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Response to Invitation to Submit Proposals - 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 Request for Proposals
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). 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 (LPM) roadmap. This response contains a review of existing LPM regulations, the Statewide CASE Team's recommendations on scope and policy framework, and background information on existing measures and test methods. It also gives an overview of the Statewide CASE team's preliminary savings potential assessment for a LPM and auto power-down (APD) standard, suggestions for how the Energy Commission may conduct the roadmap process, and the Statewide CASE Team's planned activities to gather information and develop a standards proposal.

2. Background

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. At that time, 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 Low Power Mode and Auto Power-Down Requirements

Several mandatory and voluntary measures set a precedent for LPM power targets and 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,

including both edge and network equipment.[1] Requirements include (European Commission 2014):

1. Covered products have an off or standby mode that draws 0.5 watts (W) or less, or 1.0 W or less for products with an information display.
2. For network equipment, network standby power draws 8 W or less.
3. For other end uses, network standby power draws 3 W or less (effective January 1, 2017). A more stringent level of 2 W 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 standby limits in place for several products through vertical standards, such as compact audio and televisions (CEC 2017). The computer monitors regulation, effective July 1, 2019, limits the sum of sleep and off mode power to 1.2 W (CEC 2016). 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. Additionally, some specifications include APD requirements (see the audio/video (EPA 2014a), television (EPA 2015), and computer (EPA 2016) specifications for examples).

4. Energy Commission Low Power Mode Questions

On August 22, 2017, the Energy Commission provided stakeholders with additional questions to be addressed for roadmap topics.[2] The Statewide CASE Team provides responses to several of the questions that relate directly to LPM in Table 1. In many cases, requested information is provided in subsequent sections of this document, as indicated in the responses. However, the Statewide CASE Team's research is in an early phase. As such, the Team does not yet have the data and information to offer a complete answer to some questions, but will provide updates as that information is available. We adopt the original questions numbers from the Energy Commission document.

[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

[2] http://docketpublic.energy.ca.gov/PublicDocuments/17-AAER-05/TN220851_20170822T150516_Additional_Guidance_on_Roadmap_Proposals.pdf

Table 1: Responses to Energy Commission roadmap guidance questions

Energy Commission Question	Statewide CASE Team Response
1. Should power factor and low-power modes be treated together in the same roadmap or should two separate roadmaps be developed? Should the product clusters align if the roadmaps are separated? What are the advantages and disadvantages to your proposed approach?	As stated in the Statewide CASE Team's ITP response, we encourage the Energy Commission to maintain flexibility when it comes to the scope and coupling of LPM and power factor and to allow future analyses of technical feasibility and cost-effectiveness drive these important decisions.
2. What are the products that would be included in each cluster? What is the best size for each category? For example, should we assign a category for all connected edge devices or should we break this into several smaller categories such as connected lighting devices, connected audio and video devices, connected heating and cooling devices, etc.?	Critical roadmap decisions such as cluster development should be based on data. The Statewide CASE Team is in the process of developing a testing and data collection plan to inform cluster development. To maintain a horizontal framework and reduce complexity, the Statewide CASE Team encourages the Energy Commission to create only a small number of clusters (see Section 7, Policy Framework).
3. What should be characteristics of different clusters of products that can be grouped together to evaluate low-power-mode performance? In other words, what should be the main function in the low-power mode among the devices in each group (the horizontal function)? Examples include searching for infrared light signal of a remote control, or sensor signals of a security camera.	The Statewide CASE Team is in the process of developing a testing and data collection plan to inform cluster development, including what determining characteristics group products into logical clusters.
4. What are possible additional functionalities of products in each group that require additional power consumption allowances in low-power mode (the vertical functions)? For example, maintaining clock function while the security cameras are in standby mode to stamp the time of the recordings.	The Statewide CASE Team will investigate secondary functions and their LPM power requirements in its forthcoming research (see Section 10 for a description of planned activities).

