Reality TV: Behind The Scenes to Rectify an Outdated Policy Metric to Transform the Global Television Market

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ABSTRACT

In the final decades of the last millennium, CRT televisions (TVs) commonly used 25 watts in Standby Mode. The ENERGY STAR® program helped reduce that to below 1 watt for most TVs. In 2010, plasma TVs were 3.5 times less efficient than LCD TVs when accounting for screen luminance. A combination of ENERGY STAR label, utility incentive programs, and California regulations contributed to a market transform away from that inefficient technology. Since these early wins, Standby Mode power crept back up, undetected, to over 25 watts in some cases as manufacturers offered the ability to wake by smart speaker or phone. And the test method that contributed to plasma transformation had the unintended consequence of rewarding dim, non-uniform TVs. These gaps, among others, resulted in ineffective policy.

The Northwest Energy Efficiency Alliance (NEEA) engaged Pacific Crest Labs (PCL) to perform extensive research, develop breakthrough test and metric approaches, and engage with industry, government, and NGOs to establish these improved approaches as the international standard. The Consumer Technology Association (CTA) standardized the NEEA test method, and the U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) adopted the method and metrics, as did U.S./Canada Voluntary Agreement signatories. The new test method is in the process of being adopted by the International Electrotechnical Commission (IEC) and the NEEA method and metrics are being evaluated by the European Commission and other international regulators. Its adoption will avoid 48.9 Rosenfelds or 147 TWh of energy use and even more if applied to other electronics display types. But there is still work to be done.

Introduction

The process of market transformation—intervening in a market by removing barriers and exploiting opportunities to accelerate energy efficiency adoption and creating a lasting change—is by definition, dynamic. Transformations often take years, and their associated strategies may change over time as technology, customer behavior, market barriers and opportunities all change along the way. Television energy efficiency is an example of this type of dynamic transformation process that has required a range of interventions over the past decade and continues through to today. More than 15 years ago, the Northwest Energy Efficiency Alliance (NEEA) began its market transformation efforts to bring greater energy efficiency to the television market. Since that time, fundamental display technology has changed, streaming has become a leading content delivery method, and the resolution of the average television has quadrupled. In response to changing barriers and opportunities, television market transformation efforts have included: display technology testing and evaluation, consumer end use studies, test procedure experimentation and development, industry collaboration with manufacturers, retailers, advocates and standards bodies, and incentive program implementation.

These efforts have had a significant influence on efficient television technology adoption curves and as this paper describes, we sit here today at a point where a newly adopted test procedure and metric—tailored to the latest television technology and consumer use—are poised to enable an entirely new round of energy savings. This paper details how the TV test procedure became the market barrier, the steps NEEA, and its contractor PCL took to create a dramatically improved test procedure and metrics to overcome it, and how stakeholder collaboration and engagement provided the policy mechanisms nationally and globally to enter a new chapter in TV energy efficiency efforts.

A Brief History of TV Efficiency Efforts

The modern U.S. TV efficiency movement began roughly 25 years ago, with the first half of its history well documented by Howard, Baron, and Kaplan (2012). Generally, this effort can be broken into three chapters. The first (~1998 – 2004) addressed energy use when the TV was off (Standby Mode), while the second (~2005 – 2014) added consideration of energy use when it was on and in use by the typical consumer (On Mode). Chapters 1 and 2 are briefly summarized below.

Chapter 1 – Standby Mode focused on the substantial power TVs consumed while "waiting" to be turned on. Cathode ray tube (CRT) TVs kept the cathode heater warm to reduce start-up times, and as a result, consumed substantial energy when off. The ENERGY STAR® program for TVs launched in 1998 and steadily ratcheted down the standby mode power requirement from 25 watts to 1. Despite this efficiency improvement, research by the Natural Resources Defense Council (NRDC) (Horowitz et al. 2005) demonstrated that aggregate TV energy consumption was still rapidly increasing and accounted for a growing share of global residential energy use— as much as 4%. This increase was attributed to the rise of flat-panel TVs (especially plasma technology), the analog to digital conversion, shifting consumer viewing patterns, and an increase in TVs per household. The attention of energy efficiency advocates and policymakers then turned to focus on the power consumed when a TV is in On Mode, ushering in the next chapter of energy savings.

