.<sup>4</sup> As demonstrated below, the DOE and EPA April 12, 2021 *Televisions Test Report* describing the testing reveals that some of the above-listed shortcomings of the Preliminary Draft Test Method contributed to the inconsistencies in these disparate results.

#### **A. THE PRELIMINARY TEST METHOD FAILS TO CONSISTENTLY IDENTIFY THE BRIGHTEST PICTURE SETTING**

One of the key elements of the intended new test approach is to average the on power measurements taken from default, brightest and HDR10 Preset Picture Settings (PPS). It is essential that the test method consistently choose the same PPS for a television as the brightest so that testing is measured against the correct criteria and is repeatable.

To identify the brightest PPS, the Preliminary Draft Test Method used a spot photometer to measure the luminance of all PPSs available on the TV using the International Electrotechnical Commission (IEC) 3-bar image. For two of the nine units tested by both DOE and PCL (Units 2 and 4), DOE chose a different PPS than PCL as brightest for the same television.<sup>5</sup> In one of these cases (Unit 4) the result was PCL’s measured luminance for the TV being *more than double* DOE’s measured luminance for the brightest preset picture setting.<sup>6</sup> DOE speculated that this key inconsistency may have occurred “due to the inherent variability of the spot photometer measurement method” and therefore concluded that the Preliminary Draft Test Method “may need to be updated to improve the reproducibility of the selection of the brightest PPS.”<sup>7</sup>

The Working Group has preliminarily concluded that using dynamic video instead of the IEC three-bar pattern, and adding a requirement for ambient light when identifying brightest preset picture setting, will provide consistency in the selection of the brightest PPS.

Because the Preliminary Draft Test Method instead used the less reliable static three-bar image, the data that EPA proposes to use as the foundation for establishing ENERGY STAR limits is suspect.

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<sup>4</sup> See *Televisions Test Report*.

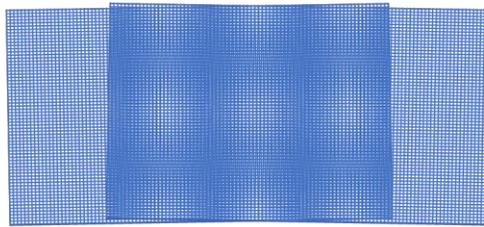
<sup>5</sup> See *Televisions Test Report* at p. 8.

<sup>6</sup> See *Televisions Test Report* at p. 7 (data for Unit 4, brightest picture setting)

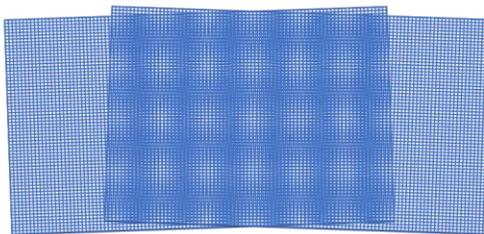
<sup>7</sup> See *Televisions Test Report* at pp. ii, 19-20.

## B. THE PRELIMINARY TEST METHOD FAILS TO ADDRESS MOIRÉ EFFECT DISTORTION

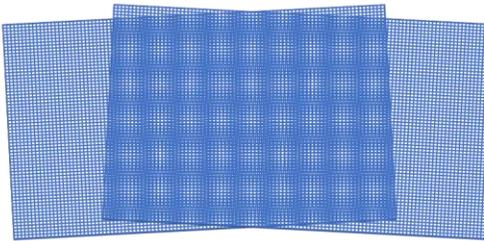
Another issue that the CTA Working Group has been addressing is that the Preliminary Draft Test Method fails to correct for distortion of TV luminance measurements resulting from the moiré effect. The moiré effect can be observed when two patterns with spatial frequencies overlap, such as when a grid pattern of the image sensor in a camera overlaps with the grid pattern of the pixels in a TV display. Figure 1 illustrates the moiré effect by showing two overlapping grid patterns and the differing pattern distortions that result as the two grid patterns are rotated.<sup>8</sup>



