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Response to Invitation to Participate - Low Power Mode

Additional submitted attachment is included below.

Low Power Mode

Codes and Standards Enhancement (CASE) Initiative
For PY 2017: Title 20 Standards Development

Response to the California Energy Commission's Invitation to Participate Phase 2 Pre-Rulemaking
Low Power Mode
17-AAEER-12

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1. Introduction

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support California Energy Commission's (the Energy Commission or CEC) efforts to update California's Appliance Efficiency Regulations (Title 20) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities (IOUs) – Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE), and SoCalGas® – sponsored this effort (herein referred to as the Statewide CASE Team). The program goal is to prepare and submit proposals that will result in cost-effective enhancements to improve the energy and water efficiency of various products sold in California. The information presented herein is a response to the Energy Commission's Invitation to Participate (ITP) Phase 2 Pre-Rulemaking for the low power mode roadmap.

The Statewide CASE Team strongly supports the Energy Commission's decision to develop a low power mode roadmap. This response contains a review of existing low power mode regulations, the Statewide CASE Team's recommendations on scope and policy framework, and background information on existing measures and test methods.

2. Background

Low power modes (LPM), particularly standby and network standby, have been a topic of extensive work internationally, in the United States, and in California for decades. As early as 1999, the International Energy Agency (IEA) drew attention to the impacts of standby power with their One Watt Initiative, urging countries to establish harmonized standby standards. Back then, standby mode in consumer products typically included "traditional" secondary functions, such as infrared sensing for remote control, indicator lights, timers, and clocks. Governments and manufacturers responded to the One Watt Initiative by delivering policies and products to reduce the impacts of traditional standby power.

Today's products, however, have increasingly more functionality in LPM, such as network connectivity, voice control, and presence sensors that can wake the device to its active state, as well as information displays and other functions that provide services beyond the product's primary function. Reducing the power impacts of LPM with this increased functionality represents a large energy savings opportunity in California. Additional savings opportunities exist for always-on devices that can be powered down when their services are not being used; 23 percent of annual residential electricity use in California is due to products in LPM and products left in active mode while unused (NRDC 2015).

3. Precedent for LPM and APD limits

Several mandatory and voluntary measures set a precedent for LPM power targets and automatic power-down (APD) requirements. Most relevant is the European Union's (EU) 2013 standby and network standby regulation, a horizontal approach that covers a range of mains-connected consumer products[1]. Its requirements include (European Commission 2014):

[1] Complete scope listed in Annex 1 of the regulatory language: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1275&from=EN

1. Covered products have an off or standby mode that draws 0.5 watts or less, or 1.0 watts or less for products with an information display.
2. For network equipment, network standby power draw of 8 watts or less.
3. For other end uses, network standby power draw of 3 watts or less (effective January 1, 2017). A more stringent level of 2 watts is currently under review and is scheduled to go into effect in 2019.
4. Power management or a similar function that powers down the product to standby or network standby state within 20 minutes when the product's main function is not in use.

Other governments have set limits on standby and/or off mode power, albeit with a vertical, product-specific approach. Canada, for example, has standby and off mode limits for televisions, compact audio, and video products; off mode power is limited to 0.5 W while products with and without displays are allowed 1.0 W and 0.5 W, respectively, in standby mode (Natural Resources Canada 2017). California has set standby limits in several standards, such as compact audio, DVD players, televisions, and computer monitors (ASAP 2017). Connecticut and Oregon have adopted the California standards for compact audio, DVD players, and televisions (ASAP 2017).

Notable voluntary measures addressing LPM include the Korean e-Standby Program and ENERGY STAR. The Korean e-Standby Program covers 22 products, setting LPM and in some cases APD requirements for each product (Korea Energy Management Corporation 2011). Similarly, several ENERGY STAR® specifications set limits on LPM, such as network standby, standby, sleep, or off mode power, and some include APD requirements (see the audio/video (EPA 2014a), television (EPA 2015), and computer (EPA 2016) specifications for examples).

4. Scope

The Statewide CASE Team recommends that the Energy Commission initially consider a broad scope for residential and commercial products that are not covered by the Department of Energy (DOE) or the Energy Commission regulations. For most of these products, little data exists in terms of stock, LPM energy use, APD opportunities, and cost-effectiveness of efficient LPM and APD designs. Collecting this information across a broad scope will allow the Energy Commission to make informed decisions about reducing scope where cost-effective technical pathways cannot be proven and to retain a scope that maximizes energy savings and cost-effectiveness, thereby optimizing their effort.

5. Policy Framework

5.1 A Horizontal Approach to Regulating Efficiency in Low Power Modes

In the Energy Commission staff's May 11, 2017 ITP presentation, the Energy Commission presented one possible horizontal framework for addressing LPM that includes a base allowance and functional adders for clusters of products. The Statewide CASE Team agrees with this approach, and here provides some additional information to expand on this framework concept.