Chapter 2 – On Mode screen-area-based metrics began in 2005 with a stakeholder workshop hosted by Pacific Gas and Electric (PG&E) with participation from NRDC, the U.S. Environmental Protection Agency (EPA), and the California Energy Commission (CEC). The stakeholders proposed a screen-area-based On Mode metric of watts per square inch (watts/in^2) to measure energy consumption more accurately and fairly across different technologies and display sizes. The screen area approach was predicated on the belief that default TV settings would persist over time.

Chapter 2 On Mode efforts helped eliminate power-hungry plasma TVs from the market, but the simple screen-area-based methodology had underlying flaws that yielded certain unintended negative consequences and limitations as the dynamic TV market continued to evolve. We cover these flaws later in the paper.

Chapter 3 of TV Efficiency – Area- and Luminance-based Approach

Multiple research projects in the mid- to late-2010s funded by NRDC and NEEA (Ecos Research 2016, Hardy et al. 2018, Hardy 2019a and 2019b, Horowitz, Hardy and Tian 2019) created a clear picture of the limitations of outdated assumptions using the simple screen-area-based watts/in^2 metric. In short, the approach (metrics and methods) gave an unfair appearance of energy efficiency to dim, non-uniform displays in the out-of-the-box default eco setting. Real-world energy use for these dim TVs was substantially higher when consumers adjusted them for better visual performance. As a result, energy use estimates were substantially under-reported.

In response, NEEA funded PCL to develop a new test procedure and metrics for measuring TV energy use and efficiency (PCL 2022a). With significant stakeholder collaboration, a methodology emerged that provided reliable test results that factored in new TV innovations and were representative of actual consumer use. Additionally, the IEC is incorporating the NEEA test method into IEC 62087 parts 1, 2, and 3 in 2024 with final approval expected in 2025 (IEC 2023).

The *NEEA test method* refers to the test protocol developed. *NEEA metrics* refer to the dimming-line based metrics that factor in area, luminance, and resolution (detailed below). The *NEEA approach* refers to both the NEEA test method and metrics. *NEEA power limits* refer to the hypothetical minimum efficiency levels developed for consideration by policymakers and market actors.

The following sections explain the old test procedure flaws and limitations, discuss the approach to modernize it, identify key policy successes to date and ongoing priorities, and offer lessons learned that can be applied more broadly to other market transformation efforts related to consumer products and appliances.

Identified Test Procedure Flaws and Limitations

The Rise of High Dynamic Range Content and New Use Models. Certain assumptions and the introduction of new technology variables challenged the old test procedure to measure TV energy use accurately and fairly. These included:

- *The rapid adoption of High Dynamic Range (HDR) content.* Consumption of HDR content via steaming service such as Netflix combined with the additional power consumed by HDR content (Hardy ACEEE 2014) demonstrated the need to incorporate that format into the test procedure in addition to Standard Dynamic Range (SDR) (Ecos Research 2016).
- *Persistence of default settings.* Default energy saving presets such as Automatic Brightness Control (ABC) were found to often be deselected by consumers. One consumer study found that only 22% of participants left TV in the default picture setting with ABC setting enabled suggesting that real-world energy consumption was significantly higher than assumed (PCL 2019).
- *The advent of smart wake features.* Technologies like Amazon Echo speakers and mobile phone apps often increased Standby Mode power from under 1 watt to between 10 and 30 watts, potentially doubling a TV's energy consumption (Horowitz, Hardy, and Tian 2019).

Screen-area-based Metrics and the Problem with Measuring Luminance at Screen Center. Luminance, or brightness, is a crucial determinant of On Mode power consumption. Policy approaches in Chapter 2 sometimes included a minimum luminance level to prevent excessive dimming – for example ENERGY STAR Version 8 for TVs. But those levels were based on research conducted using obsolete TV technologies, unknown broadcast test content, antiquated test patterns, and consumer viewing preferences of an unrepresentative age group (DOE 2012). TV testing using the old watts/in^2 metric lacks information about which TVs emit light most efficiently across the viewable screen area.