Overlapping grid patterns rotated in opposite directions by 1°



Overlapping grid patterns rotated in opposite directions by 2°



Overlapping grid patterns rotated in opposite directions by 3°

*Figure 1: Moiré effect in overlapping grid patterns*

Unless effectively addressed, the moiré effect has a material impact on TV test results. PCL shared with the CTA Working Group the results of tests on a TV in which the only variable was to focus or defocus the Basler acA720-290gm camera incorporated into its camera photometer to measure average TV luminance over a two-minute period while the standard dynamic range test clip played on the TV. PCL repeated this test five times with a focused camera as provided in the Preliminary Draft Test Method (with the results shown column A of Table 1 below) and then the same test again except this time with the camera defocused on the TV screen as a means of mitigating the moiré effect (with the results shown in column B).

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<sup>8</sup> The effect is a result of sampling differences, when a grid (such as a video picture display) is sampled by another similar pattern (such as a camera). The moiré interference pattern appears when the two patterns are not sampled completely identically, but are displaced, rotated, or have different resolution.

Table 1: Moiré effect on average luminance level and consistency

Column A: Average luminance with camera focused on TV screen (cd/m <sup>2</sup> )
20.7
19.9
20.7
20.6
20.5
Mean: 20.478
Standard deviation: 0.299

Column B: Average luminance with camera defocused on TV screen (cd/m <sup>2</sup> )
20.7
20.6
20.7
20.7
20.6
Mean: 20.660
Standard deviation: 0.049

The inconsistency in the above measurements with a focused camera exposes two important points:

- First, none of the luminance measurements from the focused camera are greater than the largest measurement from the defocused camera, because adding additional grid patterns on top of one another blocks more light, reducing the appearance of luminance. Accordingly, the moiré effect can only skew average luminance lower (and will not average out over numerous measurements that sometimes lower luminance and sometimes increase it).
- Second, moiré patterns lead to more variable results. With one exception, the repeated testing with the camera focused on the TV never produced the same result twice while the defocused camera almost always produced the same result, and never varied more than 0.1 cd/m<sup>2</sup>.

PCL also shared with Working Group 13 the following image showing the moiré pattern that resulted when a 24-inch TV in its lab was observed using a camera in the manner called for by the Preliminary Draft Test Method:

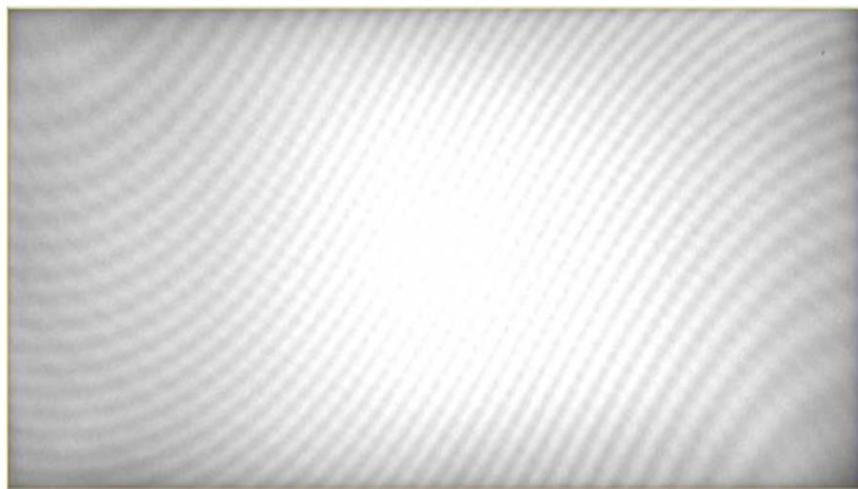


Figure 2: Moiré pattern observed using Preliminary Draft Test Method camera implementation

These results, and subsequent discussion and analysis, have led CTA Working Group 13 to tentatively conclude that the CTA-2037-C test method should require the camera to be defocused when measuring TV screen luminance. That is the procedure in draft version 25 of CTA-2037-C. Because the Preliminary Draft Test Method instead employed focused cameras,<sup>9</sup> the data EPA proposes to use for establishing ENERGY STAR limits very likely underreports actual average screen luminance, since moiré patterns were undoubtedly present in at least some tests. Waiting for a completed, validated CTA-2037-C test method would enable EPA to collect a dataset that properly avoids distortion from the moiré effect.