Energy Commission Question	Statewide CASE Team Response
5. Different groups of products might have different types of low-power modes. These low-power modes should be determined and defined for each group of products. What are the different types of low-power modes (standby "active," standby "passive," off) for each group of products?	The Statewide CASE Team encourages the Energy Commission to focus on establishing power requirements for a common mode across all products (potentially the as-shipped LPM, to be further researched), and ensuring that products power down primary and secondary functions when not in use. Introducing more LPMs requires defining them, and may require specific test set-up language in the test procedure. These conditions are necessarily product-specific, trend toward a vertical rather than horizontal framework, and add complexity. The Statewide CASE Team maintains that the LPM roadmap should be as broadly (horizontally) applicable as possible, thus common conditions across products are the ones that should be regulated.
6. What should be the proposed targets and milestones for efficiency (including base levels for horizontal function and adders for vertical function(s)) for each product cluster? These targets or milestones should also include proposed pathways to improve the energy efficiency for each cluster of products or examples of models of the same products that are more energy efficient with the same or better utility and performance.	Based on the data collected in forthcoming research, the Statewide CASE Team will propose LPM targets or milestones and technical pathways to achieve them (see Section 10 for a description of planned activities).
7. What are technical barriers to improved efficiency and technical solutions to achieve efficiency levels? In particular, specify whether increased energy efficiency for each group of products has an adverse impact to their utility; if it does, propose solutions. For example, latency can significantly impact the expected utility of small network equipment; what are ways to decrease latency while improving efficiency?	In forthcoming research, the Statewide CASE Team will identify barriers and technical pathways to achieve proposed LPM targets or milestones (see Section 10 for a description of planned activities).

Energy Commission Question	Statewide CASE Team Response
8. What are proposed test procedures for each cluster or product within that cluster (for both test setup and measurements)? Specify the metrics used for each cluster to evaluate efficiency.	The test procedure and necessary modifications are discussed in Section 6. The Energy Commission should develop a single test procedure, including test setup and measurements, and a single efficiency metric that applies to all products in the LPM scope, rather than different test procedures and efficiency metrics for different clusters, to leverage the horizontal policy concept and reduce testing and regulation complexity.
9. What research and development is needed to further improve the efficiency of each cluster or product within the cluster?	The Statewide CASE Team's planned research will characterize the LPM power requirements of current products and identify best-on-market and emerging technologies that have the potential to be broadly adopted to reduce LPM power. (See Section 10 for a description of planned activities).
10. How can the Energy Commission track whether roadmap goals or milestones are being met?	Determining whether roadmap goals or milestones are met depends somewhat on the goals or milestones themselves. To maximize savings, the Statewide CASE Team recommends the roadmap ultimately results in a standard. In Section 9, the Team outlines several LPM roadmap scenarios that result in an LPM standard. In these scenarios, the Energy Commission can use regulatory tools such as test and list and compliance testing to ensure targets are met.
Questions 11 – 13 are only relevant to the power factor topic.	

5. 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 Department of Energy (DOE). Products already regulated by the Energy Commission should remain in the initial scope. The Energy Commission has the authority to make a new rule on a product they currently regulate effective five years after the adoption date of the old rule. If the roadmap leads to a regulation, it is likely the effective date would be more than five years past the adoption of Energy Commission's newest rules, such as those for computers and computer monitors.

For most of the potentially in-scope 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, retaining a scope that maximizes energy savings, and thereby optimizing effort.

In response to the invitation to participate (ITP) several industry stakeholders commented that small network equipment (SNE) should be excluded from the LPM roadmap scope for two main reasons: an existing voluntary agreement (VA), and the inapplicability of LPM to SNE operational states. The Statewide CASE Team recommends that the Energy Commission include SNE in the LPM roadmap because SNE represents a large savings opportunity; the Team estimated that energy use of SNE could be reduced 50 percent or more from 2013 consumption levels (Statewide CASE Team 2013). Although the VA resulted in an estimated minimum of 18 percent savings in 2015 (D+R International 2016), additional savings opportunity remains. The VA ends on December 31, 2017. Unless the signatories decide to extend the agreement,[3] including SNE in the LPM roadmap will encourage continual improvement of SNE efficiency.