Chapter 2 screen center measurements benefit dim, non-uniform displays. NEEA's 2019 testing of over 100 TV models revealed that a uniform display with the same screen-center luminance as a non-uniform display can have twice the screen-average luminance as the non-uniform display. If both displays are set to the same screen-center luminance level, then the uniform screen will have a harder time staying below the power limit because it emits twice the light compared to the non-uniform screen with dark edges. (See Figures 1a and 1b.)

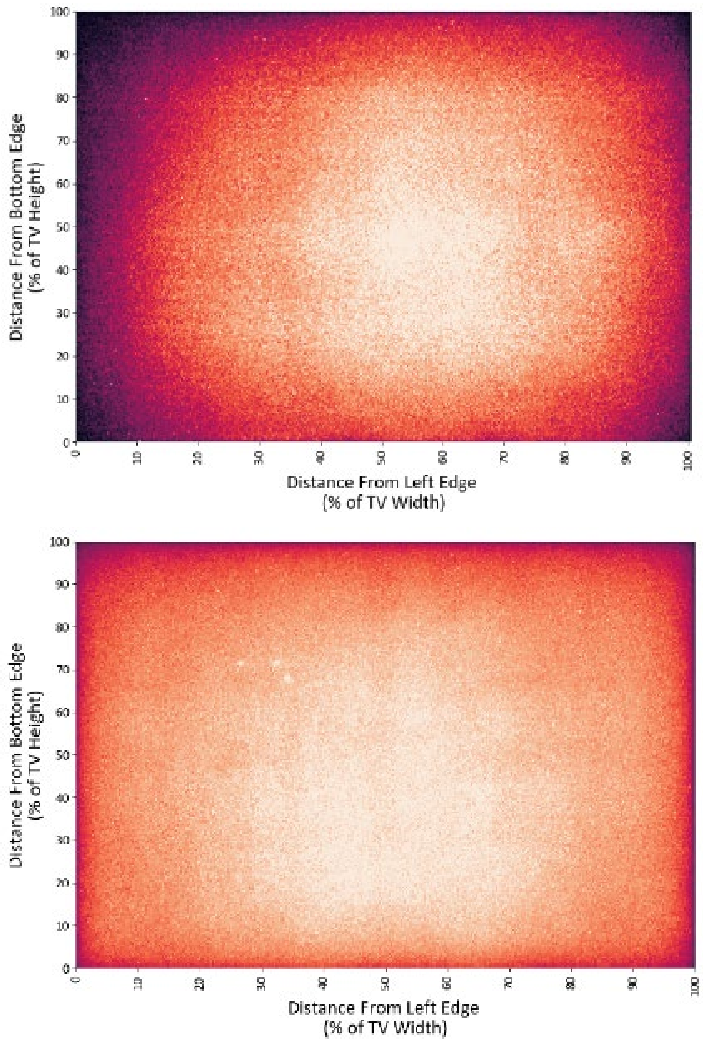

Figure 1a (top) represents a non-uniform illuminated display screen. Figure 1b (bottom) illustrates a more uniform screen typically preferred by consumers. *Source:* (NEEA 2019)

Other important deficiencies with screen-center luminance measurements include:

- TVs sometimes respond to white test patterns used in the old test method by ramping up luminance over a few seconds and, in some cases, ramping down as Automatic Brightness Limiting (ABL) engages to protect hardware components. These variations increase measurement uncertainty.
- Today's sophisticated TVs adjust the backlight based on content, which means measuring with a static test pattern (or an unrepresentative dynamic test pattern), as in the old method, is a poor predictor of luminance with real-world content.

Research Implications: Developing Smarter Methods and Metrics

NEEA and PCL concluded that the then-current approach to testing had the unintended effect of encouraging non-uniform displays with low default luminance levels that most consumers changed. The policy approach penalized more efficient TVs that were uniformly bright, and it did not consider the energy impacts of smart wake features. As a result of these and other factors, it masked actual energy use and reduced confidence in claimed energy savings. Research clearly showed the test procedure needed to be modernized. To work toward a new methodology and metric, NEEA conducted and leveraged in-depth research, prepared detailed analyses, and coordinated with a wide array of stakeholders: DOE, EPA, IEC, CLASP (formerly known as Collaborative Labeling and Appliance Standards Program), Appliance Standards Awareness Project (ASAP), NRDC, PG& E, EU stakeholders, and others, that resulted in a multi-year plan to align around a globally harmonized test method and metrics approach (Hardy 2019a and 2019b). Core elements of the approach identified the following specific requirements in a new policy approach:

- A standard HDR test clip.
- Standby Mode power measurement with common smart wake features enabled.
- Test in three different preset picture settings.
- A new area-based and luminance-based approach that encourages TV displays to emit light more efficiently regardless of what picture setting, content format, or ABC setting is used.