### **C. THE PRELIMINARY DRAFT TEST METHOD'S DIRECT-FROM-USB SIGNAL INJECTION REQUIREMENT DID NOT SUPPORT ALL PICTURE SETTINGS**

Recent ongoing evaluation of the draft CTA-2037-C has revealed that not all PPSs associated with HDMI connections are visible or accessible when playing video from a USB memory stick, as was prescribed by the Preliminary Draft Test Method used in the DOE/PCL round robin. As a result, a tester could miss the brightest PPS when direct-from-USB is selected as the input. The CTA Working Group subsequently replaced the prescription for playback of the test clip from a USB stick plugged directly into the TV and instead now calls for a USB stick to be plugged into a Blu-ray player with defined capabilities that is connected to the TV through an HDMI 2.0 or higher connection. Further study is needed to validate that change and determine its impact on the accuracy of TV test results.

### **III. THE DATA USED TO PRODUCE THE PROPOSED ENERGY STAR LIMITS IS NOT ACCURATE**

We have demonstrated above that the round robin dataset would be more accurate if it had used what is now the current version of CTA-2037-C. That said, the current version is also not ready to serve as the test method for a proper foundation for new ENERGY STAR limits while the Working Group continues to grapple with important unresolved issues.

For example, the DOE/EPA *Televisions Test Report* recognized that “tests that altered the angle at which light was directed on the ABC sensor indicated that variations in the lamp positioning, angle, and power have a large effect on the power consumption and luminance of the TV” and that “If industry is interested in allowing a range of angles at which the lamp can be positioned, additional testing would be required to determine if different TVs behave similarly at different lamp angles, or if the dimming lines at one lamp angle can be used to estimate the power consumption and dynamic luminance at a different lamp angle.”<sup>10</sup> Lamp angle has indeed been a significant and still ongoing focus of discussions in the CTA Working Group, which is still working to determine the optimal test procedure to yield the most meaningful test results. It would be premature to base ENERGY STAR limits only on tests performed with a lamp angle of 45 degrees pending completion of this analysis.

As another example, EPA proposes to set a new Standby-Active, Low Mode limit of 1W,<sup>11</sup> based upon data collected from the round robin testing. However, the DOE/EPA *Televisions Test Report* acknowledged that to improve test accuracy changes should be made to the standby mode test procedures, including longer test times and better methods for ensuring consistent implementation of

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<sup>9</sup> See *Televisions Test Report* at p. 42.

<sup>10</sup> *Televisions Test Report* at pp. 21-22.

<sup>11</sup> See Draft at lines 453-457.

enabling all available wake features for a TV.<sup>12</sup> Without these changes, the PCL and DOE/EPA tests of Standby-Active, Low mode were at times drastically different, such as Unit 5 which PCL's tests would pass at 0.4 watts while DOE/EPA's tests would fail at 5.4 watts. CTA believes that a 1 W limit is likely too low and urges that finalization of a proposed limit be deferred until consistent reliable test results are available through a validated, final test method.

There are many additional reasons to conclude that the current dataset is not ready to be used. For example, the *Televisions Test Report* acknowledged that "large variation was observed in the measurements for Unit 9, including its dimming lines which were different for the two labs and intersected each other."<sup>13</sup> The *Televisions Test Report* speculates that this material discrepancy may have occurred due to damage to the TV set during shipment from PCL to DOE.<sup>14</sup> Large discrepancies in the test results of another of the nine units (Unit 7) was not addressed in the DOE/EPA report.<sup>15</sup> Given that DOE only tested 9 units and that two more of these nine tests were plainly flawed (because DOE and PCL chose different brightest PPSs), the unreliability of 4 of 9 (44%) of the common tests is simply too high to deliver a credible data set even if the test method on which they were based had been finalized and validated (which of course in this case it had not).

#### **IV. CONSISTENTLY INCONSISTENT RESULTS BETWEEN LABS ARE NOT PROPERLY DEEMED REPEATABLE**

To reliably serve a nationwide ENERGY STAR program that will be used to test numerous devices at numerous labs, a test method must produce repeatable consistent results not only within a single lab but also across different labs.