SNE is unique compared to other products in the LPM roadmap scope because it must always be available to send and receive data without latency. Although operational modes such as "sleep" or "standby" may not apply to SNE, it can reduce its power during low traffic periods by scaling power to traffic speed, and by powering down unused hardware such as ports and radios (Statewide CASE Team 2013). The horizontal clustered approach proposed by the Energy Commission allows consideration of SNE's unique functionality and power requirements by treating it in its own cluster. With this type of policy framework (discussed in more detail in Section 7), the Energy Commission can include SNE and maximize its large savings opportunity.

6. Test Procedures

6.1 Efficiency in Low Power Modes

The LPM test procedure requires two critical elements: (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.

However, IEC 62301:2011 does not provide product set-up instructions. In fact, no harmonized test procedure includes the set-up instructions the Statewide CASE Team deems necessary for a successful LPM roadmap, including the set-up description 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, SNE, 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

[3] For more information, see the VA: http://www.energy-efficiency.us/library/pdf/SNE-VoluntaryAgreement.pdf

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 Energy Commission 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. Instructions generally direct the tester to use the product in active mode, then discontinue active use and measure the product power over 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. Policy Framework

7.1 A Horizontal Approach to Regulating Efficiency in Low Power Modes

The Energy Commission staff's May 11, 2017 ITP presentation described 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). The horizontal framework is promising because 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. Creating clusters should be approached with the goal 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.

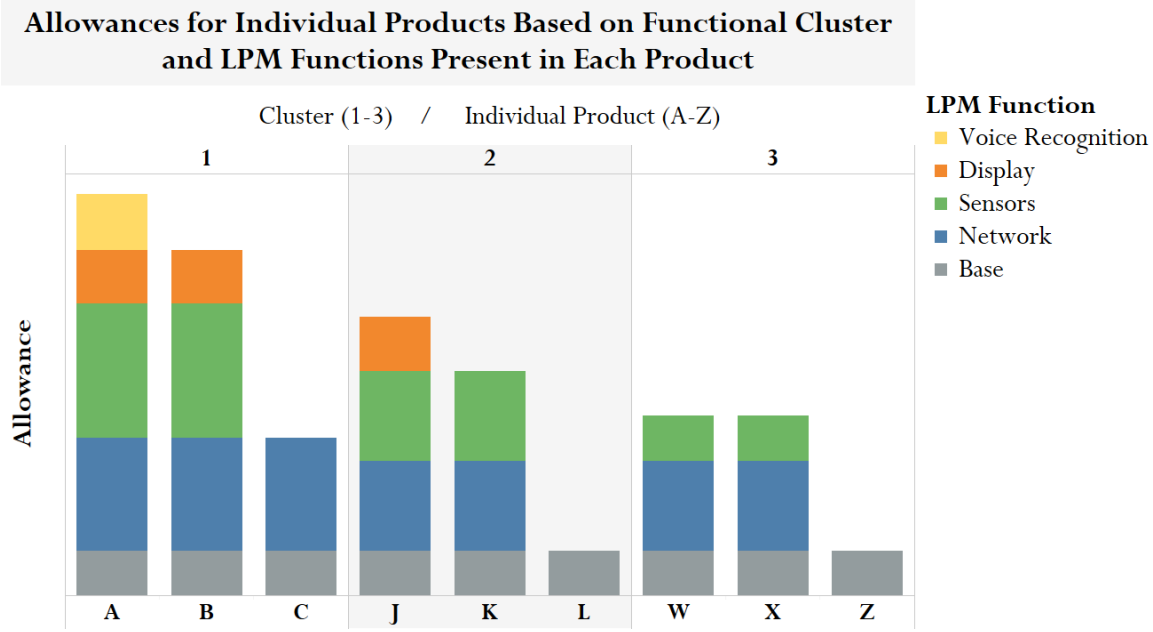

Figure 1: Conceptual illustration of allowances for individual products grouped into functional clusters. Colored sections of each bar represent the base allowance and adders for functions present.

Source: Statewide CASE Team.