With a strategic plan in place and a foundation to build a better test procedure, collaboration between NEEA, PCL, and industry stakeholders allowed for the rapid development of a new test method and metrics.

The NEEA TV Test Method and Metrics

HDR Content

The foundation for a new test procedure required representative test clips where acquiring content rights can be costly. CLASP—the global organization advocating for efficient appliances worldwide—provided source video for the development of a series of IEC test clips in HDR format. NEEA funded performance requirements analysis, as well as the development, evaluation, and standardization of a series of the twelve HDR test clips (Ecos Research 2016). NEEA presented key findings from this report to the relevant IEC TV workgroup, which set up a sub-group to develop a technical report, IEC TR 63274:2021 (IEC 2021) to define HDR test clip requirements. IEC adopted the HDR test clip in 2023, a significant policy achievement in this process.

High Dynamic Range Test Clips. TVs can operate significantly less efficiently when playing increasingly common HDR content. Work started with an extensive technical requirements analysis, "Revising the TV Energy Use Test Procedure: Incorporating HDR and other Needed Changes" (Ecos Research 2016). NEEA presented key findings from this report to the IEC TV workgroup, who set up a sub-group to focus on the development of a technical report, IEC TR 63274:2021 (IEC 2021), defining HDR test clip requirements. PCL edited CLASP-provided video content and hired Company 3, a Hollywood digital mastering firm that works on major movie titles like "A Star is Born", to color grade these clips using industry best practices. The scope of NEEA contributions is illustrated in Figure 2 below. IEC awarded PCL founder Gregg Hardy one of four 1906 Awards given internationally in 2021 for his contributions to this effort.

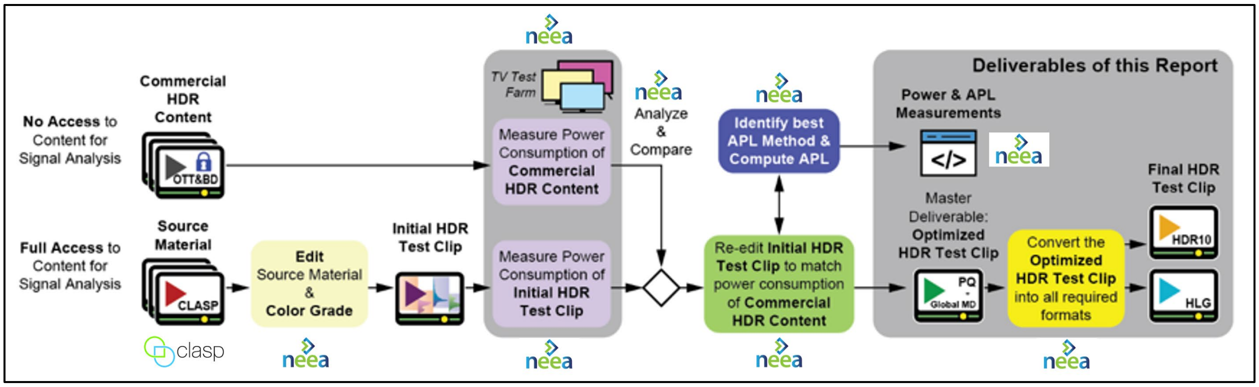

Figure 2. Collaborative contributions to develop HDR test clip requirements. Source: Ecos Research 2016, Figure 2.