While the PCL and DOE round robin testing using the Preliminary Draft Test Method varied significantly by lab, the *Televisions Test Report* declares the test method sufficiently repeatable because the percent difference between the results from the two labs was within an acceptable range, and because of alignment of their Coefficient of Variation (COV) when repeatedly tested in the same lab. While it is true that actually repeatable results should have well-correlated COVs, not all COV alignments mean that tests are accurate. Low variation in COVs for significantly different nominal power measurements may be a good sign of repeatability *if* the TV models were significantly different. But when the TV unit tested is the same device, if two labs record significantly different power levels, the test method and each lab's implementation need to be scrutinized for the huge gap between them, instead of praised for their supposed repeatability if they just so happen to produce tests with similar COVs.

This illustration shows a mock EPA efficiency limit (blue line) and power cap (orange line), with two sets of test results for the same hypothetical TV device tested at two different labs.<sup>16</sup>

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<sup>12</sup> See DOE/EPA *Televisions Test Report* at p. 20.

<sup>13</sup> See *Televisions Test Report* at pp. 11-12.

<sup>14</sup> See *Televisions Test Report* at p. 12.

<sup>15</sup> DOE/EPA's tests of Unit 7 compared to PCL's tests indicated 12.3% more power and 20.3% more luminance in the default PPS and 14.2% more power and 23.8% more luminance in the HDR10 PPS. The *Televisions Test Report* does not explain the significant difference in these results.

<sup>16</sup> The data used for this hypothetical example is set forth in Attachment 1 hereto. These figures do not pertain to any actual TV or PCL/DOE testing.

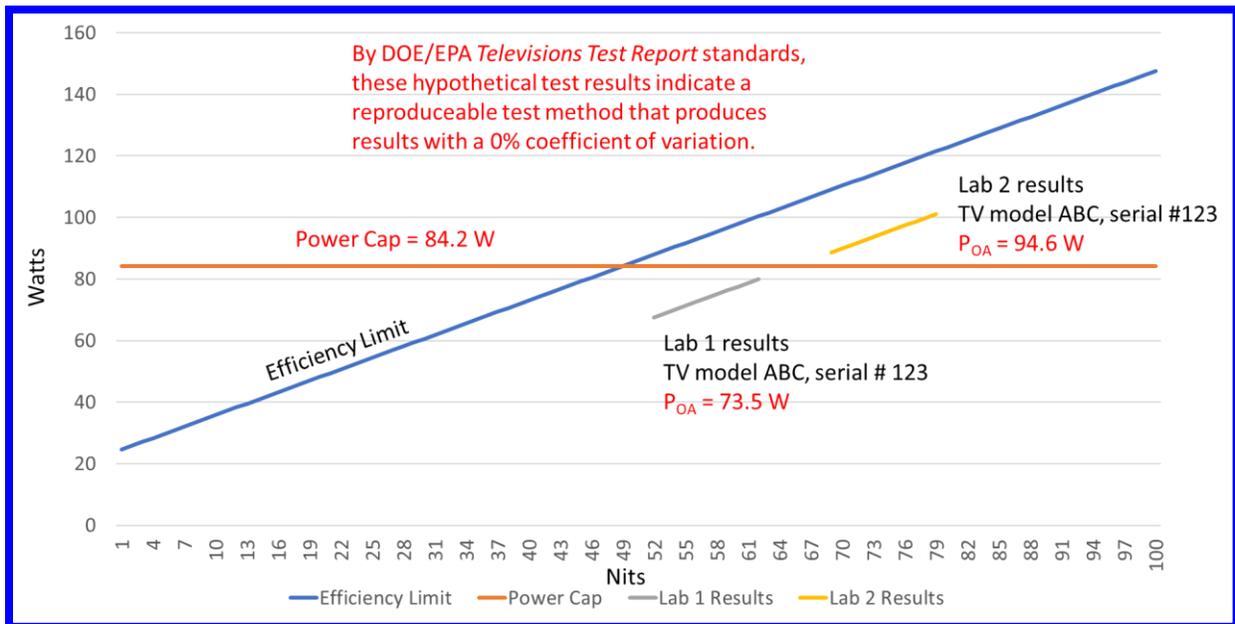


Figure 3: EPA Proposed Default PPS Limits for a 50" TV - with Hypothetical TV Data