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.[4] The Statewide CASE Team recommends starting with a simple framework and adding complexity only where necessary to develop a framework of base and functional adder allowances.

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

7.2 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. National Resources Defense Council (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 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).

8. Savings Potential: LPM and Auto Power-Down

Using a horizontal approach to address LPM and APD across a broad range of products has the potential to yield significant savings. To calculate a preliminary savings estimate of an LPM and APD standard, the Statewide CASE Team layered three separate approaches: (1) a bottom-up analysis of previously studied product categories, (2) a bottom-up analysis of those additional product categories inventoried in NRDC's home idle report, but not previously studied, and (3) a top-down analysis to estimate the remaining residential savings potential not captured by the bottom-up approaches, using data from NRDC's home idle report (NRDC 2015). The Statewide CASE Team's savings estimates exclude products that are covered by Federal standards. To be conservative, the Team also excludes current topics of the Phase 2 Pre-rulemaking, lighting and water products, televisions, signage displays, computers, and computer monitors.[5] These analyses yield a potential savings range of 2,400 to 3,600 gigawatt-hours per year (GWh/yr) after stock turnover (Figure 2). Additional data collection and analysis is necessary to improve these preliminary estimates and assess savings opportunities in the commercial sector.

[5] For the purposes of this savings estimate, the Statewide CASE Team assumes that the Energy Commission will continue to regulate televisions, signage displays, computers, and computer monitors with a vertical standard. If, however, the Energy Commission chooses not to update these regulations, these products should remain in scope of the LPM roadmap and may offer additional savings.

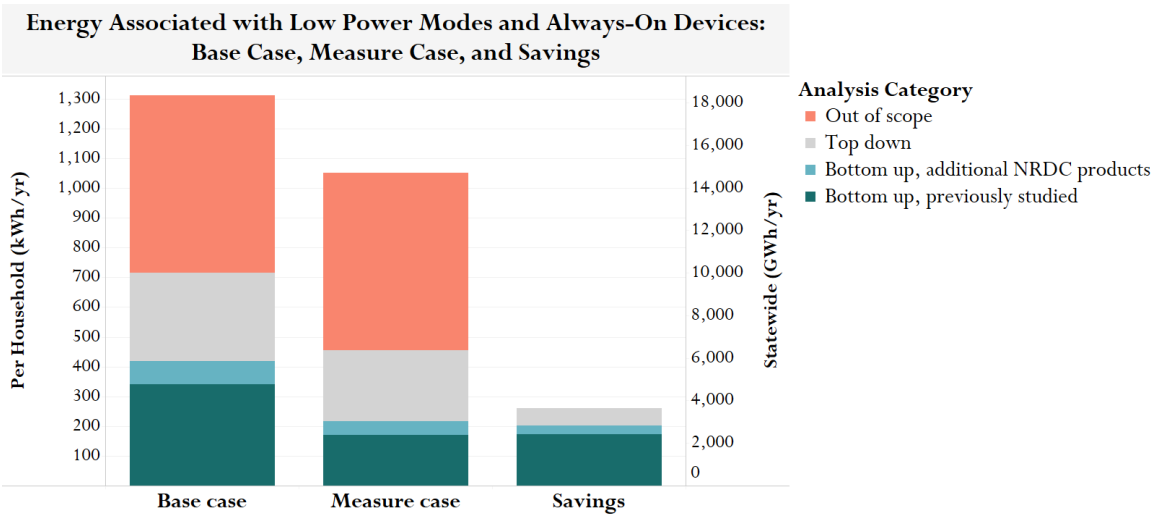

Figure 2: Base case, measure case, and savings potential estimated for a low power mode and auto power-down standard.

Source: Statewide CASE Team analysis.