Smart Wake

The NEEA test method closes a major test gap by measuring Standby Mode power with common smart wake features enabled. The methodology calls for configuring popular features—such as wake by casting video to a TV from a smartphone—and then powering-down the TV to measure Standby Mode power. These tests often involve power spikes as the TV briefly sends and receives data. These spikes require changes to international methods to update the way they specify power meter measurement uncertainty and determine when power has stabilized. Of note, Consumer Technology Association (CTA) standards meetings provided the opportunity to quickly collaborate and refine the smart wake test method with industry experts.

An Automated, Camera-based System

The inspiration for developing a test method that considers luminance-based metrics in addition to screen area comes from the Chinese test method developed for flat panel TVs in 2010 (Hu and Zhao 2014), a significant policy departure from IEC 62087. Here, luminance is determined by taking nine spot measurements in a grid pattern. PCL improved upon GB 24850 by adding a camera photometer that measures screen-average luminance concurrent with power measurements, all while broadcast content is playing.

This process of developing the camera photometer entailed extensive study of the International Display Measurement Specification (SID 2021) and substantial collaboration with a wide array of industry influencers and policymakers: Camera design experts, photometric equipment experts, photopic filter vendors, calibration equipment vendors, and others who helped determine product requirements and identify best design practices. PCL engaged third party test labs, TV manufacturers, DOE, and other industry experts to vet the policy approach.

The test and report generation process developed was automated to reduce test burden, increase laboratory reliability, and generally improve reproducibility of results. PCL (2022a and 2022b) provides complete documentation for the camera and calibration approach now known as TV EASY®. Key elements of this camera-based approach are summarized below:

- Automatically logs power and luminance data.
- Automatically guides the tester through TV configuration and test steps.
- Automatically generates compliance reports that include a record of all TV settings, compliance calculations/rules, data plots, and test equipment calibration settings (PCL 2024).

Automatic Brightness Control (ABC)

PCL led an IEC sub-group to standardize a new approach for testing ABC. To measure screen-average luminance concurrently with power while playing a broadcast video clip, the ABC LED lamp (illustrated in Figure 3), is repositioned for direct reflection into the camera, pointing at screen center. While real-world ambient room lighting is highly variable in terms of lighting direction and source (e.g., daylight, LED, CFL, etc.), CTA and IEC working groups agreed that testing with an overhead LED lamp was most representative of typical viewing environments.

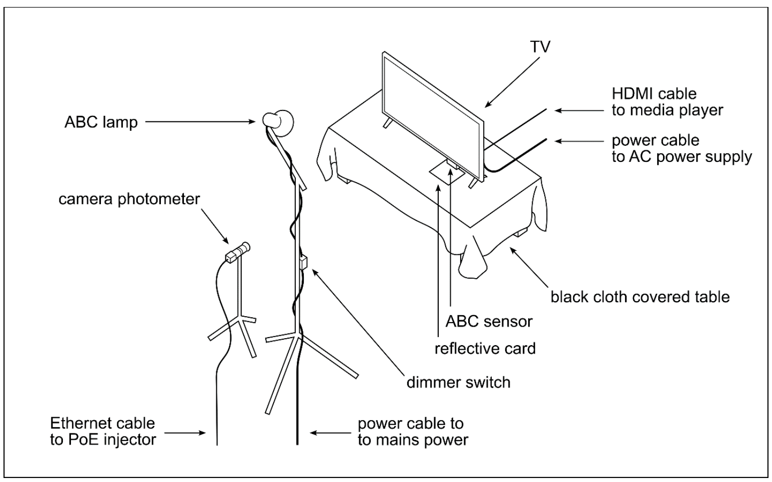

Figure 3. PCL ABC test method illustration.

Dimming Line Metrics and Trends

To address the limitations of a simple area-based, watt/in^2 metric, PCL developed the concept of dimming lines to illustrate how TV power relates to luminance while playing broadcast video. Dimming lines are critical to understanding the efficiency of TVs (EPA 2021). Efficient TVs use less power across a wide range of luminance levels. Dimming lines are determined by measuring power and luminance at several backlight settings described in detail inANSI/CTA-2037-D (CTA 2022).

Figure 4a below shows dimming lines for three TV models. TV C uses a relatively low level of across a wide range of luminance settings. NEEA research suggests that typical default luminance levels range from 25 to 75 cd/m^2.