Using the methodology of the DOE/EPA *Televisions Test Report*, because these two series of tests of the same TV device show the same dimming line and were repeated perfectly within each lab, they indicate reproducibility and repeatability.<sup>17</sup> This is despite the fact that the results were only repeated perfectly within each lab, not between labs. The DOE/EPA approach would wrongly suggest that this test is “repeatable” despite the fact that Lab 2 (consistently) found the hypothetical TV to be consuming 29% more power as Lab 1.

While CTA’s example is a hypothetical, the problem that it illustrates is real. The fact that DOE/EPA investigated the cause of variations in test results between labs for TV Units 2, 4 and 9 – but not Unit 7 – suggests that the DOE/EPA method led DOE and EPA to conclude that the Unit 7 results were close enough to be repeatable and reproducible, despite the fact that the results indicated 12.3% more power and 20.3% more luminance in the default PPS and 14.2% more power and 23.8% more luminance in the HDR10 PPS at the DOE lab versus the PCL lab. Clearly, such vastly different sets of power consumption values of the same television sets are *not* accurate reproductions of one another. For the same reason, given the many deviations between the PCL and DOE/EPA tests, EPA should not find that the Preliminary Draft Test Method has reliably produced repeatable (or accurate) test results to sufficiently inform the development of new ENERGY STAR limits.

<sup>17</sup> The dimming line equation that results from the hypothetical data from both labs is Power (W) = 1.242092 x Luminance (Nits) + 3. The mock luminance figure for Lab 2 of 73.75 nits plugged into the dimming line equations yields Lab 1 Projected Power = 1.242092 x 73.75 Nits + 3 = 94.60429 W and Lab 2 Projected Power = 1.242092 x 73.75 Nits + 3 = 94.60429 W. Since these two figures are the same, the percentage difference in COV between the results from the two labs is zero, according to EPA’s approach. Further, because each lab repeated its results perfectly three times, the results show a 0% COV. The implication seems to be that the Lab 1 and Lab 2 results demonstrate consistency, which is clearly not the case.

To reliably serve a nationwide ENERGY STAR program that will be used to test numerous devices at numerous labs, a test method must produce repeatable consistent results not only within a single lab but also across different labs.