In the bottom-up analysis of previously studied product categories, the Statewide CASE team estimated current stock, energy use, and savings potential of 25 product categories. Data for this analysis was drawn from published power and/or energy use, stock and/or sales, and duty cycle information from broad field, market, and literature review studies including Bensch et al. (2010), U.S. Energy Information Administration (EIA 2013), Fraunhofer (2014), Friedli et al. (2016), Greenblatt et al. (2013), Kisch et al. (2014), and Lawrence Berkeley National Laboratory (LBNL 2016), and product-specific studies such as NRDC (2013, 2014). Using this information, the Team estimated LPM savings potential for each product, and APD savings potential for products that spend most or all of their time in active mode. For each product, the Statewide CASE Team used average energy use as the base case, and estimated the measure case with, (1) the best-on-market product if available, (2) a similar best-on-market product, or (3) professional judgment. Cases with available national stock information were scaled by 12% to California. This analysis provides our lower bound on savings potential of 2,400 GWh/yr after stock turnover (see Figure 2, "Bottom up, previously studied" estimates).

A second group of 21 additional product categories that were identified and measured in homes by NRDC (2015) was added to the bottom-up estimate. These product types are generally newer and/or have lower market penetration rates than the 25 products addressed above. Because energy or power data for the second group of products was not available from other sources, the Statewide CASE Team relied solely on NRDC's power data to estimate potential savings, and thus places lower certainty on the resulting savings estimate. The Statewide CASE Team assumed base case power for each category as the average LPM power measured by NRDC (2015). Due to the lack of data on best-in-class efficiency for these product categories, the CASE Team assumed an LPM power of 1 W for these product categories by default (note that this assumption was only made to approximate the plausible savings potential and is not a recommendation for the level or structure of a low power modes regulation). Using these simple assumptions, the Statewide CASE Team estimated an additional 400 GWh/yr of savings potential after stock turnover (Figure 2).

Combined, the bottom-up savings potential analysis of 46 product categories yields an estimated 2,800 GWh/yr saved after stock turnover.

Finally, the CASE Team used a top-down approach to estimate the remaining residential savings potential from unspecified product categories that were not captured in either bottom-up approach. To do so, the CASE Team first calculated the difference between the always-on load found by NRDC (2015) and the CASE Team's bottom-up estimates. Whereas NRDC's analysis of smart meter data from 70,000 homes indicated 1,300 kilowatt-hours per year (kWh/yr) of always-on load (NRDC 2015), the CASE Team's bottom-up modeling of in- and out-of-scope products yielded 1,000 kWh/yr of always-on load under the CASE Team's baseline efficiency assumptions. Thus, the bottom-up approach did not capture all products in an average home. The CASE Team estimates that the additional 300 kWh/yr of always-on load is used by an average of 30 additional, unspecified products per household. Assuming these 30 products per household can achieve a measure case efficiency of 1 W in low power modes yields an additional 800 GWh/yr of estimated savings potential after stock turnover. Added to the bottom-up estimate, the upper savings estimate totals 3,600 GWh/yr after stock turnover (Figure 2).

A key take-away of the Statewide CASE Team's research to date is the need for more information related to current and best-achievable LPM power, duty cycle, and stock. The studies cited here generally focus on mature products in use today. Little information on new and emerging products, such as IoT and products with additional LPM functionality such as voice control or sensors, is currently available. To refine potential savings estimates and develop robust standards or targets, additional information must be collected. Still, even with a wide range of uncertainty, the LPM and APD savings potential equals or exceeds the savings from the recently adopted Title 20 measures. For example, the computers and monitors regulation is expected to save 2,300 GWh/yr in California after stock turnover.

9. Roadmap Scenarios

Due to the complexity and broad scope of the topic, the Statewide CASE Team supports the Energy Commission's decision to use the roadmap process. Because the roadmap concept is a new one, yet to be completely refined, the Statewide CASE Team provides some roadmap scenarios that have potential to produce a successful standard. The Team has considered a range of regulatory tools available to the Energy Commission and the likely sequence to employ particular tools to achieve a robust standard. Regardless of how the Energy Commission chooses to proceed, the Statewide CASE Team recommends using Title 20 Phase 2 to perform strategic, foundational activities and information gathering to fill gaps in the test procedure and gather data. Rulemaking in subsequent Title 20 phases may take several forms. After considering several options, the Statewide CASE Team recommends the following scenarios below and in Table 2:

One-Phase LPM & APD Regulation: After strategic activities and information gathering has been completed, the Energy Commission may choose a single-phase rulemaking process, similar to the most typical Title 20 process.