Figure 4b shows additional detail for the same three TV dimming lines. The black dots with white fill represent the TV default setpoint. Efficient TVs have setpoints that are below (lower power) than the gold limit line. The limit lines shown here do not represent any policy in force today; they are conceptual and presented here to illustrate the structure of NEEA-proposed metrics. The limit lines are structured to have a slope and y-intercept that is comparable to TVs whose set-points are close to the limit (e.g., TV A in Figure 4b). That way, there is no incentive to reduce or increase the brightness of default TV settings because it does not improve the efficiency score. The horizontal power cap line sets an absolute power limit. If a TV exceeds the power cap, the manufacturer would need to reduce the luminance of the default setting, in order to bring the TV under the limit. None of the TVs in Figure 4b below have setpoints close to the power cap.

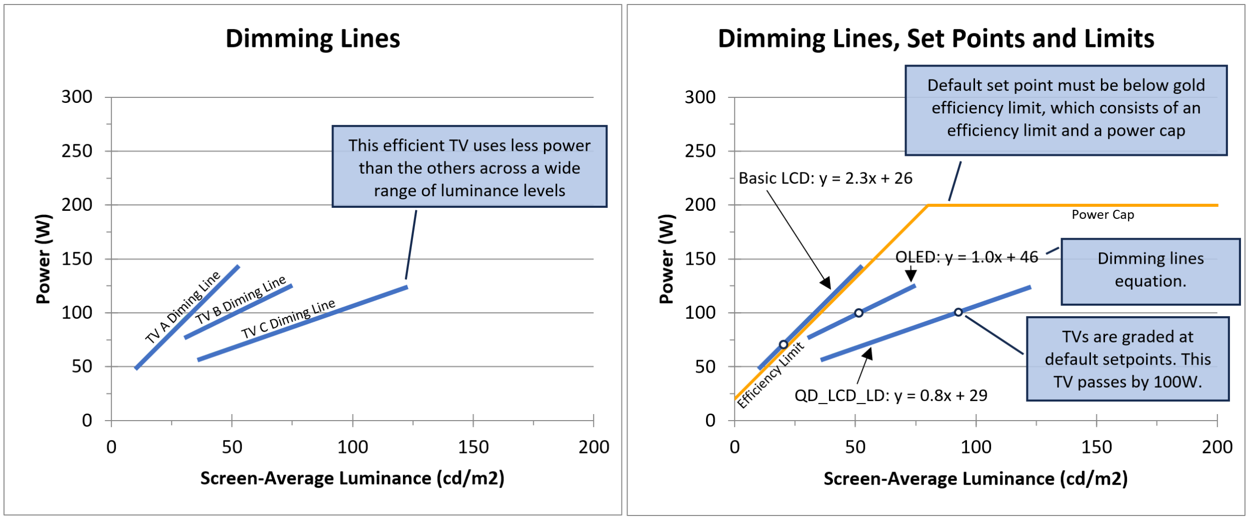

Figure 4a (left): Dimming lines represent the relationship between power and screen-average luminance averaged over the duration of a broadcast video test clip. Dimming lines are determined by measuring power and luminance at several backlight settings. Figure 4b (right): Dimming line equations are shown, where y = power and x = luminance. Dimming lines have a slope and a y-intercept. The y-intercept represents how much power the TV would use if the display were dark. The dots represent TV's default setpoint – see ANSI/CTA-2037-D (CTA 2022) for more detail. The setpoints of efficient TVs are below (i.e., lower power than) the limit lines. The limit lines shown here do not represent any policy in force today; they are conceptual and presented here to illustrate the structure of NEEA-proposed metrics. TV A is a basic LCD. TV C is a Quantum Dot (QD) LCD with Local Dimming (LD). Local dimming can improve efficiency significantly by dimming the backlight behind TV zones displaying dark content.