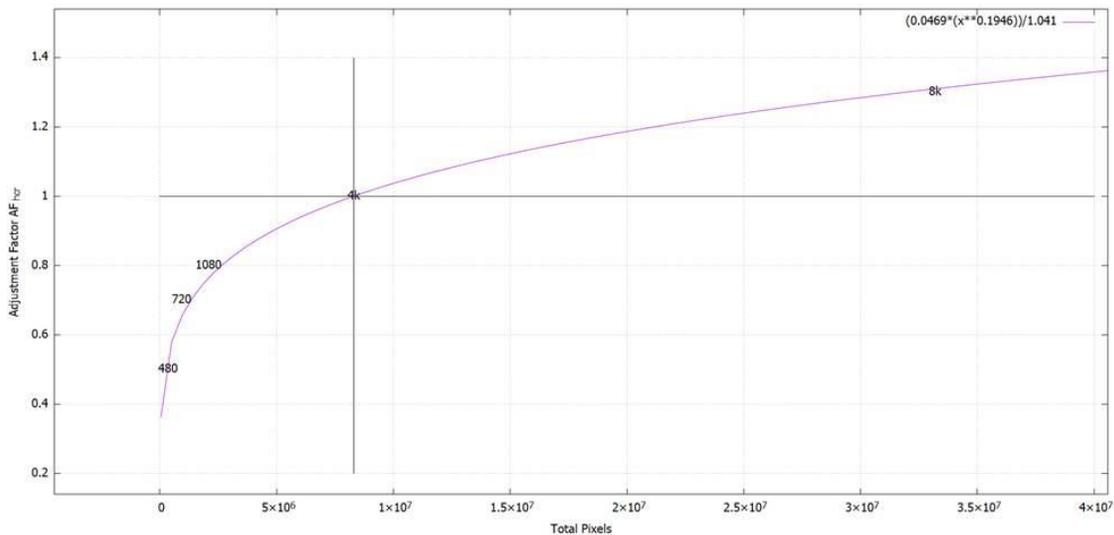
**V. ADJUSTMENT FACTORS SHOULD BE CLARIFIED OR REVISED**

There is confusion over how EPA proposes to apply the adjustment factors listed on line 397 of the Draft. In particular, it is not clear if both adjustment factors from line 397 can be applied simultaneously in the equation on line 354 of the Draft, or if only one line 397 adjustment factor must be selected based on the type of TV being tested.

Also, the rationale for the formula used to calculate the high contrast ratio adjustment factor on line 397 of the Draft is not clear. As illustrated in Table 2 below, this formula would put high contrast ratio TVs with less than 4K resolution at a disadvantage, and reward high contrast ratio TVs with screen resolutions above 4K. It is not clear why high contrast ratio TVs should be treated differently based on their screen resolution. Figure 4 below the table shows the disadvantage applied to TVs with less than 4K resolution.

*Table 2: EPA proposed adjustment factors by display type*

Display type	Vertical pixels	Horizontal pixels	Total pixels	Adjustment factor
Standard	480	853	409,440	0.556998903
HD	720	1280	921,600	0.652261999
HD	1080	1920	2,073,600	0.763759799
4K	2160	3840	8,294,400	1.000270981
8K	4320	7680	33,177,600	1.310021863



*Figure 4: Graph of AFhcr Curve*

EPA has not explained or justified the steeply lower adjustment factor for TVs with resolutions less than 4K as shown in Figure 4. Further analysis of appropriate adjustment factors should be undertaken once EPA has updated test results collected using the final CTA-2037-C test method.

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While CTA appreciates and shares EPA's interest in moving forward expeditiously to influence the market as soon as possible, the results of the Version 8 ENERGY STAR TV Specification have demonstrated that a flawed specification that does not attract voluntary participation cannot produce its intended influential effects. A cart-before-the-horse approach that prematurely sets energy targets based upon unreliable data would more likely limit rather than expedite the effectiveness of the new specification in influencing the market, not only in the near term, but thereafter.

For all of these reasons, it would be premature to attempt to publish a proposed Version 9.0 specification and test method prior to the completion of the CTA-2037-C test method.

Sincerely,

*/s/ Douglas Johnson*

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*/s/ Dave Wilson*

Dave Wilson  
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cc: Katharine Kaplan, EPA  
Ann Bailey, EPA

## Attachment 1

### Data for Hypothetical Example

	TV Power Consumption (W)		Luminance (Nits)	
	Lab 1	Lab 2	Lab 1	Lab 2
Run 1 Default PPS 3 lx	67.588784	88.704348	52	69
Run 1 Default PPS 12 lx	71.31506	92.430624	55	72
Run 1 Default PPS 35 lx	75.041336	96.1569	58	75
Run 1 Default PPS 100 lx	80.009704	101.125268	62	79
<b>Run 1 P<sub>oA</sub></b>	<b>73.488721</b>	<b>94.604285</b>	<b>56.75</b>	<b>73.75</b>
Run 2 Default PPS 3 lx	67.588784	88.704348	52	69
Run 2 Default PPS 12 lx	71.31506	92.430624	55	72
Run 2 Default PPS 35 lx	75.041336	96.1569	58	75
Run 2 Default PPS 100 lx	80.009704	101.125268	62	79
<b>Run 2 P<sub>oA</sub></b>	<b>73.488721</b>	<b>94.604285</b>	<b>56.75</b>	<b>73.75</b>
Run 3 Default PPS 3 lx	67.588784	88.704348	52	69
Run 3 Default PPS 12 lx	71.31506	92.430624	55	72
Run 3 Default PPS 35 lx	75.041336	96.1569	58	75
Run 3 Default PPS 100 lx	80.009704	101.125268	62	79
<b>Run 3 P<sub>oA</sub></b>	<b>73.488721</b>	<b>94.604285</b>	<b>56.75</b>	<b>73.75</b>