Two-Phase LPM & APD Regulation: To simplify and focus on a smaller group of products and functions, the Energy Commission may split the rulemaking across two phases. For example, in Phase 3 the Energy Commission may include in-scope well-characterized, mature products, and address the remaining products in Phase 4.

Test and List Requirements, then LPM & APD Regulation: The Energy Commission can use Test and List as a means to collect information about products' LPM and APD, while indicating intent to regulate later. The test and list regulation may be developed in Phase 3, and LPM & APD rulemaking in Phase 4.

Table 2: Activities and milestones by Title 20 phase for three roadmap scenarios

Scenario	Activities and Milestones		
	Phase 2	**Phase 3**	**Phase 4**
One-phase LPM & APD regulation	Test procedure additions Data collection activities	LPM & APD regulation	-
Two-phase LPM & APD regulation	Test procedure additions Data collection activities Determine products & functions to be addressed in 2-phase regulation	Group 1 LPM & APD regulation	Group 2 LPM & APD regulation
Test and List, then LPM & APD regulation	Test procedure additions Data collection activities	Test and list regulation	LPM & APD regulation

Source: Statewide CASE Team.

10. Utility Team Contributions and Timeline

The Statewide CASE Team plans to make significant contributions to the test procedure development and data collection effort. Once these activities are complete, the Statewide CASE Team will develop a standards proposal that includes technically achievable and cost-effective pathways towards a proposed regulation. The Statewide CASE Team's plan, delineating specific activities and the sequence in which they will be undertaken, is presented in Table 3. The Team will adapt as necessary to fit with the Energy Commission's roadmap activities and process.

Test procedure additions: The Statewide CASE Team plans to (1) develop draft set up instructions for functions including network connections and sensors, (2) vet the draft instructions with stakeholders, (3) test the robustness of instructions by coordinating round robin testing of instructions at several test labs, (4) based on round robin results, revise instructions as necessary, and (5) submit test procedure recommendations to the Energy Commission.

Data collection: The Statewide CASE Team is planning to collect and submit data from both the field and laboratory. PG&E is currently conducting a Codes and Standards Field

Study, gathering penetration rates of most mains-connected products in homes in its service territory. PG&E is deploying meters to collect power data and will analyze this data to determine modal power levels and duty cycles. In addition, the Statewide CASE Team plans to conduct testing in PG&E's soon-to-be accredited laboratory to (1) characterize as-assembled LPM power requirements for a wide range of products that fall under this roadmap's scope, (2) identify and measure power draw of the components that deliver LPM functionality by invasive inspection and testing, and (3) develop or coordinate development of prototypes to provide proof-of-concept for LPM improvements.

Develop CASE report: The Statewide CASE Team will use the information collected to develop a detailed CASE report that includes: savings potential, proposed standard framework (clusters), identification of technical pathways and analysis of their cost-effectiveness, and proposed standard levels.

Table 3: Outline of Statewide CASE Team proposed activities and their sequence.

Activity	Sequence of Activities
Test method review & development, stakeholder outreach	
Test method vetting, final recommendations to CEC	
As-assembled testing	
Invasive testing	
Technical pathways & prototyping	
Cost-effectiveness analysis	
CASE report writing	

11. Conclusion

The Statewide CASE Team strongly supports the Energy Commission's intention to develop an LPM roadmap. LPM and APD represent a large potential savings opportunity; the Team's preliminary estimates suggest 2,400 to 3,700 GWh/yr are achievable after stock turnover. 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.

Since the roadmap process is yet to be defined, the Statewide CASE Team has outlined some scenarios for the Energy Commission's consideration. The Team suggests using Title 20 Phase 2 to fill test procedure gaps and collect the data required to make decisions about scope and standard levels. The Team is prepared to contribute to the information collection effort, to inform Energy Commission decision making, a Statewide CASE standards proposal, and other stakeholders.

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