Test data highlights several dimming line trends:

- *Basic LCD TVs* have a low y-intercept and a steep slope, especially those that do not dim their backlight automatically in response to dark content. A steep slope indicates lower efficiency levels at higher luminance. Basic LCDs are inefficient compared to other TV technologies, but these other technologies cannot service high volume, budget TV segments.
- *Quantum Dot LCD Local Dimming (QDLCDLD) TVs* are the most efficient TVs, but they cost more to manufacture. Local dimming means that individual LED backlights, usually in a grid, dim or turn off when backlight is not needed in the respective dimming zone. Quantum dot films generate backlight capable of rich colors that pass efficiently through color filters.
- *Organic Light Emitting Diode (OLED) TVs* are emissive displays where each subpixel is a separately controlled light source (over 24 million for a 4K TV). Independent control of

so many subpixels require extra processing power (i.e., a high y-intercept). Contrary to past conventional wisdom, OLEDs use less power at typical luminance settings than basic LCDs.

In summary, the NEEA policy approach accounts for the fact that consumers use a wide range of TV settings and encourages manufacturers to design for efficiency across a wide range of luminance levels. The approach also encourages efficient backlight control, panel-level, and power supply design choices that lower the slope of the dimming line and reduce the base power (i.e., y-intercept). As a result, the TV will operate more efficiently regardless of what preset picture setting, content format, or ABC setting is used by the consumer. This aspect attracted ENERGY STAR, DOE, manufacturers, industry experts, and efficiency advocates as it created a more level playing field.

Policy Outcomes, Energy Impacts, and Ongoing Efforts

Regulatory Adoption

Efforts to influence display test methods have resulted in significant achievements. Some of the major results include the following, detailed in Table 1.

Table 1. TV test procedures influenced by the NEEA test method and metrics to date

Organization	Test Name	Purpose
EPA	ANSI/CTA-2037-C	ENERGY STAR Version 9.0 for TVs (EPA 2022)
American National Standards Institute (ANSI) and Consumer Technology Association (CTA)	ANSI/CTA-2037-D	Industry test procedure for voluntary U.S. Canada agreement (CTA 2022 and 2023)
U.S. DOE	Appendix H to Subpart B of Part 430	Regulatory standards test procedure: ANSI/CTA-2037-D adopted by reference in most recent ruling (DOE 2023 and CFR 2024)
EPA	Appendix H to Subpart B of Part 430	ENERGY STAR Version 9.1 for TVs (EPA 2023)

Global Reach

Stakeholder engagement is a core part of NEEA's market transformation efforts. In 2018-19, PCL led a broad stakeholder group—including EU stakeholders, DOE, EPA, CLASP, ASAP, NRDC, and PG&E—to produce a multi-year plan to align around a globally harmonized test method and metrics approach. The stakeholder game plan included a policy landscape overview, barriers and solutions, roadmap of international test standards, minimum energy performance standards (MEPS) and labeling changes.

PCL initially presented the NEEA approach to IEC TV test method workgroup members, after which CTA invited PCL to demonstrate the method to TV manufacturers at the 2020 Consumer Electronics Show (CES). CTA then met with PCL and NRDC, and the parties agreed in principle to collaborate on a TV voluntary agreement (CTA 2020). In October 2020 CTA and major TV manufacturers committed to collaborate with PCL to develop an industry standard test method based on the NEEA approach and to promote the adoption of the method by DOE, ENERGY STAR and ultimately IEC (CTA 2020). PCL led technical discussions CTA R4 Working Group 13, resulting in the industry standard, ANSI/CTA-2037-D (CTA 2022).

In parallel, PCL worked on behalf of NEEA and EPA to develop a TV data set and technical analysis in support of ENERGY STAR Version 9.0 (EPA 2022). PCL led technical discussion in IEC MT62087 regarding key updates to the TV test method (IEC 2023). As previously mentioned, PCL led the development of the current IEC HDR test clip in IEC project team PT100-15, and it led technical work in IEC PT100-24 regarding evaluation of HDR test clips with dynamic metadata. PCL supported NEEA comment letters to DOE in support of federal adoption of ANSI/CTA-2037-D (NEEA 2022). PCL leads data collection, lab qualification, and technical and policy analysis for US/Canada Voluntary agreement. PCL has led many technical and policy discussions with experts at individual TV manufacturers and third-party TV operating system vendors. Other notable global achievements include:

- More than 40 PCL test kits running NEEA Energy Assessment System software (TV EASY®) are in use today in 10 countries spanning North America, Europe, and Asia.
- PCL has collaborated with two China-based camera photometer vendors, Kernel and Color Vision, to broaden the test kit supply base.
- PCL qualified test labs performing US/Canada VA compliance testing, with lab visits to California, Korea, Hong Kong, Taiwan, Malaysia, Indonesia, and Japan.
- PCL demonstrate through > 170 camera calibration checks in three countries across Asia that both PCL and third-party cameras have about 2.6% measurement uncertainty with 95% confidence, far better than the expectation (5%) PCL set with stakeholders.