Applying a horizontal approach to LPM has been discussed among energy efficiency stakeholders (Harrington and Nordman 2010). What makes a horizontal framework so promising is that secondary functions are often implemented with similar technology across the range of consumer

products. The same Ethernet controller, for example, may be used in computers, voice activated speakers, and appliances, and have similar power requirements to provide network communication in those products. Similarly, the same circuitry that allows voice control of the smart speakers that are becoming popular today may be implemented in other consumer products that users could control with speech, such as other Internet of Things (IoT) products.

More recently, stakeholders have introduced the clustered horizontal approach, in which product categories with similarities such as active function or LPM level of service are grouped together (Siderius and Meier 2014). This approach maintains horizontal requirements across a broad range of similar product categories within a cluster, while recognizing that some product categories provide a different level of service and therefore should be treated with a separate set of requirements. For example, network equipment, which must be able to transfer data on networks at any time with no latency, may be treated separately from white goods, which may need only sporadic network communication. A goal of creating clusters should be to group as many product categories together as possible into a small number of clusters. In an examination of network standby policy approaches, for example, Harrington and Nordman (2014) suggest four clusters: network equipment, electronic edge devices, non-electronic edge devices, and non-networked products.

The clustered horizontal approach is conceptually illustrated in Figure 1, which shows three theoretical clusters. The clusters each contain a range of product categories, and the figure shows a few hypothetical products in each cluster. The base allowance, which covers traditional LPM functions, is constant across clusters. Functional adders are applied across each cluster, and may differ between clusters. Each functional adder represents the power required for that function to deliver the level of service typical for that cluster. The LPM allowance for a specific product is the sum of the base allowance and cluster-specific adders for functions present in the product. For example, Product A in Cluster 1 has network connectivity, sensors, a display, and voice recognition capabilities in LPM, while Product C in the same cluster only has network connectivity. Product A receives a higher total LPM allowance to account for its additional functionality.

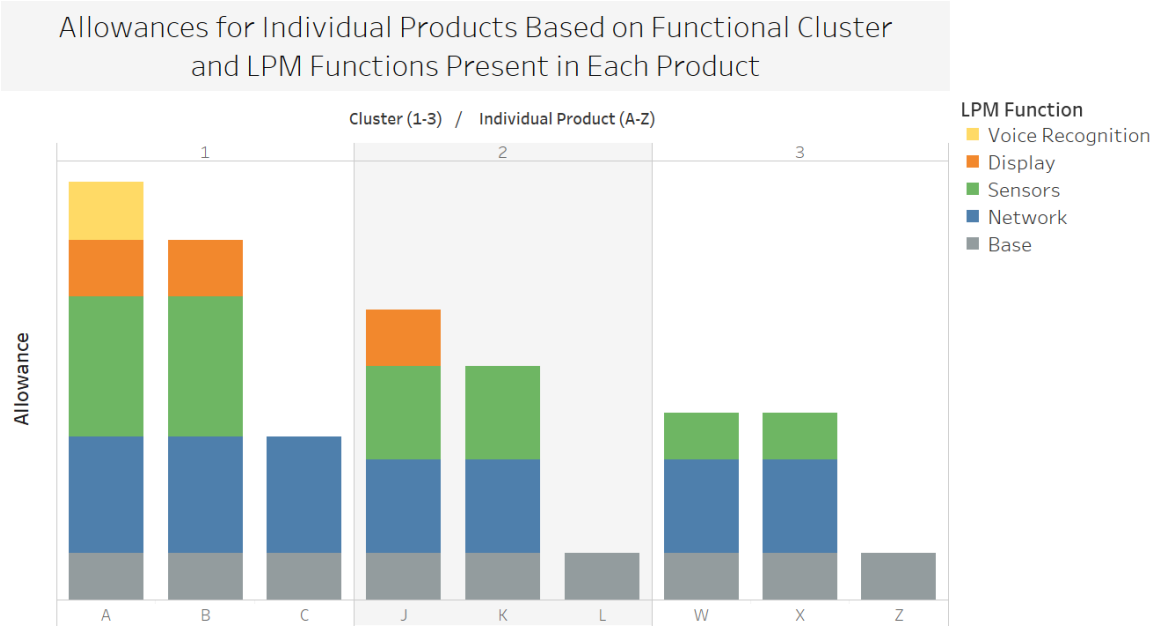

Figure 1: Conceptual illustration of allowances for individual products grouped into functional clusters. Colored sections of each bar represent the base allowance and adders for functions present.

Examples of measures that use a clustered horizontal approach include the EU standby regulation and the ENERGY STAR audio/video specification. The EU standby regulation effectively has two clusters: one for network equipment and one for all other equipment (see Section 3 above). The ENERGY STAR audio/video specification applies base allowances and functional adders to a broad range of products, such as amplifiers, video projectors, and speaker docks (EPA 2014a).