Estimated Energy Impacts

The NEEA display policy approach promises significant global energy savings. TV Standby Mode savings alone have the potential to be about 150 TWh, the equivalent annual energy output of 50 average coal power plants (50 Rosenfelds), shown in Table 2.

Table 2. Global TV savings estimates

Assumptions	Measurement Unit
2024 stock of all TVs [a]	2.9 billion
Smart TVs (73%) [b]	2.1 billion
Inefficient smart wake smart TVs (74%) [c]	1.6 billion
Smart wake power baseline for inefficient TVs [c]	14 watts
Smart wake power baseline for efficient TVs [c]	0.5 watts
Potential smart wake standby power savings per inefficient TV	13.5 watts
Average standby hours per day per TV [c]	18.7 hours
Days per year	365 days
Potential total smart wake standby power savings [d]	143 TWh/year
1 Rosenfeld [e]	3 billion kWh/year
Potential total smart wake standby power savings	48 Rosenfelds

[a] *Source:* CLASP 2024. [b] *Source:* S&P Global 2023. [c] *Source:* NEEA 2019 and 2020. [d] Equation: 13.5 x 18.7 x 365 x 1.6 billion. [e] A Rosenfeld is defined as the annual energy generation of one 500-megawatt coal-fired power plant or 3 billion kilowatt-hours per year.

This assumes that the approach avoids a scenario where all smart TVs, except those made by brands that have already demonstrated efficient smart wake designs, adopt inefficient smart wake feature implementations. This conservative estimate does not include consideration of TV On Mode savings or On and Standby Mode savings for commercial displays and computer monitors. Additional research to calculate these other energy savings opportunities is recommended for future study.

Continuing Policy Efforts

All stakeholders—including consumers and manufacturers—benefit from having well-harmonized global efficiency policies that share a fair, comprehensive, and technologically current test procedure. Towards that end, NEEA and PCL continue to advocate for the adoption of the new policy approach beyond the United States, continuing to collaborate with CLASP and other energy efficiency counterparts internationally. Adoption by Europe and China would magnify impact due to market size and influence.

Lessons Learned and Conclusions

Market transformation is a complex task that, at its core, requires test methods reflecting real-world consumer behavior and the ability to assess current technology. Television technology evolves at a rapid pace with new features that sometimes use more power. Effective test procedures should account for the latest technology and features, consider real-world product use behavior, and present a level playing field that is fair across manufacturers. By advancing a straightforward test methodology that reflects current technology and real-world customer usage, manufacturers and standards bodies have paved the way for a level playing field of TV energy efficiency measurement. Standardization and adoption of the NEEA approach has the potential to reduce the cost of energy efficiency for the entire value chain. TV energy efficiency labels become more trusted and simpler to understand which allows manufacturers to compete on efficiency, retailers to market efficiency clearly and consumers to factor efficiency into their purchases. As products improve, policymakers are able to ratchet up levels over time resulting in a sustained reduction in energy use versus the baseline. Without a clear and accurate energy scorecard, manufacturers, retailers, and customers focus on other features and benefits in this competitive and rapidly moving global product category.

The history of TV energy efficiency illustrates that market transformation is an iterative process. Particularly in a high volume and competitive market where innovation is critical, flexibility in market transformation approaches is essential. Starting with commonly held goals builds momentum and commitment among stakeholders and provides a compass for the journey. Global engagement ensures that decisions are made weighing the full impact of the approach. NEEA's efforts with PCL and wide-ranging stakeholders demonstrated that the old test procedure was ineffective and not supported by industry. By researching gaps, establishing an innovative new test platform and metrics, and engaging diligently in stakeholder forums, NEEA opened the door for the next iteration of TV market transformation with valuable lessons applicable to other appliance policy efforts.

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