Figure 1 is intentionally simplified. Even within a cluster, the level of service of some functions may vary, and would therefore require a variable adder. For example, it is possible that a constant adder would be inappropriate for information displays, because the power required for information displays varies with screen area and resolution[2]. The Statewide CASE Team recommends starting with a simple framework and adding complexity where necessary to develop a framework of base and functional adder allowances that is as straightforward as it can be, and only as complex as it needs to be.

5.2 Auto Power-Down to Low Power Modes

To address loads that are left in active mode even when the user is not in need of the primary function, the Statewide CASE Team recommends the Energy Commission include an APD requirement that specifies a maximum amount of time that a product can remain in an active or high-power standby mode (such as standby-active mode defined by ENERGY STAR) once it has ceased to provide the function of the higher powered mode. NRDC (2015) identified several such products in the homes they metered, such as heated bathroom floors and towel racks. Rather than addressing modal power levels, an APD requirement addresses the duty cycle, reducing time spent

[2] Precedent for variable adders includes the CEC computer regulation (CEC 2016) and ENERGY STAR specifications (EPA 2014a, 2015, 2016).

in active mode and increasing time spent in LPM. Although the result is an increase in LPM energy use, the product's total energy use decreases.

Precedent for an APD requirement exists in both mandatory and voluntary measures. In its standby and network standby regulation, the EU requires devices to use power management or a similar function to power down equipment within 20 minutes of inactivity (European Commission 2014). ENERGY STAR qualified computers must allow connected displays and the computer itself to enter sleep mode after no more than 15 and 30 minutes of user inactivity, respectively (EPA 2016). The recently adopted Energy Commission computers regulation harmonizes with this requirement (CEC 2016).

6. Test Procedures

6.1 Efficiency in Low Power Modes

Two critical elements are required for the LPM test procedure: (1) set-up instructions for the product under test, including LPM functions, such as network connections and sensors, and (2) instructions for measuring power. The Statewide CASE Team finds the IEC 62301:2011 test procedure to be sufficient for requirement number two; that is, once the product under test is prepared with the necessary connections and conditions, IEC 62301:2011 provides well-vetted instructions to measure LPM power. This test procedure has been used internationally to test standby or LPM compliance for voluntary and mandatory measures, such as the EU standby power regulation and ENERGY STAR specifications.

IEC 62301:2011 does not, however, provide product set-up instructions. In fact, no harmonized test procedure includes the set-up instructions the Statewide CASE Team believes necessary for a successful LPM roadmap, which includes those describing set-up of network connections, sensors, and any other function that can trigger the product's primary function to reactivate. To date, network connections have received the most attention from researchers, who have examined the elements necessary to test network connections in a representative and reproducible manner (e.g., Nordman 2011). ENERGY STAR includes set-up instructions for network connections in many of its specifications, including imaging equipment, small network equipment, computers, and displays (EPA 2014b, 2014c, 2016, 2017). ENERGY STAR also includes instructions related to motion and light sensors in its TV and display specifications (EPA 2015, 2017). The Statewide CASE Team intends to assess the available information, identify gaps related to product set-up instructions, and then make recommendations to the Energy Commission.

6.2 Auto Power-Down to Low Power Modes

Although a harmonized APD test procedure does not exist, the CEC can look to ENERGY STAR APD test methods contained within the product specifications for audio/video and computers, and the recognition program for game consoles for precedent and guidance. These methods are straightforward and generally instruct the tester to use the product in active mode, then discontinue active use and measure the product power a prescribed amount of time. The Statewide CASE Team plans to examine these APD test methods and propose APD testing instructions that are applicable to the broad range of products that could fall under the LPM scope.

7. Conclusion

The Statewide CASE Team strongly supports the Energy Commission's intention to develop an LPM roadmap. To maximize the effectiveness of the roadmap, the Statewide CASE Team recommends the Energy Commission begin with a scope that encompasses all residential and commercial products, and then take a data-driven approach to narrowing scope.

The Statewide CASE Team supports the Energy Commission's suggestion that energy consumption in low power modes could be regulated through a horizontal approach with a base allowance and functional adders. The Statewide CASE Team supports employing a clustered horizontal approach as necessary, in which functional allowances are the same within clusters, but vary between clusters as needed to reflect differences between product category groups in the amount of power required to provide LPM functions. In addition to reducing LPM energy waste, the Statewide CASE Team strongly encourages the Energy Commission to consider the opportunity for substantial energy savings by requiring products to shift to LPM after a sustained period of inactivity (NRDC 2015).

Regarding test procedures, the Statewide CASE Team believes that IEC 62301:2011 provides sufficient instructions for measuring power in LPM; however, additional set-up instructions need to be developed to ensure the measurements are accurate and repeatable. The Statewide CASE Team also recommends developing an APD test procedure that is applicable to the broad range of products that could be covered by an LPM Roadmap. Filling these gaps is crucial for a robust test procedure and a successful LPM Roadmap.

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